

Development of Islamic Gamified Learning Media for Puberty Readiness in Elementary School

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Abstract

Elementary school puberty education remains constrained by the taboo surrounding reproductive health as well as limited availability of appropriate learning media. Therefore, This study aims to design, develop, and evaluate an integrative learning media package comprising interactive digital media, digital comics, physical board games, and gamified assessments. The package integrates Al-Islam Kemuhammadiyah (AIK) values into human growth and development topics, particularly puberty readiness for fifth-grade elementary students. It addresses the need for learning resources that explain biological changes while supporting students' moral, social, and religious development. Using a Research and Development (R&D) design based on the ADDIE framework (Analysis, Design, Development, Implementation, and Evaluation), the study was conducted at a private elementary school in Purworejo, Indonesia, involving 19 fifth-grade students. Data were collected through observations, interviews, expert-validation matrices, student response questionnaires, and teacher observation sheets. Validation by science subject-matter, media and IT, and pedagogical experts produced an overall score of 95.19%, categorized as very valid. Classroom implementation produced a practicality score of 90.33%, categorized as very practical. Students demonstrated increased engagement, smoother interaction with the digital interface and board-game mechanics, and active participation during both learning sessions. The findings indicate that the AIK-integrated, gamified multimedia package is feasible and practical for supporting students' understanding of sensitive biological changes within a culturally and religiously responsive framework. Integrating gamified mechanics with theological ethics may also help reduce socio-cultural barriers to reproductive-health education for pre-adolescent learners.

Keywords

ADDIE Model, Elementary School, Gamification, Islamic Values, Learning Media, Puberty Education.



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INTRODUCTION

Puberty education in elementary schools continues to encounter systemic pedagogical and socio-cultural barriers, primarily because topics surrounding biological changes and reproductive health are frequently perceived as sensitive, taboo, and challenging to convey openly in an age-appropriate manner. Yet, human growth and development constitute a pivotal domain in elementary science education, directly intersecting with students' physiological experiences as they undergo the transitional phase from childhood to early adolescence. This pubertal stage is characterized by hormonal fluctuations triggering primary and secondary physical transformations as well as emotional instability, thereby demanding adequate knowledge and psychological readiness (Luo et al., 2024). A comprehensive understanding of puberty is essential not merely to satisfy curriculum benchmarks, but also to serve as a foundational basis for students to cultivate self-identity awareness, foster reproductive health literacy, maintain personal hygiene, and master bodily privacy boundaries. Consequently, elementary science instruction must deliver contextual, meaningful, and developmentally responsive learning experiences rather than relying on mere verbal transmission of factual information (Kutlu-Abu et al., 2023; Kerimbayev et al., 2023).

Empirically, the implementation of puberty and reproductive health education among school-aged children encounters persistent pedagogical and socio-cultural impediments. Classroom instruction relies heavily on conventional lecture methods and static textbooks, whereas puberty topics necessitate instructional media capable of translating complex bodily transformations into concrete, visual, and age-appropriate representations. This condition is further exacerbated by deeply rooted socio-cultural stigmas, wherein discussions regarding reproductive anatomy, bodily changes, and sexuality are often deemed embarrassing or inappropriate for open discourse in educational settings (Situmorang, 2024). Deficits in reproductive health literacy predispose students to cognitive misconceptions and compromise their capacity to recognize and protect their bodily boundaries. Research on school-based sexual violence prevention programs underlines the imperative of early intervention in elementary education, equipping children with the cognitive framework and practical agency to identify and respond to potentially hazardous situations (Celik, 2024). Therefore, puberty education delivered through a scientific, systematic, and developmentally aligned approach plays a vital role in building students' readiness to navigate biological changes while safeguarding themselves.

A growing body of literature indicates that innovations in instructional media and

gamification frameworks hold significant potential to enhance student engagement during the learning process. Gamification through the integration of game mechanics into educational contexts boosts intrinsic motivation, active participation, and provides an immersive, enjoyable learning experience (Kalogiannakis et al., 2021; Jaramillo-Mediavilla et al., 2024). The utilization of board games in science instruction offers students opportunities to learn through social interaction, collaboration, challenge-solving, and experiential engagement (Hashim et al., 2024). Furthermore, multi-format digital media enables information synthesis through combinations of text, imagery, visualization, and interactivity, making abstract concepts more digestible for young learners. In Islamic-affiliated school contexts, integrating religious values into science education has been increasingly developed to foster both scientific understanding and religious character (Amal et al., 2022; Dalimunthe et al., 2024). Regarding puberty topics, Islamic values can be contextually linked to the concepts of *akil baligh* (the onset of religious maturity), *thaharah* (ritual purification), personal hygiene, modesty (*aurat*), and moral responsibility upon entering adulthood (Lasmidah et al., 2025).

Nevertheless, existing literature reveals critical research gaps that remain underexplored. Gamification research in education predominantly focuses on single-medium implementations or isolated digital platforms, whereas the development of integrative learning packages combining physical and digital media into a unified instructional sequence remains relatively sparse. Moreover, the targeted application of gamification to foster puberty readiness in elementary schools has rarely integrated biological, pedagogical, and theological dimensions simultaneously. The fusion of Islamic values into science learning often remains superficial, such as merely appending Qur'anic verses or prophetic traditions (*hadith*) without establishing contextual synergy with the biological concepts being taught (Dalimunthe et al., 2024; Sutiana & Nugraha, 2025). Within the context of Muhammadiyah schools, this gap underscores an urgent demand for instructional tools that not only explain the biological mechanisms of puberty but also systematically connect them with Al-Islam Kemuhammadiyahan (AIK) values. Thus, a distinct research gap persists regarding the scarcity of gamified learning packages that comprehensively merge digital and physical media with integrated AIK values to foster puberty readiness among elementary school students.

Addressing this gap, the novelty of this study lies in the development of an integrative, gamified learning media package that harmonizes interactive digital media, digital comics, a physical board game, and gamified assessments with Al-Islam Kemuhammadiyahan (AIK) values for human growth and development instruction, specifically focused on puberty readiness. This

integration is engineered so that biological facts regarding puberty do not stand in isolation, but are contextually grounded in values of *akil baligh*, *thaharah*, personal hygiene, ethical responsibility, and bodily privacy. The hybrid combination of digital and physical media further delivers a multifaceted learning experience encompassing visual, narrative, interactive, and collaborative activities. Therefore, this study aims to design, develop, and evaluate the validity and practicality of an AIK-integrated, gamified learning media package to support puberty readiness among fifth-grade elementary school students.

METHOD

This study employs a Research and Development (R&D) approach, an empirically and systematically designed research methodology not only to test a theory but to design, refine, and validate innovative educational products or procedures centered on the concrete needs of users (Izzaturahma et al., 2021). The development model used as the architectural backbone in designing this media package is the ADDIE framework (Analysis, Design, Development, Implementation, and Evaluation). The choice of the ADDIE model is based on its structured, rational, and highly flexible characteristics in managing the lifecycle of both software engineering and instructional physical products, ensuring a fusion between media aesthetics and the integrity of learning outcomes.

The population in this study consists of fifth-grade students at a Muhammadiyah-based private elementary school located in Purworejo Regency, Central Java, Indonesia. Sampling was conducted using purposive sampling to meet specific achievement criteria, involving 19 fifth-grade students (cognitive age range 10-11 years) and one main classroom teacher. The age group of 10-11 years was deliberately chosen because biologically and psychologically, they are exactly at the threshold of entering pre-adolescence.

Data in this study were sourced from primary data collected directly from research subjects and expert teams. Data collection instruments were designed structurally and validated, including initial interview guidelines, participatory field observation sheets, and Likert-scale questionnaires. Expert evaluation used a validation matrix instrument measuring feasibility across three fundamental dimensions: scientific content accuracy, media engineering and visual communication design, and pedagogical architecture suitability. Meanwhile, to evaluate the product during field trials, instruments used included student response questionnaires (to assess utility, navigation, visual appeal, and emotional engagement) and observation sheets on teacher activity and

practicality.

Data analysis was performed using descriptive quantitative methods with empirical feasibility percentage formulas. Raw Likert scale data were extracted into percentage form with operational interpretation criteria as follows: 81% to 100% classified as Very Valid or Very Practical, 61% to 80% as Valid or Practical, 41% to 60% as Quite Valid or Quite Practical, and scores below 40% considered Not Valid or Not Practical (Ginanjar et al., 2025).

The research procedure cycle comprehensively follows the ADDIE paradigm with the following stages:

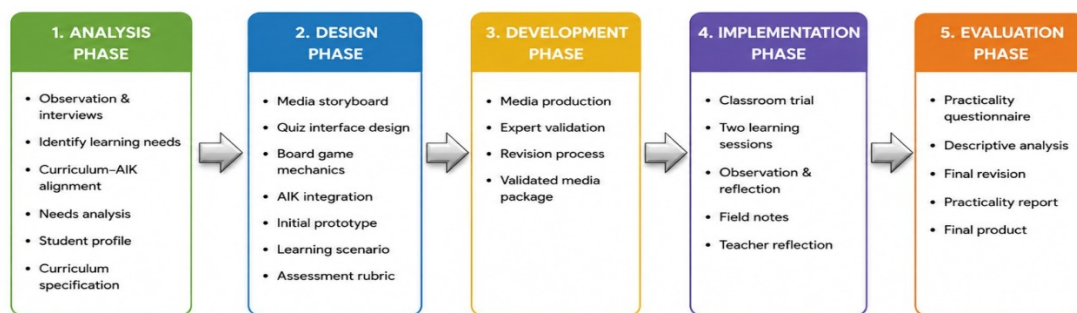


Figure 1. Research flowchart

1. Analysis Phase

The first phase initiated with a comprehensive front-end analysis to establish the empirical foundation of the learning media. Primary activities involved conducting diagnostic classroom observations and semi-structured interviews with elementary school educators to pinpoint the root causes of student anxiety and pedagogical friction surrounding reproductive health topics. Concurrently, curriculum mapping was executed to align fifth-grade puberty-related science learning indicators with core Al-Islam Kemuhmadiyah (AIK) values. This stage yielded a comprehensive needs analysis report, a detailed profile of fifth-grade student learning characteristics, and refined curriculum specifications.

2. Design Phase

The second phase focused on formulating the conceptual architecture of the hybrid media package. This entailed drafting detailed storyboards for the digital comics and designing user interfaces for the interactive quiz platform. Simultaneously, the core game mechanics and rule systems for the physical board game were structured to balance engagement with learning goals. To ensure contextual fusion, contextual Qur'anic narratives

and Islamic ethical frameworks (akil baligh and thaharah) were embedded directly into the media's instructional flow. The outputs of this phase comprised initial media prototypes, instructional execution scenarios, and gamified assessment rubrics.

3. Development Phase

The third phase centered on transforming conceptual designs into functional learning tools and ensuring their academic rigor. The hybrid multimedia package was physically and digitally assembled into a cohesive ecosystem. To evaluate content and media fidelity, a rigorous formative validation process was conducted involving three expert panel members specializing in science pedagogy, educational media, and AIK values. Feedback and quantitative ratings obtained from evaluation matrices were analyzed to execute iterative revisions. This phase culminated in a validated, expert-approved gamified learning media package ready for field testing.

4. Implementation Phase

The fourth phase involved testing the validated media package in an authentic classroom environment to evaluate its real-world instructional feasibility. Implementation was carried out through two structured learning sessions covering biological pubertal transitions and Sharia-aligned personal ethics. During these sessions, student interactions, engagement dynamics, and classroom mechanics were systematically recorded using field observation protocols, while the classroom teacher maintained reflective journals to capture qualitative instructional nuances.

5. Evaluation Phase

The final phase evaluated the overall usability and practical effectiveness of the developed media package. Post-implementation data were collected from fifth-grade students and educators using Likert-scale practicality questionnaires. The gathered quantitative data were processed through descriptive statistical analysis to determine the practical feasibility ratio of the media package. The final deliverables of this stage included a comprehensive practicality report, a systematic analysis of product constraints, and the finalized, deployment-ready learning media package.

FINDINGS AND DISCUSSION

Findings

The findings of this research and development are systematically presented following the chronology of the five stages of the ADDIE model, yielding authentic data related to the media engineering process, expert validation, and practical usability in real learning environments. In the initial phase, the Analysis stage, data triangulation involving classroom observations and in-depth interviews with the homeroom teacher revealed a significant pedagogical gap. Educators acknowledged experiencing technical and psychological difficulties in delivering puberty material comprehensively and engagingly. This challenge was triggered by the limited learning resources focusing solely on rigid textbooks and the scarcity of representative and culturally appropriate visual media. From the students' perspective, observations showed that most students tended to be passive, felt awkward, or even laughed at reproductive anatomy terms taught conventionally, indicating high affective filters and mental unreadiness. Furthermore, it was revealed that the doctrine of *Al-Islam Kemuhammadiyah* (AIK) values embraced by the school had not been integrated organically with science but was taught separately in religious studies classes. This analytical finding validated the urgency of creating a media instrument that hybridizes these two disciplines.

Based on this analytical foundation, the Design stage conceptualized the product architecture specifications comprising four instrumental elements: (1) an interactive digital media application as the main knowledge hub, (2) digital comics with everyday visual storytelling, (3) an interactive physical board game, and (4) a gamified assessment instrument. The basic design concept focused on integrating biological narratives with *Hifdzun Nafs* principles and *fiqh* rules about *thaharah* (purification). Sensitive material was redesigned as missions within the board game and contextualized through dialogues of fictional characters in the comics, thereby distancing it from any vulgar impression.

Entering the Development stage, all blueprints from the previous stage were realized into functional prototypes. Production of visual assets, audio element integration, interface design, and physical board game printing were completed in this stage. To ensure quality and academic precision, the initial product was required to undergo expert validation procedures. The validation team consisted of three main experts: a science content specialist, a learning media expert, and a pedagogy practitioner.

Table 1. Learning Media Validity Result

No.	Media Type	Percentage (%)	Category
1.	Digital Media	94,58	Highly Valid
2.	Board Game	97,12	Highly Valid
3.	Digital Comic	95,15	Highly Valid
4.	Gamified Assessment	93,94	Highly Valid
Average		95,19	Highly Valid



(a)



(b)



(c)

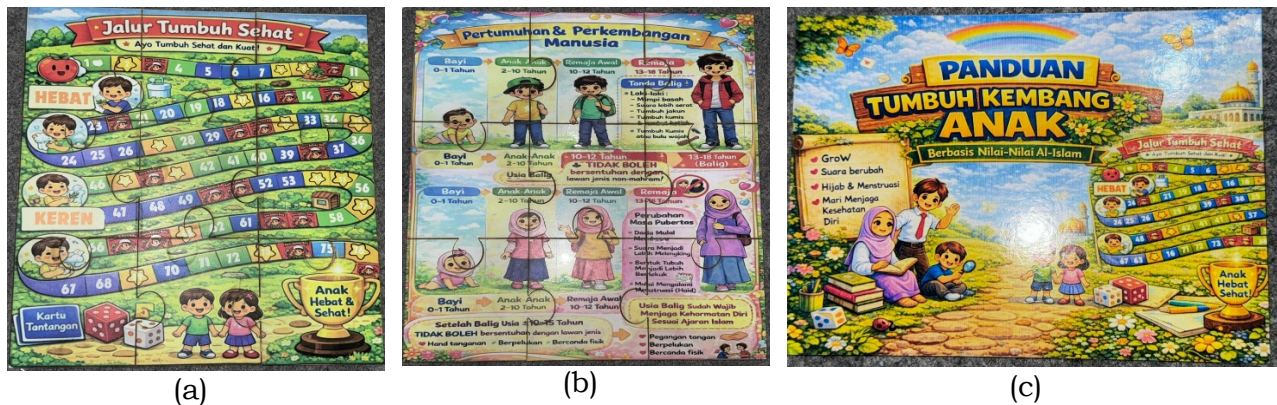
Description related to the media

Figure 1. Display of Interactive Digital Learning Media: (a) initial media page; (b) main menu page; and (c) material selection page.



Description related to the media

Figure 2. Cover Display of the Digital Comic "Jejak Iffah: Adventure to the Mukallaf Gate."



Description related to the media

Figure 3. Display of the Board Game Media "Healthy Growth Path": (a) the Healthy Growth Path game board; (b) puzzle of human growth and development stages; and (c) game user manual.

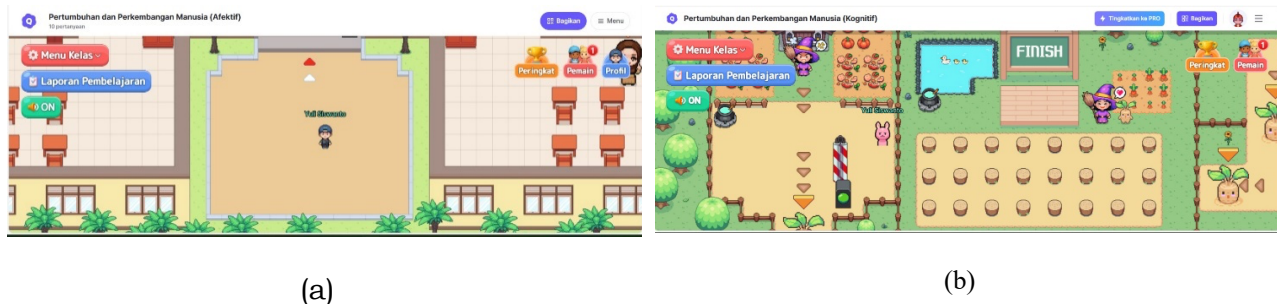


Figure 4. Display of Gamified Assessment Based on Zep Quiz: (a) affective assessment arena; and (b) cognitive assessment arena.

Table 2. Practicality Test Result

No.	Assessment Source	Percentage (%)	Category
1.	Student Response Questionnaire	87,00	Highly Practical
2.	Teacher Observation (Meeting 1)	90,00	Highly Practical
3.	Teacher Observation (Meeting 2)	94,00	Highly Practical
Average		90,33	Highly Practical

Validation Results of Learning Media by Expert Team:

Table 3. Expert Validation Results for the Learning Media

No.	Learning Media Component	Science Expert	Media and IT Expert	Pedagogy Expert	Average Score	Category
1.	Interactive Digital Media Application	96.20%	93.15%	94.40%	94.58%	Very Valid
2.	Physical Board Game	98.00%	96.50%	96.86%	97.12%	Very Valid
3.	Digital Comic	95.50%	94.20%	95.75%	95.15%	Very Valid
4.	Gamified Assessment	91.80%	95.32%	94.70%	93.94%	Very Valid

The overall cumulative average from the expert validation process reached an absolute score of 95.19%, which officially places the products in the Very Valid classification and highly recommends them for field testing. Although the final scores are very satisfying, the evaluation process remains iterative. Various critical inputs from the validators were implemented to sharpen the quality.

For example, the science expert recommended inserting audio recordings of Quranic tartil recitation in the digital media component when displaying purification (thaharah) verses to accommodate students with auditory learning styles. In the digital comic component, the media expert suggested revising the color proportions in the story transition panels to emphasize mood changes. Regarding the board game, the pedagogy practitioner recommended adjusting the complexity of the game instructions to avoid excessive cognitive load for 10-year-old readers.

In the Implementation phase, the revised instructional package was brought into an actual classroom ecosystem involving 19 fifth-grade students over two sessions (the first session dissected biological anatomy; the second reviewed social mitigation and Islamic law related to AIK). The classroom teacher relinquished lecture dominance and transformed into an active facilitator. Students were divided into several heterogeneous groups to compete healthily in solving challenges using the board game, then rotated to explore the interactive comic modules on digital devices.

The final phase, Evaluation, was dedicated to calculating the operational practicality and user acceptance of the media package. This measurement was based on a practicality questionnaire filled out independently by students post-implementation, as well as teacher observational sheets reviewing indicators of engagement, navigation smoothness, and learning enthusiasm.

Practicality Test Results Based on User Implementation:

1. Usability and Visual Appeal assessed through the Student Response Questionnaire obtained a score of 87.00% in the category of Very Practical.
2. Dynamics and Classroom Engagement assessed through Teacher Observation in Session 1 obtained a score of 90.00% in the Very Practical category.
3. Meaningful Interaction and Retention assessed through Teacher Observation in Session 2 obtained a score of 94.00% with the Very Practical category.

The cumulative practicality ratio of the media reached 90.33%, strongly establishing it in Very Practical category. An insightful trend captured from the data is the progression of positive observation from the first session to the second session. This proves that the mechanism of

adaptation of the student learning curve to the media runs very quickly and smoothly. As students and teachers increasingly interact with digital interfaces and board game rules, their levels of cognitive and affective engagement skyrocket, confirming the functionality of media as a catalyst for learning.

Discussion

The empirical findings of this study indicate that the integrative gamified learning package developed has a high level of validity and practicality for use in elementary-school puberty education. These results should be interpreted as evidence of the feasibility and usability of the media rather than its effectiveness in improving student learning outcomes, because this study did not specifically measure learning achievement. From a theoretical perspective, these findings support the Cognitive Theory of Multimedia Learning (CTML), which emphasizes that students can construct understanding through appropriately integrated verbal and visual information. The combination of interactive digital media, digital comics, physical board games, and gamified assessments provides multiple representations of biological information that can support students in understanding concepts related to human growth and puberty. This interpretation is consistent with Niwangtika and Nisak (2026), who emphasized the role of educational games and visual learning experiences in supporting science literacy. However, the present study extends this perspective by integrating several types of digital and physical media into one instructional package specifically designed for puberty education.

Beyond the cognitive aspect, the high practicality of the media during classroom implementation indicates that gamification can provide a learning environment that supports student participation when discussing sensitive topics. Puberty education often involves feelings of awkwardness, embarrassment, and socio-cultural sensitivity, particularly when students encounter terms related to reproductive anatomy and physical changes (Kusumawati et al., 2026; Situmorang, 2024). In this context, the use of game-based challenges, group activities, and interactive learning provides an alternative to conventional teacher-centered explanations. This finding is consistent with Algburi et al. (2026), who explained that gamification can support motivation through elements related to autonomy, competence, and participation. It also corresponds with the broader findings of Jaramillo-Mediavilla et al. (2024), which highlight the potential of gamification to support student motivation and engagement. Nevertheless, the present study does not claim that gamification directly reduces anxiety or improves motivation, because these variables were not measured

independently; rather, the findings demonstrate that the gamified format could be practically implemented and accepted during classroom activities.

The use of gamification in this study also supports previous findings on game-based learning in science education. Kalogiannakis et al. (2021) reported that gamification has been widely used in science learning to encourage active student participation, while Hashim et al. (2024) emphasized the potential of board-game approaches to create collaborative and interactive science-learning experiences. The similarity with the present study lies in the use of game elements to make science learning more participatory and engaging. However, the present study differs in that it does not depend on a single game-based medium. Instead, the learning process combines interactive digital media, digital comics, a physical board game, and gamified assessment as interconnected components. In addition, these media are applied to puberty education, which requires not only understanding of biological concepts but also consideration of students' emotional readiness and cultural context.

Another important contribution of this research lies in the integration of Al-Islam Kemuhammadiyah (AIK) values directly into the science content. In the Indonesian educational context, discussions of puberty and reproductive health may encounter cultural and religious sensitivities when they are presented only from a biological perspective (Phillips et al., 2025; Situmorang, 2024). Therefore, concepts of *akil baligh*, *thaharah*, personal responsibility, and bodily privacy were incorporated into the learning media as part of the instructional context. This approach is consistent with Amal et al. (2022), who showed that the integration of Al-Islam Kemuhammadiyah values in science learning can contribute to the development of religious character, and with Dalimunthe et al. (2024), who emphasized the importance of integrating Islamic values and science in educational settings. The difference is that the present study applies this integration specifically to puberty education and embeds AIK values within the media narratives, activities, and learning challenges rather than positioning religious messages as separate supplementary information. Thus, the findings extend previous science–religion integration studies into a more specific and culturally sensitive area of elementary-school science education.

The hybrid design of the media package also distinguishes this research from learning approaches that rely primarily on digital technology. The integration of a physical board game with digital learning media allows students to experience both technology-based learning and direct peer interaction. Hashim et al. (2024) emphasized that board games in science education can facilitate

collaborative learning, whereas interactive digital media offer visual and navigational flexibility that can enrich students' learning experiences. In the present study, these two forms of media are not treated as competing approaches but as complementary components. Digital media and comics provide visual and contextual representations of puberty concepts, while the physical board game facilitates discussion, cooperation, and interaction among students. Therefore, the hybrid format expands the instructional possibilities of gamification by combining individual or digital exploration with face-to-face collaborative learning.

In practical implementation, the developed media package can be adapted to elementary-school classroom conditions and used sequentially according to the learning objectives. Interactive digital media can be used at the beginning of learning to introduce concepts of human growth, development, and puberty, followed by digital comics to provide contextual and age-appropriate narratives. The physical board game can then be implemented in small groups to reinforce concepts through questions, challenges, and peer interaction, while the gamified assessment can be used as a formative activity at the end of the learning process. In this arrangement, the teacher remains an important facilitator who guides discussion, clarifies scientific misconceptions, and ensures that sensitive questions are discussed using appropriate language and in accordance with AIK values. Schools with limited digital facilities may also prioritize printed comics and physical board-game components, whereas schools with adequate technological resources can implement the complete media package. Thus, the developed media provide a flexible instructional option for elementary schools, although further research involving larger samples and experimental designs is still needed to determine its effectiveness on student learning outcomes and long-term understanding of puberty.

CONCLUSION

This research successfully developed an integrative gamified learning media package consisting of interactive digital media, digital comics, a physical board game, and gamified assessment integrated with Al-Islam Kemuhammadiyah (AIK) values for fifth-grade puberty education. Using the ADDIE model, the developed media achieved a high level of expert validity and classroom practicality, indicating that the package is feasible and practical for use in elementary-school learning. The integration of scientific concepts with AIK values, including *akil baligh*, *thaharah*, personal responsibility, and bodily privacy, provides a culturally and religiously

responsive approach to presenting sensitive puberty-related content.

The study was limited to evaluating the validity and practicality of the media and did not examine its effectiveness in improving students' learning outcomes. In addition, the field trial involved a relatively small sample and a short implementation period. Therefore, further research should involve larger and more diverse samples, longer implementation periods, and experimental designs to examine the effectiveness of the media on students' learning outcomes, puberty knowledge, attitudes, and long-term reproductive-health literacy.

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