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To cite this article: M. T. Wicaksana and Erlina, “Development of Arabic Interactive Learning Media Assisted by Kodular for Grade VIII at Islamic Junior High School,” *Lang. Technol. Soc. Media*, vol. 1, no. 1, pp. 27–41, 2023.

DOI: <https://doi.org/10.70211/ltsm.v1i1.21>

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Published online: 27 June 2023



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Development of Arabic Interactive Learning Media Assisted by Kodular for Grade VIII at Islamic Junior High School

M. Tegar Wicaksana* and Erlina

Received: 6 April 2023

Revised: 16 May 2023

Accepted: 26 June 2023

Online: 27 June 2023

Abstract

This study focuses on the development of an interactive Arabic language learning media, assisted by Kodular, for eighth-grade students at Madrasah Tsanawiyah (MTs). Arabic language learning presents challenges due to limited resources and student engagement, especially in the context of online learning. This study aimed to design and evaluate the feasibility, effectiveness, and student responses to this interactive learning media, which was developed using the 4D model: Definition, Design, Development, and Dissemination. The media was validated by experts in both media and content, receiving high ratings of 98%, categorizing it as highly suitable for educational purposes. The study employed a quasi-experimental design, with pre-test and post-test assessments conducted at two schools: MTs Guppi 2 Tanjung Karang and MTs NU Tanjung Karang, involving 40 students in total. Data were collected through questionnaires, interviews, tests, and documentation. The results from the t-test analysis showed statistically significant improvements in student learning outcomes. At MTs Guppi 2, the t-value was 12.55 ($p < 0.05$), and at MTs NU, it was 10.38 ($p < 0.05$), indicating the effectiveness of the Kodular-assisted media in enhancing student engagement and academic performance. The study concludes that the Kodular-based interactive learning media is a highly effective tool for improving Arabic language proficiency in eighth-grade students. Its advantages include accessibility without the need for internet connectivity, offering a flexible and engaging learning experience. The findings suggest that integrating mobile-based learning tools can significantly address the challenges of traditional learning environments, especially in regions with limited internet access. Furthermore, this research underscores the potential of Kodular as a platform for creating educational media, providing a low-cost, accessible solution for educators in diverse settings.

Keywords: Arabic Language; Development; Interactive Learning Media; Kodular

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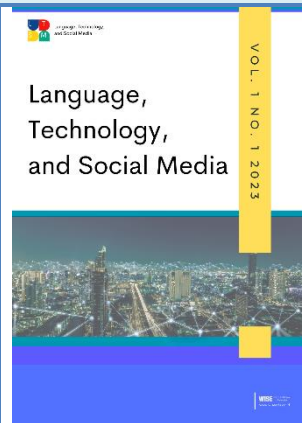
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INTRODUCTION

Education means the guidance or intentional assistance provided by adults to a student for their development. In a broader context, education is the effort of an individual or a group of individuals to influence others to grow or attain higher levels of life and spirituality [1], [2], [3]. In education, there is undoubtedly learning that can enhance one's personal quality. In the best learning activities, it is essential to demonstrate the key aspects of the subject matter. One of these is how to capture the student's attention, which can boost their interest in learning [4], [5], [6].

Arabic language is one component of Islamic religious education. Learning Arabic is a cognitive process involving four stages: selecting information through the senses, understanding the information, storing the information, and retrieving the information [7], [8]. Arabic language learning emphasizes language skills such as listening, speaking, reading, and writing [9], [10], [11]. In Arabic language learning, educators must create teaching materials that capture students' interest with attractive packaging, making them enjoy and feel comfortable while learning and facilitating comprehension of the content. To ensure a smooth Arabic language learning process, media is needed so that learners have the desire to participate in Arabic language learning. Arabic is a challenging subject for learners, making them reluctant to study it. Therefore, effective learning media will influence the Arabic language learning process itself.

In today's era, the development of information technology and computers has had an extraordinary impact on the development of learning media. This technology enables the integration of various types of media into the learning model. One such integration is the use of multimedia in learning [12], [13], [14], [15]. Multimedia involves the use of computers to present text, sound, images, animations, and videos, combined with tools and connections that allow users to navigate, interact, create, and communicate. In the field of education, multimedia is used as an educational medium [16]. Interactive multimedia is a type of media where users can control what and when elements of multimedia are delivered or displayed [17]. In the development of interactive learning media, researchers have found a website that can be used as a reference for creating Android-based learning media, namely Kodular.

Kodular is an open-source application or IDE (Integrated Development Environment). Kodular has the most features among all similar IDEs. This Kodular site can create Android applications, transfer the final results of application development to the Kodular Store, and create custom augmentations for gadgets that are not available by default. Before the code name change, this site was called Makeroid [18], [19], [20].

Based on interviews conducted by the researcher with an Arabic language teacher at MTs Guppi 2 Tanjung Karang, Mr. Muhammad Sanusi, S.Ag, he mentioned that the learning process in class VIII faces difficulties in delivering Arabic language material due to students' backgrounds, who are not able to fully grasp Arabic language lessons because of the limitations of online learning, where interactions between students and teachers are restricted by distance learning media. Mr. Sanusi also informed that the media he uses for teaching includes PDF Arabic language books sent through WhatsApp groups and Arabic language learning resources on the internet, such as YouTube and Arabic language learning websites, which, of course, require students to have internet data to access them [21].

Furthermore, the results of interviews conducted by the researcher with an Arabic language teacher at MTs NU Tanjung Karang, Ms. Fitriyani, S.Pd., revealed that in the learning process in class VIII, students face challenges due to their low interest in Arabic language learning, and

Arabic language lessons are only allotted 45 minutes per week. Therefore, Arabic language learning is not fully maximized. The media used in the Arabic language teaching process includes e-books, which lack audio for students to listen to when learning how to pronounce Arabic words [22].

Based on the researcher's observations, students nowadays own smartphones with Android-based operating systems. In this regard, the researcher provides students with the opportunity to revisit materials they have not yet mastered anywhere and anytime. The media developed by the researcher must include text, audio, images, animations, and be accessible without requiring data, so that learners can fully understand the material being taught. In line with the explanation above, the researcher conducted a study entitled "Development of Interactive Arabic Language Learning Media with Kodular Assistance for Class VIII Madrasah Tsanawiyah." In this study, references from previous research were obtained and serve as the differentiating factor between previous research and the research being conducted.

One relevant study is "Development of Arabic Language Learning Media Based on Mobile Learning with the theme of Al-shihhatu wa Al-ri'ayatu Al-shihhiyyatu for Grade XI Students at MAN 2 Bandar Lampung," conducted by Ahmad Maulana [23]. This research describes the development process of mobile learning-based educational media using Construct 2 software for Arabic language learning at MAN 2 Bandar Lampung. The relevant similarity with this research is the development of technology-based educational media, while the difference lies in the use of Construct 2 software by Ahmad Maulana and the inclusion of material for Madrasah Aliyah, whereas the researcher uses Kodular software and focuses on material for Madrasah Tsanawiyah.

Another study conducted by Nora Azlina [24], titled "Design of Interactive Media for Introduction to Multimedia Based on Android Using App Inventor 2." This research discusses the design process of interactive media for introducing multimedia based on Android using App Inventor 2 software, used in the Information Technology Education program at UIN Ar-Raniry . The similarity with this researcher's work is the development of interactive media based on Android. The difference is that Nora Azlina's research uses App Inventor 2 software, while the researcher uses Kodular for developing interactive media based on Android.

A study conducted by Rachmad Ardy Pamungkas [25], titled "Development of Learning Media Using Kodular on Branching and Looping Material to Improve Student Understanding." This research describes the development of Android-based learning media for branching and looping material for Class X TKJ at SMK 5 Sukoharjo. The similarity with this researcher's work is the focus on Kodular as the software for developing learning media. The difference is that Rachmad Ardy Pamungkas' research focuses on branching and looping material at SMK Negeri 5 Sukoharjo, while the researcher focuses on Arabic language material for Madrasah Tsanawiyah Class VIII.

Lastly, a study by Marwah Ahmad Maulana [26] titled "Development of Leaflet-Based Learning Media for Circulation Material for Grade XI at MAN 1 Makassar." This research develops leaflet-based learning media for circulation material in the Biology subject using a 4D development model. The similarity with the researcher's work is the development of learning media using the 4D development model. The difference is that Marwah Ahmad Maulana's research focuses on distributing Biology material for Grade XI at Madrasah Aliyah, while the researcher focuses on interactive learning media assisted by Kodular for 'iyaadatu al-mardho (visiting the sick) in Arabic language subject for Madrasah Tsanawiyah Class VIII.

METHODS

This study employs the Research and Development (R&D) method. The R&D method is used to produce a specific product and test its effectiveness before distribution [27]. We adopt Thiagarajan's Development Model, which consists of four phases: definition, design, development, and dissemination.



Figure 1. Research Phases

Research Objectives

The objective of this R&D method is to develop an interactive Arabic language learning media product using Kodular for Grade VIII of Madrasah Tsanawiyah. This research aims to assess the feasibility of the media, evaluate student responses to the media, and test the effectiveness of the developed product.

Research Phases

This research follows Thiagarajan's development model, which consists of four main phases:

1. **Definition:** The initial phase involves analyzing the problems and needs in Arabic language learning, as well as analyzing the abilities of the learners.
2. **Design:** In this phase, material selection, media format, and storyboard creation are carried out.
3. **Development:** This phase includes the development of learning media with the assistance of Kodular, installing the application on smartphones, and the initial design of the application before validation by experts.
4. **Dissemination:** The final phase involves validation by media and content experts, followed by testing with Grade VIII students of Madrasah Tsanawiyah. The final stage is testing the effectiveness of the developed product.

Participant Characteristics

The subjects of this research are Grade VIII students from MTs Guppi 2 and MTs Nahdlatul Ulama Tanjung Karang. This research involves two stages of testing: a small-scale pilot test with 10 students and a large-scale pilot test with 20 students.

Research Design

To measure the effectiveness of the developed product in improving Arabic language learning outcomes, we use data collection methods in the form of pre-tests and post-tests, each consisting of 20 multiple-choice questions. Pre-tests and post-tests are conducted before and after the use of interactive Arabic language learning media assisted by Kodular. After data collection, the next

step is analysis using the t-test. Before conducting the t-test, we perform tests for normality and homogeneity as prerequisites for the t-test analysis.

RESULTS AND DISCUSSION

This research and development aim to produce a product in the form of interactive Arabic language learning media assisted by Kodular for Grade VIII of Madrasah Tsanawiyah. Learning media plays a crucial role in the learning process. Creative and innovative learning media can simulate abstract content in the form of animations that are easily understood by students, thus motivating them to learn. Kodular is a website that provides tools for building Android applications using a drag-and-drop block programming concept, similar to MIT App Inventor for building Android apps using block programming [28].

Pawar et al. revealed that "students can learn at their own pace anytime with this mobile learning application." This mobile learning application allows students to learn at their own pace and can be accessed anytime. This aligns with Siraj Lehner et al.'s quote that mobile learning has two strengths: learning and teaching anytime, anywhere and while working. Majid then quoted Azmi, stating that mobile learning can function as a supplement whether it is available or not for students, as a supplement when used as an additional program for the taught learning material, and only as a supplement. I explained that it also serves as reinforcement instead. For students who do not meet learning standards. In this case, mobile learning acts as a surrogate if the learning activity model relies entirely on mobile learning. This is intended to allow students to flexibly manage their time and activities according to their daily schedules [29].

From the information above, apart from being accessible anytime, anywhere, the advantages of using mobile learning-based education are not only its ability to reinforce and review but also its potential to enhance students' learning retention for a more focused learning experience. The development model used as a reference in this research is the Thiagarajan model. This Thiagarajan model, known as the 4-D model, consists of four phases: definition, design, development, and dissemination [30].

Definition

The definition phase is the initial stage of research and development aimed at analyzing the needs of teachers and students. This is carried out through observations, interviews, and the distribution of questionnaires to determine what needs to be developed in the research [31]. In this phase, researchers gather data in the field based on interviews conducted with Arabic language teachers at MTs Guppi 2 and MTs NU Tanjung Karang. Interviews with Arabic language teachers at MT Guppi 2 Tanjung Karang and Mr. Muhammad Sanusi, S.Ag, yielded findings related to the Arabic language learning process, including difficulties in delivering materials due to distance learning and students with diverse school backgrounds, resulting in less than optimal Arabic language learning due to limited teacher supervision. Additionally, the media used during learning consisted of PDF Arabic language books and online learning resources such as YouTube and Arabic language learning websites, which required students to have internet access [21].

Subsequently, the results of interviews conducted at MTs NU Tanjung Karang with Mrs. Fitriyani, S.Pd, as the Arabic language teacher for Grade VII, also revealed issues such as a lack of student interest in Arabic language learning, with only 45 minutes per week dedicated to Arabic language instruction and the use of online textbooks or e-books as the primary teaching media

[22]. Therefore, the researcher proceeded to create Arabic language learning media that would facilitate both teachers and students in its operation. This would stimulate your interest in learning Arabic, and you can use it anytime, anywhere.

Design

The Design phase is the next step after the Definition phase, and its purpose is to develop a prototype of teaching materials. This phase includes the selection of media, content, and the creation of a storyboard [32]. In this phase, the researcher begins by selecting the content, using the Arabic language textbook for Grade VIII, specifically the topic of "Visiting the Sick" by analyzing the Competency Standards, Basic Competencies, learning indicators, and objectives. Additionally, this phase involves selecting the media format, determining the visual layout, outlining the application's flow, and creating a storyboard for the teaching materials.

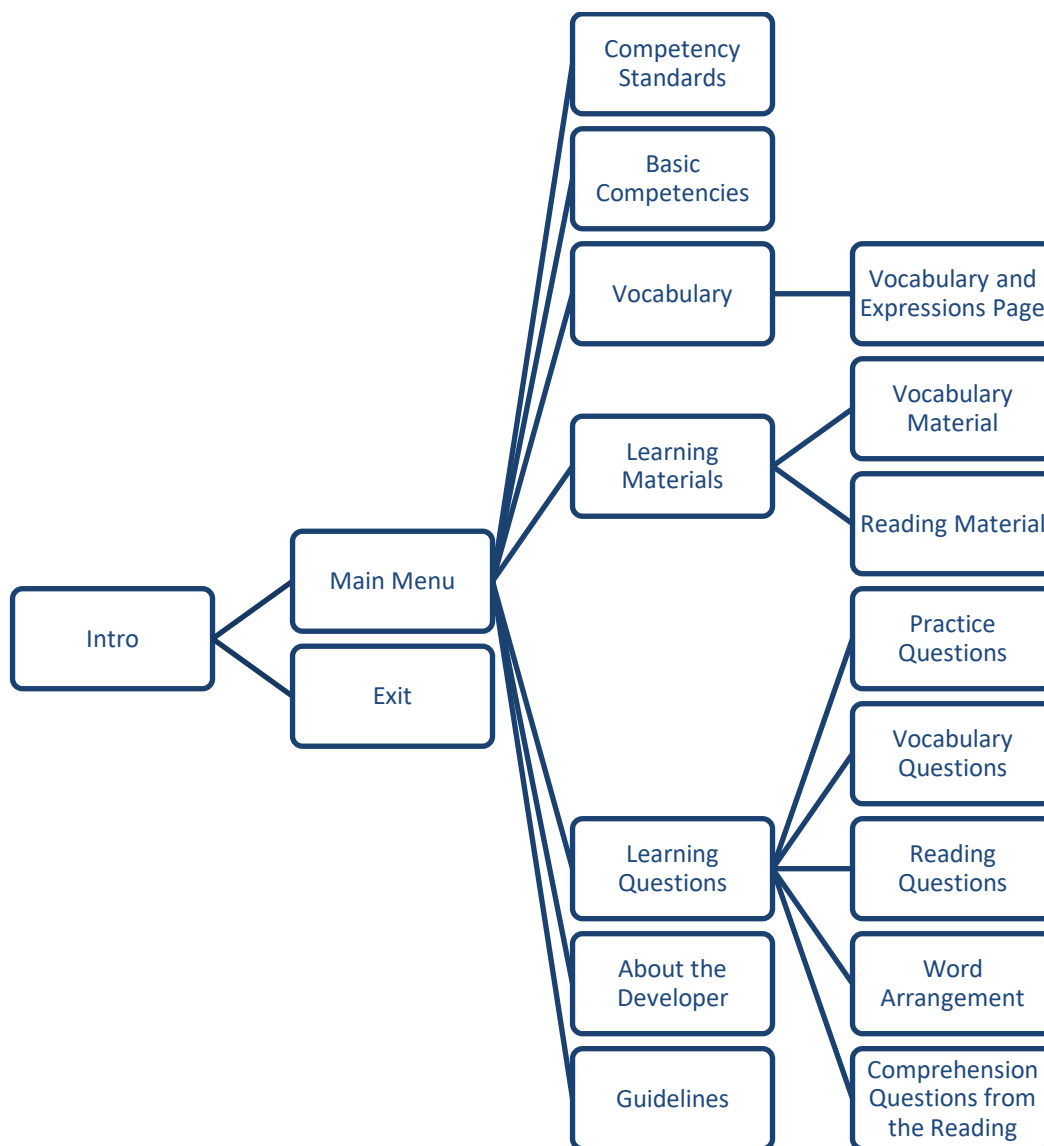


Figure 1. Learning Media Storyboard

Development

Development is the stage of modifying the prototype of the learning tool and serves as a follow-up stage to the design phase, which is the development stage for creating interactive Arabic language learning media. This phase consists of three steps: Developing interactive Arabic language learning media that supports the installation process code into the user's smartphone application, and the final step is the initial design of the interactive Arabic language learning media application that supports this code.

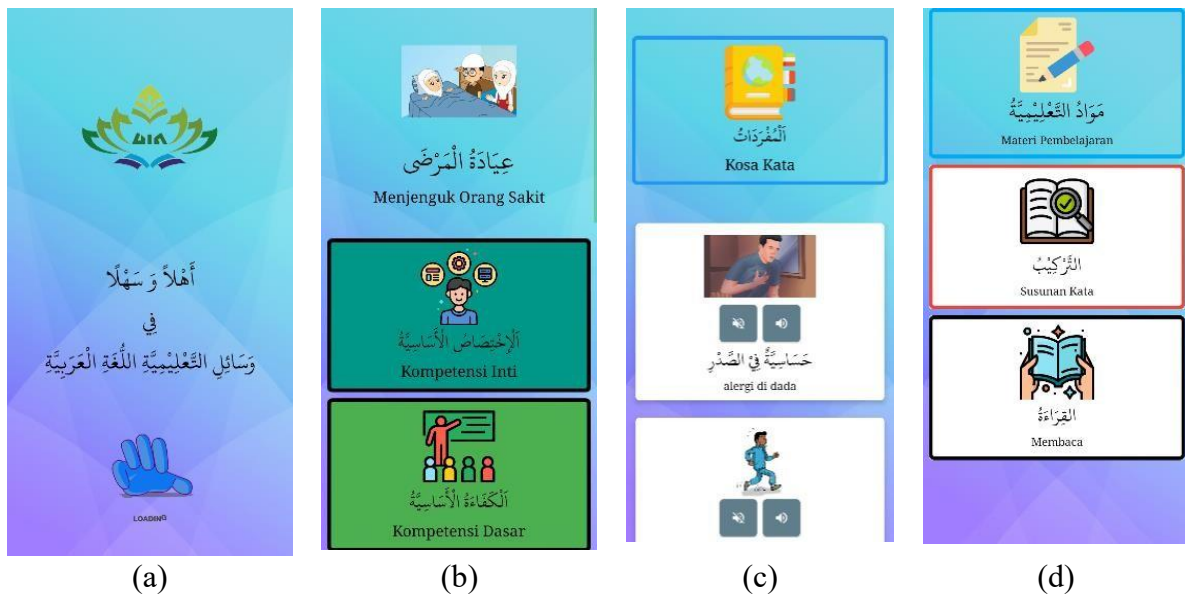


Figure 2. (a) Initial Menu Display; (b) Competency Display; (c) Vocabulary Display; (d) Learning Material Display.

Dissemination

The dissemination phase is an integral component of research and development, involving the distribution of products on a smaller scale, specifically within the context of valid media and research locations during field trials [33]. The feasibility assessment of this product is conducted by subject matter experts and media specialists. The evaluation conducted by media experts shows a 98% rating, categorizing this interactive Arabic language learning medium as viable. Similarly, the assessment of product suitability by subject matter experts yields a 98% rating, thus classifying this interactive Arabic language learning medium as suitable.

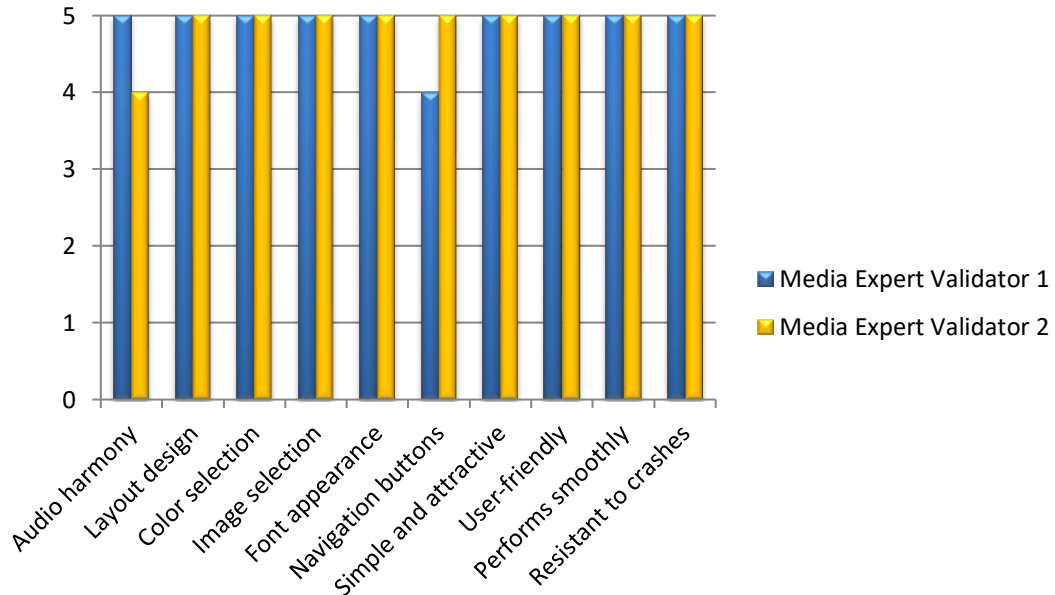


Figure 3. Media Expert Validation Results

Figure 3 above shows a rating matrix from two validators (Media Expert Validator 1 and Media Expert Validator 2) for various aspects in media development, such as audio, layout design, color selection, image selection, font appearance, navigation buttons, simplicity and attractiveness, user-friendliness, performance, and crash resistance. Here is the analysis of the results: 1) Audio Harmony: In this aspect, both validators gave high ratings (5 and 4). This indicates that overall, the validators consider the audio in this media to be harmonious and aligned with the desired objectives. However, there is a slight difference in opinion between validator 1 and validator 2; 2) Layout Design, Color Selection, Image Selection, Font Appearance: In design-related aspects like these, both validators provided high ratings (5 and 5). This suggests that the layout design, color selection, image selection, and font appearance are all deemed excellent by both validators. This is a positive point indicating that the visual design of the media is of high quality; 3) Navigation Buttons: Validator 1 gave a rating of 4, while Validator 2 gave a rating of 5. This indicates a minor difference of opinion regarding navigation buttons. There might be some room for improvement in this aspect, according to Validator 1; 4) Simple and Attractive: Both validators gave the maximum rating (5). This indicates that the media is considered simple and attractive by both validators. Simplicity and attractiveness are crucial aspects of successful media design; 5) User-Friendly: Both validators gave the maximum rating (5). This is a positive indication that the media is perceived as user-friendly. User-friendliness is a critical factor in media development; 6) Performs Smoothly and Resistant to Crashes: Both validators gave the maximum rating (5) for performance and crash resistance. This is a highly important aspect because users expect media to function smoothly without technical issues.

Overall, these results show that the media excels in many aspects, particularly in visual design, simplicity, user-friendliness, performance, and crash resistance. While there are slight differences of opinion in some aspects like audio and navigation buttons, overall, the media receives very positive ratings from both validators. This can be considered an indication that the media has succeeded in meeting many of the criteria required to be a high-quality media product.

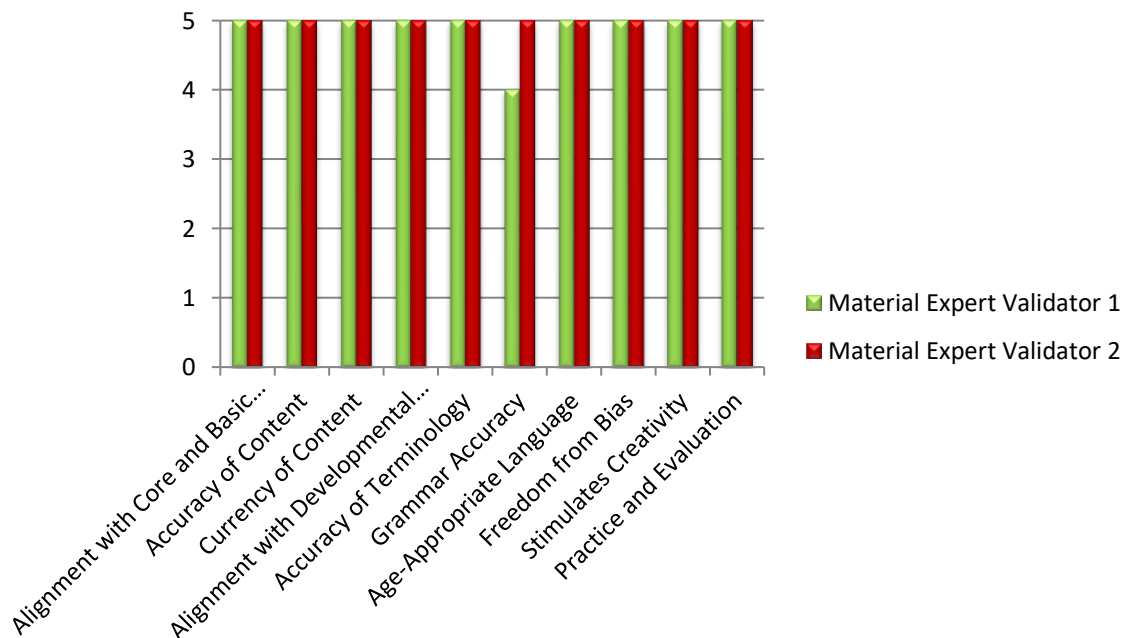


Figure 4. Material Expert Validation Results

Based on the [Figure 4](#) above, the assessment results by both Material Expert Validators (Validator 1 and Validator 2) indicate an excellent rating for various aspects of the evaluated content material. The indicators are as follows: 1) Alignment with Core and Basic Competencies; 2) Content Accuracy; 3) Content Relevance; 4) Alignment with Developmental Stage; 5) Terminology Accuracy; 6) Age-Appropriate Language; 7) Freedom from Bias; 8) Stimulating Creativity; and 9) Exercises and Evaluations all received a maximum rating of 5 from both validators. However, there is a difference in the assessment of grammar accuracy, where Validator 1 gave a rating of 4, while Validator 2 gave a rating of 5. Overall, the analysis results indicate that the evaluated content has very high quality, with minor notes regarding grammar accuracy.

After the media has been validated as suitable for use, the next step is to conduct a trial to assess the appeal or interest of students towards the developed learning media. This is achieved by creating a student response questionnaire. The initial trial took place at Guppi 2 Islamic Junior High School in the eighth-grade class, involving a small-scale trial with 10 students. The researcher obtained an average final score of 92%.

Table 1. Summary of Small Group and Large Group Trial Results at MTs Guppi 2 and MTs NU Tanjung Karang

No	Indicator	MTs Guppi 2		MTs NU Tanjung Karang	
		Small Scale Test (10 Students)	Large Scale Test (20 Students)	Small Scale Test (10 Students)	Large Scale Test (20 Students)
1	Presentation Clarity	100%	99%	82%	82%
2	Engaging Learning Material	84%	83%	84%	84%
3	Facilitating Learning	98%	96%	84%	84%

No	Indicator	MTs Guppi 2		MTs NU Tanjung Karang	
		Small Scale Test (10 Students)	Large Scale Test (20 Students)	Small Scale Test (10 Students)	Large Scale Test (20 Students)
4	Easily Understandable Language	84%	86%	82%	82%
5	Appeal of Learning Media	90%	85%	85%	85%
6	Usage Instructions	88%	90%	85%	85%
7	User-Friendly	88%	89%	85%	85%
8	Functional Buttons	94%	93%	85%	85%
9	Good Audio Quality	92%	92%	84%	84%
10	Clear Formatting, Models, and Readable Text	100%	97%	89%	89%

Based on the [table 1](#) above, the information obtained is as follows: 1) Presentation Clarity: The average score for MTs Guppi 2 in both the small-scale and large-scale tests is 99.5%, while MTs NU Tanjung Karang achieved an average score of 82%. The category for MTs Guppi 2 is "Very Good," whereas MTs NU Tanjung Karang falls into the "Fairly Good" category; 2) Engaging Learning Material: The average score for both schools is approximately 83.5%, placing them in the "Fairly Good" category; 3) Facilitating Learning: MTs Guppi 2 achieved an average score of 97%, while MTs NU Tanjung Karang scored an average of 84%. The category for MTs Guppi 2 is "Very Good," whereas MTs NU Tanjung Karang is categorized as "Fairly Good."; 4) Easily Understandable Language: The average score for MTs Guppi 2 is 85%, whereas MTs NU Tanjung Karang achieved an average score of 82.5%. Both fall into the "Fairly Good" category; 5) Appeal of Learning Media: MTs Guppi 2 has an average score of 87.5%, while MTs NU Tanjung Karang scored an average of 85%. Both schools are categorized as "Fairly Good."; 6) Usage Instructions, User-Friendly, Functional Buttons: The average score for MTs Guppi 2 for these indicators is around 90%, while MTs NU Tanjung Karang scored an average of around 86%. Both are categorized as "Very Good."; 7) Good Audio Quality: MTs Guppi 2 has an average score of 92%, while MTs NU Tanjung Karang achieved an average score of 84%. The category for MTs Guppi 2 is "Very Good," while MTs NU Tanjung Karang falls into the "Fairly Good" category; 8) Clear Formatting, Models, and Readable Text: The average score for MTs Guppi 2 is 98.5%, while MTs NU Tanjung Karang achieved an average score of 89%. The category for MTs Guppi 2 is "Very Good," while MTs NU Tanjung Karang is categorized as "Good."

Overall, MTs Guppi 2 consistently achieved higher average scores compared to MTs NU Tanjung Karang in most of the evaluated indicators. These results indicate that MTs Guppi 2 has better-quality learning materials and is more effective in facilitating the learning process for students, falling into the "Very Good" or "Good" categories. Meanwhile, MTs NU Tanjung Karang, in some aspects, achieved a "Fairly Good" category. These findings have significant implications for curriculum development and teaching methods in both schools, with the goal of improving the quality of education at MTs NU Tanjung Karang.

Table 2. Effectiveness Test of Arabic Language Learning Media at MTs Guppi 2 and MTs NU Tanjung Karang

Research Location	t-value	t-table	α (Significance Level)	Comparison Result	Average Pretest Score	Average Posttest Score
MTs Guppi 2	12,55	1,27	0,05	$12,55 > 1,27$	67,5	88,5
MTs NU Tanjung Karang	10,38	2,88	0,05	$10,38 > 2,88$	71	89

Based on the [table 2](#) above, a comparison between two groups, namely MTs Guppi 2 and MTs NU Tanjung Karang, regarding the effectiveness of using the developed media was conducted. The results of the statistical test using the t-test hypothesis indicate a significant difference between the pretest and posttest scores in both groups.

Firstly, in the MTs Guppi 2 group, the T-value of 12.55 is greater than the critical T-table value at a significance level (α) of 0.05. This indicates a significant difference between the pretest and posttest scores in MTs Guppi 2. The average pretest score in MTs Guppi 2 was 67.5, while the average posttest score increased significantly to 88.5.

Secondly, in the MTs NU Tanjung Karang group, the T-value of 10.38 is also greater than the critical T-table value at a significance level (α) of 0.05. This also indicates a significant difference between the pretest and posttest scores in MTs NU Tanjung Karang. The average pretest score in MTs NU Tanjung Karang was 71, and the average posttest score increased significantly to 89.

Therefore, based on the results of the statistical tests and the comparison of the average pretest and posttest scores in both groups, it can be concluded that the developed media is effectively used in improving student test results in both MTs Guppi 2 and MTs NU Tanjung Karang. There is a significant improvement in the average posttest scores after the use of this media, indicating the success of the media in positively impacting student learning outcomes in both research locations.

This paper aims to elaborate on the results of a research study that developed mobile learning-based instructional media with the assistance of the Kodular platform, particularly in the context of teaching the Arabic language in the eighth-grade of a Tsanawiyah Islamic school. The research was directed towards enhancing student participation levels and promoting active, creative, and innovative learning while reducing passive behaviors in the learning process.

The findings of this research demonstrate that the instructional media developed using Kodular has significant potential as a viable and effective tool in developing Arabic language teaching materials, specifically in the topic of "Visiting the Sick," for use in the eighth-grade curriculum of Tsanawiyah Islamic schools. The primary advantages of this interactive learning media are its ease of accessibility, as it does not require internet connectivity, and its flexibility of use, which can be accessed from various locations and at any time as needed. However, this research also identifies some challenges in the use of Kodular-assisted instructional media, such as the limitation of application storage capacity, which cannot exceed 30 MB. Additionally, the development of applications larger than 20 MB can present additional challenges, requiring special attention to the allocation of required quotas.

This research represents a valuable contribution in the context of Arabic language education by combining mobile learning principles with the Kodular platform. Previous studies

have emphasized the importance of interactive learning media in education, but this research adds a new dimension by integrating Kodular technology into the development of Arabic language learning materials. These findings offer practical solutions to the issue of internet accessibility, which remains a challenge in the educational environment.

Overall, this research offers significant and practical insights into the development of Arabic language instructional media, especially in the context of mobile learning. Amid the increasing role of technology in the field of education, these findings have the potential to enhance the quality of Arabic language education in Tsanawiyah Islamic schools and similar educational institutions.

CONCLUSION

This study successfully developed an interactive Arabic language learning media, utilizing the Kodular platform, and employing the Thiagarajan 4D model (Definition, Design, Development, and Dissemination). The media, which targets the enhancement of listening, speaking, reading, and writing skills in Arabic, received high validation scores of 98% from both media and subject matter experts, indicating its suitability for educational use. The findings from the small-scale and large-scale trials demonstrate the significant effectiveness of the Kodular-assisted interactive learning media in improving students' Arabic language proficiency. Specifically, the results from MTs Guppi 2 revealed a notable increase in post-test scores from 67.5 to 88.5, representing a 31% improvement, while MTs NU Tanjung Karang showed an increase from 71 to 89, reflecting a 25% improvement. The t-test analysis confirmed that the differences between the pretest and posttest scores were statistically significant ($p < 0.05$), validating the efficacy of the learning media.

This research highlights the advantages of mobile-based learning media, particularly its accessibility without requiring internet connectivity, which allows students to engage with the learning content anytime and anywhere. The positive feedback from students regarding the media's user-friendly interface, engaging content, and interactive features further underscores its potential for enhancing student learning outcomes. However, challenges related to storage limitations within the Kodular platform were identified, requiring careful consideration in future developments. Overall, this study contributes to the field of Arabic language education by providing an innovative solution to the challenges faced in traditional learning settings. By leveraging mobile technology through the Kodular platform, this research not only offers a practical tool for Arabic language instruction but also emphasizes the growing role of mobile learning platforms in enhancing educational experiences. These findings suggest the importance of integrating mobile-based learning media into the curriculum, particularly in resource-constrained environments, to promote more flexible, interactive, and engaging learning opportunities for students.

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AUTHOR CONTRIBUTION

M.T.W. developed the interactive learning media and led the design and development process. E. contributed to the validation, creation of research instruments, and the research methodology, as well as the literature review.

CONFLICT OF INTEREST

"The authors declare no conflict of interest."

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