

Kindergarten in the Digital Era: Developing Engaging Android-Based Educational Tools for Letters and Numbers

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ABSTRACT

The rapid advancement of technology has revolutionized educational methodologies, particularly in early childhood education. This study focuses on the development of interactive learning media for kindergarten students, aimed at facilitating the understanding of letters and numbers. Employing the ADDIE model, this developmental research was conducted at Cahaya Wonoasri Kindergarten, Madiun. Data collection involved observation, interviews, and questionnaires, targeting content validity, learning design, and media efficacy. The study culminated in the creation of an Android-based application, designed to be engaging for young learners. The application's effectiveness was validated through expert assessments and individual trials, demonstrating its potential in improving letter and number recognition among kindergarten students. The content, learning design, and media experts rated the application as 'good' to 'very good' in their respective areas of expertise. The findings suggest that the developed educational tool is not only viable but also beneficial in enhancing the learning experience for kindergarten children. The application's engaging design and interactive content align with modern teaching methodologies, potentially setting a new standard in early childhood education technology. This study highlights the significance of integrating technology in early education, especially in the digital era. The success of the developed Android-based application suggests a promising future for digital learning tools in kindergarten, potentially revolutionizing the way young children are introduced to fundamental concepts like letters and numbers.

1. Introduction

Information technology, which is constantly developing, has a significant impact on the world of education. (Sujana, 2019) states that education is an effort to help children physically and mentally according to their nature to become better human beings. Through the use of technology, the quality of education can be improved. Evidenced by the use of learning aids or systemized educational administration. Through technology, it will make it easier for students and educators to access everything needed.

Technology is an integral part of all aspects of human life. Almost all human activities utilize technology, whether simple or sophisticated. Likewise with the computer, which is always experiencing quite rapid development, one of which is in the field of education which is enough to help improve performance (Rahayu & Irawan, 2021). The development of computer technology has been able to

display information in various forms including multimedia. Through multimedia, information display can be in the form of text, images, sound, video, animation, graphics, and animation. Through multimedia can make the learning process more interactive and can be done independently. Interactive learning media can be made in the form of a mobile (android) to make it easier to use.

Technological developments have also indirectly changed the learning styles of students, starting from the kindergarten level to tertiary institutions. Students are more interested in things that are interesting and easy. They prefer everything that is modern than traditional. Students are more familiar with technology so that in fulfilling needs they prefer to use technology. For example, fairy tale material, children are more interested in watching videos, by utilizing YouTube. The use of mobile phones to play games and watch YouTube is something that is familiar to children.

Kindergarten Cahaya in Wonoasri is an educational institution that focuses on early childhood education. The learning process for early childhood is carried out as much as possible while playing. However, there are demands in the curriculum which state that there are competencies that students must master, namely getting to know early literacy. The introduction of numbers and letters to children must be done in an interesting way so that students pay attention. So far, teachers have used media or tools in the learning process. Utilization of support books, objects in the classroom, and creation of teacher creativity to support the learning process has been carried out. In fact, the age of students who are between the ages of 4-6 years is still less interested in the media used. Students tend to strike and play alone when the teacher tries to introduce letters and numbers. Thus there must be an effort to change the learning process with media that is interesting and familiar to students. Utilization of learning media by displaying numbers, letters, shapes, colors, and images based on interactive multimedia in mobile (android) can be a solution. Alternative problem solving by utilizing Android-based interactive learning media. The principle of play has the meaning of fun without coercion. Thus it will prioritize the process of exploring potential rather than results. Media made with a simple composition so that children and parents can easily operate it.

The requirements for choosing a learning method must consider the content of the material to be delivered, the character of the child, and the ability of the teacher (Mustaqim & Kurniawan, 2017). A good learning process is sought to be interactive, fun, challenging, motivating, and provides opportunities for students to be creative, independent, and develop their talents and interests (Suherman et al., 2017). The success of the learning process is also influenced by the accuracy in choosing media.

The role of technology is indispensable for the progress of children who are utilized in the form of mobile-based learning media. Through learning media, children's attention can be diverted so they don't get bored easily and increase concentration in quite a long time rather than not using learning media (Yuliati et al., 2022). Based on these problems, the solution that can be done is by utilizing IT-based learning media to introduce letters and numbers to students. Students can interact directly when learning is carried out. Interactive multimedia also allows students to learn independently. Meanwhile, choose mobile (Android) because it will be easier. Basically, mobile means moving freely and without using cables (Oktavia et al., 2021). Thus, through Android-based interactive multimedia, learning can be done anywhere and by anyone.

This study aims to create learning media for recognizing letters and numbers based on Android. Through IT-based media can help students to learn while playing. Through Android-based media, it is able

to provide interesting and memorable information for students. Accuracy in choosing teaching materials affects the quality of learning (Emda, 2018). Through conditions and stimulation according to the needs of children, maximum development can be achieved. Teachers are able to create a conducive learning atmosphere so that learning objectives are achieved.

Thus the basic concept of introducing letters and numbers can be fulfilled. This study will examine the feasibility of learning media based on Android to introduce letters and numbers that are considered appropriate for measuring the quality of learning media. The findings in this study will benefit teachers, students, and parents as an alternative to introducing letters and numbers to children.

Previous research was conducted by (Paino & Hutagalung, 2022) which had the aim of introducing letters and numbers to kindergarten children through a realistic approach with the Android platform. The results of the research stated by carrying out a needs analysis at the research location. At the design stage, design and application design is carried out through the buttons that will be made. Learning is done includes the introduction of letters and numbers.

2. Literature Review

Learning media plays a pivotal role in bridging the gap between teachers and students, facilitating effective learning processes (Sanaky, 2013). However, existing literature primarily focuses on the medium itself, often overlooking the impact of varying teaching approaches and student learning styles in this context. There remains a significant gap in understanding how different students interact with and benefit from varied learning media (Suryani & Setiawan, 2018).

In early childhood education, the emphasis is on holistic development, integrating both physical and psychological aspects through tailored stimuli (Maghfiroh & Suryana, 2021). While studies like Suyadi & Dahlia (2014) address the importance of educational stimuli, there is a notable absence of research on the long-term effects of these stimuli on different aspects of child development. More longitudinal studies are needed to assess the efficacy of these educational interventions over time.

The evolution of digital learning media, particularly multimedia animation like Adobe Animate, represents a significant advancement in educational tools (Septian et al., 2021). Yet, research is limited in evaluating the effectiveness of these tools in diverse educational settings. There is a gap in understanding how different demographics of students respond to and benefit from these animations in learning.

The introduction of Android, a Linux-based operating system for mobile devices, has revolutionized educational technology (Supardi, 2014; Enterprise, 2015). However, studies on Android's educational applications, such as Irsyad (2015), often

fail to address the accessibility issues and the digital divide that might limit its use in underprivileged areas. There is a need for more comprehensive research on the inclusivity and accessibility of Android-based educational tools. Interactive multimedia, combining audio, video, images, and text, is said to enhance the learning experience (Putu Abhyasari et al., 2020; Syafrizal et al., 2018). While studies like Fardiah et al. (2019) and Syukri (2020) have shown its benefits in letter and number recognition, there is a lack of research on its applicability and effectiveness in more complex subject areas and different education levels including kindergarten level.

Previous studies have largely concentrated on the media itself, often neglecting the influence of different teaching methods and student learning styles. Interactive multimedia, which integrates various digital formats, is known to enrich the learning experience (Putu Abhyasari et al., 2020; Syafrizal et al., 2018). While studies like those of Fardiah et al. (2019) and Syukri (2020) demonstrate its benefits in basic literacy skills, the application and effectiveness of interactive multimedia in kindergarten education remain under-researched. In the domain of early childhood education, comprehensive development that includes both physical and psychological aspects is emphasized

through targeted stimuli (Maghfiroh & Suryana, 2021). While existing research like that of Suyadi and Dahlia (2014) underscores the importance of educational stimuli, there's a noticeable lack of long-term impact studies in this area. This study seeks to address this by exploring the long-term effects of educational stimuli in kindergarten settings.

However, there is a gap in evaluating the effectiveness of these tools in kindergarten education, which this study aims to investigate, offering insights into how such digital tools can enhance early childhood education. Therefore, this study intends to fill this gap, specifically concentrating on the kindergarten level, where such dynamics are crucial yet understudied (Suryani & Setiawan, 2018).

3. Method

This research is a type of research and development (Research and Development) with a quantitative approach. The procedure for this study uses the ADDIE model. According to (Tegeh & Kirna, 2010) the ADDIE model has five stages, namely analysis, design, development, implementation, and evaluation

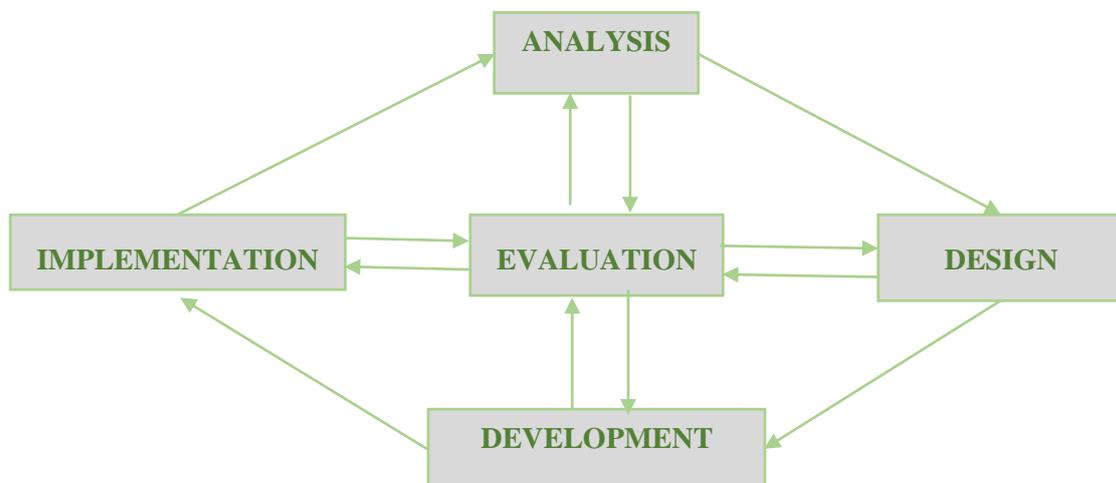


Figure 1. Research methods

The research study focused on the development of Android-based learning media for teaching children letter and number recognition. The subjects included four experts - two media experts and two material experts - who provided valuable insights into the media's design and content. Additionally, a sample of six users was selected to evaluate the practical use and effectiveness of the learning media.

A combination of observation, interviews, and questionnaires was used for data collection. Observations were conducted to understand the

interaction between teachers and students using the learning media. Interviews were carried out with the students' parents and individuals knowledgeable about child development at home, offering perspectives on the media's impact beyond the classroom setting.

Questionnaires, aimed at collecting expert validation data, played a crucial role. These were structured with a detailed grid, enabling thorough feedback from experts, thus ensuring a comprehensive evaluation of the learning media's efficacy and design.

Table 1. Learning Media Design Lattice

No	Aspect	Indicator	No item	Number of Items
1	purpose	1.Learning has a clear purpose	1	1
2.	Strategy	1.Learning activities motivate children to learn 2.The material is delivered in logical steps 3.Presentation of material can help children remember material that has been studied before. 4.Steps to use class media 5.The material presented is interesting	2 3 4 5 6	5
3	Evaluation	1.There is an evaluation to measure the ability of children	7	1

The identification sheet serves as a vital tool for gathering comprehensive information about the quality of learning media design. This encompasses an in-depth analysis of three pivotal aspects: objectives, strategies, and evaluation. Firstly, the objectives aspect delves into understanding the specific goals and outcomes that the learning media intends to achieve. It assesses how well the media aligns with educational objectives and the extent to which it meets the targeted learning outcomes.

Secondly, the strategies component examines the methodologies and approaches employed in the learning media. This includes an evaluation of the instructional design, the integration of multimedia

elements, and the interactive features that facilitate the learning process. It also considers how these strategies cater to different learning styles and how effectively they engage learners.

Lastly, the evaluation aspect focuses on the mechanisms put in place to measure the effectiveness of the learning media. This involves assessing the tools and criteria used for feedback and performance assessment, as well as how this evaluation contributes to the continuous improvement of the learning media design. Overall, the identification sheet is an essential instrument in ensuring that the learning media is not only educational but also engaging and effective in meeting its intended educational purposes.

Table 2. Grid of Expert Instrument Content of Learning Media

No	Aspect	Indicator	No item	Number of Items
1	Curriculum	1.The material is in accordance with the learning objectives 2.There is compatibility between basic competencies and indicators	1 2	2
2.	Material	1.The accuracy of the presentation of the material 2.The material is presented in an interesting way 3.The material is easy to understand 4.Suitability of the material with the child's character	3 4 5 6	4
3	language used	1.Use of language according to the child's age 2.Language is easy to understand	7 8	2
4	Evaluation	1.There is a clear target of learning outcomes	9	1

The identification sheet is used to obtain information about the quality of learning media content. Information on the appropriateness of learning

media content includes four aspects, namely suitability to the curriculum, presentation of material, language used, and learning evaluation.

Table 3. Learning Media Instruments Lattice

No	Aspect	Indicator	No item	Number of Items
1	Message Design	1. The medium is easy to use	1	5
		2. The shape and color of the media button are correct	2	
		3. Composition and color combination and music to match	3	
		4. Nice appearance design	4	
		5. Good text legibility	5	
2.	How to use	1. The medium is easy to use	6	1
3	Precision and Clarity Technique	1. The image in the media is clearly visible	7	2
		2. The letters used are clear and easy to read	8	

The identification sheet above is used to obtain information related to learning media. Information on the suitability of learning media includes three aspects,

namely media design that is easy to use, how to use the media, and the accuracy of the images and letters presented.

Table 4. Individual Trial Instrument Grid

No	Aspect	Indicator	No item	Number of Items
1	Message Design	1. Image clarity	1	4
		2. Voice clarity	2	
		3. Attractive product design	3	
		4. The text is easy to read	4	
2.	Material	1. The material is easy to understand	5	2
		2. The material is clearly described	6	
3	How to operate	1. How to use easy	7	1
4	Motivation	1. The media gives enthusiasm or motivation to the user	8	1

The identification sheet above is used to obtain information about the results of individual media trials. This indicator covers four aspects, namely design,

material, how to operate, and motivation for the media presented. The analytical method uses the following scale levels.

Achievement Rate (%)	Qualification	Description
90-100	Very Good	No revision required
75-89	Good	Little Revision
65-79	Enough	Adequately Revised
55-64	Not Enough	Many Things Revised
1-54	Very less	Repeated Creating Products

The data obtained from the trial results will be converted into five scales. The qualifications for the scale are: very good, good, fair, poor and very poor.

collection, and product design development. Each step is explained as follows. The process of preparing the introduction of letters and numbers consists of:

4. Result

4.1 Potential Analysis

The preparation stage for recognizing letters and numbers consists of four stages. These four stages include, potential analysis, problem analysis, data

Potential analysis begins with observation and interviews. Observations were made during the learning process, and interviews were conducted with

the teachers at Kindergarten Cahaya. Based on the interview results, the following data were obtained:

- 1) During the process of learning the introduction of letters and numbers, students were observed to pay less attention and be less active.
- 2) Teachers expressed a need for innovative learning media that align with students' interests.
- 3) There is a requirement for media that parents can utilize at home to aid students' understanding.
- 4) Android-based learning media, particularly for the introduction of letters and numbers, has not been used. So far, the media have been limited to teaching aids created by teacher creativity.

From the interview data, it was concluded that teachers need learning media for introducing letters and numbers. Teachers are interested in Android-based

learning media to provide additional references and to change students' mobile phone usage habits. Previously, if cell phones were used primarily for playing, this could be shifted towards introducing letters and numbers, which has the benefit of enhancing students' understanding of the material. Through Android-based media, parents can reinforce the material at home, considering that all parents already have Android cell phones.

This study identified problems related to learning media for Kindergarten Cahaya students. Until now, the media consisted of teacher-made materials, utilizing paper shaped into letters and blackboards. However, this media has not been successful in capturing attention or increasing students' understanding of letter and number recognition. Therefore, there is a need for more engaging media. The data points to potential problems as follows.

Table 5. Potential Interview Results and Problems

No	Question	Answer
1	What are the learning conditions at Kindergarten Cahaya?	Learning is done face to face
2	What media are used to convey material in the learning process?	media resulting from the teacher's creativity in the form of paper shaped according to needs, blackboards, and songs.
3	Letter and number recognition material is part of the material that must be delivered. Based on experience during the learning process, how interested are students in learning?	Students pay less attention and are less interested in the material presented.
4	Does student interest and attention have an impact on student learning outcomes?	Quite an impact, because many students do not know letters and numbers.
5	In your opinion, if the media for recognizing letters and numbers using Android will have an impact on students' understanding?	Of course, students will be more interested if the media used is IT-based, especially Android. So far, when students are observed at home, they play more about vocabulary and songs from YouTube via their parents' cellphones. If HP is given access to material to repeat at home it will be easier to understand the material provided.

4.2 Data collection

At the data collection stage, researchers seek and find supporting data that can be used as a reference for developing material content and products to solve problems in the field. Reference data collection was carried out through interviews with teachers and student guardians. The data obtained will be a strong foundation if Android-based media is needed for students. The competencies that students must master are listed in the curriculum as a reference in the preparation of media content packaged in Android-based multimedia. Researchers also seek from several references to maximize the development of learning

media. Based on the results of data collection to develop interactive learning media based on Android for Kindergarten Cahaya as follows.

- 1) The material will be presented with the help of pictures, color combinations, sounds, according to the age of the students.
- 2) There are exercises that can be done to measure the level of understanding of students.

Based on the above data exposure, it can be seen that the differences in learning media in introducing letters and numbers are as follows.

Table 6. Comparison of The Media Used

No	Teacher creativity learning media	Android-based interactive multimedia
1	Utilizing manila paper formed by letters and numbers with colors according to the paper used.	Presentation of letters and numbers through the cellphone screen which is given an attractive color.
2	Teachers add songs when introducing letters and numbers to make it easier to remember.	When the letter and number buttons are pressed, they will be followed by sounds that match the letters and numbers so that students will be guided directly.
3	Student understanding is measured by guessing before going home from school	Student understanding is measured through quizzes presented in the form of a game.

Overall, the table 6 highlights the contrast between traditional, hands-on learning methods and modern, technology-based approaches. Each method has its unique way of engaging students through different senses and learning styles, with the teacher-led method focusing on tactile and auditory learning, and the Android-based method leveraging visual and interactive elements. The choice of method may depend on the specific needs and preferences of the students, as well as the resources available.

4.3 Product design development

The development of learning media for recognizing letters and numbers based on Android is carried out through the stages of analysis, design, development, implementation and evaluation. The stages in this study are described as follows.

4.3.1 Analysis Phase

At this stage the activities carried out are to look at conditions in the field so that needs can be determined. In the field it is known that it is difficult for students to memorize letters and numbers. Students also tend to be less active during the learning process. Students are less interested in the book media used by the teacher to convey material. Therefore, learning innovations are designed according to the needs of students. The media is designed by utilizing technology considering that students are currently close to existing technology. The selected media based on Android as a learning supporter introduces letters and numbers to students.

4.3.2 The Design Stage

At this stage, an Android-based learning media is designed by collecting some materials and images that are appropriate to the age of the students. A supporting image is selected to introduce the letters A-Z so that students can easily remember. In addition, number recognition is also supported by pictures so that

students are more interested in seeing numbers. Selection of material in accordance with the demands of competence, learning methods, assessment, and evaluation. At this stage, the interface design of each item that will be displayed is made.

4.3.3 Development Stage

This stage is in the form of a process of developing from a design that has been made before. At this stage, the process of embodiment of the design takes place into a real media and is ready for use. Product development is carried out based on designs that have been made previously based on the flowchart that has been made. This stage is selected and selected backwards contained in the learning media including images, colors, sounds, and text. The results of the media developed are as follows.



Figure 2. Display of The Initial Menu

The initial menu display will present the logo for the name of the learning media application and there is an enter (play) button to be able to go to the main menu.



Figure 3. Main Menu Display

In the main menu display, two buttons are presented, namely "let's get to know and let's play or *Ayo Mengenal* and Let's Play & learn or *Ayo Bermain Dan Belajar*". Each button will lead to the material. Meanwhile, the back button is available in the top left corner.



Figure 4. Let's get to know the menu display

It will display the application logo, back button, and button to select a letter or number. The letter and number buttons will lead to the material.



Figure 5. Display Letters

In this menu, there will be three choices of material, namely the introduction of lowercase letters a-z, capital letters A-z, and recognition of letters and pronunciation followed by the help of pictures of objects



Figure 6. Lowercase Menu

This menu displays lowercase letters a-z followed by sounds in the form of pronunciation of these letters.



Figure 7. Capital Letter Menu

Almost the same as the lowercase menu display. This menu displays capital letters A-Z with the sound of each letter.



Figure 8. Object Letter Menu

Material letters A to Z with the sound of the letters, and along with the pronunciation of the objects displayed on this menu.



Figure 9. Number Menu

This menu displays 3 number recognition materials, namely the introduction of numbers 1-10, the introduction of all numbers 1 to 10, and counting objects based on the number of numbers.



Figure 10. Menu numbers 1-10

In this section, the number 1 and the arrow keys are displayed which, if pressed, will go to the next number.



Figure 11. Menu counting objects

Presented material counting numbers according to the number of objects. In this section students are trained to count *benda* or object so that the numbers they have learned can be memorized.



Figure 12. Let's play and learn menu.

In this menu, there are 2 options for the exercise and play menu, namely a letter puzzle and a number puzzle which will lead to each exercise.

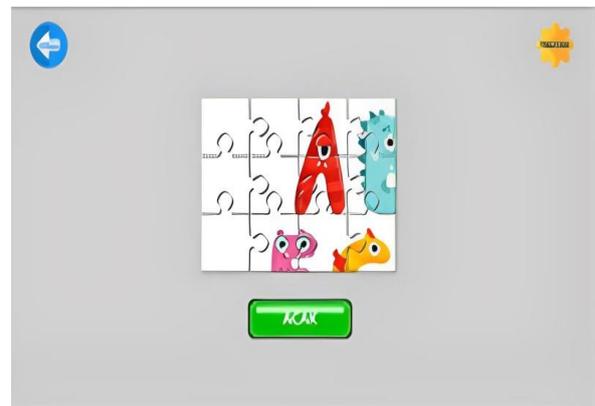


Figure 13. Puzzle Menu

In this menu there is an exercise in compiling a puzzle where when the puzzle is assembled a letter will appear



Figure 14. Number puzzle menu

The module includes engaging practice and play materials, which consist of a well-curated set of 10 numerical questions. To enhance the learning

experience, each question is thoughtfully paired with a distinct back sound that corresponds to each letter, creating a more immersive and interactive learning environment for the students.

4.3.4 Implementation Stage

In this phase, the learning media that has been developed comes to life as it is put into action. Kindergarten students are introduced to the Android-based learning media designed for letter and number recognition. The primary goal of this hands-on activity

is to assess how effective and efficient this media is in enhancing learning outcomes.

A thorough product feasibility assessment is conducted during this stage. This evaluation process involves examining factors such as user engagement, comprehensibility, and the overall impact on learning. The insights gained from the implementation are critical for fine-tuning the learning media to better cater to the educational needs of young learners in the future.

Table 7. Percentage of learning media validity results

No	Trial Subject	Results Validity (%)	Qualification Percentage
1	Learning Content Expert Test	83,8	Good
2	Learning Design Expert Test	83,6	Good
3	Learning Media Expert Test	90,2	Very Good
4	Individual Trials	88,8	Good

4.3.4 Evaluation Stage

There are two evaluations, namely formative and summative evaluations. Formative evaluation to measure or assess the developed media includes the validity of experts and individual trials.

5. Discussion

The development of Android-based learning media for recognizing letters and numbers represents a significant innovation in early childhood education. This media has been specifically designed to enhance the cognitive abilities of young learners and provide a more engaging and effective way to introduce them to letters and numbers. The rationale behind this development is rooted in the observation that traditional teaching methods often fail to captivate students' interest, and parents encounter challenges when attempting to reinforce the material taught by teachers.

One of the central findings of our research is the positive assessment of the content experts regarding the validity of the learning media. The content within the Android-based letter and number recognition media is not only easy to comprehend but also features engaging audio-visual aids. This finding aligns with the insights of previous researchers such as [Fithri and Setiawan \(2017\)](#) and [Mundia and Setiawan \(2020\)](#), who have stressed the importance of tailoring educational media to the specific needs of children. As a medium for conveying information, it is imperative that educational media be thoughtfully prepared to align with predefined learning objectives. Presenting material in a manner that is age-appropriate and

enhanced with supporting audio-visual elements enriches students' understanding and engagement. This enhancement can be attributed to the increased interaction between the user and the media, which contributes to a more effective learning process.

Moreover, the validation of our Android-based learning media by learning design experts also yielded favorable results. The media's design takes into account the actual context and conditions of students in the field. The incorporation of animal and fruit illustrations alongside letters and numbers serves as a valuable pedagogical aid for students. This finding is consistent with the views expressed by [Hasana and Maharany \(2017\)](#) and [Pura and Asnawati \(2019\)](#), emphasizing the significance of effective teaching strategies that stimulate students and maximize learning outcomes. The preparation of learning tools prior to the instructional process, as advocated by [Santoso \(2019\)](#), ensures alignment with established learning objectives. By aligning the development of Android-based media with teachers' pre-established lesson plans, the media remains relevant and purposeful, contributing to the attainment of educational goals.

Furthermore, our research found that the Android-based learning media was highly regarded by learning media experts for its effectiveness. The media is enriched with supporting illustrations and color combinations that are tailored to the developmental stage of early childhood. This thoughtful design effectively captures students' attention and aligns with the notion proposed by [Rozi and Khomsatun \(2019\)](#) that educational media should provide stimuli to engage children effectively. It is also crucial to recognize the role of teachers in transforming the

perception of cellphones from mere entertainment devices to valuable educational tools for children. In today's technologically advanced world, children can harness the power of mobile media devices owned and operated by parents to facilitate learning. This not only empowers parents to reinforce learning materials at home but also ensures that children perceive learning as an enjoyable and meaningful experience, thus facilitating the achievement of educational goals.

In addition, our research highlights the versatility and accessibility of the Android-based learning media. It can be effortlessly operated by anyone with an Android mobile phone, making it a widely accessible tool for early childhood education. The inclusion of sound and visuals that resemble children's typical interactions with cellphones ensures that learning feels more like play than a chore. This finding aligns with the perspective presented by Wahyuni et al. (2020), emphasizing the importance of incorporating playful learning into early childhood education. Acknowledging that children of this age group have a natural inclination towards play, our educational tools should align with their developmental needs and preferences. In light of these research findings and considering previous research conducted by Komang and Manuaba (2021), which demonstrated the effectiveness of interactive multimedia-assisted "zoolfabeth" media in introducing letters to early childhood learners, it is evident that Android-based letter and number recognition media possess strong validity and represent a promising alternative for introducing educational materials to young learners.

The novelty of this research lies in the development and validation of Android-based learning media that caters to the specific needs and preferences of early childhood learners. By incorporating engaging audio-visual elements, age-appropriate content, and a user-friendly interface, this media provides a novel approach to introducing letters and numbers to young children. The positive outcomes of the validation tests conducted by content experts, learning design experts, and learning media experts underscore the potential of this media to enhance early childhood education significantly.

In conclusion, the development and validation of Android-based learning media represent a significant advancement in early childhood education. The positive results obtained in our research underscore its potential to enhance learning experiences for young children and bridge the gap between classroom instruction and home learning. The implications of this research suggest a promising future for the integration of technology in early childhood education, with a focus on tailored, engaging, and accessible educational media. Therefore, future studies should assess the long-term impact of Android-based learning media on early childhood cognitive development. And should try to expanding the content of Android-based learning media to cover a wider range of subjects and topics

could further enrich early childhood education. Exploring the potential of this media for teaching mathematics, science, and other subjects should be a focus of future research.

6. Conclusions

This research marks a significant stride in early childhood education through the development and validation of Android-based learning media for teaching letters and numbers. Our study not only demonstrates the media's robustness in enhancing children's engagement and comprehension but also bridges the crucial gap between classroom learning and home reinforcement. The novelty of this study lies in its tailored approach, combining interactive multimedia with age-appropriate content, thereby offering a more immersive and enjoyable learning experience for young children. Furthermore, the positive validation from experts in content, design, and media underscores the media's effectiveness and potential as an innovative educational tool. This research contributes significantly to the larger field of educational technology by highlighting the importance of integrating user-friendly, interactive, and engaging learning media in early childhood education. The implications of this study suggest a transformative shift towards technology-integrated learning, paving the way for future research to explore the long-term impact of such media on cognitive development and expand its application across a broader spectrum of educational subjects.

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