Development of the Android-Based BINA Application as a Learning Medium for Basic Movements in Large Ball Games

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Abstract

Physical education (PJOK) in elementary schools faces significant challenges due to the limited availability of interactive learning media, resulting in low student understanding and interest in the basic movements of ball games. This study aims to develop and test the feasibility of the BINA (Belajar Interaktif Nalar Aktif or Active Interactive Learning) application as a valid and practical Android-based learning medium for this topic in elementary schools in the Pekanbaru area. The method used is Research and Development (R&D) with the Plomp model, which is carried out in three main stages: (1) Preliminary Investigation through interviews and observations to analyze needs; (2) Prototype development of an application containing demonstration videos, visual illustrations, and interactive quizzes; and (3) Evaluation, which included validation by experts in the subject matter, media, and language, as well as practical testing by two physical education teachers and 30 sixth-grade students. Data were collected using a Likert scale questionnaire and analyzed descriptively using SPSS. The results of the study show that the BINA application meets the criteria for high validity. The validation scores from subject matter, media, and language experts were 3.63, 3.62, and 3.62 (scale of 1-4), respectively. In the practicality test, the application was also found to be very practical, with an average score of 3.85 from teachers and 3.73 from students. Teachers found the application easy to integrate into learning, while students greatly appreciated the clarity of the videos and ease of navigation. It was concluded that the BINA application was successfully developed as a valid and practical learning medium to improve the quality of PJOK learning in basic ball games in elementary schools. This application is recommended for wider adoption and further research to test its effectiveness in measuring its impact on improving student learning outcomes.

Keywords: Application development; android learning media; physical education; basic movements; large ball.

Introduction

Physical education, sports, and health (PJOK) is an integral component of the education system that aims to develop students' potential holistically, encompassing physical, cognitive, social, and affective aspects (Widiastuti, 2019). In the context of education in Indonesia, particularly at the elementary school level, PJOK plays a crucial role in shaping students' character and basic skills (Iqbal, 2021). Through structured physical activities, students not only learn about the importance of health and fitness but also develop social skills, such as cooperation and leadership (Muzakki et al., 2024). However, at the implementation level in elementary schools, particularly in the Pekanbaru area, PJOK learning still faces fundamental challenges that need to be addressed.

One of the main challenges faced in physical education (PJOK) teaching is the limited availability of interactive and contextual learning media (Yanti et al., 2025). In many elementary schools, teachers often rely on conventional methods such as lectures and limited hands-on demonstrations. While these methods have their place, they often make the learning process monotonous and less engaging for students (Suastika et al., 2021). When a teacher explains basic soccer dribbling techniques only verbally and without visual aids, students may struggle to visualize and understand the movements. In such situations, students not only lose interest but also lose the opportunity to learn more effectively.

This situation is exacerbated by the limited use of visual and digital media that can dynamically explain basic movement concepts. In today's digital age, where children are exposed to a variety of technologies and media, it is crucial for education to adapt to these developments (Miyazaki et al., 2024). The use of demonstration videos showing dribbling techniques can help students see the movements firsthand, enabling them to better imitate and practice them (Hendryanto & Putra, 2025:29). However, many schools in Pekanbaru are still reluctant to integrate this technology into their learning, thus hindering students' potential for effective learning.

As a result of these limitations, students' understanding of basic movement techniques is low, and their interest in learning Physical Education (PJOK) tends to decline. Students have difficulty imagining and imitating complex movements that are only conveyed verbally or through static images. This suggests that mastery of basic movements is an important foundation for the development of higher motor skills (Rasyid et al., 2025). Without a solid understanding of basic techniques, students may struggle when transitioning to more complex games, such as soccer or basketball. In the long term, this can impact their participation in sports and other physical activities.

On the other hand, the development of digital technology, particularly Android-based applications, offers a solution opportunity to create more engaging, independent, and interactive learning media (Addai-Tuffour et al., 2021). Previous research has shown that the use of Android-based learning media can significantly increase student interest and understanding in Physical Education (PJOK) (Handayani et.al., 2022; Ibrahim et.al., 2022). By utilizing applications, students can learn in a more enjoyable and interactive way. Applications that provide interactive quizzes and demonstration videos can make students more engaged in

the learning process, thereby improving their understanding of the material being taught (Marpaung, 2025).

Although various applications are available, the majority of existing learning applications are general in nature and have not been specifically designed to address local gaps in the learning of basic ball game movements in Indonesian elementary schools. Many applications fail to address the applicable curriculum, easy-to-understand language, and the developmental characteristics of local students (Marmoah & Sukmawati, 2024:43). This highlights the need to develop applications that are more contextual and relevant to the needs of students in specific regions. Applications designed specifically for students in Pekanbaru must consider local culture and student exercise habits.

Based on this analysis, this study aims to develop the BINA (active reasoning interactive learning) application as a contextual, Android-based interactive learning media solution. This application is designed to present basic ball game movement material through multimedia integration such as demonstration videos, visual illustrations, explanatory text, and interactive quizzes in accordance with the principles of multimedia learning theory (Mayer, 2005:52). With this approach, the BINA application is expected to increase student engagement, clarify movement concepts, and support independent learning. Students who use this application can watch demonstration videos about dribbling techniques, then practice with the help of illustrations that show the steps to be taken.

Thus, the BINA app will not only provide information but also a more comprehensive learning experience. Students can learn at their own pace, review difficult material, and test their understanding through interactive quizzes. This approach is expected to address the challenges of conventional and less varied physical education (PE) learning. Furthermore, the app is expected to increase students' interest in PE and motivate them to participate in physical activities.

Physical education, sports, and health are crucial aspects of students' holistic development. Challenges faced in teaching physical education (PJOK) in elementary schools, particularly in Pekanbaru, need to be addressed with a more innovative and contextual approach. The use of Android-based learning media, such as the BINA app, can be an effective solution to increase students' interest and understanding of the basic movements of large ball games. This is expected to make PJOK education more effective and engaging, allowing students to optimally develop their potential.

Method

This study uses a research and development (R&D) method by adopting the Plomp model which consists of three systematic stages preliminary research, development/prototyping, and assessment. This model was chosen because it is suitable for developing technology-based educational products that emphasize validity, practicality, and potential effectiveness (Plomp & Nieveen, 2013:76). The study was conducted in the even semester of the 2025/2026 academic year at SD Negeri 187 Pekanbaru, with a focus on developing BINA application learning media for basic ball game movement material for sixth grade students.

Table 1. Research stages based on the plomp model

Plomp Model Stage	Research Activities	Output Generated
1. Initial Investigation	- Needs analysis through teacher & student interviews. - Observation of the PJOK learning process. - Study of the latest learning media literature.	- Identification of learning problems and needs.- Initial specifications of application features.
2. Prototype Development	- Designing the flow (storyboard) and application interface. - Content development (video, images, text, quizzes). - Programming using the AppGeyser platform (web-to-app).	- BINA application prototype version 1.0.- Application user guide book.
3. Evaluation	- Expert validation (material, media, language). - Practicality testing by teachers and students. - Revision based on input.	- BINA application that has been validated and declared practical.- Supporting quantitative & qualitative data.

Participants in this study included physical education teachers and sixth-grade students. In the validation phase, three experts were involved: one material expert, one media expert, and one language expert. In the practicality phase, participants consisted of two physical education teachers and 30 sixth-grade students. Sampling was conducted using purposive sampling, based on the relevance and availability of participants in the physical education learning context. The average age of student participants was 12 years, with an average height of 145.2 cm, an average weight of 38.5 kg, and an average body mass index (BMI) of 18.3.

Table 2. Characteristics of research participants

Participant Group	Amount	Role in Research	Selection Criteria
Physical Education Material Expert	1 person	Assess the appropriateness of the material content, suitability to the curriculum, and accuracy of the movements.	Holds a master's/doctoral degree in Physical Education and Health, has at least 10 years of teaching experience.
Learning Media Expert	1 person	Assess interface design, navigation, multimedia quality, and ease of use.	Experienced in developing digital learning media.
Linguist	1 person	Assess clarity of language, appropriateness to student developmental level, and use of terms.	Have a background in language education or have a teaching materials editor certification.
Physical Education Teacher	2 persons	Using applications in learning and assessing practicality from the teacher's perspective.	Actively teaching PJOK in grade VI, willing to participate until the end of the research.
Grade VI Students	30 people	Using the application and assessing its attractiveness, convenience, and usefulness.	Willing to participate in the trial process, have an Android smartphone with parental permission.

Data collection in this study utilized several instruments, namely interviews, observations, questionnaires, and a physical activity quiz embedded in the BINA application. Each instrument was designed to align with the research objectives and the stages of the Plomp development model applied in this study. In the initial research phase, interviews were conducted with physical education teachers and sixth-grade students to explore their learning needs, preferences, and challenges during physical education learning. These interviews helped identify gaps in the existing learning process and became the basis for designing the BINA application.

During the development and evaluation phase, a questionnaire was used to collect validity and practicality data. In the validation phase, the questionnaire was distributed to three expert validators, consisting of one material expert, one media expert, and one language expert.

These experts assessed the application based on content accuracy, media design, and language appropriateness. The questionnaire items were structured based on recognized digital learning media quality indicators and used a Likert scale ranging from 1 to 4. The results of this phase provide evidence of the content and construct validity of the BINA application. In the practicality phase, the questionnaire was administered to two physical education teachers and thirty sixth-grade students who used the BINA application during classroom learning. This instrument measured their responses regarding the application's ease of use, attractiveness, and usefulness in the context of physical education learning. These responses were then analyzed quantitatively using descriptive statistics through SPSS software, which produced objective and measurable results regarding the application's practicality.

Additionally, a physical activity quiz embedded within the app serves as an internal assessment tool to gauge students' understanding of fundamental movement concepts. The quiz consists of multiple-choice questions designed to be engaging and developmentally appropriate for elementary school students. Quiz results not only serve as formative assessment for teachers but also increase student motivation and engagement in the learning process. This instrument supports the app's educational effectiveness measurement and strengthens its role as an interactive and reflective learning tool.

Table 3. Data collection instruments and their objectives

Instrument	Format	Purpose of Use	Sample Items
Interview Sheet	Semi-structured guide	Identifying the needs and constraints of basic movement learning in the classroom.	"What are the main difficulties students face in understanding the basic movements of big ball games?"
Observation Sheet	*Checklist* and field notes	Documenting learning activities, teacher-student interactions, and media use.	"Do teachers use visual media when teaching basic movements?"
Expert Validation Questionnaire	Likert scale 1–4 (very bad – very good)	Assess the validity of the content, media, and language of the application.	"Suitability of material to the Independent Curriculum." (Scale 1–4)
Practicality Questionnaire	Likert Scale 1–4	Measuring the ease of use, attractiveness, and usefulness of the application according to teachers & students.	"The app is easy to navigate." (Scale 1–4)
Interactive Quiz in App	Multiple choice and true/false	Measuring students' initial understanding of basic movement material independently.	"The movement of kicking a ball is a basic movement... a) locomotor b) non-locomotor"

The data analysis technique used in this study is quantitative descriptive analysis, which aims to objectively measure the validity and practicality of the BINA application as an interactive learning media. Data were obtained from a questionnaire instrument distributed to three expert validators (material experts, media experts, and language experts), as well as to the PJOK teacher and sixth-grade students of SDN 187 Pekanbaru as end users. The questionnaire was compiled using a Likert scale with a range of 1 (very bad) to 4 (very good). The data were processed using SPSS (Statistical Package for the Social Sciences) software to calculate the average score for each assessment aspect.

The results were then interpreted based on predetermined feasibility categories. For the validity aspect, an average score ($\bar{x}$) in the range of $3.00 \leq \bar{x} \leq 4.00$ indicates that the media meets the validity criteria. Similarly, for the practicality aspect, an average score in the same

range indicates that the media is considered practical or very practical. The use of SPSS software ensures that data analysis is carried out systematically and accurately, thus providing reliable support for decision-making regarding the feasibility of the BINA application as a learning tool in PJOK instruction.

Table 4. Interpretation criteria for the average scores of validity and practicality

Average Score Range ($\bar{x}$)	Validity Category	Practicality Category
$3.25 < \bar{x} \leq 4.00$	Very Valid	Very Practical
$2.50 < \bar{x} \leq 3.25$	Valid	Practical
$1.75 < \bar{x} \leq 2.50$	Quite Valid	Quite Practical
$1.00 \leq \bar{x} \leq 1.75$	Invalid	Impractical

Results

This study aims to develop the BINA application as a valid and practical learning medium to support Physical Education (PJOK) learning in basic ball games in elementary schools. The results of the study are presented based on the stages of the Plomp model, including expert validation results and practicality test results. Validation was carried out by three experts (material, media, and language experts) to assess the feasibility of the BINA application before being tested. The assessment used a questionnaire with a Likert scale of 1-4. The results of the descriptive analysis used SPSS.

Table 5. Results of validation by PJOK material experts

No.	Assessment Aspects	Average Score	Category
1.	Compliance of material with the Independent Curriculum	3.75	Very Valid
2.	Accuracy of basic movement concepts and techniques	3.67	Very Valid
3.	Completeness of materials (locomotor, manipulative)	3.50	Valid
4.	Order of presentation of material	3.75	Very Valid
5.	Suitability to the developmental level of grade VI students	3.50	Valid
	Overall Average	3.63	Very Valid

Validation by three independent experts is a crucial step in ensuring the feasibility of the BINA application before implementation. All three experts gave very positive assessments of the material, media, and language aspects. The table above shows that the Physical Education and Health (PJOK) material experts gave an overall average score of 3.63, which falls into the very valid category. The highest scores were given to the aspects of material suitability with the Independent Curriculum (3.75) and the sequence of material presentation (3.75), indicating that the application content is aligned with national learning objectives and is logically structured. Meanwhile, the aspects of material completeness and suitability to student developmental levels received a score of 3.50 (valid), providing room for additional variations in movement examples in further development.

Table 6. Results of validation by learning media experts

No.	Assessment Aspects	Average Score	Category
1.	Visual quality (illustrations, colors, layout)	3.75	Very Valid

No.	Assessment Aspects	Average Score	Category
2.	Demonstration audio and video quality	3.50	Valid
3.	Ease of navigation and interactivity	3.75	Very Valid
4.	Suitability of design to the characteristics of elementary school students	3.50	Valid
5.	Clarity of application usage instructions	3.60	Very Valid
	Overall Average	3.62	Very Valid

The table above presents the assessment results from learning media experts, with an overall average score of 3.62 (very valid). Experts gave the highest appreciation to the visual quality aspect (3.75) and ease of navigation and interactivity (3.75), indicating that the application interface design is considered attractive and easy to use by the target users (elementary school students). The audio-video quality aspect and design suitability received a score of 3.50 (valid), with a note to continue to maintain quality consistency in new video content.

Table 7. Results of validation by linguists

No.	Assessment Aspects	Average Score	Category
1.	Clarity and readability of sentences	3.75	Very Valid
2.	Suitability of vocabulary to students' age level	3.50	Valid
3.	Correct use of sports terms	3.67	Very Valid
4.	Language effectiveness in interactive instruction	3.50	Valid
5.	The motivational power of text delivery	3.67	Very Valid
	Overall Average	3.62	Very Valid

The table above records the assessment of the language experts, who also gave an average score of 3.62 (very valid). The aspects of sentence clarity (3.75) and the accuracy of sports terms (3.67) received high scores, proving that the language used is communicative and technical. The experts also assessed that the language in the application has good motivational power (3.67). The score for the aspects of vocabulary suitability and instruction effectiveness of 3.50 (valid) indicates that the application has used appropriate language, although the wording for certain instructions could be further simplified. After going through revisions based on validator input, the BINA application was trialed with 2 PJOK teachers and 30 sixth grade students to assess its practicality in a real learning context.

Table 8. Results of practicality assessment by PJOK teachers (N=2)

No.	Assessment Aspects	Average Score	Category
1.	Ease of installation and application access	4.00	Very Practical
2.	Compliance of the application with the lesson plan and teaching flow	3.75	Very Practical
3.	Ease of exploring features and content	3.75	Very Practical
4.	The benefits of the application as a support for teacher explanations	4.00	Very Practical
5.	Student interest when using the application (based on teacher observations)	3.75	Very Practical
	Overall Average	3.85	Very Practical

After being declared valid, the BINA application was tested for its practicality in a real-life learning setting by teachers and students as direct users. Table 4 presents responses from

two physical education teachers. They gave a very high overall average score of 3.85 (very practical). Teachers specifically expressed satisfaction with the ease of installation and its usefulness as a supporting explanation (each with a score of 4.00), indicating that the application was not technically cumbersome and effectively functioned as a teaching aid. They also observed that the application successfully increased student interest (3.75) during the lesson.

Table 5 reveals the perceptions of 30 sixth-grade students after using the application. The average score from students was 3.73 (very practical). Students most appreciated the clarity of the videos and the motion illustrations (3.90), which proves that the multimedia content successfully addressed their main difficulties in understanding abstract motion. The attractiveness of the display (3.83) and ease of navigation (3.70) also received very positive responses. An aspect with a relatively lower score, although still in the Practical category, was the interest in independent use outside of class hours (3.57). This indicates that the application is viewed more as a formal learning tool in the classroom, and additional strategies are needed to encourage independent exploration.

Table 9. Results of practicality assessment by students (N=30)

No.	Assessment Aspects	Average Score	Category
1.	The appeal of the application interface display	3.83	Very Practical
2.	Ease of understanding menus and navigation	3.70	Very Practical
3.	Video clarity and motion illustrations	3.90	Very Practical
4.	The benefits of interactive quizzes for self-evaluation	3.67	Very Practical
5.	Interest in using the app again outside of class hours	3.57	Practical
	Overall Average	3.73	Very Practical

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Overall, the data from Tables 1 to 5 build a coherent and strong narrative that the BINA application has been successfully developed into a learning medium that is not only valid in content, design, and language (based on expert assessment), but also very practical for implementation in the Physical Education learning process in elementary schools (based on teacher and student responses). Its alignment with the curriculum, attractive and easy-to-navigate interface, and clarity of multimedia content are key factors recognized by all parties. These findings provide a solid empirical basis for recommending the BINA application as an alternative innovative learning medium that can overcome the limitations of conventional methods in teaching basic movements of large ball games.

Discussion

The results of this study consistently show that the BINA application has met the criteria as a valid and highly practical learning medium to support the learning of basic movements of large ball games in elementary schools. This finding strengthens the postulate of the cognitive theory of multimedia learning (Mayer, 2005:62) which emphasizes that learning becomes more effective when information is presented through verbal and visual channels in an integrated manner, and cognitive load is well managed. The BINA application operationalizes this theory by presenting movement instructions not only through text, but primarily through demonstration videos and clear visual illustrations.

The very high score for video clarity from students (3.90, Table 5) provides empirical evidence that this multimedia integration successfully facilitates understanding of dynamic and spatial motion concepts, which are difficult to explain using lectures or static images alone (Suastika et al., 2021). From a practical perspective, the very positive reception from teachers (3.85, Table 4) indicates that BINA is not just a technological tool, but a contextual solution that can be integrated into existing learning ecosystems. Teachers rated the application as easy to use and aligned with the lesson plan, which aligns with the principle that educational technology innovations must be teacher-friendly and aligned with curriculum needs (Addai-Tuffour, 2021).

Student feedback, which found the app engaging and easy to navigate (Table 5), also aligns with previous research that found Android-based media significantly increased student interest and engagement in Physical Education (PJOK) (Handayani et al., 2022; Ibrahim et al., 2022). This research's novelty and contribution distinguish it from similar media development studies that focus on contextually focused basic ball movements in elementary school. Many Android-based PJOK media development studies are general in nature, such as those for gymnastics (Handayani et al., 2022) or sepak takraw (Ibrahim et al., 2022). The BINA application was developed with a very specific focus, namely basic locomotor and manipulative movements in large ball games (soccer, basketball, volleyball) for elementary school students. This need was identified directly from field problems in the Pekanbaru area, thus the application has high contextual relevance.

Unlike similar research that often only includes standard demonstration videos, BINA incorporates slow-motion video elements and multiple perspectives into demonstrations of critical movements such as kicking, dribbling, and throwing a ball. This feature is specifically designed to address students' difficulty capturing the details of fast movements, an innovation based on specific pedagogical needs identified during the initial investigation phase. Most application development research requires complex native programming skills (Java/Kotlin).

This study adopted a practical approach using the AppGeyser platform to convert web-based materials into Android applications (APKs). This method not only accelerates the development process but also offers ease of replication and modification for teachers or other developers with limited resources, thereby increasing the potential for sustainability and dissemination (Sunarto et al., 2020). In addition to being used in the classroom, BINA is designed with structures and features (such as quizzes with instant feedback and simple progress profiles) that encourage students to learn and practice independently.

This distinguishes it from media that only function as teacher aids. Although the interest in independent use outside of class scored slightly lower (3.57), this feature represents a breakthrough in building independent learning, a key 21st-century competency. Comparison with relevant research and the contribution of this study confirm and extend the findings of previous studies. Like research by (Handayani et al., 2022; Ibrahim et al., 2022), our findings also demonstrate that Android-based media can increase interest and effectiveness in Physical Education (PJOK) learning. However, this study goes further by addressing specific content gaps, while (Bima et al., 2021) developed multimedia-based soccer media, BINA's coverage is broader (three major ball sports) and more fundamental (focusing on fundamental movements for elementary school level).

Unlike some app development projects that focus on feature complexity, BINA is designed with simplicity and alignment with lesson plans in mind, making it easy for teachers to adopt without disrupting the existing learning flow, as teachers' pedagogical competencies are crucial (Addai-Tuffour, 2021). The AppGeyser development approach offers a simpler and more affordable alternative to native app development, making it more likely to be adopted in schools with limited resources, such as those often found in rural areas (Widiastuti, 2019).

Overall, the BINA application has proven to be a viable and ready-to-use educational product. Its success lies not only in meeting validity and practicality standards, but also in its contextual, specific development approach, which prioritizes ease of adoption by end users (teachers and students). Thus, this research makes a significant contribution to enriching the repertoire of innovative, practical, and 21st-century digital learning media for Physical Education and Health (PJOK).

Conclusion

Based on the entire research and development process that has been carried out, it can be concluded that the objectives of this study have been comprehensively achieved. This study successfully developed the BINA (active reasoning interactive learning) application as a valid and practical Android-based interactive learning medium to support physical education, sports, and health (PJOK) learning, particularly in the basic movements of large ball games in elementary schools. In detail, the research findings answer each formulated objective.

1. Regarding the validity of the BINA application, it has met the criteria for highly valid based on assessments by three experts. The material expert (score 3.63) confirmed that the application's content is accurate, complete, and aligned with the Independent Curriculum. The media expert (score 3.62) stated that the interface design, navigation, and multimedia quality are excellent and appropriate for elementary school students. The language expert (score 3.62) confirmed that the language used is communicative, motivating, and appropriate for children's developmental levels.

2. Regarding the practicality of the BINA application, its direct users, namely teachers and students, stated that it was very practical. Physical Education teachers (score 3.85) assessed the application as easy to integrate into lesson plans, effective as a teaching aid, and able to increase student interest. Students (score 3.73) stated that the application was

interesting, easy to use, and the demonstration videos were very clear in explaining the movements, thus facilitating their understanding.

Thus, the BINA application has proven itself not only as a technological product but also as a contextual educational solution. This application addresses the main problem of limited interactive learning media in elementary schools by offering an alternative that combines multimedia learning principles, focuses on the specific needs of basic large ball movements, and is easy to use. This success makes a real contribution to the innovation of Physical Education (PJOK) learning that is more engaging, independent, and student-centered. Therefore, for further development, it is recommended that the application's effectiveness be tested with a rigorous experimental design, the application be implemented and evaluated in more schools with diverse characteristics, and supporting features such as an offline mode and a simple analysis dashboard for teachers be developed to maximize the application's impact on the quality of Physical Education (PJOK) learning in a sustainable manner.

Author's Statement

The author hereby declares that this article is the result of original research conducted entirely by the author, is free from plagiarism, and has not been published or is currently in the process of being published in any other journal or scientific media. All data used in this research has been obtained legally, described objectively, and presented with full academic integrity. The analysis and reported findings are accountable in accordance with applicable research ethics standards and scientific principles. Therefore, this article can be validated and trusted as a valid scientific contribution in its field.

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