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THE NEED ANALYSIS FOR PBL-BASED E-BOOK LEARNING WITH AR TO ENHANCE DIGITAL LITERACY AND PROBLEM SOLVING SKILLS OF ELEMENTARY SCHOOL

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ABSTRACT

Education in Indonesia faces the challenge of enhancing digital literacy and student's problem-solving abilities. In the context, the development of more interactive technology-based learning materials presents an effective solution. This study aims to analyze the need for developing Problem-Based Learning (PBL) e-book supported by Augemented Reality (AR) media to improve digital literacy and problem-solving skills in the learning of science and social studies (IPAS) at the elementary school phase C level. The result of the analysis indicate that IPAS learning still faces challenges in understanding abstract material and lacks engaging media. Therefore, the development of PBL based e-book with AR media is considered highly relevant and necessary to address the challenges of 21st century learning.
***Keywords**:* E-book; problem based learning; augmented reality; digital literacy; problem solving

INTRODUCTION

Education is a key pillar in shaping the quality of human resources in Indonesia. As a developing country, Indonesia faces significant challenges in improving the quality of education, especially at the elementary school level. One aspect that requires special attention is literacy and problem solving skills, which are fundamental skills that must be mastered by students from an early age (Mulyasa, 2021). Along with the progress of technological developments, it has an impact on learning orientation from conventional learning to digital-based learning (Kurniawan *et al*., 2021). Digital literacy is the ability of individuals to access, evaluate, use, and produce information through digital devices effectively. This literacy includes media navigation skills, ethical use of online information and responsible use of technology. Meanwhile, problem-solving skills refer to a student's success in learning across various subjects, including science and social studies (IPAS).

According to the 2018 PISA report, Indonesia ranks low in science literacy and problem-solving (Kemendikbud, 2019). This indicates that learning approaches currently used in elementary schools are still ineffective in improving student's problem-solving skills. Therefore, innovation in learning development is needed to improve literacy and 21th century skills, especially in the context of IPAS learning (E. W. Lestari *et al*., 2022).

IPAS learning integrates Natural Sciences and Social Sciences to develop student's problem-solving skills. However, the materials are often abstract and difficult for students to understand through text or

verbal explanations alone. In fact, many elementary schools in Indonesia still rely on printed textbooks as the main source for delivering material. These textbooks often contain long descriptive texts that can make students feel bored and less interested in reading. As previously conducted research states, students become bored and are less motivated when reading these static resources (Indriyani & Suparman, 2023).

Research conducted at an elementary school in Pasrepan sub-district identified the problem of students boredom in IPAS lessons due to the use of less interesting learning media and learning is still conventional which result in the average score in IPAS subjects still not being completed. In addition, IPAS learning also still lacks the use of technology that can enrich the learning experience. Technology such as e-books based on the problem-based learning (PBL) approach and equipped with augmented reality (AR) can be a very relevant solution to improve IPAS learning. E-book allow students to be more involved in the learning process through more interesting and interactive media. PBL as a learning approach invites students to be involved in solving real-world problems that are relevant to their lives, which can improve their understanding and problem solving abilities (Unsworth, 2006). The use of AR that allows students to see and interact with visual representations of the material being taught can also help them understand abstract concepts more clearly and concretely (Kholifah & I Made Tegeh, 2024).

To address this gap, integrating technology into learning is an essential step. Tools such as e-book based on PBL and supported by AR offer promising solutions. These interactive tools promote better engagement and student's capacity to solve contextual problems, while AR helps in visualizing complex systems (Sari *et al.*, 2022).

METHODS

This study uses a descriptive qualitative approach aimed at describing the phenomena occurring in the field related to the use of learning materials in IPAS teaching and analyzing the needs of teacher and students regarding technology-based learning materials. This research does not aim to test hypotheses or specific variables but focuses more on understanding the problems encountered in IPAS learning and how technology can serve as a solution to address thes issues.

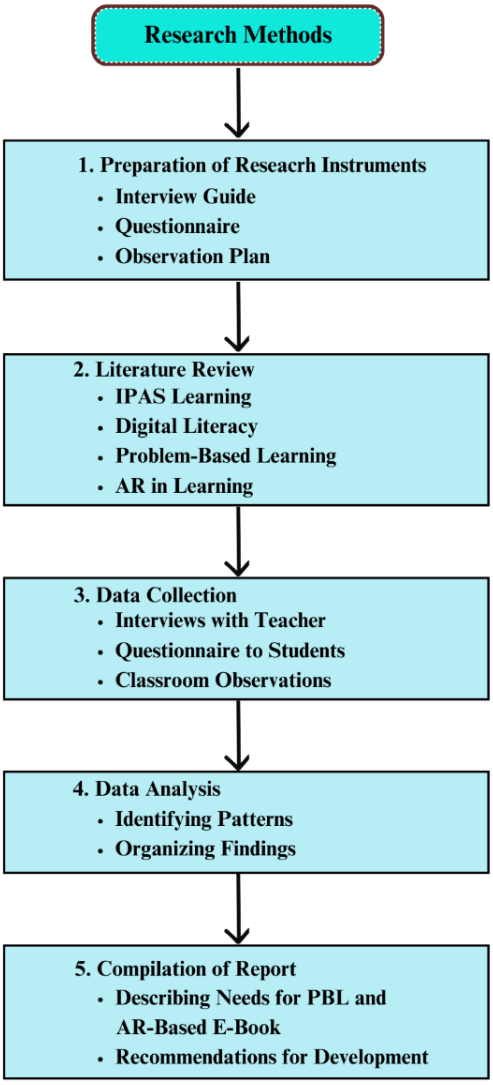
This study was conducted at one of the public elementary schools in Pasrepan District, Pasuruan Regency. This location was chosen because the schools needs to improve quality of IPAS learning, particularly in terms of understanding abstract concepts and enhancing digital literacy and problem solving skills among students. The subjects of the study consisted of sixth grade teacher and sixth grade students. Sixth grade teacher selected because they are directly involved in teaching IPAS, while students were chosen because they are the primary users of the learning materials to be developed.

Data sources in this study include two types of data: 1) Primary data obtained through interviews with sixth grade teacher and survey distributed to students. These interviews aimed to gather information about the challenges faced in IPAS learning, as well as their needs for technology base learning materials. 2) Secondary data obtained through a literature study related to IPAS learning, digital literacy, PBL, and the use of AR media in learning.

The instruments used in this study consisted of: a) Semi structured interviews with teacher to gather information about their experience teaching IPAS and the problems they face in teaching. The interview also aimed to explore how much they felt the need for technology-based learning materials to support learning. b) A questionnaire distributed to students to assess their perceptions of the learning materials currently used and how much they require interactive technology-based learning materials. c) Observations conducted during IPAS lessons to observe how students interact with the learning materials and to identify their engagement in the learning process.

The initial step undertaken by the researchers was to prepare all research instruments, including interview guides, questionnaires, and observation plans. The researchers also conducted a literature review do deepen their understanding of topics related to IPAS, digital literacy, and PBL. Then, the researchers collected data through interviews with teacher, distributing questionnaires to students, and observing classroom activities. During the data collection process, the researchers ensured that all instruments were used according to the research objectives. The nex step was to analyze the data obtained from interviews, questionnaires, and observations qualitatively. The researchers identified patterns emerging from the collected data and organized the main findings related to the need for technology-based learning materials. After analyzing the data, the research findings were compiled into a report that described the need for the development of PBL and AR-based e-book for IPAS learning in elementary schools. This report also includes recommendations for developing more interactive and technology-based learning materials.

The stage in this research methods can be seen in picture 1.



Picture 1. Research Methods

RESULTS AND DISCUSSION

This study aims to analyze the need for developing e-book learning materials that integrate the problem-based learning (PBL) model with augmented reality (AR) media to enhace digital literacy and problem-solving skills of students in IPAS learning at the elementary school phase C level. Based on the data analysis obtained through interviews with teacher, survey distributed to students, and observations of

the available school facilities, several key findings were identified related to the need for more interactive and technology-based learning materials. Below are the results and discussion of the needs analysis.

Need for More Interactive Learning Materials

One of the main findings that emerged from this study is that the learning materials used in IPAS lessons at the elementary school sixth-grade are still in the form of printed tecxtbooks, which tend to be monotonous and fail to capture student's interest. Most students reported feeling bored and lacking motivation when studying IPAS material using traditional textbooks, which generally consist of long descriptive texts that offer little opportunity for students to interact with the material. Studens struggle to understand abstract concepts presented solely through text. In interviews with teacher, many expressed that although the textbooks are systematically organized and aligned with the curriculum, they are not effective enough to engage students or enhace their participation in the learning process. Furthermore, these textbooks lack interactive elements such as images or videos that could enrich student's learning experience. These findings are consistent with survey results form students, which showed that the majority of students feel more engaged in learning when the material is presented in a more attractive and interactive format. The use of technology in influencing digital literacy learning which has an impact on improving student learning outcomes (S. R. Putri & Ahmadi, 2023). E-book are digital book that can be accessed through electronic devices (such as laptops, chromebooks, tablets, or smartphones), offering advantages in terms of portability, accessibility, and interactivity (Saiju *et al*., 2025). E-book can be integrated with various multimedia elements to help students understand abstract concepts that are difficult to grasp (R. Lestari & Fitria, 2023).

PBL based e-book assisted by AR media are considered a highly relevant solution to address this issue. The use of e-book that integrate various multimedia elements such as text, images, animations, and videos provides students the opportunity to interact with the material (Mayer, 2006). With AR visualization, students can more easily understand three-dimensional concepts or concepts that are difficult to imagine through text alone, such as the human body's movement system. Therefore, both teacher and students believe that more interactive technology-based learning materials are needed to make learning more engaging and effective. The results of the interviews with teachers are summarized in table 1.

No	Question	Teacher Response		Comment
		Yes	No	
1	Do you use materials other than textbooks in IPAS learning?		√	No, the learning materials used are printed textbooks for teachers and students.
2	Do the textbooks used contain materials relevant to daily life?	√		Yes, the materials in the textbooks are relevant to daily life.
3	Is the material taught in IPAS learning easy for students to understand ?		√	Most students find it difficult to understand, especially the topic on the human movement system.
4	Do you feel that	√		Students feel bored and less

No	Question	Teacher Response Yes	Teacher Response No	Comment
	students often feel bored or less motivated during IPAS lessons?			active, especially with the material on the human movement system.
5	Are the teaching materials used by teachers technology -based?	√		Sometimes, I use PPT and videos from YouTube to explain material to students.
6	Do you feel that students understand the material better when using visual and interactive media?	√		Students are more active when I explain material with PPT and videos from YouTube.
7	Have you had experience using technology in teaching?	√		Limited experience, and only used PPT and browsed videos on YouTube.
8	Do you agree that more interactive learning materials can improve student motivation ?	√		I strongly agree.
9	Do you agree that interactive e-books can be used for both classroom and independe nt IPAS learning?	√		I strongly agree.
10	Do you agree that e-books should include images, videos, educationa l games, and 3D media like AR to support learning?	√		I strongly agree.

Table 1. Interview Results with Teacher

Potential of Using PBL-Based E-book and AR Media

In this study, the development of PBL-Based e-book and AR media was found to be a highly relevant solution for improving the quality of IPAS learning. PBL, which focuses on solving real-world problems that are relevant to student's lives, provides students with the opportunity to engage more actively in learning (Aristiani & Anak Agung Gede Agung, 2022). E-books based on problem based learning are very interesting and have a positive impact on learning, as seen from the students' enthusiasm in learning (D. P. S. Putri & Wiarta, 2023). E-books based learning media can facilitate teachers and students in carrying out the learning and teaching process. Helping students understand the material quickly and not making students bored during the learning process. In addition, it can also improve student's digital literacy skills (Halim *et al*., 2023). For example, in the material on the human movement system, students could be given a problem that requires them to analyze and find a solution. For instance, students could be faced with the question of how technology can be used to address issues related to the human body's movement system, and they would be asked to solve

these problems using the knowledge they have gained.

In addition, AR technology enhaces student's conceptual understanding by providing 3D representations of complex phenomena. Students find it easier to understand content when they can interact with virtual models (Sari *et al*., 2022)(Putra & Wardani, 2023). The availability of smartphones and internet connectivity among students also supports the application of AR-assisted e-books (Ramadhani & Susanto, 2023).

AR offers significant advantages in visualizing abstract learning material. In IPAS learning, many concepts are difficult to understand through text alone, such as the human body system, which consists of many interconnected components. AR is a technology that ectends the physical world by adding digital information that adapts to the surrounding environment in real-time (Craig, 2013). The use of AR in IPAS learning has been shown to improve student;s understanding of concepts that are difficult to grasp through textbooks only (Sapira & Ansori, 2024). AR media enhance student's understanding of visual material that is difficult to directly imagine (Zaid *et al*., 2022)(Wibowo *et al*., 2022)(Dewi *et al*., 2024). With the help of AR, students can see and interact with 3D models of human body, showing bones, joints, and muscles work together. This provides a better understanding and allows students to interact directly with the material, deepening their understanding of how these systems function.

Interviews with teacher and students revealed that they feel AR can help visualize more complex material and make it easier to understand. As many as 88% of the students surveyed expressed that they find it more interesting and easier to understand the material when using technology-based e-book that can be accessed through their digital devices, such as smartphones or laptops. The use of technology in learning provides students with the flexibility to study outside of school hours, offering broader learning opportunities, both at home and outside the classroom (Qouri & Zulherman, 2023). The results of the survey analyzing students needs can be seen in table 2.

No	Question	Students Response	
		Yes	No
1	Does the teacher use learning materials in IPAS lessons?	100%	0%
2	Do the learning materials used by the teacher in IPAS lessons motivate you to learn?	8%	92%
3	Are the IPAS learning materials used by the teacher technology-based?	8%	92%
4	Is the IPAS topic on the human movement system easy to understand?	4%	96%
5	Are the IPAS learning materials used by the teacher well-organized and easy to understand?	20%	80%
6	Are the learning materials used relevant to your daily life?	20%	80%
7	Are you interested in learning IPAS using printed books?	4%	96%
8	Have you ever studied using an e-book that can be accessed with a smartphone or laptop?	0%	100%
9	Have you ever worked on evaluation exercises in the form of games?	0%	100%

No	Question	Students Response	
		Yes	No
10	Would you be more interested in learning if the materials used were in digital form and included interactive features like videos, games, and 3D media like AR?	100%	0%

Table 2. Survey result of The Students Needs Analysis

Students Motivation and Engagement in Learning

Students motivation is ne of the key factors influencing the success of learning. In this study, it was found that many students felt unmotivated and quickly bored with material presented through printed textbooks. Survey results show that only 8% of students are interested in reading printed books to study IPAS material. On the other hand, 92% of students expressed that they were more interested when the learning material was presented through technology-based e-book, which could be accessed on digital devices.

The use of PBL-based e-book assisted by AR media offers a more enjoyable and interactive learning experience, which can increase student's motivation to engagemore actively in learning (Andini & Setyasto, 2025).

With the inclusion of interactive elements, students feel more interested and involved in the learning process. This can improve the quality of their understanding of the material and strengthen their problem-solving skills, which are essential for IPAS learning. The ability to interact with material in a meaningful way helps students to engage in deeper cognitive processing, enhacing both their learning outcomes and motivation.

The convenience and accessibility of learning material are major advantages affered by e-book. Observations of schools facilities indicate that most students already have access to digital devices such as smarthphones or laptops, which allow them to access e-book anytime and anywhere. This convenience provides flexibility for students to learn outside of school hours, deepening their understanding of material and offering opportunities for independent learning.

PBL-based e-book assisted by AR also provide lighter learning material compared to printed textbooks, which often contain large amounts of text and information that can be difficult to understand. With the interactive features in e-book, students can learn in a more enjoyable and easily comprehensible way, and they can access material at their own convenience. This makes PBL-based e-book assisted by AR a highly effiecient solution to support IPAS learning in elementary schools phase C.

Analysis of School Facilities

The availability of technology facilities in schools also plays a crucial role in the successful implementation of PBL-based e-book assisted by AR media. Based on the observations made in the school, the existing facilities are sufficiently adequate to support the use of PBL-base e-book with AR media, such as computers and stable internet connections. However, some devices, such as smarthphone, have limitations in terms of performance, which can affect the smooth functioning of e-book in the classroom. Therefore, it is essential to improve the technological facilities in schools, such as better computers and faster internet connections, to ensure that this technology can be optimally implemented.

The details of the analysis regarding the school's facilities are presented in table 3.

No	Facility	Availability in the School
1	LCD Projector	15 units in good working condition.
2	Speaker	10 units, functioning properly.
3	Teacher's Laptop	Every teacher has a laptop, but some experience performance issues.
4	Power Supply	All classrooms are equipped with electricity.
5	Laptop/Chromebook Inventory	20 units of Chromebooks in good condition.
6	Internet Access	Stable internet connection.

Table 3. School Facility Analysis

Recommendations for Developing Learning Material

Based on the results of this analysis, several recommendations can be made regarding the development of PBL-based e-book assisted by AR media. Fist, the development of PBL-based e-book with AR media should involve various interactive elements such as videos, animations, quizzes, and 3D visualizations to facilitate student's understanding of abstract concept. Second, the e-book should be designed in such a way that they present real-life problems relevant to student's lives, allowing them to learn in a more contextual and applicable manner. Additionally, teacher need to be provided with adequate training in the use of education technology, particularly in implementing e-book in the classroom. This training aims to help teachers optimize the use of technology and maximize student engagement in learning. improvement in shool technology facilities is also necessary to support the smooth use of e-book in teaching. School must ensure that students have adequate access to digital devices and the internet to support technology-based learning processes.

CONCLUSION

The research reveals a pressing need to transform traditional IPAS learning material into more engaging and interactive formats. By developing e-book that implement PBL strategies and include AR media, teacher can significantly enhace student's digital literacy and problem-solving abilities. This digital transformation can foster independent learning and align education with the needs of generation Z (Demmanggasa Yultan *et al*., 2023). Thus, PBL-based e-book supported by AR media are not merely technological tools but necessary innovations in modern education, especially in enhancing IPAS learning in elementary school. Overall, this study shows that the development of PBL-based e-book assisred by AR media is highly needed to improve the quality of IPAS learning in elementary school phase C. The use of technology in the form of interctive e-book that integrate PBL and AR can make learning more engaging, effective, and relevant to student's lives. Therefore, the development of technology-based learning material can be a solution to improve digital literacy, problem-solving skills in IPAS learning. This study is expected to contribute to the development of innovative and effective learning materials for elementary education in Indonesia.

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