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The Use of Learning Media-Based Augmented Reality (AR) to Improving Integrated Science and Social Studies Literacy

Tetep[1*], Ali Ismail[2] & Iman Nasrulloh[3]

[1]Departement of Social Studies Education, Institut Pendidikan Indonesia Garut, Indonesia.

[2]Departement of Teacher Primary Education, Indonesia University of Education, Indonesia.

[3]Departement of Information Technology Education, Institut Pendidikan Indonesia Garut, Indonesia.

*Corresponding email: tetep@istitutpendidikan.ac.id

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Abstract: The use of learning media-based Augmented Reality (AR) to improving integrated science and social studies literacy. This study aimed to explore the use of learning media-based Augmented Reality to enhance integrated science and social studies literacy in primary school. AR-based learning media was integrated into the IPAS subject. The participants in this study were 48 fifth-grade students from elementary schools, divided into experimental (24 students) and control groups (24 students). Each class employed a cooperative learning approach, with students in the experimental groups engaged in using AR-based learning media to support their learning process. The research method used was non-equivalent pretest-posttest design. The instruments used to test literacy skills (both pretest and posttest) consisted of 5 items. The results indicate a significant difference in the enhancement of students' literacy skills in the experimental groups compared to the control group. This suggests that the use of the AR-based learning approach enhanced students' literacy skills in the context of the IPAS subject.

Keywords: AR learning media, ipas learning, science literacy, social studies literacy.

Abstrak: Penggunaan media pembelajaran berbasis Augmented Reality (AR) untuk meningkatkan literasi IPA dan IPS terpadu. *Penelitian ini bertujuan untuk mengeksplorasi penggunaan media pembelajaran berbasis Augmented Reality untuk meningkatkan literasi IPA dan IPS terpadu (IPAS) di sekolah dasar. Media pembelajaran berbasis AR diintegrasikan ke dalam mata pelajaran IPAS. Partisipan dalam penelitian ini adalah siswa kelas lima sekolah dasar yang berjumlah 48 orang, dibagi menjadi kelompok eksperimen (24 siswa) dan kelompok kontrol (24 siswa). Setiap kelas menggunakan pendekatan pembelajaran kooperatif, dimana siswa pada kelompok eksperimen diikutsertakan dalam penggunaan media pembelajaran berbasis AR untuk mendukung proses pembelajarannya. Metode penelitian yang digunakan adalah non-equivalent pretest-posttest design. Instrumen yang digunakan untuk tes kemampuan literasi (baik pretest maupun posttest) terdiri dari 5 item. Hasil penelitian menunjukkan adanya perbedaan yang signifikan peningkatan kemampuan literasi siswa pada kelompok eksperimen dibandingkan dengan kelompok kontrol. Hal ini menunjukkan bahwa penggunaan pendekatan pembelajaran berbasis AR meningkatkan kemampuan literasi siswa dalam konteks mata pelajaran IPAS.*

Kata kunci: *media pembelajaran AR, pembelajaran IPAS, literasi sains, literasi social.*

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INTRODUCTION

The education system in Indonesia has experienced increasingly positive developments in simplifying educational studies that are easily comprehended and understood by its learners. To simplify learning materials, there should be efforts to integrate the concepts of learning materials with the environmental conditions present in students' lives. Consequently, learning will become more meaningful. Subject integration at the elementary school level, for example, has already begun with subjects such as Social Studies (IPS), which integrates social sciences such as History, Geography, Economics, Anthropology, Sociology, and other social science fields (Hawkman, 2020; Russell & Waters, 2021). Subject integration in Natural Sciences (IPA) has also long been applied in the elementary school curriculum. IPA integrates various natural science subjects such as physics, biology, chemistry, the environment, and others (Smale-Jacobse et al., 2019).

Efforts to simplify various subjects in schools are commendable in providing students with easier and simpler understanding, so that learning is beneficial and meaningful for the students themselves, and they do not feel burdened by numerous subjects. The integration of IPA and IPS into IPAS, needs to be further developed to be more contextual and aligned with students' real-life experiences. This is to provide depth to the learning materials according to the context of the students' environment or daily life.

The low literacy skills of students, especially in IPAS learning, in the current situation, are undoubtedly a complex issue. This issue requires attention and a significant role that can be observed in students, particularly in solving test questions and the learning process that lacks the application of literacy, as students tend to be reluctant to read long passages. The lack of literacy and numeracy skills can lead to problems in adapting to the ongoing developments in communication and information technology. The realization of the literacy movement as knowledge and proficiency in using various numbers and symbols related to basic numeracy in solving easy problems in various everyday life contexts and analyzing information presented in various forms (graphs, tables, charts, etc.), then using the interpretation of the analysis results to predict and make decisions (Bonifacci et al., 2021).

Certainly, the low interest in literacy among students becomes a complex issue in the reality of educational institutions. Literacy skills, especially in IPAS learning, are part of digital literacy skills to cultivate students' awareness of social issues gradually occurring in society (Wahyu et al., 2020). This aligns with the idea of social realization that considers human existence as a subject of study. In the concept of IPAS learning, there is a scope of dimensions in the era of independent learning, including knowledge, skills, values and attitudes, and actions. In relation to IPAS learning, digital literacy becomes a support for developing students' knowledge of real-time social and environmental issues in society. Through literacy and numeracy as creative competencies found in research outcomes, they become indicators that can be part of skills as thinking abilities and creative habits, forming part of creativity skills that refer to academic aspects and attract academic attention.

Certainly, the low interest in literacy among students is a complex issue within the reality of educational institutions. Literacy skills, especially in IPAS learning, are part of digital literacy skills to gradually cultivate students' awareness of social issues occurring in society (Selsabila & Pramudiani, 2022). This aligns with the idea of social realization that considers human existence as a subject of study. In the concept of IPAS learning, there is a scope of dimensions in the era of independent learning, including knowledge, skills, values and attitudes, and actions. In relation to IPAS learning, digital literacy becomes a

support for developing students' knowledge of real-time social and environmental issues in society. Through literacy and numeracy as creative competencies found in research outcomes, they become indicators that can be part of skills as thinking abilities and creative habits, forming part of creativity skills that refer to academic aspects and attract academic attention.

Literacy skills can be developed using digital learning media, one of which is augmented reality. This can be done to enhance real learning experiences and effective learning (Keil et al., 2020). IPAS learning will be more engaging when presented with creative, innovative, and intelligent media, delivered in real-time media. Learning presented through augmented reality media allows learners to experience new learning experiences. Augmented Reality (AR) is an application that combines the real world with the virtual world in 2D or 3D, projected in a real environment simultaneously (Alshafeey et al., 2019). The use of augmented reality media makes it easier for students to get a closer look at the taught material, thereby impacting students' literacy skills in both oral and written reasoning, theoretical, and practical aspects (Alzahrani, 2020; Garzón, 2021).

Therefore, strengthening literacy in IPAS learning becomes a crucial element in enhancing students' understanding of the material. This aligns with the concept of IPAS learning, which considers human life as the focal point of study. The dynamic nature of human life, constantly active and demanding renewal in every learning process, underscores the need for ease of access to information and knowledge for the effectiveness of IPAS learning. Therefore, the research questions that will be answered in this present study was:

How was an implementation of learning media-based Augmented reality conducted in terms of improving literacy skills How was an enhancement of literacy skills experienced by students after they conducted learning process-based Augmented Reality?

METHODS

Research design

The research design used in this present study was a nonequivalent pretest-posttest design (Oakes & Feldman, 2001). This research method examined a specific intervention, namely cooperative learning based on Augmented Reality learning media. The intervention was provided to the experimental group during the learning process focusing on the change in the form of substances. Meanwhile, the control group underwent the conventional learning process using cooperative learning methods. The total number of physical meetings conducted in this study was two.

Participants

The participants in this study comprised 48 fifth-grade students from elementary schools engaged in the IPAS learning process. They were divided into two groups, with 24 students in each—the experimental and control groups. The participants' ages ranged from 10 to 11, and the number of female and male students was equal. All participants were from a single public elementary school in Garut city. The participant sample was selected using the purposive sampling technique.

Instruments

The use of literacy instruments focused on several aspects, including finding information in a text, understanding the text, and reflecting and evaluating the text. All these facets were tailored to the content of substance form changes for fifth-grade elementary schools. This instrument underwent validation by two experts in science education (Benner, 2004), and they concurred

that it was suitable for measuring science literacy skills. Additionally, the Rash model analysis (Goh et al., 2017) was applied after administering this instrument to different students studying form changes in substances. A total of 25 items were developed. The results of the Rasch model analysis (Goh et al., 2017) are presented in Figure One. The findings of the Rash model analysis revealed that the fit of the items exceeded 0.45, indicating that the validity of each item was good in representing every aspect of literacy skills.

TABLE 13.1 FAHAM ZOU328WS.TXT Jul 05 2023 04:38
INPUT: 24 Person 25 Item REPORTED: 24 Person 25 Item 2 CATS MINISTEP 5.6.0.0
Person: REAL SEP.: 1.64 REL.: .73 ... Item: REAL SEP.: 1.48 REL.: .69

Item STATISTICS: MEASURE ORDER

ENTRY NUMBER	TOTAL SCORE	TOTAL COUNT	JMLE MEASURE	MODEL S.E.	INFIT MNSQ	INFIT ZSTD	OUTFIT MNSQ	OUTFIT ZSTD	PTMEASUR-AL CORR.	PTMEASUR-AL EXP.	EXACT MATCH OBS%	EXACT MATCH EXP%	Item
20	3	24	2.27	.64	.95	.02	.60	-.40	.36	.26	87.5	87.4	P20
3	6	24	1.34	.50	1.39	1.53	2.65	2.95	-.24	.34	79.2	75.4	P3
24	6	24	1.34	.50	1.11	.54	1.00	.14	.25	.34	70.8	75.4	P24
10	7	24	1.09	.48	1.08	.43	1.16	.56	.26	.36	75.0	72.7	P10
13	9	24	.66	.46	1.26	1.40	1.40	1.46	.11	.39	66.7	69.1	P13
1	11	24	.25	.45	.94	-.30	.90	-.42	.47	.40	70.8	68.1	P1
4	11	24	.25	.45	.55	-3.14	.51	-2.75	.84	.40	95.8	68.1	P4
6	11	24	.25	.45	.98	-.08	.96	-.13	.43	.40	70.8	68.1	P6
15	11	24	.25	.45	.84	-.97	.77	-1.09	.58	.40	70.8	68.1	P15
14	12	24	.05	.45	1.01	.10	1.00	.05	.40	.41	62.5	67.7	P14
16	12	24	.05	.45	1.42	2.27	1.53	2.29	-.02	.41	54.2	67.7	P16
18	12	24	.05	.45	.94	-.31	.89	-.49	.48	.41	70.8	67.7	P18
19	12	24	.05	.45	1.23	1.32	1.22	1.08	.19	.41	54.2	67.7	P19
23	12	24	.05	.45	.83	-1.02	.80	-1.01	.58	.41	79.2	67.7	P23
21	13	24	-.15	.45	.55	-3.09	.51	-2.83	.85	.41	95.8	68.1	P21
5	14	24	-.35	.45	.72	-1.68	.66	-1.64	.69	.41	83.3	68.8	P5
8	14	24	-.35	.45	1.00	.04	.96	-.12	.42	.41	66.7	68.8	P8
9	14	24	-.35	.45	.69	-1.86	.66	-1.67	.70	.41	91.7	68.8	P9
22	14	24	-.35	.45	1.50	2.47	1.48	1.94	-.06	.41	41.7	68.8	P22
25	14	24	-.35	.45	1.26	1.38	1.36	1.50	.14	.41	58.3	68.8	P25
7	15	24	-.56	.46	1.06	.39	1.15	.66	.32	.40	70.8	70.3	P7
11	16	24	-.78	.47	.74	-1.32	.64	-1.33	.66	.39	83.3	72.0	P11
12	17	24	-1.01	.49	1.14	.68	1.09	.36	.26	.38	66.7	73.7	P12
2	20	24	-1.84	.58	.77	-.63	.53	-.81	.57	.32	87.5	83.4	P2
17	20	24	-1.84	.58	.84	-.38	.96	.12	.43	.32	87.5	83.4	P17

Figure 1. The number of items for literacy skills in form change of substances

Data analysis

To investigate the effectiveness of AR-based learning media in enhancing literacy skills among fifth-grade students in elementary schools, we conducted an analysis of the normalized gain between pretest and posttest scores. Each item was scored with 1 (one) assigned for a correct answer and 0 (zero) for an incorrect one. The maximum achievable score was 25, which was then converted to a scale of 100, resulting in a maximum score of 100 and a minimum score of zero. Subsequently, we elaborated on each aspect of literacy skills by analyzing the normalized gain score (Coletta & Steinert, 2020) for individual literacy aspects. Additionally, in our classroom analysis concerning the use of AR-based learning media, we presented all stages of the learning process, employing cooperative learning integrated with the use of AR-based learning media.

■ RESULTS AND DISCUSSION

We separated our findings of the result into two parts. Firstly, we would present how the integration of AR-based learning media implemented in the cooperative learning process in fifth grade elementary schools. Secondly, we presented the enhancement of literacy skills of

the experimental and control groups in the form of normalize gain for both overall and each aspect of literacy skills.

The implementation of the AR-based learning media in teaching approach

We used cooperative learning approach to integrate AR-based learning media for IPA subject. We divided the learning stages into several stages, these were: forming a question, identifying goals, creating a rubric, assigning a specific assessment task, and reflecting to adjust. All explanations of these stages followed this explanation.

Forming questions

In the context of cooperative learning, forming questions serves as a powerful tool to stimulate curiosity and guide discussions. Students are encouraged to formulate questions related to the subject matter, promoting a deeper understanding of the material; in this context students were facilitated to formulate the question about the change of liquid to gas forms. This process involves not only generating questions but also sharing them within the group, leading to a collaborative exploration of the topic (van der Laan Smith & Spindle, 2007). One of the key benefits of incorporating question formation in cooperative learning is that it shifts the role of the learner from a passive recipient of information to an active participant in the learning process. As students articulate their questions, they are prompted to reflect on the content, identify areas of confusion, and seek clarification from their peers. This not only strengthens their comprehension but also nurtures a sense of ownership over their learning.

Moreover, the act of forming questions in a collaborative setting cultivates communication skills. Students learn to express their thoughts clearly and listen actively to their peers' perspectives. This exchange of ideas contributes to a dynamic learning environment where knowledge is constructed collectively (Johnson & Johnson, 1999). Teachers play a crucial role in facilitating this process by providing guidance, encouraging meaningful questions, and moderating group discussions. They can also leverage technology and multimedia resources to diversify the sources of information, stimulating curiosity and inspiring thoughtful questions.

Identifying goals

This process involves clearly defining and articulating specific learning objectives that guide the group's activities. Incorporating goal identification in cooperative learning provides students with a sense of purpose and direction. By establishing clear objectives, students understand what they are working towards, fostering motivation and a shared commitment to the learning process (Quarstein & Peterson, 2001). This practice also helps in aligning individual efforts with the overall goals of the group, promoting a cohesive and purposeful collaborative environment. Teachers play a vital role in facilitating this implementation by assisting students in setting realistic and achievable goals. This involves breaking down larger learning objectives into smaller, manageable tasks that can be addressed collectively. Additionally, the teacher can encourage students to reflect on their progress and adjust goals as needed, promoting a dynamic and responsive learning environment.

Creating rubrics

The implementation of creating rubrics in cooperative learning is a structured approach that provides clear guidelines for assessing and evaluating collaborative activities. In this method, educators collaboratively establish criteria and performance expectations with students, fostering a shared understanding of project goals (Jones

& Jones, 2008). Creating rubrics in cooperative learning allows for transparency in assessment, as students are aware of the specific criteria against which their work will be evaluated. This not only promotes accountability but also empowers students to take ownership of their learning process. The rubric serves as a valuable tool for self-assessment, enabling students to gauge their progress and make informed adjustments. Teachers can use rubrics to provide constructive feedback, emphasizing both individual and group achievements. Additionally, the collaborative development of rubrics cultivates a sense of collective responsibility, reinforcing the importance of teamwork and mutual support in achieving common goals within the cooperative learning environment.

Assigning a specific assessment task

Assigning a specific assessment task in cooperative learning involves strategically distributing responsibilities within a group to achieve a common objective (Meijer et al., 2020). This implementation ensures that each team member of students contributes to the collective learning goals to have literacy skills. Teachers tailor assessments to focus on individual strengths, encouraging students to specialize in areas where they excel and contribute their expertise to the group. Assigning specific assessment tasks here refers to integration of learning media-based AR, students develop a deeper understanding of their roles in comprehending some phenomena in form change of substances. This targeted approach fosters accountability and encourages students to take ownership of their contributions to visualize phenomenon. It also allows for the recognition of individual achievements within the context of the group's overall success. Teachers play a crucial role in guiding this process, providing clear instructions and ensuring that the assigned tasks align with the broader learning objectives. This cooperative learning strategy not only enhances individual skills but also promotes a synergistic environment where each member's expertise contributes to the overall success of the group.

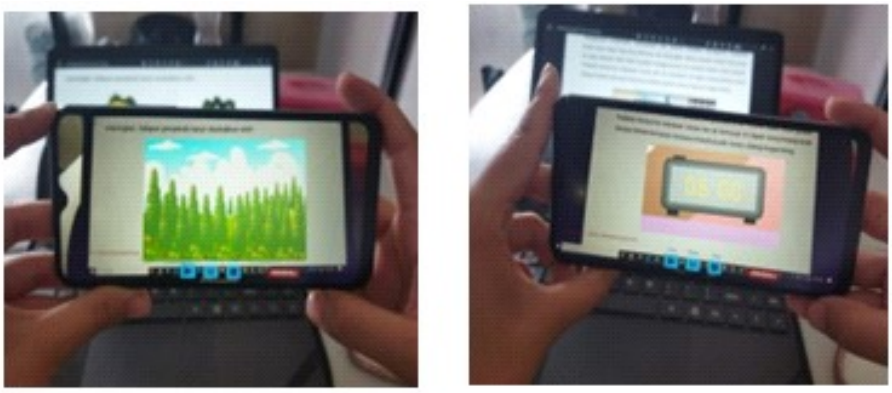

Figure 2. assigning task investigate phenomenon of form change of substance

Reflecting to adjust

Implementing reflection to adjust in cooperative learning is a valuable strategy that encourages students to critically evaluate their collaborative experiences and make informed adjustments (Erdogan, 2019). Following collaborative activities, students engage in reflective discussions to assess what worked

well, identify challenges, and propose improvements for future collaboration. Teachers facilitate this process by guiding reflective discussions, prompting students to analyze their group dynamics, communication strategies, and overall effectiveness. This reflective practice fosters metacognition, helping students become more self-aware learners. It also promotes a culture of continuous improvement within the cooperative learning environment. The implementation of reflection to adjust encourages students to take responsibility for their learning experiences, fostering a sense of agency and adaptability. By identifying strengths and areas for improvement, students can make informed decisions to enhance their collaborative skills, communication strategies, and overall group dynamics. This iterative process contributes to a more effective and dynamic cooperative learning environment.

Enhancement of literacy skills for integrating AR-based learning media.

In this part, we presented findings of pretest and posttest scores of literacy skills in the context of form change of substance. Firstly, we presented descriptive data both pretest and posttest for experimental and control groups. These data can be seen in the Table 1.

Table 1. descriptive statistics for experimental and control groups in literacy skills

Measurements	Experimental group		Control groups	
	Pretest	Posttest	Pretest	Posttest
Number (N)	24	24	24	24
Minimum score	45	70	50	70
Maximum score	75	95	70	90
Average score	59.58	80.83	62.20	77.70
Standard deviation	8.06	6.86	5.51	6.14

According to the Table 1, we could summarize that posttest score of the experimental group was higher than that of control group; however, the pretest score of control group was lower than that of experimental group. More interestingly, the standard deviation of the posttest score was lower than that of control group which this means that score posttest of experimental group more uniform than of control group. Indeed, we could not conclude anything from these data so we have to examine by using normalized gain score to determine whether the effectiveness of the experimental group was significantly difference from control group. By using the formulation of normalized gain <g> proposed by Hake (2002), finally we found that the average score for experimental group (g=0.525) was higher than average score of control group (g=0.39). This means that the effectiveness of literacy skills of experimental was better than that control group, which the intervention just used a cooperative learning approach. This also strengthens the empirical evidence that integrating learning media-based AR can facilitate students in acquisition of three aspects of literacy we used, they are to find information in a text, understand the text, and reflect and evaluate the text.

■ CONCLUSIONS

We found two conclusions from what we did about the use of learning media-based AR. Firstly, the integration of the learning media-based AR to cooperative learning was appropriate to be implemented in the stage "Assigning a specific assessment task" because it was effectively to enhance literacy skills. Secondly, the effectiveness

of the use of learning media-based AR both experimental and control group was in intermediate category; however, the use of learning media-based AR in fifth grade elementary school was more effective than that of control group.

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