Development of Mobile Learning based on Problem Solving to Improve IPAS Learning Outcomes

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Abstract: Teachers have not optimally used technology learning media and have not implemented problem solving learning models, causing low student learning outcomes. The research objective is to develop, test feasibility, and measure effectiveness of Mobile Learning based on Problem Solving to improve IPAS learning outcomes for class V. This type of research is Research and Development with the Borg & Gall model. The research subjects were 21 class V students at SDN 02 Jatipurwo Karanganyar. Data collection techniques use tests (pretest, posttest) and non-tests (observation, interviews, questionnaires). Data analysis was carried out using normality test techniques, t test, and N-Gain test. The research results show: Mobile Learning based on Problem Solving was developed using the canva application containing a cover, learning outcomes, instructions for use, developer profile, references, accompanied by learning objectives, concept maps, materials and evaluation questions; the feasible of the media is shown from the validity test of material experts, media experts, teachers and students who receive a very feasible category; and effectiveness is shown from the analysis of pretest and posttest scores. The t test results get a sig value. (2-tailed) $0.000 < 0.005$. The N-Gain test result is 0.4234 in the medium category. The conclusions in this research show that the development of Mobile Learning based on Problem Solving has been successfully developed, is very feasible, and is effectively used to improve the science and science learning outcomes of class V students at SDN 02 Jatipurwo Karanganyar.

Keywords : IPAS; Learning Outcomes; Mobile Learning; Problem Solving

Introduction

Education is a process in human life as a means of gaining knowledge which will later be useful for supporting life in the future (Sarah & Darwis, 2022). One of the foundations for the establishment of education is referring to a curriculum (Andita & Taufina, 2020). Based on Permendikbud No. 718/P/2020, the curriculum is a set of plans and arrangements regarding objectives, content and learning materials as well as methods used as guidelines for organizing learning activities to achieve certain educational goals (Kemdikbud, 2020). The implementation of education in Indonesia is currently based on the independent curriculum. The implementation of the independent curriculum in education refers to Government Regulation of the Republic of Indonesia No. 57 of 2021, as curriculum development is carried out by referring to national education standards to realize national education goals which include graduation competency standards, content standards, process standards and educational assessment standards (Andriansyah & Kamalia, 2021; Daniati, 2022).

The structure of the independent curriculum is stated in the Decree of the Minister of Education, Culture, Research and Technology No. 262/M/2022 which states that learning outcomes for SD/MI level are divided into three phases, namely phase A for classes I and II, phase B for class III and IV, phase C

for classes V and VI (Kepmendikbudristekdikti, 2022). Learning outcomes are compiled for each subject, one of which is IPAS (Natural and Social Sciences). This research focuses on science subjects, especially in the science (natural science) family. Science learning in elementary schools teaches about getting to know scientific concepts that are close to the natural environment such as plants, animals, humans and the natural environment (Ulfaturrokhmah & Ratnaningsih, 2022). Apart from that, science is a subject that can train and provide opportunities for critical and objective thinking to students by providing direct learning experiences (Fitrisyahni & Gustia Ningsih, 2023). Students' success in science subjects is closely related to problem-solving abilities (Wardani & Wasitohadi, 2020). Students must be able to identify problems and determine solutions in order to participate in currently developing science education, especially in elementary schools (Anita Bella et al., 2022).

However, in reality, in the implementation of science learning in elementary schools, students' problem-solving abilities are still low. The results of the 2018 PISA survey show that students' literacy levels, including problem-solving abilities, are still very low (Fenanlampir et al., 2019; Sujadi et al., 2023). The results of the PISA survey show that 70% of Indonesian students failed to reach level 2, while on average around 23% of students failed to reach level 2 reading 2 in 79 PISA participating countries (Ulfaturrokhmah & Ratnaningsih, 2022). The ability to read or understand problems is very important in the problem-solving process (Akben, 2020; Astuti et al., 2021; Fitriani et al., 2020; Güner & Erbay, 2021). In the world of education, the role of teachers cannot be separated from guiding students and trying to improve the learning outcomes of each student (Purbasari et al., 2020). From this opinion, teachers must determine the appropriate learning media and models to support learning to improve student learning outcomes.

Based on the results of observations and interviews conducted by researchers with class V teachers at SDN 02 Jatipurwo Karanganyar, problems were found, namely the limited use of learning media to support science learning. Teachers only use simple learning media in the form of concrete media. The learning media used by teachers does not take advantage of technological developments, making students easily bored and not interested in participating in the learning process. In learning, teachers need to choose interesting learning media to trigger students attention (Wati, 2022). This problem is based on teachers not yet mastering digital literacy as a basis for using technology-based learning media.

The learning model applied by teachers is still one-way (teacher center) from teacher to students, so that the teacher's role dominates in the learning process. The learning model used does not apply problem solving skills to science subjects. In the learning process, the teacher explains the material while students follow the teacher's presentation of the material. In addition, the opinion of Leonaldo et al. (2023) states that the use of learning models is adjusted to the objectives to be achieved, the material presented, the abilities of students and the abilities of teachers.

This problem causes the science learning outcomes of class V students at SDN 02 Jatipurwo not all to meet Kriteria Ketercapaian Tujuan Pembelajaran (KKTP). The KKTP for the science subject is 75. Based on the science subject score data, it shows that the incomplete percentage is 57% with the total number of students being 21 people consisting of 13 male students and 8 female students. Of the 21 students, only 9 students completed, while the other 12 students did not complete.

Students have difficulty understanding Natural Science (IPA) material. Especially regarding the material on the human respiratory system which still gives rise to misconceptions among students. Misconception is an understanding of a concept that is deviant or not in accordance with scientific interpretation (Dewi et al., 2021). Students cannot differentiate between the mechanisms of the thoracic and abdominal respiratory systems. Apart from that, students experience difficulties related to foreign terms related to human respiratory organs. The existence of misconceptions among students has an impact on understanding the material on the human respiratory system and influences student learning outcomes.

Based on the description of the previous problem, researchers will develop technology-based learning media, namely Mobile Learning based on Problem Solving. Technological advances in modern times is proven by the current level of development of smartphone devices which are increasingly high and cheap (Razilu, 2021). Mobile Learning was chosen to be developed because considering the condition of students, most of whom already have smartphones, so by utilizing Mobile Learning media , there is the possibility for students to carry out activities in the form of accessing learning materials, direction of objectives, and searching for lesson information anywhere and at any time without limitations. space and time to do it (Wati, 2022). Along with the views Cahyani et al. (2022) who state that Mobile Learning is a change and development of electronic learning towards learning that is independent and easy to

learn. Mobile Learning is a form of learning innovation that has an important role in changing the learning process, in the learning process students not only listen to explanations of material from educators, but students are also required to play an active role in carrying out other activities such as observing and demonstrating (Mariati et al., 2021). With the Mobile Learning, it is hoped that it will be able to create a learning process that is exciting, interesting and effective, and will have an impact on student learning achievement (Cahya et al., 2020). Apart from that, Mobile Learning can be a material to support teacher learning in the classroom so that learning can be more varied while making it easier for students to understand concepts in the learning process (Mukhtar & Yamin, 2002).

Mobile Learning was developed based on Problem Solving. Problem Solving is a basic concept of several tricks in the teaching and learning process which makes problems the main key (Singgih, 2023). In the development of Mobile Learning media, it is structured with reference to real or authentic problems in accordance with the characteristics of the Problem Based Learning model (Wardani & Wasitohadi, 2020). The Problem Based Learning model uses real situations as a starting point for students to start the learning process (Felianti & Sanoto, 2023). It is hoped that Mobile Learning based on Problem Solving can be used as an effective and easy-to-use learning medium for students to increase understanding and problem-solving abilities so that it can improve student learning outcomes (Kholid et al., 2020; Price et al., 2021).

The aims of this research include: developing Mobile Learning based on Problem Solving; testing the feasibility of Mobile Learning based on Problem Solving; and testing the effectiveness of Mobile Learning based on Problem Solving to improve IPAS learning outcomes of class V students at SDN 02 Jatipurwo Karanganyar.

Method

The research method applied is Research and Development (R&D). R&D research methods are used to develop products and test their effectiveness. (Juneli et al., 2022). Research and development of Mobile Learning media based on Problem Solving is oriented towards the Borg & Gall product development model. The Borg & Gall model has 10 stages in research and development (Siregar, 2023; Umar et al., 2023; Untoroseto & Triayudi, 2023), namely: potential and problems; data collection; product design), design validation; design revision; product testing; product revision; trial use; product

revision; and mass production (Sugiyono, 2022). In this research, we only reached stage 8, namely trial use. This is based on the researcher's limited time and costs. Carrying out product revision and mass production stages requires a long time and is not cheap. Basically there are ten steps for Borg & Gall development, but these ten steps cannot be carried out in all, but can be modified into several steps and stages according to the needs of the development being carried out (Effendi & Hendriyani, 2018).

The research was carried out at SDN 02 Jatipurwo Karanganyar. The subjects of this research included 21 class V students at SDN 02 Jatipurwo, class V teachers at SDN 02 Jatipurwo, media experts, and material experts. Data collection techniques use test and non-test techniques. Test techniques are carried out through pretest and posttest, while non-test techniques are carried out through observation, interviews and questionnaires. Initial data analysis as a prerequisite test uses the normality test. Meanwhile, final data analysis includes the t test and N-Gain test.

Result and Discussion

This research concerns the development of Mobile Learning based on Problem Solving in science subjects on the human respiratory system for class V SDN 02 Jatipurwo Karanganyar. By looking at the results of the research that has been carried out, there are three things that will be studied in these results and discussion, namely; the results of the development of Mobile Learning based on Problem Solving; the feasibility of Mobile Learning based on Problem Solving; and the effectiveness of Mobile Learning based on Problem Solving to improve IPAS learning outcomes of class V students at SDN 02 Jatipurwo Karanganyar.

Development of Mobile Learning based on Problem Solving

This research and development uses the Borg & Gall model. The first stage is potential and problems. To find the potential and problems that exist in class V at SDN 02 Jatipurwo Karanganyar, researchers conducted observations through interviews, questionnaires and document data in the form of learning outcomes of class V students at SDN 02 Jatipurwo. Based on the results of observations, it shows that there are limitations in the use of media to support science learning; not yet utilizing technology-based media; the learning model is still one-way (teacher center) from teacher to student; and have not applied problem solving skills. To overcome these problems in science learning, researchers conducted research and development of Mobile Learning on

Problem Solving in science subjects on the human respiratory system.

The second stage is data collection. Data collection in this research was through student's science learning outcomes as well as teacher and student needs questionnaires regarding the development of Mobile Learning media based on Problem Solving. Based on observations, it can be seen that student's science learning outcomes are still low. In addition, the results of the teacher and the results of the student needs questionnaire show that there is a great need for learning media that uses technology by utilizing smartphones owned by students and other existing infrastructure in schools. Students need Mobile Learning media based on Problem Solving which is equipped with pictures, videos, audio and evaluation questions which are packaged in an attractive way on the human respiratory system material.

The third stage is product design. Mobile Learning based on Problem Solving is designed using the canva application with the final result in the form of a link. Mobile Learning based on Problem Solving contains a cover, learning outcomes, instructions for use, developer profile, references, lesson 1 and lesson 2 which contain learning objectives, concept maps, learning materials, and evaluation questions. The material on the human respiratory system is divided into two lessons, namely lesson 1 regarding human respiratory organs, chest breathing and abdominal breathing, while lesson 2 is about disorders of the human respiratory system and how to prevent them. The syntax of the Problem Based Learning model includes: student orientation to the problem; organizing students to study; guide the investigation; develop and present work results; and analyzing and evaluating the problem-solving process (Febrita & Harni, 2020; Hermansyah, 2020).

The fourth stage is design validation. Validation of the Mobile Learning media design based on Problem Solving was carried out by experts consisting of material experts and media experts. Next, the fifth stage is design revision. Design revisions to the Mobile Learning media based on Problem-Solving are carried out based on assessments and notes from material experts and media experts until the media is suitable for testing.

The sixth stage is product testing. Researchers conducted trials through small groups with the aim of getting suggestions on the effectiveness of Mobile Learning based on Problem Solving. A small-scale trial was carried out at SDN 02 Jatipurwo Karanganyar with 6 class V students. Next, the researchers distributed teacher and student response questionnaires to find out responses and suggestions

for the Mobile Learning media based on Problem Solving in science subjects on the human respiratory system.

The seventh stage is product revision. Based on the results of teacher and student response questionnaires through small-scale trials carried out by researchers, there were no product revisions because they were appropriate.

The eighth stage is trial use. Usage trials were carried out through large-scale trials carried out in class V of SDN 02 Jatipurwo Karanganyar with a total of 21 students. The results of the development of Mobile Learning based on Problem Solving are presented in **figure 1-6.**
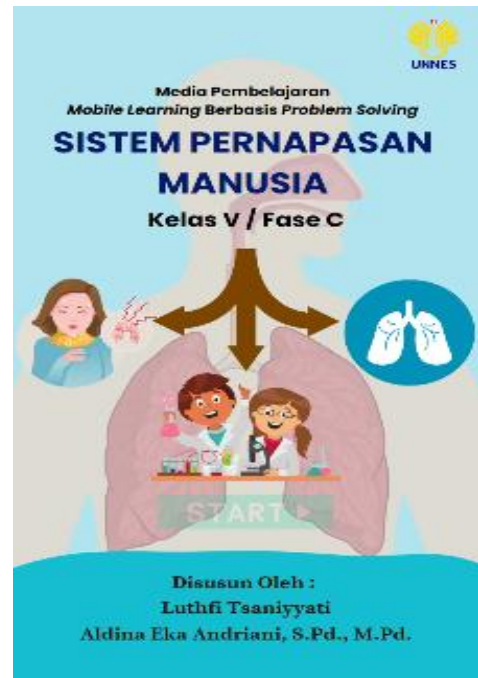

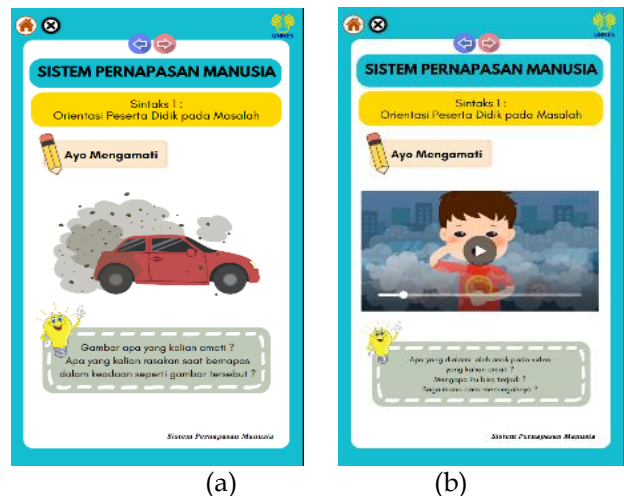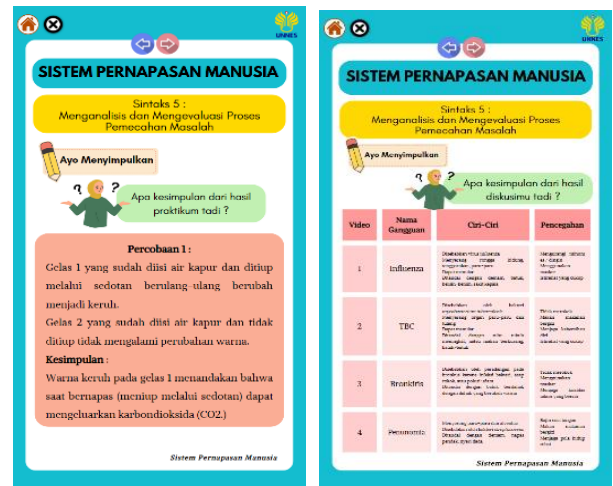**Figure 1.** Cover of Mobile Learning based on Problem Solving

(a)   (b)

Figure 2. Syntax 1 of Problem Based Learning (Students Orientation to the Problem): (a) Lesson 1; (b) and Lesson 2

Figure 3. Syntax 2 Problem Based Learning (Organizing Students to Learn)

(a)   (b)

Figure 4. Syntax 3 Problem Based Learning (Guiding Investigation) Lesson 1 (a) and Lesson 2 (b)
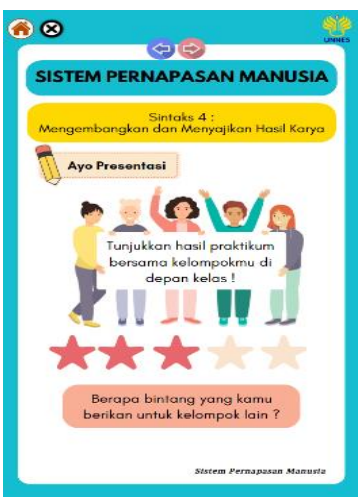
Figure 5. Syntax 4 Problem Based Learning (Developing and Presenting Work Results)

(a)   (b)

Figure 6. Syntax 5 Problem Based Learning (Analyzing and Evaluating the Problem Solving Process): (a) Lesson 1; and (b) Lesson 2

Feasibility of Mobile Learning based on Problem Solving

The feasibility of Mobile Learning based on Problem Solving on human respiratory system material is determined based on the results of validity tests by experts in the material field, experts in the media field, responses from teachers, and responses from students. Validity test by material experts and media experts to see the suitability of Mobile Learning based on Problem Solving media using an adjusted assessment questionnaire sheet (Maryono & Budiono, 2021). Aspects of the material expert assessment instrument include: language use; content and purpose; instructional; and technical or appearance. Aspects of media expert assessment instruments include: media design; language; and ease of use. The validity test results are presented in Tables 1 and 2.

Table 1. Validity Test Results of Material Experts and Media Experts

Experts	Percentage	Category
Material	91.25	Very Feasible
Media	92.50	Very Feasible

Based on table 1, it can be seen that the results of the validity test of Mobile Learning based on Problem Solving from material experts obtained a percentage of 91.25% in the very feasible category, while media experts obtained a percentage of 92.5% in the very feasible category.

Table 2. Results of Teacher and Student Responses

Response	Percentage	Category
Teacher	96.67	Very Feasible
Students	95.00	Very Feasible

Meanwhile, Table 2 shows the percentage of teacher and student response results. The teacher's response obtained a percentage of 96.67% and the student's response obtained a percentage of 95%. From the results of the validity test of material experts, media experts, teacher responses and student responses, it can be concluded that the Mobile Learning based on Problem Solving is very suitable for use in learning.

Effectiveness of Mobile Learning Learning Media Based on Problem Solving

The effectiveness of Mobile Learning based on Problem Solving material on the human respiratory system is determined based on student learning outcomes by analyzing pretest and posttest scores. The results of the pretest and posttest are presented in Table 3.

Table 3. Pretest and Posttest Test Results

Aspect	Pretest Score	Posttest Score
Mean	61.90	79.84
Highest Score	83.33	90.00
Lowest Score	50.00	60.00

Based on table 3, it can be seen that there has been an increase in the average learning outcomes of 17.93667 from the original pretest average of 61.90476 to 79.84143 in the posttest average. In this research, the data analysis process uses the help of the SPSS 23 program. Initial data analysis is the normality test, while final data analysis is the t test and N-Gain test.

The normality test is used to determine whether research data has a normal distribution or not. In this research, the normality test used the SPSS 23 program with Shapiro-Wilk. The results of the normality test are presented in Table 4.

Table 4. Pretest and Posttest Data Normality Test Results

Action	Mean	Sig.	Category
Pretest	61.90	0.540	Normal
Posttest	79.84	0.073	Normal

The normality test criterion is that the data can be said to be normally distributed if the sig value. > 0.05, whereas if the sig value < 0.05 the data is said to be not normally distributed. Based on table 3 which refers to the Shapiro-Wilk test, it can be seen that the sig. pretest data was 0.540 and posttest data was 0.073. The significance value in the pretest and posttest data is more than 0.05. Therefore, the conclusion that can be drawn is that the research pretest and posttest data have a normal distribution.

After carrying out the normality test, the t test can then be carried out, namely the Paired Sample T-Test using SPSS 23 to determine the effectiveness of the Mobile Learning based on Problem Solving. Table 5 shows the results of the Paired Sample T-Test.

Table 5. Paired Sample T-Test Results

Action	Std. Deviation	Std. Error Mean	Sig. (2-tailed)
Pretest - Posttest	5.73702	1.25192	0.000

The test criteria for the Paired Sample T-Test is if the sig value. (2-tailed) > 0.05, so there is no significant difference in the pretest and posttest results. Meanwhile, if the sig value. (2-tailed) < 0.05, then there is a significant difference in the results of the pretest and posttest. Based on table 4, it can be seen that the sig (2-tailed) value is 0.000 < 0.05. So it can be concluded that the Mobile Learning based on Problem Solving is effective for use in learning, especially in science subjects regarding the human respiratory system.

The N-Gain test is used to measure the average increase in scores between the pretest and posttest. In this research, the N-Gain test was carried out using the SPSS 23 program. The results of the N-Gain test are presented in Table 6.

Table 6. N-Gain Test Results

Action	N	Mean	N-Gain	Category
Pretest	21	61.90476	0.4234	Medium
Posttest	21	79.84143		

Based on table 6, it can be seen from the N-Gain test that the learning outcomes of class V students at SDN 02 Jatipurwo Karanganyar using the Mobile Learning based on Problem Solving experienced an increase in the average N-Gain score of 0.4234 in the medium category. Therefore, the conclusion that can be drawn is that the application of Mobile Learning based on Problem Solving approach is effective in learning and can improve student learning outcomes, especially in science subjects covering the human respiratory system.

The results of the validity test of Mobile Learning based on Problem Solving were in the very feasible category, while the results of the N-Gain test data analysis were in the medium category. This is influenced by different learning styles, learning readiness, and understanding of students to achieve higher learning outcomes. Readiness in learning is very important as a basis for teaching, readiness is the capacity both physical and mental to do something, therefore teaching is carried out if the individual has

readiness (Herlina et al., 2022; Hety, 2020; Setiawan, 2017). So it can be concluded that the Mobile Learning based on Problem Solving is effective for use in learning, especially science subjects, material on the human respiratory system.

Conclusion

Developing Mobile Learning based on Problem Solving in science subjects on the human respiratory system using Research and Development research. Based on the results of the validity test of material experts and media experts, the Mobile Learning based on Problem Solving was declared very suitable for use in learning with a percentage of 91.25% from material experts and 92.5% from media experts. Mobile Learning based on Problem Solving was declared effective for use in learning as seen from the increase in learning outcomes in science subjects on the human respiratory system through the results of pretest and posttest score analysis. The results of the Paired Sample T-Test analysis show sig. (2-tailed) 0.000 < 0.05 and the N-Gain test result is 0.42 in the medium category. It can be concluded that research into the development of Mobile Learning based on Problem Solving has been successful in being developed, is very feasible and effective for use in science learning material on the human respiratory system and can improve the science and science learning outcomes of class V students at SDN 02 Jatipurwo Karanganyar.

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