Development of LKPD through Cognitive Conflict Strategy Learning Assisted with Augmented Reality to Improve Mathematical Problem Solving Capability

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Abstract: This research aims to analyzing the validity, practicality and effectiveness of students' worksheets through cognitive conflict strategies to improve mathematical problem-solving abilities through learning cognitive conflict strategies assisted by Augmented Reality. The Ploomp model was used in this study. The subjects in this research are students in class VIII of SMP Negeri 4 Percut Sei Tuan. The research results showed that the student worksheet developed met the valid criteria based on an average score of 4.02, the practical student worksheet based on learning implementation IO =4.21 (high). The student worksheets developed have met the effective criteria in terms of classical completeness reaching 82.70%, student responses obtained above 80% for all students, namely 92%, increased problem- solving abilities seen from the average N-Gain value of trial of 0.30 increased to 0.60 in trial II, indicating that it was in the "medium" category. For the next implementation, it will be applied to several state junior high schools in Percut Sei Tuan District and analyze differences in mathematical problem-solving abilities seen from the school ranking, namely the accreditation of the state junior high school.

Keywords: development of LKPD; cognitive conflict; augmented reality.

Pengembangan LKPD melalui Pembelajaran Strategi Konflik Kognitif Berbantuan Augmented Reality untuk Meningkatkan Kemampuan Pemecahan Masalah Matematis

Abstrak: *Penelitian ini bertujuan untuk menganalisis kevalidan, kepraktisan dan keefektifan lembar kerja siswa melalui strategi konflik kognitif untuk meningkatkan kemampuan pemecahan masalah matematika melalui pembelajaran strategi konflik kognitif berbantuan Augmented Reality. Model Ploomp digunakan dalam penelitian ini. Subjek dalam penelitian ini adalah siswa kelas VIII SMP Negeri 4 Percut Sei Tuan. Hasil penelitian menunjukkan bahwa lembar kerja siswa yang dikembangkan memenuhi kriteria valid berdasarkan nilai rata-rata 4,02, lembar kerja siswa praktis berdasarkan keterlaksanaan pembelajaran IO = 4,21 (tinggi). Lembar kerja siswa yang dikembangkan telah memenuhi kriteria efektif ditinjau dari ketuntasan klasikal mencapai 82,70%, respon siswa yang diperoleh di atas 80% untuk semua siswa yaitu 92%, peningkatan kemampuan pemecahan masalah terlihat dari nilai rata-rata N-Gain uji coba sebesar 0,30 meningkat menjadi 0,60 pada uji coba II yang menunjukkan berada pada kategori "sedang". Untuk implementasi selanjutnya akan diterapkan pada beberapa SMP Negeri di Kecamatan Percut Sei Tuan dan menganalisis perbedaan kemampuan pemecahan masalah matematika dilihat dari peringkat sekolah yaitu akreditasi SMP Negeri.*

Kata kunci: *pengembangan LKPD; konflik kognitif; augmented reality.*

1. Intoduction

Mathematics learning is said to be successful if the learning objectives can be achieved. According to Kamarulllah's mathematics learning goals in 2017 (Purba & Purba, 2023) must be directed by curriculum understanding the concepts of mathematics, explaining the relationships between concepts and applying the concepts or algorithms in a professional way. Accurate, efficient and precise in solving problems, 2) carrying out reasoning based on characteristic patterns, carrying out mathematical manipulations in forming mathematical generalizations, ideas and statements, 3) solving problems that involve the ability to understand problems, design mathematical models, complete models and interpret the solution produced, 4) communicating ideas with symbols, tables, diagrams or other media to explain the error or problem. 5) have an attitude of appreciating the

advantages of mathematics in life, namely having curiosity, attention and interest in learning mathematics as well as a sincere and confident attitude in solving problems. Based on the reasons and objectives of mathematics, it is clear that primary mathematics subjects are offered to students from elementary school level to higher levels.

Teaching mathematics is not just a learning process for delivering teaching materials to students, but there are many factors that must be taken into account, one of which is how an involve students in the learning process actively and can also understand the concept that is being taught, which is a form of learning so that students can be interested in learning mathematics. can develop or construct knowledge on their own. It is important to keep in mind during the learning process that students' proficiency in problem solving, thinking, connection, communication, and development must already be evident at the conclusion of the learning activities. Therefore, there must be action during the learning process. The goal of learning is the development of self-directed skills. The creation of student worksheets is one of the last resorts for enhancing general education competency. In the learning process, it should be remembered that at the end of the series of learning activities, problem solving, reasoning, connection, communication, and development must already appear as the result of students' learning. Therefore, in the learning process there must be activity. Learning is directed towards the emergence of self-directed competencies. One of the ultimate efforts to improve overall education competency is to develop student worksheets (LKPD).

The LKPD developed in this research uses the Ploomp model (Fathiyyah Firdauls & Marina Angraini, 2023). This is similar to development research assisted by Augmented Reality, but the development model is the ADDIE model (Damayanti et al., 2023). The development of Ploomp includes activities, namely: Phase I is preliminary study, Phase II is Prototype Development and Phase III Trial & Final Assesment. In this article, the author presents Phase I and Phase II. The development concept can be seen in Figure 1.

The development of Student Worksheets (LKPD) in this research was adopted from the 2013 Ploomp development model which has been used in developments carried out by other researchers, namely Zahara and friends (Zahara et al., 2020).
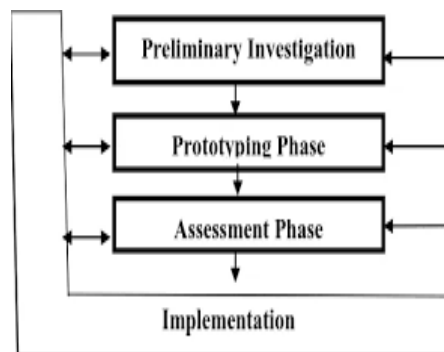

Figure 1. Ploomp model 2013 (Zahara et al., 2020)

Based on the author's initial observation that the ultimate goal of achieving the learning objectives that the mathematics learning curriculum wants to achieve is that students must have a high level of ability to solve mathematical problems, but in reality the ability to solve mathematical problems of average students is low. This has been proven on the International scale developed from the Program for the International Student Asselssmelnt (PISA) in 2022 (Lewalter et al., 2023) that the average score obtained by Indonesia is 366, with a low ranking of 66 and a high ranking of 76 for Mathematics Performancel at National and subnational level, however, there is something that gives a feeling of pride with the existence of the Independent curriculum, Indonesia's ranking has risen by 5-6 positions compared to 2018. Furthermore, the national scale results have also happened the same thing, namely that the mathematics abilities of students are also low when compared to other subjects, so their abilities Mathematics for Indonesian students is, at the bottom. (Kemendikbudristek, 2023). Based on direct observations at school, the problem is also the same, namely that students do not like to learn mathematics and students always learn that mathematics is a difficult and less interesting subject.

This is a big responsibility for the teacher to be able to develop the learning process to be more attractive for students so that the attraction becomes one of the ultimate motivations for students' ability to solve mathematical problems. that's it develops LKPD which is designed as well as possible and one of the plans that has been finalized by the author is the development of LKPD to Increase Capacity.

Solving Mathematical Problems Through Cognitive Conflict Strategy Learning with the Assistance of Augmented Reality is a way that will make it easier for students and motivate students to solve problems well and seriously, In

line with Ausubell's learning theory (Indartiningsih et al., 2024) inplanning mathematics learning, primary educators must understand the importance of learning alone. According to Ausubell, learning focuses on how individual cells obtain information. Information can emerge from learning and meaningful learning Rote learning is learning by using memory to memorize mathematical concepts, whereas meaningful learning is learning that is done by paying attention to basic skills, even though early learning can be attributed to learning or learning. This new experience is the concept of cognitive conflict strategy. Cognitive conflict strategies have phases or stages that follow Piaget's cognitive learning stages (Rohana et al., 2019). Piaget's cognitive stages consist of awareness, imbalance, and re-formulation. The same thing about Piaget's theory (Laja & Hijriani, 2022). This stage must be present in students' cognitive construction. The cognitive conflict strategy consists of three stages, namely: 1) encompassing students' initial conceptions, 2) creating conceptual conflict, and 3) encouraging cognitive accommodation to occur (Sari & Putra, 2019). In this research, the cognitive conflict strategy indicator implements cognitive accommodation in *Augmented Reality (AR)*. This means that personal accommodation may still not exist *but* still appear to be structured and systematic so that students can relate and ea[l]sily m∂ ve f[l]orward[l]and can be used in solving the problems they face. The material presented in the LKPD is the Geometri material which includes the calculation of cube and beams which was designed using the help of Augmented Riality and one of the images which appeared in the LKPD is about understanding the concept of cube and beams by developing an animation of one of the nets of cubu and beam. Furthermore, the LKPD is designed with materials and questions that increase students' ability to solve mathematical problems. This is also the case with research (Sari & Sullisworo, 2023). The development of AR applications as a medium for students' mathematics learning can attract students' interest and motivation. In line with research (Hasanah et al., 2023) using animated videos. The development of the AR application provides advantages in its implementation, helps students understand the material as well as develops skills, but its implementation is still limited to using a laptop, so it is recommended to develop media that can be accessed mobile from a Smartphone. In this research, the LKPD developed by Material can be viewed o a laptop, and the link can also be shared with students and can be viewed via Smartphone.

There are also LKPD that have been developed including material designs as well as pictures of cube and animations of cube netting which are finally complete in completing the culculature processing as described in Figure 2.
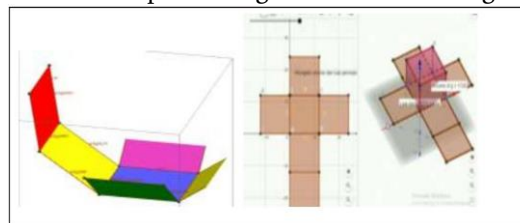

Figure 2. Animation of Cube mesh and Cube Surface Area

2. Research Method

The type of research carried out is Development research. The development stages used are performance analysis, preliminary design in line with research (Amaliah et al., 2023), validation and testing on the development. These stages are simplified according to the values presented in Figure 3.
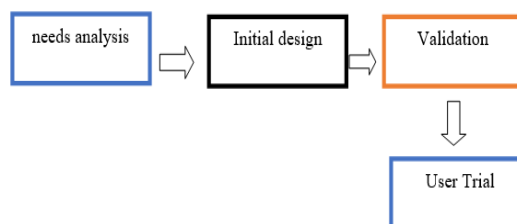

Figure 3. Simplified development stages

This research student is a class VIII student at SMP Negeri 4 Percut Sei Tuan. Trials were carried out at 2 different SMP Negeri 1, namely one class VIII, SMP Negeri 6, Sampali, one class VIII, SMP Negeri 3, Percut Sei Tuan. This research is still at the trial stage, which is in Phase II.

The instruments used include questionnaires on students' responses to LKPD which have been developed with cognitive conflict strategies assisted by Aulgmelnteld. Relality is measured on a scale of 1 (very not so), scale 2 (not at all), scale 3 (very well) and scale 4 (very little The items observed are Ulselfullnelss (utility), Elasel of ulsel (ease of use), Elasel of learning (skillfulness of learning), Satisfaction (excellence), which ultimately leads to an efficient learning design. The strategy in this lesson aims to minimize student misconceptions. A more optimal ability to solve mathematical problems was obtained. Qualitative data was obtained by carrying out

calculations using the help of SPSS 25 from the preliminary test data of the LKPD during the learning process. implementing the developed LKPD is carried out Preltels, after learning, use the LKPD that has been developed in postels. Ulntulk recognizes that there is an increase in the ability to solve problems, namely carrying out preltels and postels data analysis by implementing the ttelst test (Preltels-Postelst) The first belda test is carried out in pairs (Riadi, 2016).

3. Result And Discussion
Results

Before conducting research, researchers analyzed several aspects by conducting literary studies, student characteristics, material and learning objectives. Based on the results of initial observations and analysis according to students' needs regarding the media used when students use LKPD, it is necessary to develop LKPD with the help of multimedia. The low ability of students to understand concepts in Geometry material to calculate the surface area of a cube means that visualization of the shape of the cube is required. With innovation in presenting material and LKPD which is equipped with the help of Augmented Reality so that students' understanding is better and has an impact on their mathematical problem- solving abilities.

Based on the results of the trial for large groups, the results obtained from students' mathematical problem solving abilities after using AR-assisted LKPD are as follows,

Table 1. Gain Index Test of Students' Mathematical Problem Solving Ability

Kemampuan Pemecahan Masalah Matematis	Pretest	Posttest
Indeks gain	0,30	0,60
Pengembangan LKPD	30%	60%

Based on Table 1, it can be explained that before the AR-assisted LKPD development trial, the student gain index value (pretest) was 0.30 or equivalent to 30%. Furthermore, after the AR-assisted LKPD development was carried out on Geometry material in the large class trial, the results were obtained in the form of a gain index of 0.60 or equivalent to 60%.

The results of the impact of developing AR-assisted LKPD on students in terms of motivation to work on problem solving well are as follows,

Based on Table 2, it can be explained that the students' responses during learning using LKPD before being developed using AR, students'

motivation in solving mathematical problems was 51.24% and after using LKPD developed with AR, students' learning motivation in solving mathematical problems was 71.05%. Based on the criteria for students' questionnaire answers for students' responses, both conditions include most students having great motivation, but from the magnitude of the numbers, there is an increase of 19.81, meaning that there is a significant influence on the development of LKPD on students' motivation to solve problems presented on the LKPD sheet.

Table 2. Results of students' answers in response to learning on developing LKPD assisted by LKPD

Kondisi Proses Pembelajaran	Persentase Rata-Rata Keseluruhan Jawaban Siswa	Kriteria	Penafsiran
Pembelajaran Sebelum Pengembangan LKPD.	51,24%	50% < P < 75%	Sebagian Besar
Pembelajaran Setelah Pengembangan LKPD.	71,05%		

Discussion

There are steps in the cognitive conflict strategy that are designed in the LKPD as follows. 1) Students are presented with various building blocks from various forms around the student's living environment by answering comprehensive cell questions in the field of cellphone learning. 2) Presenting the structure of the nets of culculature and blocks, students are given the ultimate opportunity to think about things that students already know by comparing new concepts. received by presenting pictures including animations assisted by Augmenteld Reality and also eliminating students' misconceptions. According to research (Cervantes-Barraza & Araujo, 2023) that cognitive conflict strategies can minimize misconceptions that have an impact on problem solving.

The ultimate validity test of the LKPD that has been developed is an expert validation questionnaire that is used to check the completeness of the material content in the LKPD (which consists of the completeness of the material content with KI-KD), construction (which consists of the complete construction of the ideal LKPD format and the complete construction with Problem-based learning is intended to improve critical thinking skills to

assess aspects of the readability of the worksheet being developed. The validity test results with an average of 4.02 and the validity criteria are good. Small group test analysis is used to examine the feasibility, reliability and usefulness of the product being developed.

After the small group test was declared valid and effective, a medium group test was carried out consisting of a group of 10 students. In the medium group test, valid results were obtained with minor revisions. After minor revisions were made and another trial was conducted. Based on the results of the trial after the revision, the validity test results were obtained with a value of 4.01 The small group and medium group tests were valid, so the trial was carried out for the large group, namely in one class consisting of 35 students in class VIII of SMP Negeri 4 Percut Sei Tuan.

The usefulness of the product is achieved through student responses through one- on-one tests. The one versus one test questionnaire has 4 answer choices. The product will be revised if students choose the answers " quite interesting "interisting" not attractive". Based on the test results, it was found to be interesting and useful. The effectiveness test was obtained with the classical results, namely a score of 82.70%, which means that after completing, the success criteria with a value of 80%, it can be concluded that the LKPD developed is efficient.

The next step is to test the effectiveness of the product, namely by calculating the N-Gain value, where the results of the first trial are 0.30 and the second trial is 0.60, meaning that the product being developed, namely the LKPD, produces the results of increasing the ability to solve students' mathematical problems.

So it can be concluded that the product performance test is efficient. This is also the case with research (Yunipiyanto, 2020). The resulting development product is a LKPD sheet. The for Cover LKPD that has been developed can be seen in Figure 4.

Based on Figure 4, it can be explained that for Figure point A before revision and point B after revision of the LKPD Cover being developed. This research is to apply LKPD which has been developed with cognitive conflict strategies assisted by Augmented Reality to improve mathematical problem-solving abilities. This aims to ensure that conflicts that occur within students will be bridged by visualization of Augmented Reality building space from cubes and blocks so that there will be no misconceptions among students when receiving new material, namely calculating the surface area of cubes and blocks

because of Augmented Reality. The impact that will emerge is that mathematical problem-solving abilities will increase.
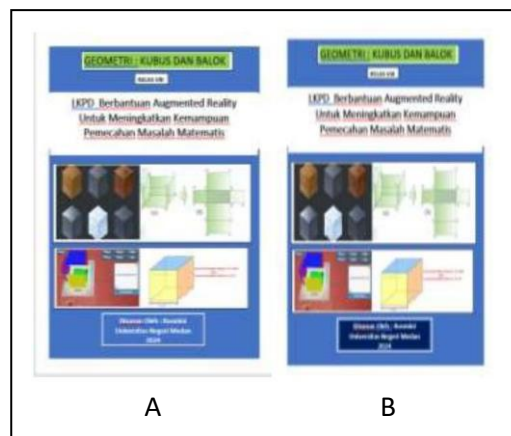

Figure 4. Cover LKPD before and after revised

This research is limited only to the material of finding the surface area of cubes and blocks by creating animations of cube and block nets, but for other materials it cannot be ascertained whether mathematical problem-solving abilities will also increase as with the use of LKPD which has been developed through assisted cognitive conflict strategies. Augmented Reality.

Based on previous research, learning with cognitive conflict strategies with the PBI approach in improving problem-solving skills produced significant results even without the assistance of AR (Saefuloh et al., 2020). Learning with cognitive conflict strategies without AR assistance has shown its high significance in problem solving, especially if LKPD is developed with AR assistance, of course the results will be more optimal, such as in this study where the author has developed the LKPD with AR assistance, this is in line with the research (Syaputri et al., 2024) However, this study uses the Thaigarajan 4-D development model.

Expert validation and material validation for this study ranged from 70% -80%. For the research that the author conducted for expert validation and material validity of 82,70%, meaning that between the Thiagarajan 4-D development model and the Ploomp development model have a success rate that is not much different, depending on the implementation in the classroom, both the teacher and the condition of the students concerned or the character of the students who carry out the learning process in the classroom.

Furthermore, regarding the same thing regarding the development of LKPD assisted by AR carried out by (Rachmawati, 2020), the results obtained from the developed teaching

materials, namely augmented reality mathematics (MAR), are suitable for use in the mathematics learning process.

For the same thing, the development of AR-assisted teaching materials, but the learning method is Problem Based Learning (Ikarihayati, 2023) very significant results were obtained in motivating students to solve problems properly and correctly.

4. Conclusion and Suggestions

The LKPD developed is valid, practical and effective in order to increase the ability to solve mathematical problems. Students are motivated to learn to implement the LKPD developed. The development of student worksheets (LKPD) using Augmented Reality (AR) is an innovation that can enhance the learning experience in an interactive and interesting way. AR technology allows virtual information or objects to appear in the real world, which can help students to better understand the subject matter with clearer visualization. With students better understanding the material presented, it will have an impact on students' mathematical problem solving. The basic concept of students being able to solve problems well is that 1) students must really understand what the problem is, 2) students must know how to plan the method used to solve the problem, 3) There is a process that students carry out to solve the problem, 4) After the results are there, students must be able to convince whether the answer or solution is correct or not. So the development of LKPD assisted by AR is a promising solution.

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