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# The Effect of Augmented Reality-Assisted Student Worksheets on Students Conceptual Understanding in Science and Social Studies (IPAS) Class IV Elementary School Students

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**ABSTRACT**

*The problem in this study was the low conceptual understanding of fourth-grade students at SDN 11 Metro Pusat. This study aims to determine the effect of using augmented reality-assisted worksheets (LKPD) on students' conceptual understanding. This research method was a quasi-experimental study with a nonequivalent control group design. The population was selected using purposive sampling, with 63 students and a sample size of 46 students. Data collection was conducted using tests and non-test techniques in the form of observation sheets. Hypothesis testing used simple linear regression with the calculated F result > F table, namely 34.640 > 4.32 with a significance level of 0.000 < 0.05, it can be seen that there is a significant influence on the use of LKPD assisted by augmented reality on students' understanding of concepts in the subject of science in grade IV of SDN 11 Metro Pusat.*



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## 1. INTRODUCTION

Education is a lifelong learning process that takes place in positive situations and conditions throughout human development. Education is a fundamental necessity that should be received by every individual. It is also one of the main pillars in the development of a nation. Along with the advancement of time, education in Indonesia continues to experience changes and curriculum development as an effort to improve the quality of education. Quality education is education that can shape generations who are intelligent, possess strong character, and have adequate skills to face future challenges. The Law of the Republic of Indonesia Number 20 of 2003 concerning the National Education System states that education is a conscious and planned effort to help improve the development of children's potential and abilities so that they can be beneficial for their lives as individuals and as citizens in the future.

Education plays an important role in shaping intelligent and well-characterized generations. However, education is continuously faced with new challenges, particularly the need to equip learners with 21st-century skills. Learning in the 21st century is designed to develop educational quality that is increasingly adaptive to the development of the times. The advancement of science and technology in the 21st century has changed the characteristics of students, requiring learning methods that are more innovative and student-oriented. Global developments demand the education sector to prepare students with 21st-century skills, including critical thinking, creativity, communication, collaboration, and digital literacy. In addition, one of the most important aspects in supporting 21st-century skills is conceptual understanding.

Students who possess good conceptual understanding will be able to think critically, creatively, and solve problems in innovative ways. One of the subjects that plays an important role in developing students' conceptual understanding is Natural and Social Sciences (IPAS). Conceptual understanding in IPAS helps students not only memorize the material but also relate it to concrete experiences in everyday life. The ability to understand and connect IPAS concepts with daily experiences becomes the foundation for developing conceptual understanding, which in turn supports the development of 21st-century skills. Therefore, conceptual understanding in IPAS at the elementary school level serves as an essential foundation in education.

IPAS stands for Natural and Social Sciences. It is an important subject in shaping students' understanding of the environment and social phenomena. IPAS integrates concepts from both Natural Sciences (IPA) and Social Sciences (IPS). As stated by Agustina in Viqri et al. (2024), the independent curriculum integrates learning between natural sciences and social sciences. According to the Ministry of Education and Culture (Kemendikbud, 2022), learning IPAS enables students to develop themselves comprehensively.

However, based on the results of the Trends in International Mathematics and Science Study (TIMSS) in 2015, Indonesia ranked 44th out of 49 countries in science, with a score of 397, which is below the international average score of 500. This indicates that students' conceptual understanding in Indonesia still needs improvement. Conceptual understanding is one of the key aspects of learning. It refers to the ability to grasp and understand something after it has been studied and remembered. According to Harefa (2020), conceptual understanding is students' ability to restate what has been communicated

to them, apply concepts in different situations, and develop various implications arising from a concept.

Conceptual understanding is one of the important aspects of education, especially in the subject of IPAS (Natural and Social Sciences) at the elementary school level. A good understanding of basic concepts not only helps students remember information but also enables them to apply knowledge in broader contexts. Based on data from the Ministry of Education and Culture, the average national examination score for IPAS subjects, particularly science at the elementary school level, only reached 65, which is below the minimum passing standard of 75. Difficulties in conceptual understanding are caused by several factors, including the lack of variation in the use of concrete technology-based teaching materials. Students' conceptual understanding can improve when supported by engaging teaching materials, as instructional tools encourage students' direct involvement in the learning process. One way to achieve this is by utilizing information and communication technology. Technology and information have become major supports for changes in various aspects of life, including education.

Education in Indonesia continuously undergoes changes, particularly due to technological developments. According to data from Statistics Indonesia (Badan Pusat Statistik, 2022), the number of smartphone users in Indonesia reached 67.88%. This large number presents both opportunities and challenges, especially in the field of education. Despite these challenges, the availability of smartphones provides new opportunities for the development of educational technology. In the current digital era, information and communication technology (ICT) has become an integral part of the teaching and learning process. Education in the digital era requires educational institutions, teachers, students, and parents to be prepared to facilitate and utilize computer-based technology. According to Maulani (2024), education in the digital era offers several benefits, including more modern learning curricula, improved learning outcomes through digital data analysis, the creation of engaging and collaborative learning environments, and easier evaluation of students' learning outcomes.

The use of technology in education facilitates access to information and improves the quality of learning. Learning, as a teaching and learning activity conducted by teachers and students, aims to achieve knowledge, attitudes, skills, and desired learning objectives. The integration of technology in learning provides significant potential to create a more dynamic learning environment. However, despite its great potential, there are still challenges to overcome, such as the fact that not all teachers possess adequate skills in utilizing technology. This is in line with a survey conducted by the Ministry of Education and Culture in 2018, which showed that only around 40% of teachers (excluding ICT teachers) were ready and capable of operating digital technology.

Furthermore, according to Statistics Indonesia (2018), a survey on the use and utilization of information and communication technology in the education sector at the elementary school level showed a percentage of 64.55%. This data indicates that although many schools have utilized technology, 35.45% have not yet optimized its use. In addition, the use of mobile phones in teaching and learning activities at the elementary school level was only 36.45%. This demonstrates that although technology has been introduced, there are still obstacles in effectively implementing technology-based learning. The lack of implementation of technology-based learning has impacted the low conceptual understanding of students in IPAS.

Problems related to students' low conceptual understanding in IPAS subjects were also found at SDN 11 Metro Pusat. The researcher selected this school as the research location based on observation and interview data collected on July 21, 2025. The learning problems identified at the school were related to the limited use of teaching materials. The teaching materials used were still limited to simple pictures, objects around the school environment, and printed books, which tended to be passive and less interactive. In addition, based on interviews conducted with teachers regarding the achievement of conceptual understanding indicators, several students had not yet achieved the expected indicators of conceptual understanding. For example, when teachers conducted classroom learning activities and asked students to provide examples (exemplifying) related to parts of plants, some students instead mentioned types of plants.

Based on these findings, it can be concluded that the indicators of conceptual understanding have not yet been achieved optimally. This may be caused by the use of teaching materials that are not yet capable of encouraging students to improve their conceptual understanding. This is in line with Magdalena (2021), who stated that the achievement of cognitive domains in conceptual understanding can be assessed through Learning Objective Achievement Criteria (KKTP) and Student Worksheets (LKPD). The KKTP data on IPAS understanding for Chapter 1, "Plants as the Source of Life on Earth," for fourth-grade students in the 2025/2026 academic year showed that out of 69 students, 13 students fell into the "needs guidance" category, while 17 students were categorized as "sufficient." In total, 30 out of 69 students were classified as still having low understanding of IPAS concepts.

The Learning Objective Achievement Criteria (KKTP) can serve as a benchmark for measuring students' conceptual understanding because it demonstrates the extent to which students achieve competencies in IPAS learning objectives. The researcher proposes a solution to overcome these problems by implementing teaching materials that align with students' characteristics, namely teaching materials that are effective, efficient, engaging, enjoyable, and concrete.

Teaching materials are all forms of materials used in the learning process to assist students in learning activities. According to Magdalena et al. (2020), teaching materials are all forms of materials, information, or media used by teachers to support the learning process. Furthermore, Hayati (2025) stated that the purpose of teaching materials is to deliver learning content systematically, clearly, and effectively so that students can easily understand the concepts or topics taught by teachers. Teaching materials are also designed to facilitate learning and are developed according to students' needs in order to help them master the competencies they must achieve. Teaching materials include several learning components, such as information or content, instructional guidelines, exercises, and learning activities. In practice, teaching materials can be classified into several types, including textbooks, worksheets, student worksheets (LKPD), learning audio, modules, and others.

There are various innovations in teaching materials, each with its own advantages and disadvantages. Therefore, teachers must carefully consider the selection of teaching materials that are believed to help students understand the competencies being learned, one of which is the use of Student Worksheets (LKPD). LKPD can facilitate students in understanding material and conducting experiments both inside and outside the classroom as well as at home because LKPD can be designed interactively by integrating text, images, audio, videos, materials, and exercises in digital formats. Consequently, teachers are expected to be active, creative, innovative, and collaborative in responding to technological

developments and educational trends in order to create enjoyable and meaningful learning environments. One such innovation is the use of augmented reality-assisted LKPD in teaching materials.

Augmented reality-assisted Student Worksheets (LKPD) have become one of the innovative solutions to improve students' conceptual understanding. By using augmented reality-assisted LKPD, students can more easily understand the concepts being taught. Augmented reality provides clear and in-depth visualization of difficult material, enabling students to directly observe and interact with objects. Augmented reality offers an interactive and immersive learning experience.

Augmented reality is a computerized process that combines virtual objects with real objects naturally, making them appear as if they exist in front of users. It can also be defined as a technology that integrates the real world with digital elements. This technology enables students to explore three-dimensional objects related to the subject matter being studied. Such experiences provide students with opportunities to explore and understand concepts more deeply, contextually, and meaningfully. When students are involved in interactive learning experiences, they become more focused and enthusiastic.

Several previous studies have shown that the use of augmented reality can improve students' understanding. Research conducted by Purwanti et al. (2024) revealed that augmented reality can enhance students' conceptual understanding in science subjects because it can visualize objects that cannot be seen directly with the naked eye, making abstract science concepts easier to understand visually. Similarly, research by Sati et al. (2024) found that augmented reality positively influences learning success, including improving conceptual understanding, encouraging students to become more active in learning, and increasing students' learning motivation.

Based on the phenomena described above, it can be concluded that technology-based learning is highly important. This is due to the fact that transformation in the digital era has created a new paradigm in learning methods. According to Hasnida (2024), educational technology in the digital era is not merely the introduction of new technologies but a revolution in learning approaches. By utilizing innovative methods, education becomes more qualified and relevant. One of the innovations currently developing is the implementation of augmented reality-assisted LKPD in the learning process.

Based on these problems, this study aims to determine whether augmented reality-assisted Student Worksheets (LKPD) influence students' conceptual understanding in the IPAS subject.

## 2. RESEARCH METHODOLOGY

### 2.1 Research Desain

This study employed a quantitative research approach using an experimental method in the form of a quasi-experimental design. Quasi-experimental research is an experiment that involves treatment, impact measurement, and experimental units but does not use random assignment to create comparisons in order to determine changes caused by the treatment. According to Sugiyono (2019), a quasi-experimental design is a development of the true experimental design, which is often difficult to implement. This design includes a control group; however, it cannot fully control external variables that may influence the implementation of the experiment.

The researcher provided treatment to the experimental class by using augmented reality-assisted student worksheets (LKPD), while the control class, as the comparison group, was taught using YouTube video-assisted LKPD. Before and after the treatment, both classes were given a pretest and posttest using the same instrument.

The sampling technique used in this study was purposive sampling. The samples in this study consisted of 23 fourth-grade students of class IV C as the experimental class and 23 fourth-grade students of class IV B as the control class. The selection was based on the data of the Learning Objective Achievement Criteria (KKTP) regarding students' conceptual understanding in IPAS.

### 2.2 Research Source

This study involved 69 students. A total of 23 students participated in assisting the research by taking part in the instrument testing process, while the remaining 46 students were used as the research sample.

### 2.3 Data Collecting

Data was collected using test and non-test techniques. The tests used pretest and posttest questions, while the non-test techniques used observation sheets to monitor learning activities. The test instruments consisted of descriptive questions that had been tested for validity, reliability, discriminatory power, and difficulty level before use.

### 2.4 Data Analyzed

Data analysis was conducted quantitatively to determine the level of students' conceptual understanding between the experimental class and the control class. The data were analyzed through prerequisite tests, namely the normality test and homogeneity test. Furthermore, the improvement in students' understanding was calculated using the N-Gain test, followed by hypothesis testing using simple linear regression with the assistance of SPSS software. The results of the analysis were used to determine whether there was an effect of using augmented reality-assisted student worksheets (LKPD) on students' conceptual understanding.

## 3. RESULTS AND DISCUSSION

This study aims to improve students' conceptual understanding in Natural and Social Sciences (IPAS) learning at SD Negeri 11 Metro Pusat through the use of augmented reality-assisted student worksheets (LKPD).

### 3.1 Research Result

#### 3.1. 1. Implementation Of Research

This research began with observation activities on July 8, 2025. The research was conducted at SDN 11 Metro Pusat located at Jalan Veteran No. 50, Hadimulyo Barat Village, Metro Pusat District, Metro City, Lampung Province in grade IV of the odd semester of the 2025/2026 academic year. Learning activities in the experimental class

and the control class were each carried out for five meetings. In the control class (IV B) the first meeting began with a pretest, then continued with three times of learning on photosynthesis material using LKPD assisted by YouTube videos, and ended with the provision of posttest questions. Meanwhile, for the experimental class (IV C) the first meeting began with a pretest, then continued with three times of learning on photosynthesis material using LKPD assisted by augmented reality, and ended with the provision of posttest questions.

### 3.1.2 Normality Test

Normality testing was conducted using pretest and posttest data analyzed using SPSS 26 using the Shapiro-Wilk test at a significance level of 0.05 or 5%. The results of the normality test can be seen in Table 1 below:

**Table 1** Normality Test Results

| Class | Sig | Conclusion |
|---|---|---|
| Control Grup Pretest | 0,142 | Normal |
| Control Grup Posttest | 0,141 | Normal |
| Experimental Group Pretest | 0,065 | Normal |
| Experimental Group Posttest | 0,185 | Normal |

Based on Table 1 above, the significance value of the pretest in the experimental class was 0.065 and in the control class was 0.142, while the significance value of the posttest in the experimental class was 0.185 and in the control class was 0.141. Therefore, all significance > 0,05, indicating that the pretest and posttest data in both classes were normally distributed.

### 3.1.3. Homogenity Test

Uji homogenitas dilakukan dengan menggunakan bantuan program SPSS 26. Adapun hasil uji homogenitas dapat dilihat pada tabel 2 berikut:

**Tabel 2 Hasil Uji Homogenitas**

| Data | Sig | Conclusion |
|---|---|---|
| *Pretest* | 0,233 | Homogen |
| *Posttest* | 0,856 | Homogen |

Berdasarkan tabel 2 diatas, diperoleh hasil uji homogenitas pada data *pretest* dengan nilai signifikansi 0,233, sedangkan data *posttest* nilai signifikansi sebesar 0,856. Data uji homogenitas tersebut menunjukkan bahwa nilai signifikansi > 0,05 sehingga data *pretest* dan *posttest* dinyatakan bersifat homogen.

### 3.1.4. Pretest dan Posttest Data Analysis

The data analyzed were fourth-grade students' conceptual understanding of photosynthesis in the natural sciences topic, as measured by a pretest and posttest, each

consisting of 10 descriptive questions. The frequency distribution of pretest scores in the experimental and control classes can be seen in Table 3 below:

**Tabel 3** Frequency Distribution of Pretest Scores in the Experimental and Control Classes

| **Control** | | **Eksperimental** | |
|---|---|---|---|
| **Class Interval** | **Frequency** | **Kelas Interval** | **Frequency** |
| 35-42 | 5 | 35-41 | 4 |
| 43-50 | 8 | 42-48 | 9 |
| 51-58 | 6 | 49-55 | 8 |
| 59-66 | 2 | 56-62 | 1 |
| 67-74 | 0 | 63-69 | 0 |
| 75-82 | 2 | 70-76 | 1 |
| **Total** | 23 | **Total** | 23 |

Based on table 3 above, it can be seen that the value interval with the highest frequency is at frequency 8 in the interval 43-50, while the lowest frequency is at frequency 0 in the interval 67-74. Then in the experimental class, the value interval with the highest frequency is 9 which is at interval 42-48, and the lowest frequency is at frequency 0 in the interval 63-69.

**Table 4** Frequency Distribution of Posttest Scores in the Experimental and Control Classes

| **Control** | | **Eksperimental** | |
|---|---|---|---|
| **Class Interval** | **Frequency** | **Class Interval** | **Frequency** |
| 60-64 | 1 | 73-76 | 3 |
| 65-69 | 2 | 77-80 | 3 |
| 70-74 | 4 | 81-84 | 6 |
| 75-79 | 6 | 85-88 | 6 |
| 80-84 | 8 | 89-92 | 1 |
| 85-89 | 2 | 93--96 | 4 |
| **Total** | 23 | **Total** | 23 |

Based on Table 4 above, it can be seen that the control class had the highest frequency of 8 in the score interval of 80–84, while the lowest frequency of 1 was found in the interval of 60–64. Meanwhile, the experimental class had the highest frequency of 6 in the score intervals of 81–84 and 85–88, while the lowest frequency of 1 was found in the interval of 89–92.

The scores obtained by students from the pretest and posttest results in both the experimental and control classes were analyzed. The average pretest and posttest scores of fourth-grade students in class IV C as the experimental class and class IV B as the control class can be seen in Table 5 below:

**Table 5** Students' Conceptual Understanding Scores in the Experimental and Control Classes

| **Score** | **Eksperimental** | | **Control** | |
|---|---|---|---|---|
| | ***Pretest*** | ***Posttest*** | ***Pretest*** | ***Posttest*** |
| Hightest | 75 | 95 | 78 | 85 |
| Lowest | 35 | 73 | 35 | 60 |
| Total Score | 1119 | 1941 | 1176 | 1754 |
| Average | 48,7 | 84,4 | 51,1 | 76,3 |

Based on Table 5 above, it can be seen that the average value of conceptual understanding of the experimental class in the pretest was 48.7 and the average value of the posttest was 84.4. These results indicate an increase in the experimental class's score of 35.7. Meanwhile, the average value of the control class in the pretest was 51.1 and the posttest was 76.3. The data are presented in the following bar chart:

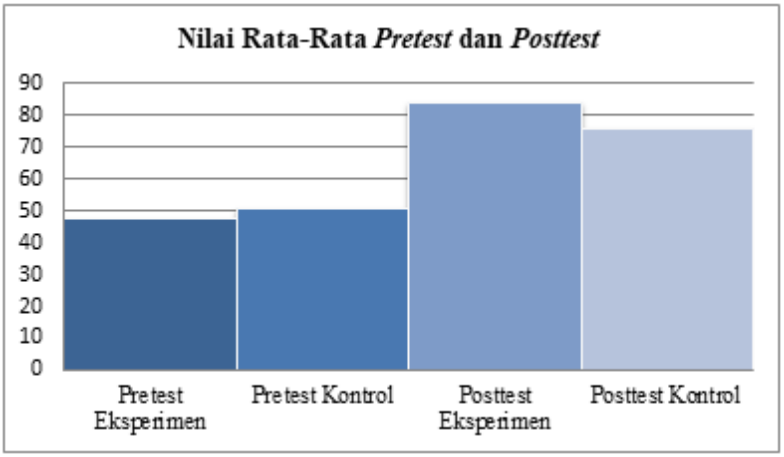


**Figure 1. Average Pretest and Posttest Scores of the Experimental and Control Classes**

### 3.1.5. Improvement of Students' Conceptual Understanding

The improvement of students' conceptual understanding was also analyzed based on the conceptual understanding indicators proposed by Suryani, namely interpreting, exemplifying, classifying, summarizing, inferring, comparing, and explaining. The improvement of conceptual understanding based on these indicators in both the experimental and control classes can be seen below:

**Table 6.** Improvement of Students' Conceptual Understanding in the Experimental Class

| Indicator | *Pretest (%)* | *Posttest (%)* | Improvement (%) |
|---|---|---|---|
| Ke-1 | 45 | 77 | 32 |
| Ke-2 | 59 | 89 | 30 |
| Ke-3 | 47 | 72 | 25 |
| Ke-4 | 65 | 91 | 26 |
| Ke-5 | 32 | 77 | 45 |
| Ke-6 | 36 | 84 | 48 |
| Ke-7 | 58 | 98 | 40 |

**Table 7. Improvement of Students' Conceptual Understanding in the Control Class**

| Indicator | *Pretest (%)* | *Posttest (%)* | Improvement (%) |
|---|---|---|---|
| Ke-1 | 43 | 70 | 27 |
| Ke-2 | 62 | 79 | 17 |
| Ke-3 | 40 | 71 | 31 |
| Ke-4 | 61 | 93 | 32 |
| Ke-5 | 35 | 66 | 31 |
| Ke-6 | 45 | 67 | 22 |
| Ke-7 | 75 | 96 | 21 |

Based on tables 6 and 7 above, it can be seen that the pretest and posttest data for each indicator in the experimental class showed a more significant increase compared to the pretest and posttest data for each indicator in the control class. This can be seen in the pretest phase, where student abilities in both classes tended to vary, with the lowest score in the experimental class being in the drawing inference indicator (32%), while in the control class, the lowest score was in the drawing inference indicator (35%). However, after the treatment, the posttest results showed significant gains in the explaining indicator in both the experimental and control classes: 98% in the experimental class and 96% in the control class.

This indicates that, in general, students were able to re-explain the material concepts very well. In terms of the impact on increasing conceptual understanding, the experimental class consistently showed higher growth than the control class. The most significant increase in the experimental class was seen in the comparing indicator, at 48%. Meanwhile, the control class experienced a relatively lower increase in the summarizing indicator, at 32%. Overall, these data show that the application of treatment in the experimental class using LKPD assisted by augmented reality is more effective in improving the conceptual understanding of fourth grade students at SDN 11 Metro Pusat.

### 3.1.6. Observation Data on the Use of Augmented Reality-Assisted Student Worksheets (LKPD)

Observations were conducted in the experimental class using augmented reality-assisted student worksheets (LKPD) to examine students' engagement and the effectiveness of learning in improving students' conceptual understanding. The observations were carried out over three meetings. The data on students' activities can be seen in Table 8 below:

**Table 8**. Observation Data on the Use of Augmented Reality-Assisted Student Worksheets (LKPD)

| No | Students' Akctivities | Average | Category |
|---|---|---|---|
| 1 | Active involvement in learning | 73 | Active |
| 2 | Ability to understand concepts through augmented reality-assisted student worksheets (LKPD) | 70 | Active |
| 3 | Collaboration and discussion | 81 | Very Active |
| 4 | Learning independence | 83 | Very Active |
| 5 | Enthusiasm and learning motivation | 86 | Very Active |
| 6 | Able to relate augmented reality displays to real concepts or phenomena | 79 | Very Active |

Table 8 shows that observations of Grade IV C students using Augmented Reality-assisted Student Worksheets (LKPD) during three meetings revealed a high level of activeness. Overall, all student activity indicators ranged from active to very active, with average scores ranging from 70 to 86. This indicates that the application of Augmented Reality-assisted Student Worksheets (LKPD) is capable of creating a student-centered learning process. The highest level of activeness was found in the enthusiasm and motivation to learn indicator, with an average score of 86, categorized as very active. This indicates that the use of Augmented Reality-assisted Student Worksheets (LKPD) is able to attract student attention and increase interest in learning through interactive visual displays.

Conversely, the lowest level of activeness was found in the concept understanding indicator through Augmented Reality-assisted Student Worksheets (LKPD), with an average score of 70, categorized as active. Therefore, it can be concluded that Augmented Reality-assisted Student Worksheets (LKPD) are very active in increasing student motivation and enthusiasm for learning. However, it needs to be accompanied by learning support strategies to improve conceptual understanding across the board.

### 3.1.7. N-Gain Score

The N-Gain test was conducted to measure the extent of the improvement in students' abilities after being given the treatment compared to before the treatment was administered. The results of the N-Gain test calculation can be seen in Table 9 below:

**Table 9.** Result of the N-Gain Test Calculation

| Class | Eksperimental | Control |
|---|---|---|
| Average Pretest | 48,7 | 51,1 |
| Average Posttest | 84,4 | 76,3 |
| N-Gain | 0,69 | 0,48 |
| Category | Moderate | Moderate |

Based on the N-Gain test above, it can be seen that the average N-Gain score of the experimental class is 0.69, which means it is in the moderate category, while the control class obtained a score of 0.48, which means it is in the moderate category.

### 3.1.8. Hypothesis Testing

The hypothesis test in this study used a simple linear regression test with the assistance of the SPSS 26 program. The results of the simple linear regression test can be seen in Table 10 below:

**Table 10.** Simple Linear Regression and R Square Calculation Test

| **Simple Linear Regression** | |
|---|---|
| Calculated F-value | 34,640 |
| Sig | 0,000 |

| **R Square Result** | |
|---|---|
| Regresi | 0,789 |
| *R Square* | 0,623 |

Based on the results of the hypothesis test above, it can be seen that the value of f count = 34.640 and f table = 4.32, which means F count > F table, namely 34.640 > 4.32 with a significance level of 0.000 < 0.05 so that $H_0$ is rejected and Ha is accepted, so it can be concluded that there is an influence of the LKPD variable assisted by augmented reality (X) on understanding the concept (Y).

### 3.2 Discussion

The problem addressed in this study was that the teaching materials used in the learning process lacked variation, as they were still limited to printed books and simple pictures. As a result, students' conceptual understanding had not yet achieved the Learning Objective Achievement Criteria (KKTP) determined by the school. This problem affected the low level of conceptual understanding among fourth-grade students at SDN 11 Metro Pusat. To overcome this problem, the researcher proposed the implementation of augmented reality-assisted student worksheets (LKPD). This study was conducted using two class groups, namely the experimental class and the control class, which received different treatments.

In the experimental class, learning was conducted using augmented reality worksheets (LKPD). This aligns with the opinion expressed by Nasution (2022), who stated that augmented reality is a technology capable of displaying three-dimensional digital objects in a real-world environment, allowing students to observe concepts more concretely and interactively.

The study in the control class used LKPD supported by YouTube videos. Video is an abstract medium that displays moving images and narrative explanations. However, student understanding of the material tended to be passive, as they only received information. This is in line with the opinion expressed by Arsyad (2019), who stated that video media can help students understand learning messages through a combination of visual and audio elements, but student engagement remained one-way.

The use of augmented reality-assisted LKPD was evaluated through observation sheets of student activities during the learning process. Activities on the observation sheet have six indicators, namely active involvement in learning, the ability to understand concepts through augmented reality-assisted LKPD, collaboration and discussion, learning independence, enthusiasm and motivation to learn, and application of concepts in context. Based on the results of observations of the experimental class that used augmented reality-assisted LKPD teaching materials, it showed a higher level of student activity compared to the control class that used YouTube video-assisted LKPD. In the experimental class, the indicators of enthusiasm and motivation to learn were in the very active category with the highest average value, followed by indicators of learning independence and collaboration and discussion. Augmented reality allows students to interact directly with learning objects through three-dimensional visualizations that can be observed and explored, thus encouraging student interaction to actively ask questions, discuss, and discover concepts independently through LKPD. Meanwhile, in the control class that used student worksheets (LKPD) assisted by YouTube videos, learning activity tended to be passive because the information presented was one-way, allowing students to receive the material visually and audibly. However, student interaction with the material was more limited, and learning activities tended to rely on teacher explanations. This resulted in students' levels of independence and collaboration not developing optimally.

This difference can be explained through constructivism theory, which emphasizes that knowledge is not transferred directly from teacher to student but is actively constructed by students through learning experiences. According to Herliani et al. (2021), constructivist learning emphasizes the process and freedom to explore knowledge. This finding aligns with Vygotsky's theory, which posits that constructivism is learning that occurs through interactions between internal and external aspects within a social environment. Observations indicate that the use of augmented reality-assisted student worksheets (LKPD)

provides students with the opportunity to observe and explore virtual objects displayed in real-life settings, enabling them to construct conceptual understanding based on their experiences and learning activities.

Furthermore, research has shown that the use of augmented reality-assisted student worksheets (LKPD) significantly improves students' conceptual understanding in fourth-grade science, as measured by conceptual understanding indicators: interpreting, exemplifying, classifying, summarizing, drawing inferences, comparing, and explaining. The indicators of understanding the concept were then linked to indicators of student involvement in observation activities during three meetings.

### 3.2.1 Interpreting

The interpreting indicator relates to students' ability to understand the meaning or concept of the material or information presented. Students' interpreting ability improves with their active involvement in learning activities facilitated by augmented reality-assisted worksheets (LKPD). Through three-dimensional object visualization, students are able to observe learning objects in a realistic three-dimensional visual form, enabling them to do more than simply read conceptual descriptions. Furthermore, the ability to understand concepts through augmented reality-assisted worksheets also helps students connect visual representations with conceptual explanations in the worksheets. This aligns with research by Rahma (2022), which states that augmented reality can help students interpret abstract concepts through concrete visualizations, thus facilitating the understanding of the material.

### 3.2.2 Exemplifying

The indicator exemplifying also showed an improvement in students' conceptual understanding during the learning process using AR-assisted LKPD. This can be observed in classroom implementation, where students found it easier to relate abstract concepts to real-life examples visualized through augmented reality. In addition, high enthusiasm and learning motivation encouraged students to be more active in providing examples. In line with Sari and Sulisworo (2021), AR-assisted LKPD is able to improve students' ability to provide examples of concepts because learning becomes more contextual and engaging.

### 3.2.3 Classifiying

The classifying indicator also showed improvement, supported by collaboration and discussion among students. The use of AR-assisted LKPD encouraged students to engage in discussions while observing augmented reality objects and helped them compare the characteristics of the objects, enabling them to classify concepts or identify similarities and differences accurately. In addition, independent learning supported students in exploring AR objects on their own and determining appropriate categories. In line with Rizkiana et al. (2023), the use of augmented reality in LKPD can help students group concepts systematically because the information is presented in a clear and well-structured visual form.

### 3.2.4 Summarizing

The summarizing indicator is related to learning independence, enthusiasm, motivation, and the ability to understand concepts through AR-assisted LKPD. Based on observations during the research process, students showed high enthusiasm and learning motivation when engaging in learning activities using AR-assisted LKPD. This is in line with Lu'luilmaknum et al. (2021), who stated that factors influencing conceptual understanding include students' learning motivation, learning independence, and self-confidence.

### 3.2.5 Inferring

Students' inference-making abilities also improved. When asked to deduce a concept based on visualizations presented through augmented reality, they were able to draw logical conclusions from their observations of the object. This improvement in inference-making abilities is related to collaboration and discussion as a means of exchanging ideas. This finding aligns with research by Dunleavy and Dede (2014), which states that the use of augmented reality in learning can improve higher-order thinking skills, including inference-making and conclusion-making.

### 3.2.6 Comparing

Students' ability to compare two or more concepts can develop through active student involvement and application of concepts in the context presented in the visualization of LKPD assisted by augmented reality, so that students can actively see and explore concepts more concretely. In addition, collaboration and discussion between students also play a role in improving the comparison indicator in students. This is in line with research conducted by Pratama et al., (2025) stating that through interactive visualization in augmented reality-based learning is able to provide a more interesting and realistic learning experience for students, especially in understanding abstract concepts.

### 3.2.7 Explaining

The indicator explains that students are able to re-explain learned concepts coherently and logically, both verbally and in writing. Students' explanations demonstrate a deepened understanding. This ability to explain is supported by enthusiasm and motivation to learn, as well as collaboration and discussion, which provide opportunities for students to explore new experiences and thus explain concepts effectively. This aligns with Arsyad's (2019) opinion that interactive learning can improve students' ability to communicate conceptual understanding.

Based on the seven indicators of conceptual understanding, the most significant improvement after treatment was found in the comparing indicator. Meanwhile, the least improvement was found in the summarizing indicator. Furthermore, the research findings presented above provide a clear picture of the effect of using augmented reality-assisted worksheets on students' conceptual understanding. The results of this study indicate a significant effect of using augmented reality-assisted worksheets on students' conceptual understanding in the fourth-grade science subject at Metro Pusat 11.

The results of this study are relevant to previous research conducted by Rahma et al., (2024) which showed that the use of augmented reality-based LKPD in science learning has an effect on improving students' conceptual understanding in junior high schools/Islamic junior high schools. Research by Masruroh et al., (2023: 56-63) states that the application of augmented reality can display multimedia that can clarify abstract concepts so that it has an impact on increasing students' conceptual understanding abilities. Then research conducted by Milasari (2024: 119) shows that the use of augmented reality has an effect on improving students' conceptual understanding. The suitability of this research further clarifies that LKPD assisted by augmented reality is the right teaching material to be applied in an effort to improve students' conceptual understanding.

## 4. CONCLUSION

Based on the results of research and discussion regarding the effect of using augmented reality-assisted LKPD on students' conceptual understanding in the subject of Natural and Social Sciences (IPAS) of grade IV SDN 11 Metro Pusat, there is a difference in the average pretest and posttest scores in both classes, this shows that the experimental class has a higher score compared to the control class. This statement can be proven by the results of the hypothesis test using simple linear regression, the results of which are known to be F count> F table 34.640> 4.32 so that ha is accepted and h0 is rejected. From these results, researchers can conclude that there is a significant influence of the use of augmented reality-assisted LKPD on students' conceptual understanding of grade IV SDN 11 Metro Pusat.

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