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The Effect of The CTL Model Assisted by Digital Pop-Up Books on The Learning Outcomes of IPAS Subject In Fourth Grade Elementary School

Pengaruh Model CTL Berbantuan Pop-Up Book Digital Terhadap Hasil Belajar IPAS Kelas IV SD

Defia Damayanti[1*)], Diki Rukmana[2)]
1) 2) Pendidikan Guru Sekolah Dasar, FKIP, Universitas Muhammadiyah Prof.Dr.Hamka, Indonesia

Abstract

The low learning outcomes of IPAS elementary school students, especially in the material on changes in the form of abstract objects, shows the need for a more contextual and visual learning approach. So far, various studies have discussed the CTL model and *digital pop-up book* media separately, but there are still limited studies that combine these models and learning media.therefore, This study aims to examine the effect of applying the Contextual Teaching and Learning (CTL) model**,** supported by digital pop-up book media, on the learning outcomes of Grade IV elementary school students in the subject of Integrated Natural and Social Sciences (IPAS)**,** specifically on the topic of changes in the states of matter. The research employed a quantitative approach with a pre-experimental one-group pretest–posttest design, involving 30 students as participants. The findings indicated that the data were normally distributed. Furthermore, the results of the paired sample t-test revealed a significant difference between the pretest and posttest scores (t_{count} 7.758 > t_{table} 2.042 and sig. 0.000) The calculation of the effect size using Cohen's d yielded a value of 1.416, which falls within the very large category**.** Accordingly, it can be concluded that the implementation of the Contextual Teaching and Learning (CTL) model, supported by digital pop-up book media, is effective in enhancing the learning outcomes of Grade IV elementary school students in science subjects, particularly on the topic of changes in the states of matter.
Keywords*:* Contextual Teaching and Learning (CTL), Pop-up Book Digital, Learning Outcome, IPAS.

Abstrak

Rendahnya hasil belajar IPAS siswa SD, Khususnya pada materi perubahan wujud benda yang bersifat abstrak, menunjukan perlu adanya pendekatan pembelajaran lebih kontekstual dan visual. Sejauh ini berbagai penelitian telah membahas model CTL maupun media pop-up book digital secara terpisah, namun masih terbataskajian yang mengkombinasikan model dan media pembelajaran tersebut. Dengan demikian, penelitian ini bertujuan untuk menganalisis pengaruh penerapan model Contextual Teaching and Learning (CTL) yang dipadukan dengan media pop-up book digital terhadap hasil belajar Ilmu Pengetahuan Alam dan Sosial (IPAS) pada peserta didik kelas IV sekolah dasar yang mempelajari topik perubahan wujud benda. Penelitian ini menerapkan pendekatan kuantitatif dengan desain pra-eksperimen one-group pretest-posttest, melibatkan 30 siswa sebagai subjek penelitian. Analisis data memperlihatkan bahwa distribusi data ada pada kategori normal. Hasil uji paired sample t-test mengindikasikan adanya perbedaan signifikan antara skor pretest dan posttest (t_{hitung} 7,758 > t_{tabel} 2,042 dan sig. 0,000) perhitungan effect size menggunakan cohen's d memperoleh nilai 1,416 yang termasuk dalam kategori sangat tinggi. Oleh karena itu, dapat ditegaskan bahwa penerapan model Contextual Teaching and Learning (CTL) yang dipadukan dengan media pop-up book digital terbukti efektif dalam meningkatkan capaian belajar Ilmu Pengetahuan Alam dan Sosial (IPAS) peserta didik kelas IV sekolah dasar pada materi perubahan wujud benda.
Kata Kunci*: Contextual Teaching and Learning (CTL), Pop-up Book Digital, Hasil Belajar, IPAS.*

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*Corresponding author:
E-mail: defiadamayanti64@gmail.com

INTRODUCTION

Education plays a crucial role in technological advancements in the field of learning. In the digital era, technology is utilized as a creative tool to improve the quality of the learning process. Character development and basic skills, along with increased motivation to learn, are essential for students to achieve optimal learning outcomes. Active student interaction with teachers and peers significantly impacts academic achievement. Therefore, teachers are required to create a pleasant learning environment to keep students motivated and prevent boredom. Many students struggle to understand material, which can impact their low enthusiasm and learning outcomes. Selecting and determining an appropriate learning model is important (Samsiati et al., 2022).

Learning outcomes are defined as the assessment of activities or processes carried out to organize information to assess students' level of success in meeting the formulated learning outcomes (Wilis et al., 2024). To determine this achievement, student behavior is observed through activities such as answering questions, completing assignments, or conducting experiments (Latifah & Cahyo, 2022). According to Bloom in an article (Yuswanto, 2022), learning outcomes are classified into three domains: cognitive, affective, and psychomotor. Factors influencing learning outcomes include internal aspects such as motivation and discipline, and external aspects such as the teacher's delivery of material (Samsudin, 2020).

The 2022 Independent Curriculum (Kurikulum Merdeka), the IPAS subject, which is an integration of science and social studies, through science learning, students not only learn concepts but are also trained to think critically, understand their surroundings, and solve problems in everyday life. Current science learning is presented in an interesting and relevant way to students' development in elementary schools, which needs to be studied in order to improve student learning outcomes (Marwa et al., 2023). With this approach, students are expected to understand the relationship between scientific concepts and social life more meaningfully. The positive impact of effective science learning is not only seen in increased science learning achievement but also in increased self-confidence, positive character development, and student readiness to face various challenges in the future (Hazmi & Rohmani, 2024). The lack of a science learning model and less interesting learning media can hinder the learning process and make students quickly bored. Determining the learning model and media is one of the key factors in successful learning (Makalao et al., 2021).

To find a solution in an effort to improve IPAS learning outcomes by implementing the CTL model effectively supported by digital Pop-Up Book media. CTL is created so that students can understand the subject matter through its connection to real experiences and the knowledge and skills gained can be used flexibly in various situations (Muslihah & Suryaningrat, 2021). According to Inayah et al., (2024), CTL allows students to explore and develop their thinking independently in learning materials and relate them to real life. The application of this model includes learning principles such as constructivism, inquiry, questioning, community-based learning, modeling, reflection, and authentic assessment (Simarmata, 2023).

To support the CTL model, appropriate learning media makes the learning process more effective. Appropriate learning activities can improve concentration (Modeong & Kahar, 2023). Digital Pop-Up Book media was developed into an adaptive and innovative learning strategy. Digital pop-up book media is an interactive visual book that presents two- or three-dimensional images and moving and interesting elements when opened. This media has been proven to increase student learning interest because it combines colors and dynamic visuals and can be accessed through digital devices (Maulifia et al., 2024; Febriyanti & Sulistyawati, 2024). This media provides attractive visualizations and flexible learning time that is relevant to the needs of IPAS subject in the digital era. In IPAS subject, it has several advantages, increasing greater engagement and motivation, as well as easier accessibility and supporting individual and collaborative learning to the application of gamification (Momani et al., 2023).

According to Lakari et al. (2021), the use of media is expected to improve student learning outcomes, support a smooth learning process, and encourage full attention and effective concentration on the material presented. CTL media makes it easier for students to remember the information presented, and media serves as an intermediary to stimulate various aspects of child development, including moral, spiritual, social-emotional, and cognitive development.

Based on the results of initial observations, the majority of fourth-grade students at SDN Tegal Alur 09 Pagi experienced difficulties in understanding the material. The main problem arose due to students' low attention to teacher explanations, which caused students to tend to be passive during learning activities and low interest in learning the results of the learning material. Mid-term exam learning data showed the achievement of

learning outcomes. Of the 30 students, 24 students had not succeeded in achieving the KKTP.

One of the challenges students face with this material is the abstract and difficult-to-visualize nature of the material, which is dominated by lectures and textbooks, which make the learning process monotonous, thus failing to capture student interest and attention. To address students' low understanding and learning interest, a more active and contextual approach is needed. The CTL model was chosen as a solution because it connects abstract material with students' real-life experiences, encourages active participation, increases learning motivation, and makes the CTL model a significant contributor to improving learning outcomes.

This supports previous research on the application of the CTL model and digital media to learning outcomes. Agustina et al. (2023) demonstrated that the CTL model effectively improves science learning outcomes, as evidenced by a significant difference between pretest and posttest scores. This finding was further supported by Pasaribu (2024), who demonstrated the significant influence of the CTL model on science learning outcomes through a comparison between experimental and control classes. The digital Pop-Up Book media proved to be a powerful learning aid, highlighted by Hafid et al. (2024). Previous research showed an increase in learning outcomes in the control class, confirming that the combination of the CTL model and innovative media has great potential in improving student learning outcomes.

Researchers offer a novelty that has not been widely studied in the education literature: the integration of a real-world context-based CTL model supported by digital pop-up books. The main novelty lies in the combination of a real-life learning model with the use of interactive digital media technology. This combination of model and media aims to provide a comprehensive and engaging learning experience for students. Using digital pop-up books, this study attempts to overcome the limitations of traditional concrete learning media and offers an innovative solution to effectively and enjoyably enhance students' conceptual understanding.

This research offers significant potential for understanding and optimizing student learning outcomes, particularly on the topic of changes in the state of matter, through the application of the CTL model supported by digital pop-up books. Learning is made more contextual and interactive through this approach. Students' motivation and conceptual understanding are expected to be significantly enhanced. Theoretically, these

findings can serve as an alternative for science teachers in creating more effective and engaging classrooms, improving learning outcomes. This study provides a tangible contribution to the development of innovative digital learning media that can be further developed by researchers in the field of education.

Innovation in IPAS learning is expected from the combination of the CTL model and digital pop-up book media, the material on changes in the state of objects can be understood and is interesting for students. Through this approach, students are not only encouraged to be actively involved but also helped to simplify the concept of the material to be more real and interesting. This research is focused on testing in depth the effect of implementing the CTL model assisted by digital pop-up book media on the science learning outcomes of fourth grade elementary school students. It is hoped that this solution can improve low learning outcomes by creating real and meaningful experiences.

METHOD

This study uses a quantitative approach with a pre-experimental design of the One Group Pretest-Posttest Design type, which involves a single group and without a randomization process. The aim is to influence the CTL model supported by digital Pop-Up Book media on the science learning outcomes of fourth-grade elementary school students. The subject of this research included 30 fourth-grade students at SDN Tegal Alur 09 Pagi, West Jakarta. The sample was taken using a purposive sampling technique because there is only one fourth-grade class in the school and has been based on criteria that have been set by the researcher.

The main instrument was a 40-item multiple-choice learning outcome test structured according to learning indicators on the material on changes in state of matter in science lessons within the Merdeka curriculum. Before being used for primary data collection, this research instrument underwent a pilot test. This process involved 30 fourth-grade students at SDN Tegal Alur 08 Pagi, selected as they matched the characteristics of the study. To ensure quality, a comprehensive validity test was conducted, encompassing content validity, statistical validity, and statistical validity. This process is crucial to ensuring that the instrument effectively measures student learning outcomes.

The content validation process involved subject matter experts to ensure that the instrument's questions covered all material and aligned with the established learning

indicators. The questions were structured based on learning objectives and cognitive levels as the basis for instrument development. The subject matter experts' assessment provided suggestions and input regarding the level of difficulty and clarity of the material. Revisions based on the suggestions and input from the subject matter experts served as the basis for the instrument's pilot test to obtain accurate statistical validity data. The following are the test questions' validity results, as seen in Table 1:

Table 1. Learning Outcome Test Instrument Grid

No	Main Material	Learning Indicators	Cognitive Level	Number of questions
1	Characteristics of the Form of Objects	Students are able to identify, differentiate, apply, analyze, and conclude the characteristics and changes in the three forms of matter (solid, liquid, gas) based on the influence of temperature and the form of everyday events.	C2–C5	9
2	Change of Form: Melting and Freezing	Students are able to understand, apply in real life, analyze, evaluate, and design experiments related to changes in state, melting and freezing.	C2–C6	8
3	Changes of State: Evaporation and Condensation	Students are able to explain, apply, analyze, evaluate, and design events of changes in state such as evaporation and condensation in the context of life and simple experiments.	C2–C6	8
4	Changes of State: Sublimation and Crystallization	Students are able to determine, connect, analyze, and evaluate various events of changes in state, sublimation and crystallization, based on data, cycles, or experiments.	C2–C5	6
TOTAL OF QUESTIONS				**31**

In addition, statistical validity can be measured using the Pearson Product Moment correlation validity test to assess the correlation of each question item with the entire test. Validity testing is carried out by applying the Pearson Product Moment correlation formula processed through Microsoft Excel and SPSS. Of the total 40 questions tested and as many as 31 questions were declared valid because they met the correlation criteria with a calculated r value above the r table (0.361) which indicates that the questions are suitable for measuring student learning outcomes. The reliability test found 31 valid questions using the Cronbach Alpha formula obtained a value of 0.870. This value is far above the minimum standard of 0.6. It can be concluded that this instrument has high consistency or reliability and is trusted to be applied in research as a tool for data collection. The following is a summary of the instrument grid table of 31 valid questions. The results of the instrument reliability can be seen in Table 2.

Table 2. Reliability Test Instrument

Reliability Statistics

Cronbach's Alpha	N of Items
.870	31

To ensure the accuracy of the data results in this study, several stages were used. The first stage used the Shapiro-Wilk normality test because the sample size was below 50 students (Sianturi, 2024), the second stage used the paired sample t-test applied at the sig.0.05 level to obtain the differences that occurred between the pretest and posttest scores (Saragih, 2024). The third stage, the researcher measured the effectiveness of the treatment by calculating the effect size value using the Cohen's d formula (Hanum et al., 2021), the analysis of this study was to determine the extent to which the learning model applied was categorized as small, medium, or large.

RESULTS AND DISCUSSION

The study focused on revealing the extent of the influence of the CTL model with the help of Digital Pop-Up Book media on the learning outcomes of fourth grade students in the IPAS subject, especially the material on changes in the state of matter involving 30 students. Researchers compared the abilities of those who took the pretest (before) and posttest (after). The average student score was 64.43 after using the new method with a changed classroom atmosphere and student learning outcomes increased significantly to 73.866. For the lowest score which was initially 32 increased to 42. These results indicate that learning with the help of digital visual media can have a positive impact on students.

Table 3. Descriptive Statistics of Pretest and Posttest Results

Statistic	Pretest	Posttest
Number of Students (N)	30	30
Score Range	61	54
Minimum Score	32	42
Maximum Score	93	96
Mean	62.433	73,866
Std. Deviation	14.827	13.912

Data normality testing was performed before the hypothesis testing. The Shapiro-Wilk test was applied because the sample size was less than 50. Data were considered normal if the Sig. value was > 0.05 based on the established decision-making criteria. The results of the normality test are in Table 4.

Table 4. Normality Test (Shapiro-Wilk)

Variable	Shapiro-Wilk (W)	Sig. (p-value)	Interpretation
Pretest	0,975	0,678	Normal Distribution
Posttest	0,962	0,342	

The sig. value for the pretest was 0.678 and the posttest was 0.342, both > 0.05, indicating normal pretest and posttest scores. Since the data were normal, a hypothesis test was conducted using a paired sample t-test to understand the difference in mean learning outcomes before and after the treatment. The following are the results of the hypothesis test in Table 5.

Table 5. Paired Sample t-Test

Mean Pretest	Mean Posttest	t-value	Sig. (2-tailed)	Interpretation
62,433	73,866	7,758	0,000	There is a significant difference

The calculation results show a t-value of 7.758 > t-table of 2.042, and a sig. (0.000) < 0.05. H_0 is rejected, and H_1 is accepted. There is a significant difference between the pretest and posttest scores, indicating that the application of the CTL model assisted by the Pop-Up Digital Book media has an impact on the learning outcomes of fourth-grade students.

To measure the strength of the treatment's influence, an effect size analysis was conducted using Cohen's d formula. The Cohen's d value of 1.416 indicates that the CTL model assisted by the Pop-Up Digital Book media has an impact on improving student learning outcomes. Therefore, this learning model has proven effective in increasing students' understanding of changes in the state of matter in fourth-grade IPAS lessons.

The study, conducted at SDN Tegal Alur 09 Pagi, West Jakarta, involved one experimental class: a fourth-grade class, with 30 students. Data collection included pre-treatment and post-treatment tests. The analysis yielded a mean pre-test score of 62.433, which increased to 73.866 in the post-test. This indicates an increase in student learning outcomes after implementing the CTL model with the aid of the Pop-Up Digital Book media.

Statistical testing was conducted using a Paired Sample T-Test. The analysis revealed a two-tailed significance value of 0.000, <0.05. Therefore, H_0 is rejected and H_1 is accepted, indicating a significant difference between pre-test and post-test scores. To

assess the effectiveness of this approach, using Cohen's d, the result was 1.416, indicating a very large impact. This provides strong evidence that combining the CTL learning model with digital pop-up books facilitates students' understanding of the material on changes in the state of matter, and improves student learning outcomes.

The learning barriers experienced by fourth-grade students were effectively addressed through the application of the CTL model and digital pop-up books. Students who were passive and had low learning interest prior to the intervention were now actively engaged in discussions and enthusiastically participated in each experiment. Concepts were understood more deeply because they were connected to real-life experiences. As Muslihah & Suryaningrat (2021) stated, the connection between teaching materials and students' real-life experiences, along with the facilitation of deeper meaning in the learning process, can improve student learning outcomes.

In addition, the use of Digital Pop-Up Book media adds value to the learning process. The media is not just a tool. Interactive three-dimensional visual displays are presented by this media to attract students' attention and help explain abstract concepts concretely. The character of elementary school students who have a visual learning style is very suitable for using this digital media. According to Maulifia et al., (2024), learning materials can be presented more lively and interestingly through digital pop-up book media and make it easier for students to understand the process of changing the form of objects as evidenced by the many connections shown during the learning process.

Figure 1. Explanation of material using digital pop-up book media

The learning process activities begin by assessing the students' initial understanding through a pretest and material briefing. The teacher directs students to conduct experiments in groups. The CTL model and digital pop-up book media are used for three meetings. To measure learning outcomes after the treatment, a posttest is given

at the end of the third meeting. Active discussions, completion of experimental results, and presentations of experimental results are carried out by students with high enthusiasm during the learning process with great enthusiasm.

Figure 2. CTL Implementation

A more concrete, enjoyable, and accessible learning experience can be achieved through the support of this learning model and media. Knowledge is actively constructed by students, so they are not merely positioned as listeners. Student activities include observing, asking questions, experimenting, and reflecting on the material they are working on. Understanding is generated through direct experience and independent exploration through the space provided by the learning model and media.

The gaps in previous research are filled by the findings of this study, which demonstrated the effectiveness of combining the CTL model with digital pop-up book media. These findings were also reinforced by researchers Sukron et al. (2024) and Syaifuddin et al. (2021). A significant difference in conceptual understanding between the experimental and control classes was demonstrated by findings by Wati et al. (2025). Given the limited research on changes in state of matter in elementary schools, this combination of the two is highly worthy of further development by future researchers.

The effectiveness of this approach has been demonstrated through data on student learning outcomes after the treatment. This study provides new opportunities for future researchers to develop innovative and relevant teaching media. The researchers encountered several obstacles in implementation, such as disrupted media displays and time-consuming projectors. Students' lack of focus due to their unfamiliarity with active learning was also a key factor in the learning process, requiring creative

approaches and strategies to be implemented by teachers, who play a crucial role in achieving optimal student engagement.

This study's limitations stem from its implementation in a single school with a limited number of students. Therefore, generalization of the results is not possible. Student learning conditions can also be influenced by several external factors, such as school facilities, teacher readiness, and student conditions. Future research is recommended to implement the study in schools with different characteristics. Exploration of other variables, such as learning interest and critical thinking, is also necessary to gain a deeper understanding.

This study contributes to the development of an effective digital media-based contextual learning model for elementary school students. This approach provides innovative alternatives for teachers, providing opportunities for further research on other learning variables to explore other aspects of education.

CONCLUSION

The positive impact on fourth-grade students' IPAS subject learning outcomes on the topic of changes in state of matter was achieved through the application of the CTL model assisted by digital pop-up books. The effectiveness of the CTL model has been demonstrated in the learning process, resulting in more meaningful student understanding and optimally facilitating the connection between concepts and real-life experiences. At the same time, the digital pop-up book serves to attract students' attention and facilitate understanding through interactive and attractive visual presentations. The integration of the CTL model and digital pop-up books creates an active, enjoyable learning environment and encourages students' direct involvement in the knowledge construction process. These findings indicate that a learning strategy that connects material to real-life contexts and is supported by appropriate visual media significantly enhances the effectiveness of the learning process.

Further research is recommended to be implemented in schools with different characteristics and sample sizes. Furthermore, other variables can be explored to gain a broader understanding of the effectiveness of the CTL model assisted by digital pop-up books.

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