

The Impact of Transformative Deep Learning on the Development of Reflective Critical Thinking Skills and Meaningful Understanding Among High School Students in Malaka Regency

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ABSTRACT:

This study was conducted with the objectives of (1) analyzing the impact of transformative deep learning on the improvement of reflective critical thinking skills among students at Alkani State High School and Biudukfoho State High School in Malaka Regency, and (2) analyzing the impact of transformative deep learning on the improvement of meaningful understanding among students at Alkani State High School and Biudukfoho State High School in Malaka Regency. The type of research used was a quasi-experimental study, in which each school designated two classes consisting of one experimental class and one control class, or consisting of two experimental classes and two control classes. Based on the results of the Paired Sample T-Test, the average 21st-century skills score after the treatment (Mean = 79.07) in the experimental class was higher than before the application of the transformative deep learning approach (Mean = 65.74). The test results indicate a significant difference with a t-value (26) = -8.832 and a significance level of $p = 0.000$ ($p < 0.05$). This means that the implementation of the transformative Deep Learning approach significantly influences the improvement of students' reflective critical thinking skills. The average learning outcome after the implementation of the transformative Deep Learning approach was 469.26, whereas it was 273.52 previously. The test results showed a t-value ($t(26)$) of -2.239 with a significance level of $p = 0.034$ ($p < 0.05$), indicating a significant improvement in students' meaningful comprehension skills following the implementation of the transformative Deep Learning approach. In the control class, although there was an improvement, the relationship between the non-transformative Deep Learning treatment and students' meaningful comprehension ability was weaker compared to the experimental class; the average score for reflective critical thinking skills in the control class increased from 65.74 to 79.07.

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The results of the Paired Sample T-Test showed a t-value (26) = -8.832 with a significance level of $p = 0.000$. Although significant, this increase cannot be attributed to the treatment because the control class did not receive the transformative Deep Learning intervention. The average meaningful comprehension ability of students in the control class increased from 273.52 to 555.19. The test results showed a t-value (26) = -3.783 with a p-value of 0.001, indicating a significant increase. However, based on the lower correlation and higher significance compared to the experimental class, this increase was not as strong as the effect observed in the experimental class. The mean score for students' meaningful comprehension ability after the implementation of transformative deep learning was 469.26, whereas it was 273.52 previously. The test results showed a t-value (26) = -2.239 with a significance level of $p = 0.034$ ($p < 0.05$), indicating a significant improvement in students' meaningful comprehension of the learning material following the implementation of the transformative deep learning approach.

Keywords: Deep Learning, Transformative, 21st-Century Skills, Learning Outcomes.

Introduction

Transformative learning is a crucial educational process because it fosters critical thinking skills, creativity, and practical intelligence, which emerge from students' meaningful understanding during the learning process and enhance their confidence in interacting with their environment (Hardika, 2020). The transformative deep learning approach incorporates models and methods capable of shifting students from rote memorization to conscious, purposeful learning accompanied by a comprehensive understanding of the material. It encourages students to explore meaningful comprehension to alter their perspectives, attitudes, and old behaviors that are less positive, or encouraging students to shift their old mindset (growth mindset) to position themselves correctly in observing phenomena and acting appropriately and with dignity as human beings who embrace the principle of global diversity.

There is a tendency for learning in average schools to focus more on cognitive processes aimed at instilling rote knowledge in students, and the result is that students do not achieve a deep level of understanding of the material, thus

failing to foster their self-awareness to learn voluntarily. An emphasis on rote memorization fails to develop students' ability to meaningfully understand learning materials, preventing them from transforming old mindsets, attitudes, and behaviors into new ones characterized by high values and strong character as learning outcomes. In this regard, the focus remains predominantly on the lower and middle levels of the cognitive domain, while Higher Order Thinking Skills (HOTS) receive insufficient attention, let alone the affective and psychomotor domains (Weng, Chen, & Ai, 2022). If this approach continues to be predominantly applied in schools, students will not be prepared to compete in the 21st century. It is therefore urgent that students living in the 21st century be prepared through learning that trains them to think critically, reflectively, creatively, collaboratively, and communicatively through various effective learning approaches, models, and methods.

Efforts to develop reflective critical thinking skills and 21st-century skills among students require innovative and effective learning models or methods—that are designed to enhance students' skills as citizens ready to compete.

According to Al-Tabany (2015), the Problem-Based Learning model has the following characteristics: (a) it is capable of developing various student skills, namely active thinking, communication, data search and processing, and drawing conclusions; (b) learning activities are directed toward solving problems creatively; (c) problem-solving is conducted using a scientific approach and is carried out systematically and empirically, or based on clear data or facts; (d) it encourages cooperation or collaboration in completing group tasks; (e) it trains students to develop their ability to interact and communicate, particularly in conveying ideas and concepts during group discussions and class discussions.

Syahrial (2025) argues that there are three thinking processes: critical thinking, reflective thinking, and creative thinking. Sutiani, Situmorang & Silalahi (2021) state that critical thinking is a thinking process in which we evaluate the truth of information by validating received information through information identification, data collection, data analysis, and drawing conclusions. Meanwhile, reflective thinking is a thinking process that involves past knowledge and experience by deeply reflecting on and analyzing an event with the support of data, feelings, and reasons for the event. The steps include problem identification, analysis and evaluation, conducting a SWOT analysis, and drawing conclusions.

Gagne, as cited by Suyono and Hariyanto (2011), emphasizes that in learning, a process of receiving information occurs for processing, resulting in an output in the form of learning outcomes. During the interaction process, communication occurs between the student's internal state and the external conditions necessary to achieve learning outcomes. For learning to take place, specific learning conditions must be established; the learning atmosphere must be designed to encourage students to realize their creative ideas (21st-century skills). Mystakidis (2021) states that the use of the Problem-Based Learning (PBL) model, supported by a deep learning approach, is a form of learning innovation that creates a learning

environment enabling students to develop various types of 21st-century skills.

In the experimental activity in class XIA at State High School 4 in Kupang City, students were also divided into 6 groups with an average of 5 members per group. The results of observations regarding collaboration skills or aspects of cooperation among students showed that collaboration was dominated by 1–2 students per group, meaning that approximately 12 students were involved in collaborating to complete their group tasks, while approximately 19 students adopted a passive and non-collaborative attitude toward their peers. Communication skills were also closely observed, both during group discussions and during the presentation of group work results. The results showed that out of 31 students, only 14 (45%) were actively involved in expressing ideas—such as asking questions or answering questions—with participation dominated by certain students, while 17 (55%) remained silent and did not participate in the communication process during the discussion.

The manner of communication, which was polite and positive, was also observed during the presentation discussion. Regarding life skills—specifically flexibility, leadership, initiative, productivity, and social skills—possessed by students in the experimental class, these were not closely observed; only a general observation was made that, just as the previously described skills were low, so too were the life skills possessed by the students. One of the focuses of this study is to address the following research question: What innovative learning strategies, models, or methods are most relevant to fostering a learning environment that cultivates various 21st-century skills among high school (SMA) students, ensuring graduates are prepared to compete in the 21st century? Among the various learning models with complex characteristics designed to address 21st-century learning needs and prepare students with the skills required for the 21st century is the Problem-Based Learning model.

This study was conducted by implementing an experiment using a transformative deep learning approach—a learning process in which teachers

strive to maximize students' awareness (*mindful learning*) to actively engage in learning activities, and guide students toward a deep self-understanding of the problems being solved, thereby fostering meaningful learning (*meaningful learning*) for the students themselves and creating a learning environment that is enjoyable for students (*joyful learning*) by using the Problem-Based Learning (PBL) model, games such as icebreakers, pantun, debate discussions, and others. The purpose of using the PBL model with the debate method is to train students to develop 21st-century skills, namely critical thinking skills, creativity skills, polite communication skills, and collaboration skills with others. The research questions are: (1) Does Transformative Deep Learning have an impact on improving the reflective critical thinking skills of high school students in Malaka Regency? (2) Does Transformative Deep Learning have an impact on improving meaningful understanding among high school students in Malaka Regency? The objectives of this study are (1) to analyze the impact of implementing the transformative deep learning approach on the improvement of reflective critical thinking skills among high school students in Malaka Regency, and (2) to analyze the impact of implementing the transformative deep learning approach on the improvement of meaningful understanding among high school students in Malaka Regency. The research hypothesis is that there is a significant effect of the implementation of the transformative deep learning approach on the reflective critical thinking skills and meaningful comprehension abilities of 11th-grade students at Alkani State High School and 11th-grade students at Biudukfaho State High School.

Research Methodology

This study used a *paired-sample t-test* via SPSS to compare pre- and post-treatment scores in two groups: the experimental class (using the deep learning approach) and the control class (without the deep learning approach). The research was conducted at two high schools in Malaka Regency, namely Alkani State High School and Biudukfoho State High School, both located in Betun City, Malaka Regency. The research

subjects at Biudukfaho State High School consisted of 12 students in the experimental class and 15 students in the control class. At Alkani State High School, there were 13 students in the experimental class and 14 students in the control class. The total number of students from both schools in the experimental class was 27, and the total number of students in the control class from both schools was also 27. The analysis technique used a t-test statistical difference test.

Research activities at Alkani State High School in the experimental class utilized a transformative deep learning approach with the assistance of the Problem-Based Learning model and discussions. The research in the experimental class involved 15 students, 5 observers including the Civics teacher, 8 observers, and 1 person acting as the teacher. Meanwhile, the research activities in the control class did not use a transformative deep learning approach but continued to use the Problem-Based Learning model. The research in the control class involved 12 students, 5 observers, 1 observer who was the Civics teacher, and 1 person acting as the teacher.

The research activities at Biudukfoho State High School in the experimental class used a transformative deep learning approach with the assistance of the Problem-Based Learning model. The research in the experimental class involved 12 students, 8 observers and monitors, and 1 person acting as the teacher. Meanwhile, the research activities in the control class used only the Problem-Based Learning model. The research in the control class involved 15 students, 7 teachers serving as observers, and 1 person acting as the teacher.

Prior to the implementation of the experimental learning, the research team conducted an explanation and discussion with the teachers—who also served as observers—regarding the components of the deep learning-based independent curriculum teaching modules during the learning activities in the experimental class. Once the module was well understood, an explanation of the observation sheet followed, aimed at helping the teachers/observers

understand how to fill out the observation sheet correctly.

During the experimental learning at Alkani State High School, observations were conducted by 13 (thirteen) teachers using the observation guide, and at Biudukfoho State High School, observations were conducted by 8 (eight) teachers, including the principal. The teachers observed the teachers' performance in accordance with the steps of the PBL model and the manifestations of deep learning aspects (mindful, meaningful, joyful) as well as the noting things that were interesting and novel to them, noting the shortcomings or weaknesses in the teachers' performance, and noting items demonstrating 21st-century skills displayed by students during the learning process, namely indicators of students' critical thinking, indicators of students' creativity skills, indicators of students' communication skills, and indicators of students' collaboration/teamwork skills during the learning process in the experimental class.

Results and Discussion

Based on the research conducted to analyze the impact of transformative deep learning on the improvement of reflective critical thinking skills and meaningful understanding in two groups—the experimental class and the control class—the following results were obtained;

a. Experimental Class

Four cases related to religiously motivated acts of intolerance were presented, consisting of two domestic cases, one case involving a regional head election, and one international case—the conflict between Israel and Hamas in Gaza. The learning model used in both the experimental and control classes was Problem-Based Learning (PBL), but for the control class, a specific method capable of transforming students' thinking (transformative) was employed: the problem-solving approach using the Case Method and debate method to cultivate reflective critical thinking skills, to raise students' awareness and foster meaningful understanding, so that they voluntarily replace their old ways of thinking or perspectives with new ones (transformative),

whereas the control class utilized the PBL model with standard discussion methods. The average score for transformative deep learning was 65.74; the average score for reflective critical thinking skills regarding alternative solutions to the presented problems/cases was 79.07; and the average score for students' meaningful understanding regarding the utility of learning materials capable of changing their thinking and behavior based on their own decisions was 469.26. Correlation between transformative deep learning and reflective critical thinking skills: 0.273 (sig. = 0.168); correlation between transformative deep learning and meaningful comprehension ability: 0.141 (sig. = 0.483). The difference in the mean scores for transformative deep learning and reflective critical thinking skills is significant, with $t(26) = -8.832$, $p = 0.000$. The difference between transformative deep learning and students' meaningful comprehension skills is also significant, with $t(26) = -2.239$, $p = 0.034$. There is a significant increase in students' reflective critical thinking skills and meaningful comprehension abilities following the implementation of transformative deep learning.

1. Transformative deep learning on reflective critical thinking skills.

Based on the results of the *Paired Sample T-Test*, the mean score for reflective critical thinking skills after the intervention (Mean = 79.07) was higher than before the intervention using the transformative deep learning model (Mean = 65.74). The test results indicate a significant difference () with a *t-value* (26) = -8.832 and a significance level of $p = 0.000$ ($p < 0.05$). This means that the use of the transformative deep learning approach significantly influences the improvement of reflective critical thinking skills in formulating solutions to problems or cases presented during group discussions or debates.

2. Deep Learning on Students' Meaningful Comprehension Skills.

The average learning outcome after the implementation of transformative deep learning was 469.26, whereas it was 273.52 previously. The test results showed a *t-value* (26) = -2.239 with a significance level of $p = 0.034$ ($p < 0.05$),

indicating a significant improvement in meaningful comprehension ability following the implementation of the transformative deep learning approach.

b. Control Class

The relationship between the transformative non-deep learning model and reflective critical thinking skills, as well as between transformative non-deep learning and students' deep comprehension abilities, was examined. The mean score for transformative non-deep learning was 65.74, the mean score for reflective critical thinking skills was 79.07, and the mean score for students' deep comprehension abilities was 555.19. Correlation between transformative non-deep learning and reflective critical thinking skills: 0.273 (sig. = 0.168); correlation between transformative non-deep learning and meaningful comprehension ability: -0.058 (sig. = 0.775). The difference in the mean scores of transformative non-deep learning and reflective critical thinking skills is significant, with $t(26) = -8.832$, $p = 0.000$. The difference between transformative non-deep learning and students' meaningful comprehension ability is also significant, with $t(26) = -3.783$, $p = 0.001$. Although there was an improvement, the relationship between the transformative non-deep learning treatment and students' meaningful comprehension ability is weaker compared to the experimental class.

1. Transformative Non-Deep Learning on Reflective Critical Thinking Skills.

The average score for reflective critical thinking skills in the control class increased from 65.74 to 79.07. The results of the *Paired Sample T-Test* showed a t -value of $t(26) = -8.832$ with a significance level of $p = 0.000$. Although significant, this increase cannot be attributed to the treatment because the control class did not receive the transformative deep learning intervention.

2. Non-transformative deep learning on students' meaningful comprehension skills.

The average meaningful comprehension ability of students in the control class increased from

273.52 to 555.19. The test results showed a t -value (26) = -3.783 with $p = 0.001$, indicating a significant increase. However, based on the low correlation and higher significance compared to the experimental class, this increase was not as strong as the effect observed in the experimental class.

Although both the experimental and control classes showed improvements in students' reflective critical thinking skills and meaningful comprehension abilities, the experimental class that used the transformative deep learning approach had a smaller p -value and a higher correlation, indicating a stronger treatment effect. The transformative deep learning approach proved effective in significantly improving critical thinking skills in solving religious intolerance-based problems/cases and cases in regional head elections involving issues of local sons, indigenous and non-indigenous people, as well as students' meaningful comprehension abilities, compared to conventional learning in the control class. The results of the *Paired Sample T-Test* analysis show that the deep learning approach has a significant impact on improving students' reflective critical thinking skills and meaningful comprehension abilities. Higher correlations and significance values demonstrate the effectiveness of the transformative deep learning approach in the experimental class compared to the control class.

Joice (2016) emphasizes that there is currently a strong movement emphasizing what are known as 21st-century skills. These include collaborative and cooperative skills, communication skills, reflective critical thinking skills, and creativity skills. Meanwhile, Edward Thorndike, as explained by Greadler (1991), reminds us that the appropriate laboratory for conducting research is the classroom, and the suitable subjects for experiments are students. Based on this perspective, this quasi-experimental study was designed to be conducted in a classroom where students in a single class serve as the experimental subjects.

To demonstrate reflective critical thinking skills, creativity skills, collaboration skills, and

communication skills, the learning activities in this quasi-experimental study intentionally provided four cases to be distributed among student groups for discussion, aiming to generate effective alternative solutions to the cases. Each group, consisting of 4–5 students, receives one case to solve collaboratively within the group, drawing on various reading materials—including student textbooks and resources specifically prepared by the research team—since students at both target schools lack direct access to diverse learning resources. Under the guidance of the teacher team, each group conducted an analysis and then formulated alternative solutions to the case/problem. Following the group work, a debate or argumentation session took place among the student groups under the direction, guidance, and motivation of the teachers, students were guided to develop 21st-century skills, particularly reflective critical thinking skills, creativity skills, collaboration skills, and communication skills, with the aim of fostering a strong sense of awareness (understanding) and the ability to derive meaningful understanding from today's learning materials.

The observations and reflections conducted by the teacher teams at each target school indicate that the implementation of the transformative deep learning approach clearly creates a joyful, pressure-free atmosphere, enabling the majority of students to demonstrate various reflective critical thinking skills regarding the problems or cases discussed and debated very effectively. The transformative deep learning approach is presented by focusing students on several dilemmatic problems or cases. The cases are distributed among groups of 4–5 people to seek alternative solutions that are debated after each group presents under the coordination of lecturers and teachers, then, based on their own awareness and meaningful understanding resulting from reflection, students formulate conclusions in the form of knowledge conclusions, positive attitude conclusions that become shared values, and conclusions regarding what transformative actions change students' perspectives, attitudes, and behaviors. In the final session, students reflect on themselves and the

positive aspects of change following this learning experience.

Meanwhile, the team of lecturers and teachers of Pancasila education observed and filled out observation sheets on students' attitudes and behaviors to document various 21st-century skills, including critical thinking, creative thinking, global diversity, collaboration, mutual assistance, and other skills resulting from the application of the transformative deep learning approach (Rehman et al., 2024). One notable aspect was the collaboration skill: each student in the group actively fulfilled their respective roles to contribute to completing their group's task. This model also effectively developed students' communication skills through debates during the Q&A session following the presentation. Initially, the students were very reluctant to participate in asking or answering questions, but during the debate session, it was evident that students in each group divided their roles between debaters and presenters of information supported by data. In the debate session, in accordance with the guidelines to avoid personal attacks, the focus was on building logical arguments supported by reading materials.

The aspects of critical thinking skills addressed in this study include the ability to effectively analyze issues discussed in group sessions, the ability to evaluate effectively, the ability to effectively solve problems discussed in group sessions, the ability to make sound decisions, the ability to ask analytical questions, and the ability to construct arguments during discussion sessions and Q&A sessions following the presentation of group work results (Dimiyati, 2013). Overall, the experiment with the transformative deep learning approach in the research cases at both high schools revealed that some target students were less able to develop critical thinking skills—specifically, they remained silent—likely due to the influence of a feudal cultural background within their families, which provides little space for students and the general public to debate, let alone express differing opinions. In the community of Malaka Regency, there are several central areas that strongly adhere to feudal culture, a culture that does not typically involve

debating issues because decision-making power lies with traditional leaders or male elders.

The implementation of the transformative deep learning approach also contributes positively to the development of other 21st-century skills, namely collaboration skills, communication skills, and creativity skills (Ly, 2022). Students' collaboration skills were clearly evident when they worked together in groups of 4–5 to solve cases or problems provided by the teacher; each group member was highly active in collaborating according to their respective roles, which had been defined by the teacher. Communication skills develop very well when the group presents their assignments, answers questions in structured discussions, and engages in debates to support or oppose a discussion topic. These debate discussions were highly engaging yet remained grounded in mutual respect, ensuring no derogatory language was used toward one another. Through group work, students developed creativity in their respective roles to formulate appropriate alternative solutions to problems.

According to Suyono and Hariyanto (2011), communication and interaction among learners through tasks assigned by the teacher are useful for the formation of students' understanding of meaning. Communication skills are among the essential 21st-century skills, while meaningful learning processes for learners are the essence of the *deep learning* approach. In this context, the *deep learning* approach significantly enhances meaningful learning processes by utilizing the Problem-Based Learning model. The transformative deep learning approach emphasizes the teacher's efforts to design approaches, models, and methods capable of changing students' self-awareness regarding the essence of the material, developing meaningful understanding directly related to daily life, while simultaneously transforming students' values and behaviors into individuals skilled in critical and reflective thinking, creative thinking, collaboration, and effective communication in various forms of social interaction (Mao, et al., 2021).

In this regard, the transformative deep learning approach not only enhances students' reflective critical thinking skills and meaningful comprehension abilities but also, as observed during group activities throughout the learning process, creates a vibrant and enjoyable classroom atmosphere for students—whether during group discussions, during presentations, as well as in students' honest testimonials regarding the strengths, weaknesses, and significance of the learning experience—all of which help students transform their future daily lives. Starting from self-awareness, by recognizing and understanding the benefits of the learning material, students then make their own decisions to undertake transformative changes in their lives (*growth mindset*) (Ly, 2023).

One of the main principles in the transformative deep learning approach is the aspect of *meaningful learning*. Suyono and Hariyanto (2011) explain that meaningful learning involves two key elements: first, the characteristics of the material being studied must be meaningful—that is, it must consist of terms with defined meanings and meaningful concepts—and second, new material should be substantively and systematically linked to students' existing cognitive structures.

The results of the test of the effect of the transformative deep learning approach on the improvement of reflective critical thinking skills showed a significant effect, namely $p = 0.000$ ($p < 0.05$). Similarly, the results of the test of the effect of transformative deep learning on students' meaningful comprehension ability () showed a significant effect, namely $p = 0.001$ ($p < 0.05$). In this regard, the use of this approach is likely to be less effective in developing reflective critical thinking skills among students in rural school environments, especially given the tendency for students to predominantly come from a feudal social structure.

Conclusion

Based on the research conducted, it can be concluded that the transformative deep learning approach focuses on students having a high level of understanding and awareness (rather than rote memorization) of what is learned, gaining

meaningful understanding to guide their attitudes and behavior so that students are able to change their (*growth mindset*), how they view themselves (self-confidence), how they view the world (global diversity), and act intelligently and with dignity, upholding human values and civilized progress.

The use of a transformative deep learning approach at both target high schools had a significant effect on students' meaningful comprehension skills. There was a significant difference between the meaningful comprehension abilities of students in the experimental class and those in the control class, where the average meaningful comprehension score of the experimental class was much higher than the average meaningful comprehension score of students in the control class. Both the experimental and control classes used the same learning model, namely Problem-Based Learning, without a transformative deep learning approach.

Although both groups showed improvements in reflective critical thinking skills and meaningful comprehension, the experimental class using the transformative deep learning model had a smaller *p-value* and a higher correlation, indicating a stronger treatment effect. The transformative deep learning-based learning model proved to be significantly more effective in enhancing both reflective critical thinking skills and meaningful comprehension compared to conventional learning in the control class. The results of the *Paired Sample T-Test* analysis indicate that the transformative deep learning approach has a significant impact on improving students' reflective critical thinking skills and meaningful understanding, where higher correlations and significance values demonstrate the effectiveness of the transformative deep learning approach compared to the non-transformative deep learning approach in the control class.

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