

Blended Learning and Critical Thinking in Acrylic Removable Partial Denture Theory Course

Fitriyanti^{1(*)}, Didik Marsigid², Sri Wiwik Wiyanti³

¹Politeknik Kesehatan Kementerian Kesehatan Jakarta II, DKI Jakarta, Indonesia

Abstract

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This study aimed to examine the influence of blended learning model and critical thinking on students' learning outcomes in acrylic removable partial denture theory course. The research was preceded by designing a blended lesson on acrylic removable partial denture theory course using the ASSURE learning model by considering objective conditions in the Department of Dental Engineering, Health Polytechnic, Ministry of Health, Jakarta II. Experiment was used as the research method with 2x2 treatment by level design. The data analysis was carried out using two-way analysis of covariance (ANCOVA). The results of the research found that students' learning outcomes in the blended learning acrylic removable partial denture theory course were generally better than face-to-face learning, especially in the group of students with high critical thinking. The group of students with low critical thinking did not produce significantly different results.

Keywords:

Learning model; critical thinking; study results of acrylic removable partial denture theory course.

(*) Corresponding Author:

fitriyanti@poltekkesjkt2.ac.id

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INTRODUCTION

Advances in information and communication technology (ICT) have influenced various aspects of life, one of which is education. The era of globalization has impact on competition between countries. In order a country to survive, it can improve the quality of its human resources; and Indonesia is no different.

Improving the quality of higher education can be done through human resources. There are several ways to improve the quality of human resources, one of which is through education. Education improvements can be carried out at macro and micro levels. If quality improvement is carried out through the learning process in the classroom or at the institution which is the responsibility of the educator, this is a micro improvement. Improving the quality of education at a micro level can be done through improving the learning process (Darling-Hammond et al., 2020) (Giantari et al., 2022). Many have carried out and researched various learning innovations both segmentally and comprehensively, starting from basic education to higher education.

Learning innovation in higher education cannot be separated from advance in ICT. The impact of advance in ICT, especially network technology in the form of the internet, is the emergence of innovative learning models based on ICT. Learning model innovation is based on increasing the number of students

(educational literacy)(Simamora et al., 2020)(Alan & Yurt, 2024). As well as the wide range of areas of students who will take part in the learning process (Paristiowati, 2015) (Munna & Kalam, 2021).

The background of students is heterogeneous, especially in certain schools such as health polytechnics, Students are not only high school graduates but also those who are already working, so the needs and learning styles of students vary. Apart from that, the demand for expanding access to education is the basis consideration for developing learning models, especially in the world of higher education.

The COVID-19 endemic encouraging the use of online learning to be developed into a learning model (Eugenia,2009) in universities, both public and private, in all parts of the world today, including Indonesia. There are several online learning models, namely learning using the web, teleconference, video conference, etc. In essence, online learning is web-based learning with an open learning environment that can be accessed via the internet to facilitate learning and building students' knowledge through meaningful interactions. The interaction patterns that occur are between students in their learning groups, between students and learning materials, and between students and educators (Hastuti et al., 2020) (Mahmud et al., 2021). Online learning has weaknesses, including: social interaction between educators and students or between students which can slow down the formation of values in the learning process; ignoring academic aspects but encouraging the growth of business aspects; tending towards training rather than education. These weaknesses can be offset by face-to-face learning. The weakness of face-to-face learning is freedom of learning activities. The solution to both of online and face-to-face learning models' weaknesses is a combination of both which is called blended learning. With blended learning, the positive aspects of online and face-to-face learning can be optimized, so that students are facilitated openly to be actively involved in learning activities independently and flexibly, but still have opportunities for face-to-face interaction with other students and educators in structured learning.

ASSURE is a learning system design model proposed by Smaldino, Lowther, and Russell. It developed to create effective learning using technology and media (Smaldino et al., 2018). The procedures for the ASSURE learning model are(Sami et al., 2019)(Batır & Özlem Sadi, 2021):

1. Analyze learners, which is the first step to determine the learning design and help students achieve learning goals;
2. State standards and objectives, determining specific learning objectives that refer to the syllabus and curriculum;
3. Select the learning strategies, technology, media, and materials is a step that becomes a bridge between students' competencies and learning goals achievement;
4. Utilize technology, media, and materials, using these three components in the learning process;
5. Require students' participation is the active involvement of students in understanding learning material;
6. Evaluate and revise, to assess the effectiveness of learning and students' learning outcomes.

ASSURE model is suitable for application on a small scale therefore, effective interaction between users of technology, media, and learning materials can be implemented. The LMS software application used for delivering the acrylic removable partial denture theory course was Moodle (Modular Object-Oriented Dynamic Learning Environment) which is an open-source program. The Moodle application can be downloaded for free from the official website <http://www.moodle.org> and can be modified for anyone with GNU license (General Public License). Moodle used in this research is the version of Moodle 4.1.5+(Build: 20230826). Product preparation was done online via the website address. The implementation of ASSURE model in this study was:

1. Analyze learners: to identify students' readiness. Related to their ability to use computers. Obtained through distributing questionnaires. For students at the beginning of the lecture (Liana et al., 2024);
2. State standards and objectives: Learning objectives are set by the Semester Learning Plan (RPS) and curriculum. Referring to the curriculum of the Department of Dental Engineering which was being revised. The learning objective in this research is "to analyze the manufacture of theoretical removable acrylic dentures through installing a working model in the articulator, the flasking process, and the packing process";
3. Select strategies, technology, media, and materials. This stage is a bridge between students' competencies and achieving learning outcomes through selecting appropriate strategies, technology, media, and learning materials;
4. Utilize technology, media, and materials: After determining the strategy, technology, media, and learning materials, the next step was to use them in the learning process. So that the technology components, media, and learning materials can function well and suit the conditions of the learning environment. Trials needed to be carried out. The results of the trials decided whether the technology, media, and learning materials can be used;
5. Require students' participation: Students who were actively involved will support in understanding the learning material. Students can be actively involved through group discussions, Internet activities, or computer-based learning;
6. Evaluate and revise: After carrying out the learning, the final step taken was evaluation to assess the effectiveness of learning and students' learning outcomes.

The first step, which was analyzing the student, was carried out to find out how ready students were in accepting a new learning model or learning environment. The result of the analysis of students' readiness became the basis for designing blended learning in the course of acrylic removable partial denture theory, especially the perspective of the ability to use computers and internet networks. The results of the analysis showed that all students who took the acrylic removable partial denture theory course in computer, both desktops and netbooks, were able to use the internet. In general, students used computers for three to five hours every day. As many as 12.5% used computers not every day, as needed. One of the uses of computer was to access the internet. The majority of students, namely 59.4%, accessed the internet using mobile modems, and the rest accessed via internet networks installed at home, campus, and internet cafes. In general, students

accessed the internet to download lecture materials, read news, access learning resources, and interact through social networks. A small percentage of students used the internet to play games, download songs, and watch films. All students had email addresses, usually to receive assignments from lecturers and submitted the assignments to lecturers. Obstacles faced by students in accessing the internet include slow network, intermittent connection, weak signal, and loading taking a long time. Therefore, the students were ready to take part in blended learning which combined online and face-to-face learning.

This step was also to find out whether the lecturer was ready to carry out the blended learning. The result of the analysis showed that all lecturers in the Dental Engineering Department had used computers for lecture purposes, for example preparing lecture material and making Power Point media. The Internet network was also used by some lecturers to search for learning resources and provide course assignments to students via email.

At the second step, the selection of acrylic removable partial denture theory materials was also carried out to choose which materials that can be presented through blended learning model. Learning materials for acrylic removable partial dentures theory course included four dimensions of knowledge, namely factual, conceptual, procedural, and metacognitive.

The theory chosen to be delivered online in blended learning was conceptual and procedural material, which were the process of installing a working model in the articulator, the process of flashing, and the process of packing. These materials were chosen on the basis that it had already been introduced in the acrylic removable partial denture theory course, and was not a new concept that was not yet known. So, students would not have difficulty studying the material further and in more depth.

After determining the materials, blended learning materials were created, specifically for online learning (attachment to: <https://elearning.poltekkesjkt2.ac.id/>). The prepared learning materials were divided into learning sections, namely: a) Installation of the working model on the articulator, consisting of material description, materials in PDF format, discussion topics, and group assignments; b) Flashing, consisting of materials in PDF format, PowerPoint, discussion topics, and individual assignments; and c) Packing, consisting of material description, materials in PDF format, PowerPoint, discussion topics, and individual assignments.

METHODS

The research used was an experimental approach on the Ministry of Health Jakarta II Health Polytechnic students. The variables were: learning model that combines face-to-face meetings with online material (blended); face-to-face learning model; study results of acrylic removable partial dentures theory course. This research was focused on students of the Department of Dental Engineering level 1 for the 2022/2023 even academic year who took part in learning acrylic removable partial denture theory course. Jakarta II Ministry of Health Polytechnic was where the research took place. Data collection was carried out using a

questionnaire which was preceded by making an instrument grid; followed by assembling the instrument, then validating the instrument by experts with panelists, then conducting empirical validation of the instrument through trials; the test results are analyzed. Valid and reliable instruments were ready to be used. The research data was subjected to a statistical test of the treatment design by level 2x2, then an analysis of the research results was carried out.

RESULTS & DISCUSSION

This research provided the following results: 1. GTSL learning outcomes between students treated with blended learning and face-to-face learning. The average GTSL learning outcomes of students with blended learning treatment were higher than the average GTSL learning outcomes of students with face-to-face learning treatment; 2. GTSL Learning Outcomes with Face-to-Face Treatment: Most students got score between 72 to 76, while the overall distribution of learning outcomes tended to vary within the predetermined range of scores; 3. Students' critical thinking abilities with blended learning treatment: The students' lowest score was 62, but the highest score was 91 with an average of 76.44, and a standard deviation of 8.12. It also showed that 24% of students obtained class average scores, 28% above the average score, and 48% below the average score; 4. Data on students' critical thinking ability with face-to-face treatment, 16% of students got class average score, 32% of students got score above the average value, and 52% got score below the average value.

Before testing the hypothesis, prerequisite analysis testing was carried out. Provision testing analysis included; 1. Normality test. The results of the normality test showed that L_{count} was smaller than L_{table} as seen in the attachment, the last page of this report. So, the research data came from normally distributed population; 2. Homogeneity test. To find out whether the population diversity values were the same statistically, a homogeneity test was carried out using the Bartlett test at the $\alpha=0.05$ level. Homogeneity testing was carried out by finding the X^2_{count} and then comparing it with the X^2_{table} from data distributed by Chi-Square. The testing criteria was to reject H_0 if $X^2_{count} > X^2_{table}$, which meant the data group did not have homogeneous variance. Instead, accepting H_0 if $X^2_{count} < X^2_{table}$ which meant the data group had homogeneous variance. Homogeneity test of variant for students with blended learning treatment (A_1) and students with face-to-face treatment (A_2). Hypothesis testing the homologous nature of GTSL learning outcomes data between students with blended learning treatment (A_1) and students with face-to-face learning treatment (A_2) below.

Based on calculations using the Levene Test, it was obtained: Sig. = 0.750 was greater than the Alpha significance level of 0.05, so H_0 accepted. This result meant that the GTSL learning outcomes of students in the four treatment groups had the same or homogeneous variance. Hypothesis testing at the implementation stage of GTSL learning was carried out using the Covariance Analysis (ANCOVA) technique. The results of data analysis calculations using the two-way ANCOVA test were as follows: The interaction between the learning model and critical thinking skills on GTSL learning outcomes. Theory based on the result of the covariance

analysis (ANCOVA), showed $F_{\text{count}} = 5.472 > F_{\text{table}}$ at $\alpha=0.05$. Figure 1 below was a graph of the effect of the interaction between the independent variables on the dependent variable.

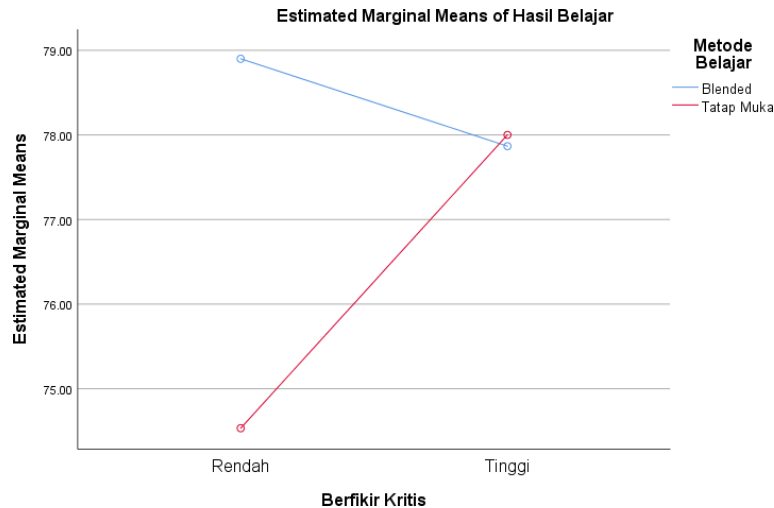


Figure 1. Interaction between the learning model and the ability to think critically GTSL Learning Outcomes

The results listed in Figure 1 related to interactions, meaning that H_0 was rejected at the significance level of 0.05. This meant that at a significance level of 0.05, there was an interaction. Thus, it can be concluded that there was a significant interaction effect between the learning model and critical thinking skills on GTSL learning outcomes. Based on the graph in Figure 1, it can be seen that the GTSL learning outcome scores of students with blended learning treatment were higher than the GTSL learning outcome scores of students with face-to-face learning treatment. Students who had high critical thinking skills with blended learning treatment tended to have high learning outcome scores. However, students with face-to-face learning tended to have low learning outcome scores. The group of students who had low critical thinking skills with blended learning treatment tended to get low learning outcome scores but tended to get slightly higher scores with face-to-face learning treatment. This result meant that there was no significant interaction effect between the independent variable and the dependent variable. Therefore, we did not proceed with testing differences without using a one-way analysis of variance and the Turkey test.

This research produced a blended learning design for the acrylic partial denture theory course. ASSURE the selected learning model matched the characteristics of the objective conditions of the Dental Engineering Department to design blended learning. There had been an increase in the number of students majoring in Dental Engineering from year to year, not accompanied by additional equipment, what's more, there was a decline in the function of the equipment. Thus, students must queue according to the waiting list if they wanted to use the equipment, including micromotors, pen blasts, and sandblasts.

Schedule problems related to the use of micromotors, Sund blast pen blast can overcome the problem of queuing and waiting list. Since blended learning was a

combination of face-to-face learning and online learning, queuing time can be transferred to blended learning. What's more, blended learning was not always in the study room, but it can learn anything, anywhere and anytime. In this way, one class can be used for learning more than one subject at the same time.

Most of the lecturers' ability to use computers in the Dental Engineering department was good. However, the learning process delivered by lecturers to students in the Dental Engineering Department generally still used face-to-face learning. Alternative online learning or a combination of face-to-face and online learning, known as blended, had not yet started in the Dental Engineering Department based on the results of observations of lecturers.

With the ability to design and implement blended learning in the acrylic removable partial denture theory course, blended learning by lecturers can be implemented. However, computer equipment and facilities, as well as internet signal networks in both the Dental Engineering Department and the Jakarta II Ministry of Health Polytechnic, really determined how conducive blended learning was.

Identified problems with the quality of learning outcomes for acrylic removable partial dentures theory course. The theory was satisfactory, but there were still those who got grades C, D, and E. So far, face-to-face is a learning model that was still generally delivered by lecturers in the Dental Engineering Department through question-and-answer lectures (CTJ), discussions, as well as assignments. Generally, students can take part in learning even without being ready to learn, so that student independence was not optimally explored.

For student independence to be explored, learning conditions were needed that lead to independent learning, by the skills that a human resource person should have in the 21st century, namely: the ability to think critically and solve problems; creativity and innovation abilities; collaboration capabilities; communication skills to improve students' abilities in solving problems, analyzing, giving arguments, and drawing conclusions.

With the existence of an independent learning curriculum on an independent campus, the conditions of the learning environment were directed so that it can accommodate the various learning styles of each student, as an embodiment of this curriculum on campus.

This research conducted blended learning which was a combination of face-to-face learning with online learning on the acrylic removable partial denture theory course. So blended learning was a lecture where some of the learning was delivered face-to-face, and some parts were delivered via e-learning.

Blended learning had the potential to deliver learning that consisted of one topic, or even several topics in the learning. The consideration for providing the selected study substance was that students were familiar with the materials when studying acrylic removable partial denture theory, so it was easier for students to continue with the learning materials. The choices for the substance of the study are: 1. Installation of the working model on the occludator or articulator; 2. Flasking and boiling out process; and 3. Packing, curing, deflasking, finishing, and polishing.

The blended learning design for learning the acrylic removable partial denture theory used a Learning Management System (LMS) as its support. Moodle was the LMS used in this research which was hosted via poltekkesjkt2.ac.id. Through this

website, online learning course about acrylic removable partial denture theory can be followed. To enter online learning, students must log in first. All students' activities can be detected by the lecturer, starting when the students logged in; downloaded learning materials and assignments; uploaded assignments; and knew whether active students were ready. All monitoring was facilitated in the Moodle LMS.

Implementation of blended learning design through treatment design by level 2x2. Implementation of blended learning design through 2x2 treatment by level design. The theory of acrylic removable partial dentures course aimed to test how blended learning and students' critical thinking abilities influence the learning outcomes by comparing them with face-to-face learning. The treatment was implemented in the even semester of the 2022/2023 academic year in parallel classes in the Dental Engineering Department. Parallel class 1 was a group that was given a blended learning treatment. Parallel class 2 was the group that was given face-to-face treatment. Each class was determined by groups of students who had high and low critical thinking abilities

This research found that there were general differences in learning outcomes for acrylic removable partial denture theory course between the group of students who were given blended learning treatment and the group who were given face-to-face learning treatment. The implementation of different learning models produced different learning outcomes. Besides that, differences in students' critical thinking abilities also result in different learning outcomes. Critical thinking can be categorized as follows: very good 86-100%, good category 76-85%, fair category 60-75%, poor category 55-59%, and very poor category <54% (Elisanti et al., 2018).

Sari's research (2023) found that the implementation of online learning training that was mixed asynchronous and synchronous regarding the prevention and handling of prominent stunting was not effective (Sari, 2023). Likewise, the implementation of synchronous online learning training on preventing and handling prominent stunting was also considered less effective. The cause of this was the asynchronous arrangement which was carried out only by independent asynchronous (AM) without the presence of a facilitator. The presence of a facilitator can play an important role in maintaining and sustaining students' levels of learning motivation and facilitating relationships between training participants and the facilitator. Likewise, the implementation of synchronous online learning training on the prevention and handling of stunting was also considered to be less effective. The important cause was that the internet network cannot be accessed by participants, especially from remote areas. So, it was very difficult for participants to participate in synchronous learning as a whole. Research by Ridwan Sudirman (2023) found that there was a significant influence (t count 7.79 > t table 2.415) on Pencak Silat subject after blended learning was implemented. The effect was produced; classified as high, the percentage increased by 8.80%. Referring to the results of this research, the blended learning method had a significant influence on students' Pencak Silat psychomotor abilities compared to the online learning method.

Referring to the results of the data analysis carried out. The following were found: Differences in learning outcomes for acrylic removable partial denture

theory course between students who were given blended treatment and face-to-face learning. ANCOVA calculations resulted in the two treatment groups obtaining a value of $F_{\text{count}} = 7.536$ while $F_{\text{table}} = 4.038$. At $\alpha = 0.05$, which meant that H_0 was rejected. These results showed that there were differences in learning outcomes between groups of students who were given blended treatment and groups of students who were given face-to-face treatment. This difference was shown by the average scores of the group of students who were given blended treatment and the group of students who were given face-to-face treatment as follows. It can be synthesized that the average learning outcomes in the group of students who were given blended learning are higher than the average learning outcomes in the group of students who were given face-to-face learning. The result of this research was supported by research by Supriyadi et al. (2023) which found an effect size value of 0.71 and an N-gain of 0.82. So, STEM-integrated blended learning is effective in increasing the level of scientific literacy of students in Indonesia. It can be synthesized that blended learning supported the learning process in Indonesia by increasing students' literacy in learning. Likewise, research in Ghana showed that blended learning had better social interactions in students' online experience in 2020 when COVID-19. This was driven by the rapid use of mobile technology and social media to organize blended learning (Adarkwah & Huang, 2023).

Apart from that, research in Egypt showed the same thing. Training programs with blended learning showed positive influence on students' knowledge and practice in post and follow-up tests. The blended training provided a safe learning environment for engineering students. So, it recommended that the blended learning program should be used as a learning approach in implementing health training programs (Aljawfi et al., 2023). What's more, students' literacy levels will certainly increase even more, because they were young adults who already had quite mature thinking. Supported by digital literacy which was like a tsunami today. A filter was needed to filter quality learning sources. Students should have these abilities.

The interaction between the learning model and the ability to think critically on GTSL learning outcomes. Analysis of covariance (ANCOVA) in the two groups gave the following results: $F_{\text{count}} = 5.472 > F_{\text{table}}(2;46)$ at $\alpha 0.05 = 3.20$. Referring to these results, it can be said that H_0 was rejected at the significance level $\alpha = 0.05$. This meant that there was an interaction effect between the learning model and critical thinking skills on learning outcomes.

The course of acrylic removable partial denture theory not only contained physics concepts but also chemical concepts, so you need to understand both things. Students can get good learning outcomes in acrylic removable partial denture theory course if they comprehensively understand the physical and chemical phenomena contained therein. To understand the concept comprehensively, students can strive for a learning environment that supported every learning process, discussion was one way to make students active. Discussion activities were carried out online in blended learning. Educators presented a problem to be discussed together and encouraged students to respond. Students can also provide discussion material for those who do not understand the discussion material. Discussion activities were taken place between educators and students, as well as between fellow students. In this way, the learning process carried out in conducive and enthusiastic condition. The creation of better learning outcomes as a result of the

learning process taking place in a conducive and enthusiastic environment.

Supported by the result of Suryono's research, (2023), which found an average effect size of 0.79 with medium criteria. This finding stated that the determinants of the blended learning model were significant for students' critical thinking abilities. The blended learning model made it easier for students to develop their critical thinking skills when studying. The environment, situation, and conditions of face-to-face learning created ample opportunities for students to interact in learning in the classroom, thus independence as a demand in blended learning was not needed in face-to-face learning.

Different from blended learning, students can participate in learning well because the atmosphere was supportive, even though these students had low critical thinking skills. During online discussions, students can think longer about opportunities. Due to online discussions, they did not directly meet face-to-face with other students or lecturers, students did not feel embarrassed if the answers uploaded were not correct. We can find this in the learning results of groups of students who have low critical thinking skills.

CONCLUSION

Based on research result that referred to the problem and research objectives, the following conclusions can be drawn: 1. GTSL learning outcomes for students who were given blended learning were higher than students who were given face-to-face learning; 2. There was an interaction between the learning model and critical thinking skills which influenced students' GTSL learning outcomes; 3. GTSL learning outcomes for students who were given blended learning were higher than students who were given face-to-face learning; 4. GTSL learning results of students who were given blended learning was lower than students who were given face-to-face learning in students who had low critical thinking abilities. Following up on the conclusions of this research, we suggested designing a blended GTSL learning through: 1. Design a blended GTSL learning; 2. Semester Learning Plan (RPS) blended GTSL; 3. Building GTSL online learning by utilizing the Moodle Management Learning System which is ready on each institution's website.

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