

DEVELOPING CRITICAL THINKING SKILL THROUGH E-LEARNING: A CASE STUDY AT MUHAMMADIYAH UNIVERSITIES IN INDONESIA

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ABSTRACT-Critical thinking skill is one of the abilities that must be possessed by students as agents of change in order to be able to maintain their existence in the era of the industrial revolution 4.0, but not a few of them are less able to develop and improve it. In an increasingly sophisticated age, e-learning is clear evidence of digitalization that has spread to all dimensions of life, not least in the scope of education. E-learning is a learning system that is relevant to the times, and with features available in e-learning, it is expected to be able to increase students' critical thinking. The focus of this research was to examine how much influence of the e-learning system in Muhammadiyah University on improving the critical thinking skills of its students. This research used a quantitative approach, with the type of survey research. Data were collected using questionnaires, interviews, and documentation. The data analysis used descriptive statistical tests and simple linear regression tests. The results of his research were: (1) The implementation of e-learning systems in Muhammadiyah Universities could be classified as moderate, with a percentage of 45.5%. (2) The level of critical thinking skills of Muhammadiyah University students could be categorized as moderate, with a percentage of 60.7%. (3) The results of the data analysis showed that the value of sig, $0,000 < 0.05$, meaning that there was a significant influence of the implementation of e-learning systems on students' critical thinking skills at Muhammadiyah Higher Education with the impact of 29.0%.

Keywords-- Developing, critical thinking skills, e-learning, higher education.

I. INTRODUCTION

Critical thinking skills are skills that are needed in every individual, especially as the agents of change [1]–[5], and critical thinking skills are not only limited to ordinary thinking but more than that. Bandyopadhyay and Szostek [6] stated that critical thinking ability is the attitude of individuals who do not easily believe, and often put suspicion about a phenomenon or fact that is not yet known to be true and certain. Every person, who has good critical thinking, will be able to analyze the situation and manage him/herself in all conditions. It is because critical thinking is considered as an analysis, assessment, and self-regulation that produces interpretation, evaluation, and

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inference. It is also an explanation of consideration, conceptual, methodological, criteriological, and contextual basis [7].

It needs to be understood that critical thinking skill is an ability that is very much needed in the 21st century, which will be full of complex problems and news that are easily spread due to the high use of digital technology in society. Therefore, it is necessary to embed critical thinking skills in humans optimally [8]–[10].

Ideally, critical thinking skills are applied by humans since they were at school. Critical thinking skills, which were embedded from the beginning, will make these abilities well and firmly attached to humans. Therefore, the critical thinking skills in students as agents of change are needed to face the 21st century and to become a person who still exists in the 21st century. Critical thinking skills that are embedded in life's problems and can create problem-solving for those problems are as stated by Bandyopadhyay and Szostek [6] that critical thinking is reinforced when individuals become sensitive to problems and generate ideas. Embedding critical thinking skills in the learning process can be done by implementing a learning system that can foster critical thinking skills and are relevant to the times, for example, the e-learning system. The learning system is a combination consisting of human elements, facilities, materials, procedures, and facilities that work together in an organized manner to achieve the goals [11].

E-learning is an electronic technology that is used to send, assess, support, and improve learning effectiveness. E-learning is one part of the distance learning process, and online learning is part of e-learning. E-learning is the latest educational tool and is needed because it has been proven to have a positive impact on learning. In addition to being relevant to the times, the E-learning system can be a bridge to improve critical thinking skills for students because there is space to train students to be able to think critically. The learning uses a contextual approach and begins with relying on things that are real for students, discussing, collaborating, emphasizing student ability, arguing in forums so that students can finally solve a problem from their thoughts rather than from the teacher (teaching telling).

II. CRITICAL THINKING SKILL

The existence of the industrial revolution 4.0 will facilitate each individual in living his/her life, but on the other hand, it gives particular concern for every human being. It is because machines and technology will replace the human resources that are typically utilized. The role of humans, which have been displaced by technology, is also a problem of the industrial revolution; it will fundamentally change the procedure, work, and relate to one another.

In line with this, people are required to develop their abilities to compete and survive in the era of industrial revolution 4.0. The industrial revolution 4.0 was marked by digitalization, which spread throughout all sectors of life. In the previous era, the dynamics of movement rate were centralized on human resources as subjects that moved the growth and development of every aspect of life. Very different from that, this era has experienced a shift that, at first, human beings as vital subjects were slowly replaced by digital technology and mechanical automation in the life cycle. Greenlaw, Deloach, Greenlaw, and Deloach [12] state that "the impact of digital technology towards the industrial revolution 4.0 will result in 52.6 types of jobs being destroyed and experiencing

a shift in the next five years". In line with it, each individual must have the ability and prepare mentally to be able to maintain and increase their existence in global competence in a distracting era. One way that can be taken to be able to have a superior self-existence is to have good behavior (behavioral attitude), increase self-competence, and functional literacy; all the needed supplies can be obtained through education (long-life education) [13].

Students, as agents of change [7], must have skills in facing the era of the industrial revolution 4.0. Various skills must be possessed by students, including critical thinking skills. Chan [14] states that 21st-century skills and literacy include: necessary skills, problem-solving skills, technology skills, communication skills, analytical and creative skills, digital skill, inquiry skills, multicultural and multilingual skills. It needs to be understood that critical thinking skill is an ability that is very much needed in the 21st century, which will be full of complex problems and news that are easily spread due to the high use of digital technology in society. Therefore, it is necessary to optimally embed critical thinking skills in humans.

The reality in the field, which is left unchecked, will lead to the difficulty of developing critical thinking skills in students. Therefore, an educator must be able to apply a learning system that can improve critical thinking skills in students and relevant to the times. The purpose of this study was to determine how high the implementation of e-learning systems in Muhammadiyah Higher Education and the level of critical thinking skills, as well as to find out how much influence the e-learning system in Muhammadiyah Universities on the critical thinking skills.

III. METHODS

Population and Sample

The hypothesis proposed in this study was that there was an influence of the e-learning learning system on improving the critical thinking skills of Muhammadiyah Higher Education students. This research was a survey research methodology, where the purpose of this research was to find information and data from a particular place naturally and not artificial. The approach used in this study was quantitative because the data obtained in the field were in the form of numbers and analyzed statistically using the SPSS program. The population in this study were all students of Muhammadiyah Universities, which were divided into 170 Muhammadiyah Universities in Indonesia. The samples in this study were 112 students from 11 Muhammadiyah Universities who have used the e-learning learning system in the lecture process.

Data collection techniques used in this study were; observation, questionnaire, interview, and documentation. The measurement scale used was a Likert scale with five answer choices. Validity test was analyzed using SPSS (Statistical Product and Service Solutions) software. The corrected item-total correlation approach was applied to test each questionnaire item by examining the correlation between the scores of each questionnaire item and its total score. The reliability test in this study used the Cronbach's alpha reliability test on a decision that if the Cronbach's alpha value is smaller or less than 0.6, then it is not good; At the same time, 0.7 is acceptable, and above 0.8 is very good [15]. The hypothesis test used simple linear regression, which was used to look for the influence of one predictor variable or looked for a relationship between one variable with another variable [16].

Procedure

The step taken by the author before entering into research was to compile research instruments concerning the indicators of each variable. To obtain valid and consistent research instruments, the authors conducted a validity and instrument reliability test on 30 students of the Islamic Counseling Communication Study Program at the Muhammadiyah University of Yogyakarta. After being declared valid and reliable, the next step was the writer to go directly and distribute the research instruments to 112 Muhammadiyah University students to get information about the application of e-learning and the level of critical thinking skills of Muhammadiyah Higher Education students. The next step to get more in-depth information related to the implementation of e-learning was that the authors conducted an in-depth interview with the Study Program parties of Muhammadiyah Higher Education.

IV. RESULTS

Based on the results of the reliability test, the instrument was declared reliable and could be used as a research instrument. Research instruments that have been declared valid and reliable were then used to retrieve data related to the implementation of e-learning and the level of critical thinking skills of Muhammadiyah Higher Education students.

Table 1: Three box test results for the E-learning method

| Indicator | Index | Category |
|----------------------|--------------|-----------------|
| User convenience | 72,4 | moderate |
| Form | 67,4 | moderate |
| Accuracy | 69,6 | moderate |
| Speed of responding | 51,1 | low |
| Privacy and security | 70,4 | moderate |

Table 2: Three box test results for the critical thinking skill method

| Indicator | Index | Category |
|------------------|--------------|-----------------|
| Interpretation | 74,2 | moderate |
| Analysis | 67,4 | moderate |
| Evaluation | 91,2 | high |
| Inference | 77,3 | moderate |
| Self-regulation | 96,6 | high |
| Explanation | 54,9 | moderate |

Figures 1 and 2 are the results of a descriptive analysis of each study variable using the three-box method to determine the index size for each indicator. The quality of e-learning utilization in terms of the user convenience component obtained an average index of 72.45; these results indicated that the user ease indicator in the e-learning variable was in the moderate category. The problem found by the authors in the user convenience indicator made

students felt burdened by e-learning, including the lecturer asking students to do all e-learning tasks from the beginning of the learning material to the end at one time at the end of the semester. The next problem was the e-learning response, which sometimes made students uncomfortable.

The quality of e-learning utilization in terms of the form component obtained an average index of 67.44. These results indicated that the form indicators in the e-learning variable were in the medium category. Constraints that the authors got in the form indicators included lecturers who had not fully understood the e-learning component so that it was less optimal in managing e-learning, especially the less-varied of learning objects. It was also due to the lack of supporting facilities to make learning objects more exciting and following the needs of students.

The quality of e-learning utilization in terms of the accuracy component obtained an average index of 69.6. These results indicated that the accuracy indicator in the e-learning variable was in the moderate category. The obstacles that the writers found in the accuracy indicator were that there were often differences in perceptions between lecturers and students so that there were students who make a mistake in doing their assignments because they were not by the instructions the lecturer intended.

The quality of e-learning utilization in terms of the speed of the response component obtained an average index of 51.1. These results indicated that the speed indicator in responding to e-learning variables was in a low category. The problem that the authors found was that the campus internet connection was not fast enough in some places resulting in slow e-learning and hard to access it. The quality of e-learning utilization in terms of security and privacy components obtained an average index of 70.4. These results indicated that the security and privacy indicators were in the moderate category. The problems that the writers found in the indicators of security and privacy were that the lecturer had not been able to find out the fraud committed by students when working on assignments and exams in e-learning.

Interpretation is a person's ability to give judgment, understand the experience, data, understand and assess an event, rules, and so on [17]. Based on the results of research related to critical thinking skills, the authors analyzed that the interpretation ability possessed by students was included in the moderate category. It refers to the index obtained by an interpretation indicator of 74.2. When viewed from the frequency of the questionnaire answers, the respondents interpreted this indicator tended to answer by giving a score of 4. If related to the theory of Yalcin Dilelki, students who were categorized as having excellent critical thinking skills were easy to understand something, able to judge an event, and ready to assess a form of ability in interpretation.

An analysis is the ability to identify the relationship between events that occur and can link concepts. It examines and explains how something happened, including comparing and distinguishing various elements and understanding relationships with personal subjects or topics [18]. Based on the results of the study, the authors analyzed that some respondents still had low analytical skills. It was seen from the questionnaire answers in which there were still some students showing themselves unable to identify something, connect concepts, and argue with credible data. In addition, some of them had not been able to consider the consequences as well. It is very contrary to the theory that has been stated at the beginning. If looking at the average index, the student's analytical skills were in the moderate category, with an index score of 75.4. It could be concluded that the ability to identify relationships between events and connect concepts was a sufficient category.

The inference is the ability to draw conclusions based on accepted premises or available evidence or draw conclusions from existing factual statements. Based on the results of the study, the authors analyzed that most respondents were able to make an inference. It was seen from the frequency of answers that showed students were able to make inferences more than those who were not or were not able to do it. It was also supported by the average index of 77.3, which was categorized as medium. Students, who had excellent inference skills, were able to deduce things thoroughly and made concept maps well. Someone is said to have excellent critical thinking skills if he/she is capable and has excellent inference skills.

Evaluation is the ability to judge logically from an inferential relationship, such as a situation, a description of a statement, and a question. Based on the results of the study, the authors concluded that the evaluation ability possessed by respondents was high. It was supported by the results of research showing an evaluation index of 91.2, where the number was included in the high category. Respondents who had excellent evaluation skills were able to judge things logically and objectively, were able to measure success either on themselves or others and were able to comment on the value of something.

Self-regulation is self-awareness owned by individuals to monitor the activities of themselves or others. This ability should be possessed by someone who has excellent critical thinking skills because this ability depicts someone capable of carrying themselves well. Based on the research, the authors concluded that the self-regulation ability possessed by respondents was relatively high. It was seen from the acquisition of the self-regulation index of 96.9, which was included in the high category. Respondents who could self-regulate could be sure they had good adaptability, excellent socialization skills, and were able to carry themselves well. An agent of change need those things to stay exist in the 21st century.

The explanation is the ability of individuals to explain and provide an explanation methodically, coherently, and reasonably [19]. Based on the results of the study, the authors analyzed that the ability of respondents' explanations was moderate. It was seen from the achievement of the explanation index of 54.9. The numbers were included critical because they only had a little difference with numbers that were categorized as low. Seeing the explanation index, the respondents still needed to learn a lot so that they would have the ability to explain well. It is because someone who has good critical thinking skills can explain systematically, argue logically and methodically, define clearly and in detail anything which will be described, and defines all aspects in particular related to an understanding and others.

The next stage was a descriptive test to determine the level of implementation of e-learning systems and the level of student critical thinking. Descriptive test results of the two research variables are presented in tables 3 and 4

Table 3: E-learning categorization

| Category | Range | Frequency | Percentage |
|----------|------------------|-----------|------------|
| Low | $X < 76$ | 36 | 32.1 % |
| Moderate | $76 \leq X < 92$ | 51 | 45.5 % |
| High | $92 \leq X$ | 25 | 22.3 % |

Table 4: Critical Thinking Skill Categorization

| Category | Range | Frequency | Percentage |
|----------|------------------------|-----------|------------|
| Low | $X < 106,5$ | 22 | 19,6 % |
| Moderate | $106,5 \leq X < 124,5$ | 68 | 60,7 % |
| High | $124,5 \leq X$ | 22 | 19,6 % |

Based on the table above about the e-learning variable category, it can be seen that e-learning is included in the moderate category, with a percentage of 45.5% with a frequency value of 51. The critical thinking skill variable was included in the moderate category, with a percentage of 60.7%, with a frequency value of 68. After a descriptive analysis of the variables was done, the next step was the hypothesis test using a simple linear regression test. Simple regression is used when there is only one dependent variable that is influenced by one independent variable. Simple regression is used to look for the influence of one predictor variable or look for the relationship between one variable with another variable. Simple regression test results are presented in Table 5.

Table 5: Simple Regression Test Results

| Coefficients ^a | | | | | | |
|---------------------------|-----------------------------|------------|--------------|------|-------|------|
| Model | Standardized | | | t | Sig. | |
| | Unstandardized Coefficients | | Coefficients | | | |
| | B | Std. Error | Beta | | | |
| 1 | (Constant) | 68.151 | 7.063 | | 9.648 | .000 |
| | E-learning | .576 | .085 | .544 | 6.807 | .000 |

a. Dependent Variable: Critical Thinking

Based on the above output, it could be seen that the significant value (Sig.) of $0,000 <$ from 0.05, so it could be concluded that H_a was accepted. In other words, there was a significant influence of the e-learning system on the critical thinking skills of Muhammadiyah Higher Education students with the Y regression equation = $68.151 + 0.576X$. From the line equation, it could be concluded that the e-learning variable (X) had a positive relationship with the variable critical thinking skill (Y). If the value of the e-learning variable (X) increases by 1%, then the critical thinking skill (Y) variable increases by 0.576, and vice versa. If the e-learning variable (X) decreases by 1%, then the critical thinking skill variable (Y) decreases by 0.576. It means that the better the implementation of e-learning, the critical thinking skills owned by students will also be better. Based on the output of the simple linear regression test results, it could be seen the contribution of e-learning in influencing critical thinking skills. The results of this study prove that the implementation of good e-learning would affect the improvement of the critical thinking skills of Muhammadiyah Higher Education students.

To find out the size of the independent variable (X) in influencing the dependent variable, then determinant analysis (R square) was used. The results of the determinant analysis test (R square) are presented in table 6

Table 6: Determinant Test Results

| Model Summary | | | | |
|----------------------|-------------------|-----------------|--------------------------|-----------------------------------|
| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
| 1 | .544 ^a | .296 | .290 | 9.872 |

a. Predictors: (Constant), E-learning

The table above shows that the R-square coefficient of 0.290; thus, it can be concluded that the effect of e-learning variables on the variable critical thinking skills is 29.0%. E-learning was considered appropriate to improve students' critical thinking skills because it directly involved students in the learning process.

V. DISCUSSION

An e-learning system is a learning system that utilizes network-based communication and information technology in the learning process. The e-learning learning system is very relevant to the current development where the use of digital technology has spread in all aspects of life, including in the element of education [20]. The existence of e-learning can change the learning model from conventional or face-to-face to visual and without face-to-face. Teachers can prepare and provide learning materials for students, control the content that will be given to students, explore student activities, such as online assignment gathering, online presence, and chat online with students. The existence of e-learning facilitates the learning process in which learning can be done in the distance, more effectively, efficiently, easily, and quickly [21].

Verburgh [22] argues that "the advantage of e-learning is that it does not only increase access but also enhance engagement, learning, experience in exploring, as well as empowers students to take responsibility for scheduling and managing the learning process. In addition, it is learning, which is contemporary and can be accessed from any site by using appropriate and effective technology.

The existence of e-learning as the results of research obtained by the author indicated that with the application of e-learning in the learning process, it could increase student confidence, also, provide an excellent opportunity for students to interact with each other through online discussion forums. These strengths can provide opportunities for students to practice expressing their opinions in the forum and help to remove barriers, including those that have the potential to hamper participation, such as the fear of talking to other students. In a situation where an era that continues to develop and the development of information technology, doing the learning process only with the classical method is not enough. Strauss and Strauss [23] state that lecturing method will be ineffective if it is applied in a large class; the causative factors are teachers more active than students, and teachers are less optimal in supervising students.

Each lecturer must be able to follow the development of technology and implement the technology in the learning process [24]. The learning system that can be applied is the e-learning system because it can affect the critical thinking skills of students. The results of research conducted by the authors showed that there was an influence of e-learning on the critical thinking skills of Muhammadiyah University students. The description is as follows:

The Influence of User Convenience Indicators on Critical Thinking Skills

Based on the results of this study, it could be seen that user convenience had a positive effect on students' critical thinking skills. The results of descriptive analysis showed that user convenience was in the moderate category, with a score of 72.45. It means that not all students were satisfied with the ease of using or accessing e-learning. The highest index found in the sub-indicator did not become a burden for users with an index value of 77.5. It showed that students considered one of the essential aspects felt by them was the pleasant atmosphere and ease in e-learning.

Samson [25] states that the perceived use of the convenience of e-learning will affect the attitudes, interests, and behaviors of users. Having a good attitude and good interest in using e-learning will create a comfortable attitude when using the e-learning learning system. Students will continue to involve themselves in the e-learning system and agree on whatever is the decision in the e-learning system. It is what will unconsciously grow students' critical thinking skills. Lorencová et al. [26] state that involvement is one of the factors that influence someone's critical thinking skills, meaning that someone who is involved in a forum or an issue then he/she has a role in expressing ideas and the right to follow joint decisions.

The Effect of Form Indicators on Critical Thinking Skills

Based on the results of this study, it could be seen that the form indicators had a positive effect on students' critical thinking skills, which were indicated by their significance level of $0,000 < 0.05$. Based on the results of descriptive analysis, it showed that the form indicators were in the moderate category, with a score of 67.44. It means that the form in e-learning was not yet thoroughly good and satisfying. The highest index was found in the sub-indicator of content relevant to learning, with an index value of 71.6. It showed that the content in e-learning was considered capable of meeting the learning objectives. One of the contents available on e-learning was an online discussion forum. Garrison [27] reveals that e-learning provides a good opportunity for students to interact with each other through online discussion forums. This advantage can allow students to practice expressing their opinions in the forum. Discussion is one alternative that can improve and train students' critical thinking skills. The problem that needs to be discussed will train students to analyze the problem, interpret an idea, summarize many ideas, and convey ideas to themselves. Things like these can improve students' critical thinking skills as said by Chan [14] that critical thinking skills are cognitive skills, such as interpreting, arguing, concluding, analyzing, evaluating, making proposals, making, creating, and making decisions in context, looking for information that is relevant and reliable, adaptable, and flexible about change.

The Effect of Accuracy Indicators on Critical Thinking Skills

Based on the results of the study, it could be seen that the accuracy indicator had a positive effect on students' critical thinking skills, which was indicated by the significance level of $0,000 < 0.05$. Based on the results of descriptive analysis, it showed that the accuracy indicator was in the moderate category, with a score of 69.6. It means that the accuracy in e-learning was not yet entirely excellent and satisfying. The highest index contained in the material sub-indicator was delivered systematically with an index value of 72.5. The material gave routinely by the instructor will train students to think systematically, as well as understanding the flow of material systemically. Train oneself always to think and act systematically, and it will improve students' ability to think critically. The more someone accustomed him/herself to practicing systematic thinking, the more critical his/her thinking will become. It is in line with the narrative [28] that the ability to think critically can be formulated in the activity of thinking and acting systematically and regularly by paying attention to parts of the whole problem.

The Effect of Response Speed Indicators on Critical Thinking Skills

Based on the results of the study, it could be seen that the speed indicator responded positively to the critical thinking skills of students, as indicated by the significance level of $0,000 < 0.05$. Based on the results of descriptive analysis, it showed that the indicator of the speed of response was in the moderate category with a score of 51.1. It means that the speed of responding to e-learning had not been thoroughly good and satisfactory. In other words, there was still much that needs to be improved. The highest index was found in the adequate infrastructure sub-indicator with an index value of 70.8. It showed that one of the essential things that students should feel was the existence of infrastructure that supported the learning process through e-learning, one of which was an internet connection on campus that must be smooth. Smooth relationship affect the ease of students in accessing information. Bezanilla, Fernández-nogueira, Poblete, and Galindo-domínguez [29] argue that e-learning can improve the efficiency of knowledge and qualifications through the ease of accessing information. Easy for a student to get information will help them to increase their knowledge related to whatever material is needed. The number of material references obtained requires students to reflect or consider the new information they have obtained. Frequently reflecting new information will improve critical thinking skills because it is one of the key steps in critical thinking [7], [30], [31].

The Effect of Security and Privacy Indicators on Critical Thinking Skills

Based on the results of the study, it could be seen that the safety and privacy indicators had a positive effect on students' critical thinking skills, which were indicated by the significance level of $0,000 < 0.05$. Based on the results of descriptive analysis, it showed that the security and privacy indicators were in the moderate category with a score of 70.4. It means that the security and privacy in e-learning were not yet wholly good and needed to be improved. The highest index was found in the student privacy sub-indicator maintained with an index value of 78. It showed that the security and privacy that existed in e-learning was essential to be improved for the sake of student comfort. The more privacy of students in e-learning, the spirit of using e-learning will also increase. It relates to the theory of self-regulated learning. When students participate in distance learning or independent learning, they need self-regulated learning, which is defined as the ability of individuals to monitor their behavior

and is a hard work of individual personality. Although the lecturer cannot see cheating done by students when doing e-learning assignments, students who have good self-regulated learning will monitor themselves not to commit fraud. Self-regulated learning is closely related to critical thinking skills because self-regulated learning itself is part of the critical thinking steps. It is as according to Bandyopadhyay and Szostek [6] that critical thinking skills are analysis, reasoned considerations, self-assessments that produce interpretations, evaluations, and inferences, as well as an explanation of evidence, conceptual, methodological, criteriological, or contextual considerations on which judgments are based.

VI. CONCLUSION

After data analysis, hypothesis testing, and research findings had been found; it could be concluded that; (1) The implementation of the e-learning learning system in Muhammadiyah Higher Education could be categorized sufficiently with a percentage of 45.5% (2) Critical Thinking Level Skill of Muhammadiyah Higher Education students could be adequately categorized with a percentage of 60.7% (3) The correlation coefficient of 0.503 showed the moderate relationship between the implementation of the e-learning system and the critical thinking skills of Muhammadiyah Higher Education students. Whereas the sig value of 0,000 <0.05, meaning that there was a significant influence between the implementation of the e-learning system on the critical thinking skills of Muhammadiyah Higher Education students, with an influence of 29.0%, and the other 71.0% were influenced by other factors not discussed in this study.

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