

Online-based activities to improve students' critical thinking, problem solving, and communication

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ABSTRACT

This study aimed to explain how students' critical thinking, problem solving and communication skills can be developed through student development activities in online-based scientific discussion programs at universities. This study used a mix method approach with a sequential explanatory model. The research was conducted using quantitative methods in the first stage and then in the second stage using qualitative methods. Management discussion model was measured through questionnaires and interviews. The quantitative data analysis was employed to identify the effectiveness of the discussion model and its impact. The qualitative data analysis was carried out in three stages, namely data reduction, data presentation; and drawing conclusions. The research findings showed that the model of student development activities with online-based scientific discussion methods can significantly improve students' critical thinking, problem solving, and communication skills. The results of this study indicated that universities provide opportunities for students to improve critical thinking skills, problem solving and communication skills through online-based scientific discussion programs.

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1. INTRODUCTION

One of the qualities of higher education is measured by the quality of students. Indicators of student quality can be seen in academic and non-academic scores. Academic or non-academic quality excels because of learning materials, facilities, student focus, assessment quality, social activities and service quality [1]. One strategy to improve the quality of students is through coaching in the non-academic field. The student development program is carried out to improve the quality of the student's personality. So far, there have been several forms of developing student activities at universities such as the development of interests and talents, leadership, development of social awareness, environmental care, cultural tolerance, scientific development, spiritual development, skill development and community involvement as well as sports development [2], [3]. The forms of student development activities are expected to be able to produce students who have academic and non-academic advantages.

Student development activities aim to improve the character and personality of students so that they behave honestly, are skilled at developing themselves, live socially, are skilled at self-control, humanity, communication and moral competence and are responsible for living life in the future [4]. This is in line with the previous study that student development has the aim of encouraging students to grow, progress, and

increase their development capacity as a result of enrollment in higher education institutions. Thus, students have competence, emotional attitudes, interdependence, personal maturity, self-identity, purpose and integrity of life [5]. In addition, students will form an appreciation for culture, understand issues of democracy and justice as citizens, respect ethnicity, gender, sexual identity so that their lives are more meaningful, involved and progress academically in higher education [4], [6].

Student development activities seek to create opportunities for leadership development, managerial skills, practical experience, ability to build networks, and also self-awareness [7]. Students have the opportunity to apply theory in practical life. This is the implementation of the Education Policy of the Government of the Republic of Indonesia as stated in Law Number 12 of 2012 concerning Higher Education which confirms that students have the right to receive educational services that are in accordance with their talents, interests, potential and abilities [8]. The development of student talents, interests, and abilities according to Law Number 12 of 2012 is carried out through curricular activities, co-curricular activities as supporting activities for the educational process, and extra-curricular activities as activities carried out through student organizations.

The ideal purpose of the student development activities is supported by the results of several researches. The results of study by Hemafitria, Rohani, and Novianty stated that the character building of student is getting better and better with student development activities in higher education [9]. Then, Sinuraya, Rajagukguk, and Fabian stated that student development encourages students to be more mature intellectually, socially, able to manage emotions, have goals and build integrity [10].

Based on the analysis result on the needs in the field, the issues on the student's development program are the absence of specific development programs in the curriculum, the development programs that are not well programmed, lacking in guiding the students to develop their critical thinking, solving problems, and effective communication, and limited resources of funding for the programs. These affected the low competitive culture and the competitiveness of the graduates of the university. The results of Anwar and El Fiah research showed that the problem of student development is a funding problem so that activities in the field of students cognitive are considered to receive less serious attention so that it has an impact on student achievement [11]. Then, the research of Saputra, Kusmanto, and Turnip revealed that student development in higher education has not been carried out optimally due to the fact that the standard operating procedures in the field of student affairs have not been carried out properly [12].

The gap between theory and implementation shows that there are problems with student development activities in higher education. This study aims to explain the effectiveness of developing student activities through online-based scientific discussion programs in universities. The results of the research will be a recommendation to improve the quality of the implementation of student activity development programs in the future.

2. LITERATURE REVIEW

2.1. Critical thinking

Critical thinking ability is a means to reason and make better decisions to avoid reasoning and decision-making biases that aim to produce interpretations, analysis, evaluations, and inferences, as well as explanations of evidentiary, conceptual, methodological, criteriological, or contextual considerations that become assessment basis [13]. Critical thinking skills train a person to analyze problems, think based on evidence, see problems comprehensively, question assumptions, and identify the relevant context needed for a solution [14]. Meanwhile, according to previous research, critical thinking encourages a person to think clearly and rationally about what to do and the potential consequences of each action, encouraging reflective and independent thinking [15].

Someone who has the ability to think critically is expected to be able to demonstrate competence in understanding logical relationships between ideas; categorizing the applications and consequences of ideas; contemplating the rationalization of one's own thoughts and principles; identify, construct, and estimate arguments; distinguish inconsistencies and common errors in reasoning; and finally, can solve problems systematically [15]. That's why universities continue to improve students' critical thinking skills. Empowerment of critical thinking skills is one of the goals of education in the 21st century [16].

2.2. Problem solving

One of the 21st century skills tested in this study is problem solving skills. The definition of problem solving itself varies. By definition, problem solving is the ability to understand the environment, identify complex problems, and analyze information, evaluate strategies and find solutions [17]. Problem solving can also be defined as a thought process. According to Gürsan and Yazgan, problem solving is a part of the thinking process to solve complex problems using higher order thinking skills [18].

Meanwhile, problem solving skills are the ability to find new solutions and ideas. To improve this ability, one needs to hone thinking skills, generate more solutions so that it is possible to find ideas that are considered new [19]. Problem solving skills can be defined as the ability to solve problems by thinking creatively and integratively with knowledge in several functional areas [20].

Problem solving abilities can encourage students' thinking skills at school. The results of Malcok and Ceylan's research showed that the effect of STEM activities on the problem solving skills of 6 year old preschoolers has a positive impact [21]. This means that students' problem solving abilities can be improved through technology-based learning activities.

2.3. Communication

Communication is the process of expressing, receiving, and understanding messages that contain factual information, emotions, ideas, and needs by two or more individuals [22]. While communication skills are related to the ability to listen actively, give and receive feedback, understand body language (nonverbal cues), sympathy, persuasion, questioning, and speaking so as to be able to understand and be understood by others [23], the ability to listen effectively, use correct grammar in oral and written communication and write clearly, concisely, correctly and completely [24].

Strategies to develop communication skills are diverse. Good communication skills strategies are a source of confidence, enabling a person to exercise more control in their life by acquiring knowledge, researching effectively, conceptualizing, organizing, and presenting ideas and arguments [25]. In the context of education, students' communication skills can be done through discussions, class presentations, or getting used to communicating in the real world [26].

3. RESEARCH METHOD

3.1. Types of research methodology and design

This development research model employed a mix method approach. Mix method is a research approach that combines qualitative and quantitative method [27]. The research model uses an explanatory sequential design model. In this model, there are two interactive sequential or sequential research phases. The first phase, the researcher collects and analyzes quantitative data which has priority to answer research questions. The second phase, the researcher collects qualitative data following the previous phase, the researcher interprets the qualitative data to help explain the results obtained in the quantitative phase.

3.2. Population and sample

The population of this research is students of the first year education management master program (even semester 2021-2022) with 38 populations. The reason for choosing first year students for even semester 2021-2022 is that students become participants in online-based student development activities through scientific discussion programs, participants are students studying in postgraduate programs so that they have basic knowledge and skills in the application of critical thinking, problem solving and communication skills.

In quantitative research, the sampling technique used is the non-probability sampling technique of the saturated sampling model. Saturated sampling model is a sampling technique when all members of the population are used as samples [28]. This technique was chosen because the population is relatively small, about 30 people. The saturated sampling subjects in this study were students of the first year education management master's program (even semesters 2021-2022) with 38 populations. They are students, participants in online-based scientific discussions with material on critical thinking, problem solving and communication skills.

In qualitative research, the subject selection technique used is a probability sampling technique with a simple random sampling model. The taking of sample members from the population is carried out randomly without regard to the strata that exist in the population [29]. This technique was chosen because the population is relatively homogeneous, namely students of the first year educational management master's program in the even semester of 2021-2022.

3.3. Data collection techniques and instruments

Techniques and instruments in collecting data are divided into two parts, namely quantitative data collection and qualitative data collection. Quantitative data obtained through a questionnaire. The instrument used in the questionnaire is based on aspects of critical thinking, problem solving and communication skills. Questionnaires are given to identify the level of success in aspects of critical thinking, problem solving and communication skills in scientific discussion programs. Meanwhile, qualitative data were obtained through interviews with randomly selected participants. The interview instrument aims to explore the success rate of scientific discussions in terms of critical thinking, problem solving and communication skills.

3.4. Data analysis technique

Data analysis in this study consisted of quantitative data analysis and qualitative data analysis. Quantitative data analysis was processed descriptively by calculating the average and categorization, and testing the validity, reliability and standard deviation of aspects of scientific discussion management, critical thinking, problem solving and communication skills. The qualitative data analysis technique was carried out through three stages, namely data reduction, data presentation, and drawing conclusions [28]. Table 1 shows the categorization guidelines.

Table 1. Categorization guidelines

Category	Average value
Very not good	1 to 1.75
Not good	>1.75-2.75
Good	>2.75-3.50
Very good	>3.50-4.00

4. RESULTS

4.1. Online based scientific discussion platform

Scientific discussion platform on the student's development program used is the Zoom meeting application and the Google Form. The scoring aspect upon the online based scientific discussion platform are the aspects of preparation, conduct and evaluation. The aspect of preparation covers the objective, topic, time and facility. The aspect of conduct covers the materials, keynote speakers, committee, facility, participation and time. The aspect of evaluation covers the conclusion and the follow up.

Based on the result of the recapitulation, it shows that the score of the online based discussion platform overall is 3.34, where based on the guide of the categorization is in the category of "good". The lowest average score from the online discussion platform is on the aspect of "Recommendation to be followed up is available" with the average score of 3.06 and is in the category score of "good". Meanwhile, the highest average score is in the aspect of "The online facilities ease the conduct of discussion" with the average score of 3.44. Besides, a research instrument is said to have a good validity score if it has a score higher than 0.3 and is said to be reliable if it has the reliability coefficients score (Cronbach alpha) larger than 0.3 and having the coefficients score larger than 0.7. The result of the scoring of the online based scientific discussion platform is shown in Table 2.

Table 2. Management of online based scientific discussion

Aspects	Description	RT	%	Validity	Reliability	Standard deviation
Preparation						
1. Objective	The objective of the scientific discussion is clear.	3.44	86	0.826	0.907	0.504
2. Topic	The determination and formulation of the topic is appropriate.	3.41	85	0.789	0.909	0.615
3. Time and facilities	The time and facilities are prepared well.	3.34	84	0.790	0.909	0.545
Conduct						
1. Content	The content is easy to be understood.	3.31	83	0.728	0.913	0.471
2. Keynote speakers	The keynote speakers have the expertise in its field.	3.31	83	0.844	0.906	0.592
3. Committee	The moderator and committee lead the flow of discussion well.	3.41	85	0.644	0.917	0.499
4. Facilities	The online facilities ease the conduct of discussion.	3.50	88	0.603	0.919	0.508
5. Participation	The platform encourages participation.	3.31	83	0.880	0.903	0.592
6. Time	The conduct is done on time.	3.31	83	0.681	0.915	0.535
Evaluation						
1. Conclusion	Conclusion of the discussion is available.	3.28	82	0.746	0.912	0.457
2. Recommendation	Recommendation to be followed up is available.	3.06	77	0.694	0.919	0.716
Average score		3.34				

4.2. Critical thinking skill

Critical thinking is measured using eight aspects of indicator. The critical thinking aspects are open minded and able to interpret, formulate and limit the question, also able to test and analyze, along with the ability to answer questions and statements, able to consider, and draw conclusion, as well as to identify the assumptions and facts, and finally determine the actions accordingly. Based on the recapitulation result on

Table 3, it shows that the improvement of critical thinking skill of the students overall is at the score of 3.34, which means that it falls on the category of “good”. The lowest average score is from the aspect of critical thinking is on the “ability in testing and analyzing” with the average score of 3.19, which falls on the category of “good”. Meanwhile, the highest average score is related to “growing open mindedness and interpretation appreciation” with the average score of 3.50. In the other hand, the result of validity test indicates the validity coefficients score of all indicators of critical thinking skill improvement is larger than 0.3 and having the reliability coefficients score that is larger than 0.7. With that, it can be concluded that all indicators in this variable here have good validity and reliability degree. The improvement on the critical thinking skill seen from the eight aspects are shown on Table 3.

Table 3. The improvement of critical thinking

No	Aspect	Indicator	RT	%	Validity	Reliability	Standard deviation
1	Growing open mindedness and interpretation appreciation	The discussion encourages me to be open minded and to appreciate various interpretation.	3.50	88	0.734	0.871	0.508
2	Formulate and limit the questions	The discussion helps me to formulate and limit the questions.	3.22	81	0.704	0.875	0.491
3	Testing and analyzing	The discussion helps me in testing the scientific data and analyzing different statements.	3.19	80	0.669	0.885	0.592
4	Answering questions and statements	The discussion helps me to answer the questions about an explanation and statement.	3.28	82	0.722	0.872	0.457
5	Considering ideas	The discussion helps me to consider whether an idea is reliable or not.	3.28	82	0.769	0.866	0.457
6	Drawing conclusion	The discussion improves my skill in drawing conclusion from various ideas and to judge a certain issue.	3.44	86	0.813	0.861	0.504
7	Identifying assumptions and facts	The discussion improves the skill in identifying the assumptions and also facts.	3.44	86	0.770	0.867	0.504
8	Determining the action	The discussion improves my skill in determining the action upon the different statements and interacting with the other individuals.	3.38	85	0.799	0.863	0.49
Average score			3.33				

4.3. Problem solving skill

Problem solving skill is measured using five aspects of the ability. Those are identifying the questions, analyzing the problem, formulating the solution, choosing the solution, and evaluating the solution. Based on the recapitulation result on Table 4, it shows that the scoring on the overall problem solving skill of the students is at the score of 3.30, which means that it falls on the category of “good”. The lowest average score is from the aspect of critical thinking is on the “choosing the solution” with the average score of 3.28, which falls on the category of “good”. In the other hand, the result of validity test indicates the validity coefficients score of all indicators of problem solving skill improvement is larger than 0.3 and having the reliability coefficients score that is larger than 0.7. With that, it can be concluded that all indicators in this variable here have good validity and reliability degree. The result of the five aspects of problem solving skills can be observed on Table 4.

Table 4. The improvement of problem solving skill

No	Aspect	Indicator	RT	%	Validity	Reliability	Standard deviation
1	Identifying the questions	The scientific discussion improves my skill to identify the questions regarding the discussion topic.	3.31	83	0.867	0.937	0.535
2	Analyzing the problem	The scientific discussion improves my skill in analyzing a problem.	3.31	83	0.927	0.921	0.471
3	Formulating the solution	The scientific discussion improves my skill to formulate the solution upon the emerging problem.	3.31	83	0.893	0.930	0.535
4	Choosing the solution	It improves my skill in choosing the alternative solution to solve the problem of a discussion topic.	3.28	82	0.906	0.929	0.581
5	Evaluating the solution	The scientific discussion pushes me to be good at evaluating the solution chosen.	3.31	83	0.927	0.921	0.471
Average score			3.30				

4.4. Communication skill

Communication skill is measured using five aspects. Those are the ability in training the content delivery, pushing the interactive discussion, the opportunity in delivering idea/statement, the discussion is clear, concise and easy to be understood, as well as the mastery in delivery language. Based on the recapitulation result on Table 5, it shows that the overall improvement of communication skill of the students is at the score of 3.35, which means that it falls on the category of “good”. The lowest average score is from the aspect of communication skill is on the “training in content delivery” and the “language mastery” with the average score of 3.19, which falls on the category of “good”. Meanwhile, the highest average score is related to “opportunity in delivering idea/statement” with the average score of 3.41.

In this case, the impact on the improvement of communication skill, according to the respondents, is good. The result of validity test indicates the validity coefficients score of all indicators of communication skill improvement is larger than 0.3 and having the reliability coefficients score that is larger than 0.7. With that, it can be concluded that all indicators in this variable here have good validity and reliability degree. The evaluation results upon the five aspects of communication skill can be observed in Table 5.

Table 5. The improvement of communication thinking

No	Aspect	Indicator	RT	%	Validity	Reliability	Standard deviation
1	Training the content delivery	The scientific discussion trains to deliver an ideal content	3.31	83	0.873	0.835	0.535
2	Encouraging interactive discussion	The management of the scientific discussion pushes the discussion to be interactive among the students	3.38	85	0.805	0.861	0.554
3	Opportunity in delivering idea/statement	The scientific discussion gives the opportunity in delivering the idea or statement	3.41	85	0.756	0.872	0.499
4	Discussion is clear, concise and easy to be understood	The scientific discussion pushes clear discussion, that is concise and is easy to be understood	3.34	84	0.887	0.832	0.483
5	Language mastery	The scientific discussion pushes the correct use of language	3.31	83	0.814	0.870	0.644
Average score			3.35				

5. DISCUSSION

The management aspect of the online based scientific discussion indicates that every indicator gets the score with the category of “good”. The aspect of planning, conducting, evaluating and the following up gained responses that is very satisfying. The satisfaction is the success indicator in the phase of management of the online discussion platform that covers the preparation, conduct and evaluation as well as the follow up for the discussion. This is relevant to the statement of Ragupathi that an online discussion needs to be designed in terms of concept and topic, preparation, facilitators and the moderator are able to facilitate the discussion, stimulating participant to raise questions, participate and making the discussion structured [30].

With the better management on the learning discussion, then the online based discussion may give impact on the development of the remote community, the improvement of the quality of the scientific online discussion and the improvement of the participants [31]. The learning of online scientific discussion has the advantage because it is more flexible and more independent [32], [33]. The online facility gives the advantage on scientific discussion. Every participant can communicate remotely, the information is clearer, more cost effective, and it teaches independence [34].

On the aspect of critical thinking, the findings show that there is improvement in each indicator with the score of the category of “good”. According to Semadi, the discussion method can improve the critical thinking skill of the students [35]. The critical thinking skill of the students in the discussion experiences some improvements. Then, the study of Helterbran explained that the discussion method through debate can grow the critical thinking on the students, so that it can improve their independence, capability, skill in interpreting, analyzing, evaluating, and drawing conclusion [36].

The findings of this research and the previous researches are supported by the theory of Reinstein and Bayou, that the improvement of critical thinking is marked with the ability in analyzing issues, the skill in judging critically upon the conclusion drawn, it needs the checking on logic and sensible conclusion [37]. These findings are different from what mentioned by Jiwandono. According to Jiwandono, the improvement in critical thinking of students is still lacking [38]. Also, Haryandi *et al.* [39] mentioned that the critical thinking skill of the students are still at the low level, that is shown from two sub-indicators that are drawing conclusion from the investigation and conducting the evaluation (formulating the alternative solution) that is still low [39].

On the aspect of problem solving, the findings of the research showed the improvement in the skill of the students with the satisfaction level of “good”. These findings have the similarity to the research of Lutfauziah *et al.* [40] that revealed that there are improvements on the problem solving skill of the students through the discussion method on the subject of structure and development of plants. Then, the research of Moma [41], shows that the improvement of the achievement in the problem solving skill on the students using the discussion model is better than those experienced the conventional learning [41]. This is relevant to the theory of Valentine, Belski, and Hamilton [19] that one who own the problem solving skill has the skill in thinking, producing more solutions so that it enables one to discover ideas considered new [19]. One of the strategies in improving the problem solving skill on the students is the scientific discussion.

On the aspect of communication skill, the findings of this research showed that the satisfaction of the participants is in the level of “good”. These findings have the similarities to those of Dallimore, Hertenstein, and Platt that revealed that the online discussion method can increase the communication skill of the students [42]. Then, the research of Rahmawati and Farozin [43] showed that the discussion method can improve the interpersonal communication skill on the students [43]. This is relevant to one mentioned by Iksan *et al.* [26] that the communication skill of the students can be trained through discussion, class presentation, or self habituation to communicate in real world. Scientific discussion can improve the communication of the students. Communication skill is seen on the skill of active listening, giving and accepting feedback, understanding some body language (non-verbal communication), sympathy, persuasion, questioning, and speaking so that it enables one to understand and being understood by other people [23].

6. CONCLUSION

This study aims to identify the effectiveness of the program of student’s development using online discussion to increase critical thinking, problem solving and communication skill. The conclusion that can be drawn from the research are: i) The management of the online scientific discussion that covers the aspects of preparation gained the scores in the category of “good”; ii) The aspect of critical thinking skill in the category of “good”; iii) The aspect of problem solving in the category of “good”; and iv) The aspect of communication skill in the category of “good”. Overall, it can be concluded that the activity of online based students’ development program has some impacts on the improvement on the skills of critical thinking, problem solving and the communication of the students, but it still needs some improvement on several indicators.

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