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Problem-solving method to enhance students' critical thinking

[1]Faiz Ushbah Mubarok, [2]Atiqah Nurul Asri
[1,2] Information Technology Department of State Polytechnic of Malang, Malang, East Java, Indonesia
[1]faizum@polinema.ac.id, [2]Atiqah.nurul@polinema.ac.id

ABSTRACT
The focus of this research is the implementation of the Problem-Solving method by students to develop their Critical Thinking Skills. Critical Thinking is the ability or way of thinking rationally, objectively, and systematically in solving a problem or answering a question. By using this ability, students are expected to think more critically, logically, structured and carefully. This study used a quantitative descriptive research method, involving 55 students (two classes combined into one) of the third semester students of 2018/2019 academic year of Informatics Management Study Program of Information Technology Department of State Polytechnic of Malang. This research was conducted when they were taking the English Informatics 2 course. In each class, the students were divided into 9 groups, consisting of three people. They were asked to make an idea for an E-commerce startup accompanied by a brief description and also the problems that might arise and presented in the form of a paper board. Furthermore, the other groups from other classes were asked to solve these problems by offering the most effective, logical and systematic and structured solutions as well as practicing their argumentative skills accompanied with its relevant data. From the explanation above, the data were obtained from student observation sheets, questionnaires, and videos. After that, the data is collected, calculated, and analyzed using SPSS. The results of this research were proven to be able to increase the level of students' mindset in critical, and analytical manner in solving problems and effective solutions to any existing problems.
Keywords: *problem solving method, critical thinking skills*

INTRODUCTION
Critical thinking is the ability to train and think in processing information, which involves cognitive abilities such as analyzing, evaluating, interpreting, making and determining decisions based on context (Elder and Paul, 2009 and Van Gelder, 2009). This concept emphasizes the further process of developing a mindset that also rests on the search for relevant and reliable information, and is also easy to adapt to changes. Students are asked to understand a condition or reading material both critically and evaluative. By having this condition, they do not only understand information, but also comprehend and able to answer questions in a deeper thought. Furthermore, the concept of critical thinking has been applied in various developed countries and has made this an essential component for the social and personal development of students (Al-Busaidi & Sultana, 2014).

In the context of higher education, research from Shaw (2011) shows that the readiness of campus alumni for the market share of professional job vacancies is still not fully fulfilled. The results of this study explain if the abilities of graduates are not suitable in certain areas that are desired by job recruiters. The skills they have tend to be general abilities and only rely on hard skills at work and put aside their respective soft skills. Therefore, soft skills are needed to develop a professional worker career and meet market demands.

Research results from Robinson & Garton (2008) and Wagner (2012) show that several types of soft skills are needed in this era, namely teamwork, problem solving, and also critical thinking. These three things are interrelated and are one of the main focuses of educators to develop a student mindset to prepare them to enter the world of work. Apart from that, this training can also be an added value in discussing and expressing opinions. By applying the above matters to teaching, students are expected to be able to develop their abilities more critically, collaboratively, and be able to offer solutions effectively. In the context of vocational colleges, researchers plan to apply these three skills in teaching English 2.

English for Informatics 2 course applies specific English learning based on topics related to Information Technology. In accordance with the character of the institution, teaching puts forward the application of four language skills, namely listening, speaking, writing, and reading. These four things are integrated according to the needs of students in the world of work. Furthermore, this course also teaches specific components of English, namely grammar and vocabulary which are synchronized directly related to the context of information technology. These components are also in line with the vocabulary and needs of students in the Information Technology field.

English for Informatics 2 course consists of six chapters, and one of them is E-commerce material. This material explains the ways and types of buying and selling on the internet. More specifically, in this chapter, problem solving methods can be applied as well as used to develop students' critical thinking skills, especially the Information Technology Department of Information Management Study Program.

According to Hamalik (2004) the problem solving method is a teaching method in which students are faced with a problem that they must solve based on accurate data or information so that they get a conclusion. In addition, the problem solving method is not only a teaching method but also a method of thinking, communicating, searching and processing data, and finally drawing conclusions. Previous research on this Problem Solving was carried out by Putra, Pargito, and Sinaga (2015), the conclusions of this study were 1) the use of problem solving methods (problem solving) could effectively improve critical thinking skills optimally in understanding accounting equations; 2) the use of problem solving methods found suitable actions and can improve critical thinking skills by 93% .

Meanwhile, recent studies that refer to critical thinking, one of which was written by Tuzlukova & Al-Busaidi (2017) in their research entitled Critical thinking in the language classroom: Teacher beliefs and methods which refer to the methods and perceptions of lecturers at the Language Center from Sultan Qaboos University, Oman. In this study,

researchers discussed the relationship between the lecturers' point of view regarding critical thinking in teaching English, and the relationship between critical thinking and language learning methods. Based on real examples in the classroom, 96% of the lecturers' perceptions of the total 24 people who participated in the study stated that critical thinking plays a very important role in learning and teaching activities. Furthermore, researchers also argue that critical thinking helps students face their future academic studies, and also increases readiness in the world of work.

Further related research was carried out by Hosseini et al. (2012) entitled *Exploring the Relationship between Critical Thinking, Reading Comprehension and Reading Strategies of English University Students*. This study examines the ability of 70 Iranian students in critical thinking. In detail, this study investigates the relationship between critical thinking patterns and reading skills. The instruments used were the TOEFL Reading Test, Reading Strategies questionnaire, and the California Critical Thinking Ability Test to measure five categories, namely analysis, evaluation, inductive and deductive reasons, as well as the conclusion. Judging from the three variables, the results show a positive relationship between reading skills, critical thinking, and reading strategies. Furthermore, the achievements of this study also prove that the need for critical thinking is needed in the world of work.

Based on the explanation above, a study entitled "Application of Problem Solving Methods in Developing Critical Thinking Skills" was conducted. Students in groups were expected to train and develop critical thinking skills in solving problems related to E-commerce as one of the topics discussed in the English for Informatics 2. It focused on topics related to three soft skills for industry 4.0 era, namely teamwork, critical thinking, and problem solving.

METHOD

This research is a qualitative descriptive study, namely a type of research that produces descriptive data in the form of written or spoken human words and their behavior can be observed (Setiyadi, 2006). Moreover, the implementation of the methods was based on those proposed by Perkins & Murphy (2006) comprising four stages, namely: (1) clarification, (2) assessment, (3) inference, and (4) strategies.

The subjects in this study were students of the third semester of the Informatics Management Study Program, Information Technology Department, and State Polytechnic of Malang. They were students who took English Informatics 2 course in academic year 2018/2019. The subjects were then split into several groups consisting of 3-4 people in 16 E-commerce groups. After that, students were asked to fill out a questionnaire and also an observation sheet in the next class (cross checking evaluation) to evaluate their understanding and analysis on problem solving and critical thinking. In addition, the researchers also prepared an observation checklist and field notes.

Based on the research instrument mentioned above, it could be seen that the data to be analyzed is student assignment documents, a student paper board containing E-commerce ideas, problems and solutions that could occur in the future.

RESULTS

As it is mentioned before, this study follows the four stages proposed by Perkins & Murphy (2006), namely (1) clarification, (2) assessment, (3) inference, and (4) strategies. Each stage has its own interrelated coverage pattern. At the clarification stage, it covers aspects that refer to the stage of stating, clarifying, describing or defining a problem. The assessment stage is a step that intends to consider aspects such as making decisions, presenting arguments or connecting problems with other problems. In the third step, the inference stage is when students can show the relationship between a numbers of ideas, draw appropriate conclusions by deduction and induction, generalize, explain and make hypotheses. The final stage is strategies which is the stage of proposing, evaluating a number of actions that may occur. Explanation of further descriptions related to this process can be seen in Figure 1.

CLARIFICATION				
All aspects of stating, clarifying, describing (but not explaining) or defining the issue being discussed.				
Proposes an issue for debate.	Analyses, negotiates or discusses the meaning of the issue.	Identifies one or more underlying assumptions in a statement in the discussion.	Identifies relationships among the statements or assumptions.	Defines or criticizes the definition of relevant terms.
ASSESSMENT				
Evaluating some aspect of the debate; making judgments on a situation, proposing evidence for an argument or for links with other issues.				
Provides or asks for reasons that proffered evidence is valid.	Provides or asks for reasons that proffered evidence is relevant.	Specifies assessment criteria, such as the credibility of the source.	Makes a value judgment on the assessment criteria or a situation or topic.	Gives evidence for choice of assessment criteria.
INFERENCE				
Showing connections among ideas; drawing appropriate conclusions by deduction or induction, generalizing, explaining (but not describing), and hypothesizing.				
Makes appropriate deductions.	Makes appropriate inferences.	Arrives at a conclusion.	Makes generalizations	Deduces relationships among ideas.
STRATEGIES				
Proposing, discussing, or evaluating possible actions.				
Takes action.	Describes possible actions.	Evaluates possible actions.	Predicts outcomes of proposed actions.	

Figure 1 - Critical Thinking Process by Perkins and Murphy

Clarification stage

Each stage of critical thinking from the results of this study is taken based on the research procedure steps above. In the clarification stage, students were asked to think of a start-up idea that they would like to create in the future. Furthermore, after each student has their own ideas, they were divided into groups of 3-4 people. There were 17 groups recorded in one large class involving 47 students. They were asked to discuss one start-up idea that should be chosen from the three ideas that each member has. In addition, students are also asked to determine the type of E-commerce business that must be written on the paper board along with the name of the business and a brief explanation regarding what business they are running. The following is an example of a paper board regarding the name of E-commerce and its brief description in Figure 2.

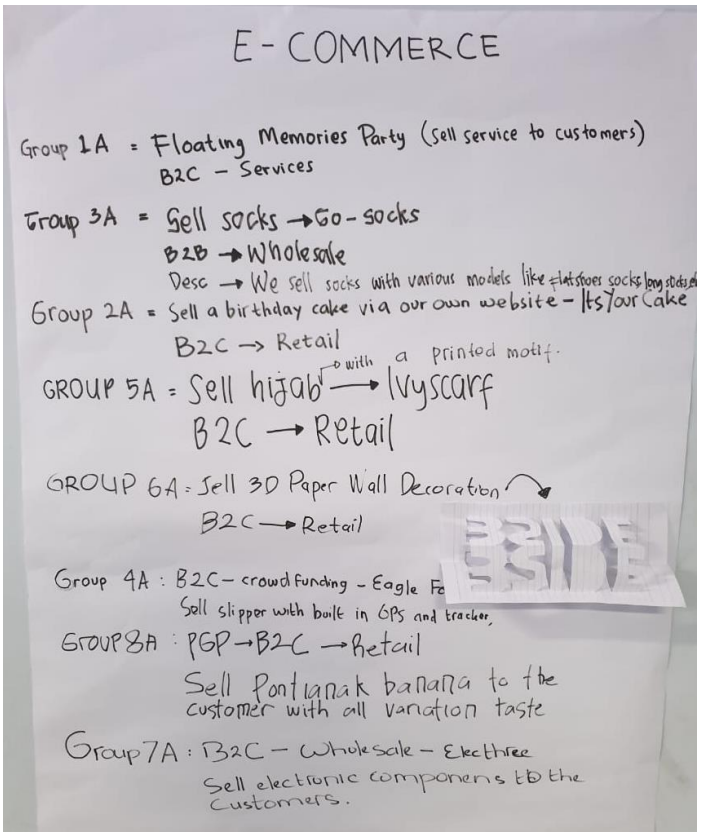

Figure 2 - Paper Board E-commerce Ideas

Assessment

In the second stage of assessment, students were asked to determine a business idea they want, the researcher asks them to discuss what problems will arise in the future. At this stage, students began to discuss and used the evaluation process in critical thinking when predicting the big problems they may face. Each group was required to write down the two main problems written on the provided paper board. The following was an example of a paper board in Figure 3.

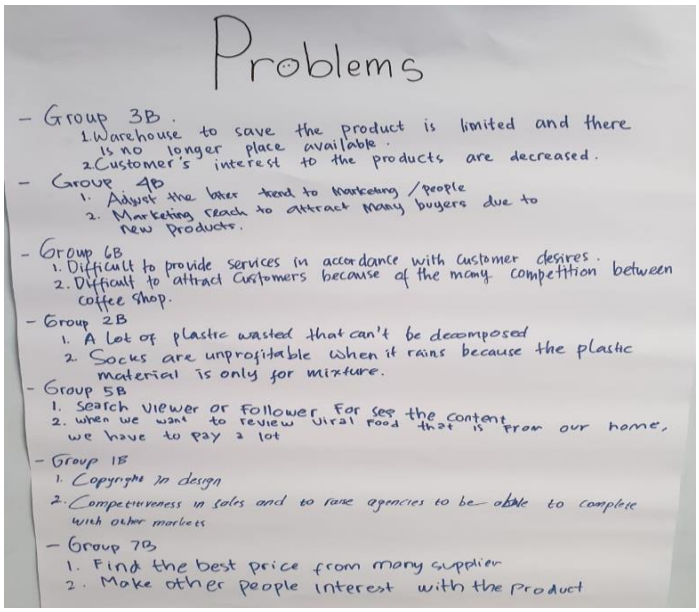

Figure 3 - Predicted Problems in Paper Board

Inference

In this stage, students have finished discussing and started to formulate each problem written on the paper board. After all the problems were written down, the researcher asked other groups to solve problems randomly. Each group should provide solutions to problems from other groups by providing logical reasons and in accordance with their analysis. Students involved their critical thinking when they try find the right solution. They began to seek to draw the right conclusion by deduction and induction. In addition, students also tried to make hypotheses regarding which solution was right for the two main problems on the paper board. Furthermore, they also synthesize each idea in the group while trying to solve the main problem.

Strategies

In the final stage, the researcher asked students to explain the solutions that they have offered to the target group verbally. When solving a problem, they are asked to present each solution in a detailed and structured manner. Additionally, the target group should also ask whether their solution is in accordance with the problem posed. Thus, there was an exchange of opinions regarding the most suitable solution for the problem to be solved. When the two groups have agreed on the proposed solution, the other group members must write the solution on the paper board according to Figure 4. At the end of the activity, the target group assessed the other group members who have presented the previous solutions.

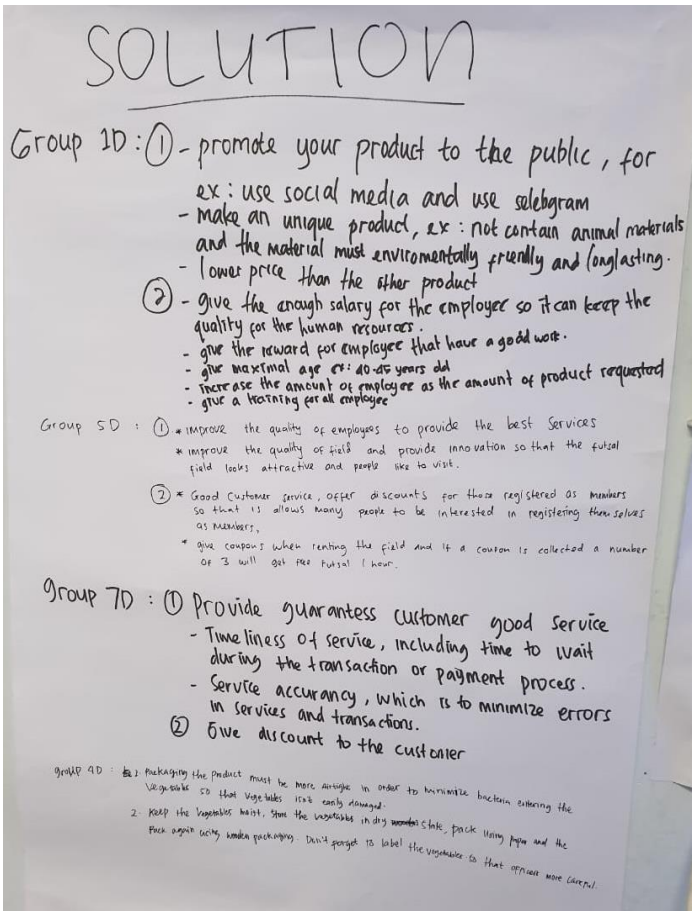

Figure 4 - Offered Solution Results

Questionnaires and observation sheet results

Before applying into the research results, the authors checked the validity and reliability of the research instruments. In this study, two instruments were used, namely (1) questionnaires, and (2) student observation sheets. Students were given both of these instruments online via Google Form after teaching is complete. Next, students filled out the form that has been given according to the data in the class during the discussion. The questionnaire validity data was attached in Table 1.

Table 1. Questionnaire Validity

Correlations			
1	E-commerce1	Pearson Correlation	.719”
2	E-commerce2	Pearson Correlation	.578”
3	Participation1	Pearson Correlation	.792”
4	Participation2	Pearson Correlation	.600”
5	Discussion1	Pearson Correlation	.829”
6	Discussion2	Pearson Correlation	.622”
7	ProblemSolving1	Pearson Correlation	.694”
8	ProblemSolving2	Pearson Correlation	.706”
9	ProblemSolving3	Pearson Correlation	.815”
10	GivingSolutions1	Pearson Correlation	.614”
11	GivingSolutions2	Pearson Correlation	.821”
12	GivingSolutions3	Pearson Correlation	.778”

Since there are 12 presented items, the limit should be more than 0.576 according to r table. After the validity test was done, all questions reached the lower limit of table r. Thus, all 12 of these items were proved valid. The second test was the reliability test, the researcher checked the questionnaire data statistics and still uses the SPSS software. Based on Sujarweni (2014), data could be said to be reliable if Cronbach's Alpha number exceeds > 0.6. From the data calculated using the Cronbach's Alpha method, the number was 0.893 out of the 12 questions in the questionnaire. So, it can be concluded that this questionnaire is reliable.

Table 2. Questionnaire Reliability

Cronbach's Alpha	N of Items
.893	12

The next stage, the authors calculated the results of the questionnaire according to Table 4.3 which listed items, averages, and results. In this instrument data, the value of the questionnaire results is recorded 70-80% as "agree" and "80-100%" as "strongly agree". It is noted that only items number 4 and 10 are below the value of 80%, namely "agree". Both statements include participation and ways of providing solutions to problems. According to

this data, a total of 10 questions in the questionnaire stated that the students "strongly agree" with the positive statements given. Furthermore, detailed questionnaire data for each question is presented in Table 4.3.

Table 3. Questionnaire Results

No.	Item	Average	Results
1	E-commerce1 I understand what e-commerce is, also its type and business model	3,42	85,42%
2	E-commerce2 I can formulate an e-commerce topic and describe it	3,23	80,73%
3	Participation1 I can discuss with other group members about the types and types of e-commerce business models	3,53	88,02%
4	Participation2 In a group, I was able to determine what products to sell along with the type and type of business model	3,19	79,69%
5	Discussion1 I can sort out what problems our e-commerce group will face in the future	3,32	82,81%
6	Discussion2 I can discuss and share with group members to find solutions to problem solving from other groups	3,57	89,06%
7	Problem Solving 1 I can find solutions / troubleshoot problems from other groups	3,42	82,81%
8	ProblemSolving2 I was able to explain how to solve these problems to other groups in a structured manner	3,38	84,38%
9	ProblemSolving3 I can provide arguments and systematic logic on how to solve the problem	3,25	81,25%
10	GivingSolutions1 I read references such as modules, books, or articles to express opinions or provide solutions to problems in other groups	2,82	70.31%
11	GivingSolutions2 I was able to answer questions from other groups	3,32	82,81%
12	GivingSolutions3 I can get other groups to accept the solutions I offer	3,49	86,98%

The next step is to check the observation sheet instrument for students. In the validity test of this second instrument, it was recorded that 15 questions were given. While the r table of the total 15 questions is 0.514, then the value of each questionnaire item must be above that number. Of all items, the overall numbers were recorded to exceed the minimum target of table r which proved valid. The validity test data in detail are shown in Table 4 below.

Table 4. Observation Sheet Validity

	Correlations		
1	E-commerce1	Pearson Correlation	.838”

2	E-commerce2	Pearson Correlation	.902”
3	E-commerce3	Pearson Correlation	.653”
4	Participation1	Pearson Correlation	.913”
5	Participation2	Pearson Correlation	.842”
6	Participation3	Pearson Correlation	.925”
7	Discussion1	Pearson Correlation	.845”
8	Discussion2	Pearson Correlation	.940”
9	Discussion3	Pearson Correlation	.831”
10	ProblemSolving1	Pearson Correlation	.859”
11	ProblemSolving2	Pearson Correlation	.718”
12	ProblemSolving3	Pearson Correlation	.891”
13	Solution1	Pearson Correlation	.838”
14	Solution2	Pearson Correlation	.845”
15	Solution3	Pearson Correlation	.787”

Regarding the reliability test, Cronbach's Alpha score should exceeded > 0.6. In this reliability test, all of the items exceeded the limit. With this result, the questionnaire was proved reliable according to Table 5 below.

Table 5. Observation Sheet Reliability

Reliability Statistics	
Cronbach's Alpha	N of Items
.969	15

Regarding the reliability test, Cronbach's Alpha number from this student observation sheet exceeds> 0.6. In this reliability test there is a value of 0.969 from the 15 items tested. With this, this questionnaire was proved reliable according to Table 6 below.

Table 6. Observation Sheet Results

No.	Item	Average	Results
1	E-commerce1 Students can understand the types of e-commerce business models and types of E-commerce	3,29	83,81%
2	E-commerce2 Students can look for similarities and differences regarding business models and types of E-commerce	3,35	84.37%
3	E-commerce3 Students can share / discuss with group members about E-commerce	3,35	84.37%
4	Participation1 Students can understand the assignments given by the lecturer	3,29	83,81%
5	Participation2 Students formulate e-commerce topic ideas that will be made carefully	3	75%
6	Participation3 Students can briefly explain what E-commerce will be made	3,35	84.37%
7	Discussion1 Students discuss with their group members about making E-commerce	3,41	85,93%
8	Discussion2 Students discuss with their group members about the E-commerce problems they will face	3,29	83,81%
9	Discussion3 Students find E-commerce problems that they will face	3,06	76,56%

10	ProblemSolving1 Students can write E-commerce ideas on the paperboard	3,23	81.25%
11	ProblemSolving2 Students write on paperboards about future E-commerce problems	3,12	78,12%
12	ProblemSolving3 Students discuss with their group members to find solutions to E-commerce problems in other groups	3,41	85,93%
13	Solution1 Students write on paperboard about E-commerce problem solving solutions	3,35	84.37%
14	Solution2 Students come to the target group, and explain how and why the proposed solution solves the problem	3,47	85,93%
15	Solution3 Students come to the target group, and explain how and why the proposed solution solves the problem	3,41	85,93%

The questionnaire data showed that students can develop critical thinking after implementing problem-solving methods. It was noted that almost all students agreed that this method could improve their abilities. Meanwhile, only two statements from the students agreed and indicated 70% and 79% if this method was appropriate.

Furthermore, regarding the observation sheet, the lecturer was not only carried out the observation sheet himself but also asked students to cross-check the work of their peers to make it more effective. In addition, they could provide feedback to fellow students if there were problems that cannot be resolved or were not good at conveying problem solutions. According to the observation sheets that have been carried out by students, the feedback they provide regarding this teaching is indicated as positive. They also appreciated each solution from other groups after discussing their respective opinions.

Related to the constraints of lecturer observations on students, the lecturer notes important things that need to be considered for future researchers, especially on research subjects. Considering that this research was conducted in a large class with approximately 50 students, they often had limited space and were distracted by other groups who were discussing it. In addition, more than one sheet of paper board should be provided to maximize the time they take turns writing.

Some students also looked confused after discussing with other groups, this was because they had difficulty finding a comfortable discussion place due to the narrow space. The next point was the frequent use of code switching by students, which they were forced to do when they could not find the appropriate vocabulary. Besides that, lecturers also could not keep checking their English because of the large number of students who have to be monitored.

CONCLUSION

Based on the explanation above, it could be concluded that the research can improve students' soft skills, namely team work, critical thinking, and problem solving. Students were also mastered the skills well even though they faced some obstacles in the field. Further, these skills had to be mastered by students in preparing themselves to face

competition in the industrial era 4.0. By applying these three skills, they could possibly meet the workforce with a prepared mindset and ideas.

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