

ICT ASSISTED PROJECT-BASED LEARNING MODEL TO IMPROVE STUDENTS' CRITICAL THINKING SKILLS

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Abstract: This study aims to develop students' learning by employing ICT in a project-based learning (PBL) model to improve students' critical thinking skills in economics subject. A Research and Development design was applied in this study by using exploratory and quasi-experimental methods with a non-equivalent control group pretest-posttest design. This study involved students of XI IPS class at SMAN 1 Kadugede. The collected data from tests, observations, and focus group discussions were then analyzed using quantitative and qualitative methods. As a result, this study obtained a learning model and learning media in the form of syllabus, lesson plan, teaching materials, observation sheets, and tests for critical thinking skills that can be used in the economics subject at SMAN 1 Kadugede. Besides, this study also proved that the ICT assisted project-based learning (PBL) model is effective in improving students' critical thinking skills as well as students' enthusiasm for expressing their opinions, suggestions, and input on the topic being discussed.

Keywords: ICT; critical thinking skill; project-based learning.

INTRODUCTION

In order to compete and succeed in the global world, critical thinking has become essential (All et al., 2021; Li et al., 2021). Students' critical thinking skills can be developed when education is not only directed at mastering and understanding concepts or materials, but also at improving students' thinking skills by involving them in meaningful learning activities. It has also been viewed as one of education's main goals (Merta et al., 2023).

One of these educational aims is learning that can develop students who are competitive, imaginative, creative, and able to think critically

(Mogea, 2022; Sobri et al., 2020). According to Aristin and Purnomo (2022), Dwyer and Walsh (2020), Gökçearsan et al. (2019), and Jatmaiko et al. (2018), critical thinking is an intellectual process that is actively used to conceptualize, apply, analyze, synthesize, and evaluate information obtained through observation, experimentation, reflection, and communication. It also involves taking action. When deciding between right and wrong, critical thinking is also used (Nawawi & Wijayanti, 2018). In this case, students' thinking skills are directed at skills in taking action as well as in connecting and associating their experiences with the materials to

deal with the problems being discussed. Hence, it is clear that, in carrying out teaching and learning process, teachers are not only required to have theoretical understanding, but are also required to have practical experiences. Through effective learning planning, teachers must consistently instill and enhance critical thinking abilities (Ghanizadeh et al., 2020; Wahyudi, 2020).

These two things are crucial as teachers' role is not only conveying materials, but also creating meaningful learning experiences in order to achieve the learning objectives.

In economics learning, one of the students' skills that needs to be developed is critical thinking skill as it can make the learning process more complex and meaningful. Critical thinking skills are useful for processing information to solve a problem. Hence, critical thinking skill becomes an important goal in learning economics. However, in reality, critical thinking skills are less developed during the learning process, especially in economics. In current learning process, teachers are still oriented at conveying the materials, so that students tend to receive more information and have fewer opportunities to develop their critical thinking skills.

Based on the observations and the pre-test results at SMAN 1 Kadugede, it was known that many students had low critical thinking skills, as it can be seen from the fact that they had difficulty in asking and expressing their opinions during the discussion. The pre-test results on students' critical thinking skills are presented in Table 1:

Table 1. *Pre-test results on students' critical thinking skills*

No	Aspect	MCC	Average Score	Category
1.	Critical thinking skills	75	57	Low

From the table, it can be seen that students' critical thinking skills are in the low category. This is supported by the observation results showing that students are not able to analyze, criticize, and draw conclusions from the problem being discussed. In other words, students find it difficult to solve everyday problems because the process of evaluating information is not running well.

During the discussion, it was seen that the students were not brave enough to ask questions or give comments on the information received. Besides, in terms of conveying arguments or

opinions, they tend to use less reliable evidence and less reasonable arguments. It is because the teaching and learning process carried out by the teacher does not provide opportunities for students to participate actively and to put the materials they have learned into practice. Here, the teacher often uses the conventional teaching method where the teacher's role is dominant and the students tend to be passive and less creative.

This study applied a project-based learning (PBL) model as the economics subject contains materials requiring good understanding and high-level thinking skills in order to solve social problems that occur. The goal of project-based learning is to help students develop their competencies by giving them the freedom to choose topics, analyze problems, solve them, and make decisions. It also gives them the chance to work independently to create projects that they can use in their daily lives. PBL can enhance self-directed learning as well (Bruna et al., 2020), which can enhance problem-solving abilities (Buheji & Buheji, 2020). As stated by Titu (2015) and Chen and Yang (2019), PBL is a learning model that seeks to relate everyday problems with technology or school projects. In this case, PBL uses projects or activities as the learning core. Here, the students explore, assess, interpret, and synthesize information to produce various learning outcomes.

According to Abidin (2014), PBL is a learning model that actively involves students in the learning process by having them work on a research activity or complete a particular learning project. In order to solve difficulties, students must combine their critical and creative thinking skills (Isabekov & Sadyrova, 2018; Ridlo et al., 2020). This requires them to recognize problems. Therefore, PBL encourages students to be more active, independent, and creative in solving problems. Therefore, PBL can be used to overcome learning problems, especially in terms of helping students express their opinions, ask or answer questions, and be more active during discussions.

The two most important pillars of today's worldwide educational environment are critical thinking and technology (Tathahira, 2020). Technology integration helps students enhance their ability to think critically. Furthermore, one of the efforts that can be made to improve learning quality is the use of information and communication technology (ICT), which can be combined with PBL.

According to Apriani et al. (2020), ICT is a good fit for many facets of education, including lesson design, method, processes, media, content, and assessment. Reading books, writing on the chalkboard to explain chapters and topics, and taking notes in their books are no longer the only methods of instruction in the classroom (Gurunath & Samanta, 2022). In this digital era, learning cannot be separated from the use of technology. The use of technology is believed to be able to create a higher learning quality. In fact, the versatility and unobtrusive nature of modern technology make learning more appealing to the future generation (Haleem et al., 2022), as well as more motivating and meaningful for students (Kumar et al., 2022). Technology offers many real-world issues that can be exploited to encourage students' critical thinking, and it also gives them a platform to openly express and present their arguments (Jannah et al., 2020; Rusdin, 2018).

This is in line with Susilo (2016), who states that, in addition to choosing the right teaching method, teachers must also pay attention to the paradigm shift in 21st century learning, where information is available and accessible anywhere and at any time. This shift has changed conventional or traditional learning methods into modern methods assisted by ICT. The rapid advancement of technology is seen as both a requirement and an opportunity to raise the standard of education around the globe (Wiranda et al., 2020). UNESCO even requires all countries, both developed and developing, to get access to ICT and to provide the best educational facilities.

METHOD

This Research and Development (R&D) used the ADDIE development model, aiming at developing an ICT assisted project-based learning model. The ADDIE development model consists of five stages, namely analysis, design, development, implementation, and evaluation. This development model is more rational and complete than other models, e.g., the development model by Dick and Carry (1996).

RESULTS AND DISCUSSION

The results of the study conducted on the development of the ICT assisted project-based learning model to improve students' critical thinking skills will be discussed based on the stages carried out using the ADDIE development

model, namely analysis, design, development, implementation, and evaluation.

Analysis

Potential problems arising in this study can be detected during the analysis stage. At this stage, the main activity is to analyze the need to develop a new learning model, as well as the feasibility and requirements for developing a new learning model. The development of a new learning model begins with a problem in the existing model. Problems can occur due to the irrelevance of the existing learning model to the target needs, the learning environment, the technology, and the student characteristics. The analysis stage can be carried out by answering the following questions: 1) whether or not the new model or method is able to overcome the learning problems encountered; 2) whether or not the new model or method has enough facilities to be implemented; and 3) whether or not the teacher is able to apply the new model or method. In this analysis stage, it should not be a case where a good model or method cannot be implemented due to some limitations, e.g., there are not enough facilities to support its persistence or teachers' inability to implement the new model or method. Hence, the analysis of a new learning model needs to be done to determine its feasibility.

At the analysis stage, an introductory study was carried out in class XI IPS 2 at SMAN 1 Kadugede. This class has received economics material on employment and has done five questions with levels C4, C5, and C6 related to students' critical thinking. Besides, a non-formal interview has also been done with an economics teacher related to students' critical thinking.

The ICT assisted project-based learning model has been tested and is relevant for use in economics learning activities in class XI IPS at SMAN 1 Kadugede. The application of each step in the ICT assisted project-based learning model is designed according to the needs and leads to a more integrated learning concept. By emphasizing students' activities on contextual learning at the beginning, the ICT assisted project-based learning model can train students to solve problems in a cooperative and collaborative manner and is oriented towards improving their' critical thinking skills.

The implementation of the ICT assisted project-based learning model is effective in improving students' critical thinking skills. In this case, students' thinking habits in integrating knowledge and building productive attitudes will

be able to improve their critical thinking skills. The general objective of education is not only to transfer knowledge, but also to improve learning skills. Thus, the ICT assisted project-based learning model can present effective learning criteria. Here, the majority of students have positive perceptions and attitudes towards learning, seek to broaden and deepen their knowledge, are able to apply knowledge, skills, and attitudes in an integrated manner, and build productive behavior and thinking habits.

Furthermore, the implementation of the ICT assisted project-based learning model is also able to improve students' enthusiasm for expressing their opinions, suggestions, and input on the topic being discussed. Further, based on the post-test results, there is a high increase in students' scores when the ICT assisted project-based learning model is applied in the experimental class. It reflects that this model is able to help students create a productive and meaningful learning activity that leads to the improvement of students' critical thinking skills.

Design

At this stage, an improvement to the ICT assisted project-based learning model will be carried out by referring to the analysis results done at the beginning of the study. The final result expected at this stage is the improvement of the ICT assisted project-based learning model. The activities carried out at this stage are reviewing documents in the form of an ICT assisted project-based learning model, a lesson plan, a syllabus, as well as complex multiple-choice questions to measure students' critical thinking skills.

Development

The development stage in the ADDIE model contains product design realization activities. In the design stage, a conceptual framework for implementing the new learning model has been prepared. In the development stage, the conceptual framework is realized into a product that is ready to be implemented. When a conceptual framework has been designed to implement a new learning model at the design stage, learning media, such as lesson plans and teaching materials, are prepared at the development stage by referring to the new learning model.

Implementation

After validating, a limited product trial was carried out on students. The limited trials were

carried out in class XI IPS 1 as the experimental class and class XI IPS 3 as the control class. The number of students in class XI IPS 1 was 33 students and 31 students in class XI IPS 3. After the limited trial, an evaluation was carried out before testing the product to all XI IPS classes at SMAN 1 Kadugede.

This limited trial was carried out by referring to the material prepared by the researchers. The learning activity begins with a prayer and then continues with a brief direction from the economics teacher to the students. This brief relates to the limited trial that will be carried out so that students feel comfortable with the presence of new people in class. During the discussion, students began to dare to express opinions, and other students responded critically (marked by various responses and questions). The learning atmosphere becomes quite conducive as it involves students' active participation.

In general, during this limited trial, students are very active, passionate, and enthusiastic in discussing employment in Indonesia, both in analyzing the meaning of employment and identifying factors affecting employment opportunities, types of workforce, efforts to improve workforce quality, wage systems, as well as problems arising in employment in Indonesia.

After carrying out limited trials in classes XI IPS 1 and XI IPS 3 at SMAN 1 Kadugede, the ICT assisted project-based learning model was evaluated. The points highlighted on the expert judgment are shown as follows.

Model Name. The model name is recognized when it is applied in the learning process so that there is a difficulty at first. Yet, after the third limited trial, it can be seen that the model is effective in improving the learning quality. This model is considered to be able to provide an alternative learning model so that economics learning becomes more powerful and is able to improve students' critical thinking skills. In this case, the model can help students connect the teaching materials with their prior knowledge.

Model characteristics and concept. After a limited trial, it is known that the ICT assisted project-based learning model has a distinctive feature in improving students' critical thinking skills. The evaluation refers to an assessment result showing that, based on its characteristics, this model can be applied in order to form a systematic, structured, and knowledge-based mentality and way of thinking, which then leads to critical thinking habits. Therefore, this model can also be designed more simply to be

implemented in lower grades, such as junior high school or elementary school levels, in order to train students from an early age to think critically, especially in solving social problems within themselves or their surroundings.

Syntax/Learning Stage. Referring to the learning stages, this model is effective in creating an effective and qualified economics learning in class XI IPS SMAN1 Kadugede, especially in terms of improving students' critical thinking skills. Here, in the core activities, students are directed at constructing their prior knowledge and critically discuss questions on employment and unemployment issues, as well as their countermeasures.

After the limited trial, the revised version of learning media was then tested extensively in 4 classes, namely XI IPS 1 with a total of 33 students and XI IPS 2 with a total of 32 students as experimental classes, and XI IPS 4 with a total of 31 students and XI IPS 5 with a total of 31 students as control classes. In each trial, the researchers were accompanied by an economics teacher.

The effectiveness of the ICT assisted project-based learning model is assessed qualitatively and quantitatively. Qualitatively, the effectiveness of the ICT assisted project-based learning model is assessed based on the learning activities. In this case, students' critical thinking skills can be identified based on their activities in expressing opinions as well as making analyses and providing solutions on certain issues. Meanwhile, quantitatively, the effectiveness of the ICT assisted project-based learning model is assessed based on the results of critical thinking tests given at the beginning (pre-test) and at the end of the learning process (post-test). A further description of the effectiveness of the ICT assisted project-based learning model is presented as follows.

Detailed observations were carried out on each student during the learning process. This activity is purposely designed to measure whether or of the ICT assisted project-based learning model is in line with its purpose to improve students' critical thinking skills.

From the observations, it can be seen that there is an increase in students' thinking quality and

habits in each meeting in the four classes, namely class XI IPS 1, XI IPS 2, XI IPS 4, and XI IPS 5. In this case, there are some points highlighted: 1) students showed high enthusiasm during the learning process, 2) students were able to provide solutions and new ideas to solve problems and issues on employment in Indonesia contextually during the presentation, and 3) students' thinking activities were more constructive and contextual.

Accordingly, it is clear that the ICT assisted project-based learning model is effective in improving students' critical thinking skills. Implementing this learning model is able to increase students' active participation in the teaching and learning process. Here, students' active participation is crucial in creating a student-oriented learning atmosphere and can help improve students' critical thinking skills, resulting in a qualified and effective learning process.

Quantitatively, the effectiveness of the ICT assisted project-based learning model is assessed based on the results of critical thinking tests given at the beginning (pre-test) and at the end of the learning process (post-test) using inferential statistics. Referring to the pre-test and post-test results carried out in four classes, it can be concluded that an improvement in students' critical thinking skills was identified in the majority of students. As the result of the paired sample t-test showed that the scores for the four classes was a sig. $0.000 < 0.05$ and t-count was greater than t-table. This indicates that there is a significant difference in students' critical thinking skills before and after implementing the ICT assisted project-based learning model.

Furthermore, the results of the normality and homogeneity tests showed that the pretest and posttest data for the experimental and control class were normally distributed and homogeneous. As the data were normal and homogeneous, the next step was hypothesis testing using an independent sample t-test. The hypothesis is that the ICT assisted project-based learning model is effective in improving students' critical thinking skills. The result of the hypothesis testing is presented in Table 2 and 3.

Table 2. Hypothesis testing results of the experimental class (XI IPS 1 and XI IPS 2)

Levene's Test for Equality of Variances		t-test for Equality of Means			Sig. (2-tailed)
F	Sig.	t	df		

	Equal variances assumed	6.785	.011	2.605	63	.005
HOT	Equal variances not assumed			2.605	43.077	.005

Table 3. Hypothesis testing results of the control class (XI IPS 4 and XI IPS 5)

				Levene's Test For Equality of Variances	t-test for Equality of Means			
				F	Sig.	t	df	Sig. (2- tailed)
HOT	Equal variances assumed			.044	.835	.210	57	.041
	Equal	varances	not assumed			.210	7504.383	.041

Based on the data, it can be seen that the sig. (2-tailed) < 0.05 meaning that the ICT assisted project-based learning model is effective in improving students' critical thinking skills.

Final model

The final model, named an ICT assisted project-based learning model, has been tested both conceptually and practically. In this case, the conceptual test was carried out to assess the model's feasibility using expert judgment. Meanwhile, the practical test was carried out through an experimental process in XI IPS class at SMAN 1 Kadugede. The determination of the final model was carried out after going through the refinement stage and being validated by expert judgment. Here, the validated model is a hypothetical model whose validity has been tested through expert judgment and field tests.

The validated model is the effectiveness testing result in a series of field tests in the form of learning practice carried out in two stages, namely limited and extensive trials. The limited trials were conducted in two classes, namely XI IPS 1 and XI IPS 3 SMAN 1 Kadugede. The results of the limited trials showed deficiencies in each model application, as described in the form of quantitative and qualitative data above. Various weaknesses and recommendations obtained from the limited trials were used as basis for a revised model. This revised model was then used for extensive trials.

Meanwhile, the extensive trials were conducted in four classes, namely XI IPS 1, XI IPS 2, XI IPS 4, and XI IPS 5 of SMAN 1 Kadugede. The results of these extensive trials were then used as the basis for refining the model. The revised model, which has been tested for its effectiveness in the first stage, was re-tested for its effectiveness in the second stage through extensive classroom practice. After assessing the

processes and results, the model was refined to create the final formulation. In the process toward the final model, the ICT assisted project-based learning model has followed development standards. As Joice and Weil (in Widada, 2011) emphasized, a learning model is a conceptual framework describing a systematic procedure for organizing learning experiences to achieve certain learning goals and serves as a guide for teachers in designing and implementing learning activities. Hence, developing the ICT assisted project-based learning model followed these steps: 1) Designing a learning syntax that clearly describes the ICT assisted project-based learning model, 2) Designing social systems or learning environments, namely situations or atmospheres and norms governing activities, interactions, and communication among students or between students and teachers during the learning process, 3) Designing a reaction principle, namely giving an overview to the teacher of how to treat students as learning subjects who have perception, imagination, experience, and reasoning, as well as how the teacher's behavior is in facing and responding to students' behavior during learning, 4) Designing a support system, namely the terms or conditions needed to implement the learning model being designed, and 5) Designing the impact of learning, both instructional and accompaniment impact. After carrying out extensive trials and final refinements, the final model was formed.

Evaluation

At this stage, an evaluation of the results obtained in the previous stages was carried out. This evaluation was in the form of a formative evaluation, namely an evaluation carried out by researchers during the process of developing the learning model, lesson plan, and syllabus. The results of this formative evaluation were in the

form of an overview of the advantages and disadvantages of the learning model, lesson plan, and syllabus.

Based on the processes and procedures implemented, the development of the ICT assisted project-based learning model has been able to meet the formulated standards of a learning process. In limited and extensive trials, the ICT assisted project-based learning model has been implemented effectively, where students' learning outcomes show a satisfactory level of achievement. Besides, the observations show that the ICT assisted project-based learning model is running well in terms of: 1) Efficiency – this model has utilized supporting resources to achieve the formulated goal, namely improving students' critical thinking skills, and 2) Attractiveness – the ICT assisted project-based learning model is able to create a fun and exciting learning process for students. In limited and extensive trials, it was found that the ICT assisted project-based learning model can bring up students' enthusiasm and motivation in the learning process. The students were stimulated to ask questions, discuss certain issues, and convey ideas and opinions. In relation to employment issues in Indonesia, students have been able to identify problems, analyze impacts and causes, find solutions to unemployment issues, and think about taking practical actions.

The results of the data analysis on limited and extensive trials showed the effectiveness of the implementation of the ICT assisted project-based learning model. Hence, it can be concluded that this model is effective in improving students' critical thinking skills. Besides, the results also indicated the importance of associating students' prior knowledge with the facts that occur in the surrounding environment. As stated by Haladyna and Shaughnessy in Stahl (2008, p. 8), both the teachers' strategies and the learning environment play a crucial role in forming students' critical thinking skills. Effective strategies will stimulate students to be able to analyze, interpret, respond, evaluate, and create (Shukla & Dungsungnoen, 2016).

The statement is supported by Arends (2013, p. 29) and Noor (2009, p. 62) who say that what knowledge students receive depends on what is taught by the teacher. Therefore, learning must shift from learning to remember to learning to think. In the end, the final goal to be achieved from the learning process is for students to have basic skills for logical and critical thinking, curiosity, inquiry, and problem solving, as well as

social skills. It is well known that the critical thinking skill is crucial as it is one of the contents to be achieved in the learning process, especially in economics learning where students have to be able to think logically and critically to understand concepts and principles related to patterns and spatial distribution, social interaction, and community development to create better living conditions and/or overcome problems. In order to facilitate teachers in achieving educational goals, the ICT assisted project-based learning model can be directly implemented in the learning process. This is in accordance with the results of Islamiyah and Lestari's research (2018) which shows that there is an influence of the teaching aids-assisted project-based learning model on students' critical thinking skills. Besides, Puspitasari and Wulandari (2022) also stated that there is an influence of the project-based learning model on students' higher order thinking skills.

The implementation of the ICT assisted project-based learning model has stimulated students' enthusiasm for carrying out a more oriented learning process towards their critical thinking skills. The point is the more effective the learning is designed, the better the results will be achieved. Therefore, learning must shift from learning to remember to learning to think. Finally, it can be concluded that the development of the ICT assisted project-based learning model is able to facilitate teachers' application of 21st century learning and endorse students' critical thinking habits.

CONCLUSION

Based on the analysis, it can be concluded that the implementation of the ICT assisted project-based learning model is effective in improving students' critical thinking skills. In this case, students' thinking habits in integrating knowledge and building productive attitudes will be able to improve their critical thinking skills. Besides, implementing the ICT assisted project-based learning model to the learning process is able to improve students' enthusiasm for expressing their opinions, suggestions, and input on the topic being discussed. Further, based on the post-test results, there is a high increase in students' scores when the ICT assisted project-based learning model is implemented in the experimental class. It reflects that this model is able to help students create a productive and meaningful learning activity leading to students' critical thinking skills improvement.

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