Journal of Innovation in Educational and Cultural Research

Volume 4 Issue 4 Year 2023 Pages 580-586
ISSN 2722-9688 | e-ISSN 2722-9696
http://jiecr.org | DOI: 10.46843/jiecr.v4i4.791

Inquiry-Based Learning on Students' Critical Thinking Skills at Aviation Vocational College

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Abstract: This study aims to examine the influence of the Inquiry-Based Learning model on students' critical thinking skills in two locations, namely Makassar Aviation Polytechnic and Surabaya Aviation Polytechnic. The research sample consisted of 48 learners selected in total sampling. The research method used was a pretest-posttest design with a single group (one group pretest-posttest design). Data were analyzed using an independent T-test, and the findings indicated that the Inquiry-Based Learning model did not significantly affect students' critical thinking skills. This suggests that other variables did not lead to a decline in critical thinking skills (variable Y). However, it's important to note that this study lacked a comparison or control group, which limits the generalizability of the results. Future research could enhance our understanding by incorporating additional variables or increasing the sample size to further explore the impact of the Inquiry-Based Learning model on students' critical thinking skills, thereby contributing to the advancement of educational science.

Keywords: Inquiry-based learning, critical thinking skills

Recommended citation: Sabur, F., Kona, M., & Suprapto, Y. (2023). Inquiry-Based Learning on Students' Critical Thinking Skills at Aviation Vocational College. *Journal of Innovation in Educational and Cultural Research*, *4*(4), 580-586.

INTRODUCTION

The Aviation Polytechnic, under the auspices of the Ministry of Transportation, refers to the change in terminology on July 29, 2020, which has begun to adapt to technological development in the application of learning concepts. The use of technology in education is generally referred to as e-learning. E-learning is an alternative to traditional education in a planned learning process that occurs in different places from regular schools (Kumar Basak et al., 2018; Oliveira et al., 2016). Horton (2011) defines e-learning as a set of instructions delivered through all electronic media such as the Internet, intranet, and extranet (Alabaddi et al., 2016; Haleman & Yamat, 2021; Kattoua et al., 2016). Technological developments also show several things; first of all, is the openness and ability of students to use I.C.T. (technology savvy). Communication systems that utilize commonly used internet facilities are blogs, Friendster, SMS/WhatsApp, chat, social networking, instant messaging, and email are the main parts currently used to communicate. The conventional learning concept causing the boredom of students in receiving material transfers from lecturers is one of the factors that triggered the birth of the e-learning-based learning process. Students who often have problems absorbing material from lecturers or seem slow to absorb material from lecturers are expected to be helped by the e-learning-based learning process. Students who should study because their lecturers cannot attend or students who participate in non-academic competition activities assigned to represent the campus can make students miss the material or not receive the material as a whole.

The application of the e-learning-based learning process, in addition to helping lecturers and students in facilitating the teaching and learning process, is also so that students can more wisely use the internet to minimize students to open harmful sites but more in a positive direction. Student-centred Learning allows students to more easily access all available and accessible learning resources using I.C.T. The completion of several sub-subjects was also given by lecturers to students by applying different learning models, including inquiry-based Learning. The origin of inquiry-based Learning (I.B.L.) is rooted in Dewey's pioneering work, which states that the learning process is based on the control of experience through inquiry theory, which is characterized by the scientific method and its principles of experimentation, generalization, and verification (Choowong & Worapun, 2021; Decker-Lange, 2018; Laudano et al., 2020) while Iskandar et al. (2019) state that Inquiry is a learning approach that involves students in finding and using various sources to increase particular understanding of the material. This inquiry-based Learning is applied at Makassar Aviation Polytechnic and Surabaya Aviation Polytechnic. The results of Hanafi and Samsudin's (2012) research on Mobile Learning Environment System (MLES): the case of android-based learning application on undergraduates" learning

(Mobile Learning Environment System). Research conducted to investigate the impact of such an environment enabled by Android platforms on the learning process among undergraduate-level learners at Sultan Idris University of Education, Malaysia, showed that respondents were very receptive to the interactivity, accessibility, and convenience of the system but they were pretty frustrated with occasional interruptions due to internet connectivity issues. Overall, the online mobile learning system can be utilized cheaply and powerfully to complement the learning process of learners. The definition of Learning, according to Slameto (2010), is the process of a person's efforts to change behavior as a whole based on the experience of interacting with their environment (Hidayati & Ismail, 2018; Nadeak & Naibaho, 2018; Rahman & Erianjoni, 2022; Sriyono & Nur'aisyah, 2018; Zahra et al., 2022) while according to Djamaludin (2019), learning is a process or effort made by each individual to obtain behavioral changes, both in the form of knowledge, skills, attitudes and positive values as experience from various materials that have been learned (Novianti et al., 2022). Theories about passive Learning, according to Kosmiyah (2012), namely cognitive learning theory, humanism learning theory, cybernetic learning theory, and behavioristic learning theory. Learning is the meaning of mastering science through the results of experience, the process of remembering, the process of mastering knowledge, and the consequences of obtaining information or findings (Kannapiran et al., 2018) According to Idi (2011), implementation is applying ideas, concepts, policies, or innovations in practical actions to impact changes in knowledge, skills, values and attitudes.

The implementation of Learning, is the action or implementation of a plan prepared carefully, systematically, and in detail in implementing the learning process. In simple terms, the implementation of Learning can be interpreted as implementation in Learning, as presented by Uno (2012). Kuntarto (2017) suggests that the online learning model is effectively used in Indonesian lectures in the undergraduate program. The online learning model has increased students' exposure to lecture material, with an increase of more than 81% compared to only using the face-to-face learning model. Unlimited time and space is the reason for improving student learning outcomes. The need for information that could be obtained quickly began to be felt as an absolute necessity, and distance and location were no longer obstacles. This is where LMS comes from. Learning Management Systems (L.M.S.) is a popular Internet technology that has supported remote, face-to-face, and hybrid/blended teaching and learning processes (Fathema et al., 2015). The rapid development of L.M.S. does new thinking to traditionally overcome interoperability problems between LMS and one another. Emerging forms of standards include standards issued by AICC (Airline Industry CBT Committee), IMS, IEEE LOM, and ARIADNE. 1999 is the year of Web-based E-learning Applications. The development of LMS towards Web-based e-learning applications is growing totally, both for learners and teaching and learning administration. LMS began to be combined with information websites, magazines, and newspapers. E-Learning infrastructure can be personal computers (PCs), computer networks, internet, and multimedia equipment. E-Learning Systems and Applications are often called software systems that virtualize conventional teaching and learning processes.

The content and teaching materials in the e-learning system (Learning Management System) can be in the form of Multimedia-based Content (interactive multimedia) or Text-based Content (text in the form of text as in ordinary textbooks). Learning objectives are the achievement of learning outcomes that students will have after going through the learning process in the form of behavior that can be observed and measured as a determination of whether students have achieved the competence of learning goals. To carry out the learning process, thinking about the right learning strategy or method is necessary. Learning methods or strategies set by teachers should bring students to learning processes that allow the achievement of learning goals both in cognitive, affective, and psychomotor aspects, not just learning products that, in fact, only emphasize the cognitive aspect. According to Sumiati and Asra (2009), the accuracy of using learning methods or strategies depends on the suitability of learning methods, learning materials, teacher abilities, student conditions, sources or facilities, situations and conditions, and time. The learning approach can be interpreted as a point of departure or our point of view on the learning process, which refers to the view of the occurrence of a process that is still very general, in which it accommodates, inspires, strengthens, and underlies learning methods with a particular theoretical scope.

The learning approach is the teacher's way of choosing learning activities, flexible but straightforward and planned. Teachers consider students' needs, interests, and learning styles when choosing activities. The aim is to create an engaging and effective learning environment for all students. An exciting and effective learning environment will undoubtedly affect many components, one of which is influencing the achievement of educational goals in the 21st century, namely the ability to think critically. Critical thinking is the main focus of the learning process in the 21st century (Birgili, 2015; Fuad et al., 2017; Samri et al., 2020). Critical thinking skills are part of analytical or higher-order thinking skills (Azizi-Fini et al., 2015; Changwong et al., 2018; Suardana et al., 2018). One way to discover critical thinking skills is to see what someone does in facing and solving a problem (Hidayat et al., 2022; Rismayanti et al., 2022). Therefore, it is said that critical thinking skills are an ability that can create strong thinkers and reliable problem solvers (Astuti et al., 2022; Ningsih et al., 2018). Based on the description above, this research aims to examine the effect of the Inquiry-Based Learning

model on students' critical thinking skills in two locations, namely Makassar Aviation Polytechnic and Surabaya Aviation Polytechnic. To achieve the research objectives, what was done was to provide treatment to the experimental class, namely the inquiry-based learning class.

METHODS

This study used Pre-Experimental Design research method, with One-Group Pretest-Posttest Design research design (Sugiyono, 2014). In this research design, a single group of participants were pretested. Then researchers gave treatment and collected posttest data on the same measure. If a significant difference is found in the scores between the pretest and posttest, then treatment is considered helpful (Ma et al., 2019). The research was conducted at Politeknik Penerbangan Makassar and Politeknik Penerbangan Surabaya with a population of 48 people, with the number of samples in this study being a whole sample of the existing number of samples.

The research conducted was to treat the experimental class, namely the inquiry-based learning class. The research design used was a Nonequivalent Control Group Design with pre-test and post-test types. The type of data used in this study was quantitative data in the form of the number of students, the results of questionnaires, and the results of academic assessments of students. Data analysis techniques and data validation using the normality test were calculated using the Kolmogorov-Smirnov test with the SPSS program. The homogeneity test was calculated using the Lavene Statistic test with the SPSS program; The hypothesis test was carried out by performing a t-test. The t-test was carried out after the data was declared normal and homogeneous. The t-test was performed using the SPSS program.

RESULT AND DISCUSSION

Validity of critical thinking skills instrument trial questions consisting of 10 essay test questions used the SPSS program. The Critical Thinking Question Validity Test Table (source: 2022 research result data), shows that the corrected value of item-total correlation in question items 1, 4, 6, 9, and 10 < r_{table} = 0.444 so that the question item number is declared invalid, while the other 5 question items are questioned items number 2, 3, 5, 7, and 8 > r_{table} so that the question item is declared valid. The assessment of learning outcomes shows that the corrected value of the item-total correlation of question items 2, 6, 15, 19, and 20 < r table = 0.444 while the other 17 questions are question items number 1, 3, 4, 5, 7, 8, 9, 10, 11, 12, 13, 14, 16, 17, 18, 21 and 22 > r_{table} so that the question items are declared valid. Based on the reliability test of the instrument using the SPSS program, it was obtained that Cronbach's alpha obtained in the critical thinking question item was 0.641, then the question was declared reliable as stated in the table below.

Table 1. Instrument Reliability Test

Cronbach's Alpha	N of Items
0.641	10

Table 2. Critical Thinking Normality Test Pre-test

Class	Sig.	Sig.2 value criteria Tailed Table > α (0.05)	Conclusion Sig.>0.05 (normally distributed)
Inquiry-based Learning	0,358	0,05	Normally distributed

The Normality Test of critical thinking shows that the pre-test value in the inquiry base learning class, a significant pre-test value of 0.358 > α (0.05), was obtained, so in this study, the data came from normally distributed data so that it could be continued with the homogeneity test.

Table 3. Post-test Critical Thinking Normality Test

Class	Sig.	Sig.2 value criteria Tailed Table > α (0.05)	Conclusion Sig.>0.05 (normally distributed)
Inquiry-based Learning	0,741	0,05	Normally distributed

The normality value of critical thinking during the post-test in class showed that in the inquiry class, a significant post-test value of 0.741 > α (0.05) was obtained, so in this study, it came from customarily distributed data so that it could be continued with the homogeneity test.

Table 4. Homogeneity Test

Validity	Category	Question Point
rcalculate> rtabel	Valid	2, 3, 5, 7, 8
rcalculate< rtabel	Invalid	1, 4, 6, 9,10

The homogeneity test in this study using the Lavene Statistic test with the SPSS 16 program showed significant results on critical thinking questions in both classes at pre-test 0.537 and post-test 1.214. The result > 0.05, so it can be concluded that the data above is homogeneous.

Table 5. Independent T Test

	Variable	Phase	Sig.	Sig.2 value criteria tailed table > α (0.05)	Conclusion Sig.>0.05 (normally distributed)
Levene Statistic	Think critically	*Pre-test*	0,537	0,05	Homogeneous Data
		Post-test	1,214		

The hypothesis test in this study using an independent t-test showed that the results of testing the critical thinking skill hypothesis for the independent t-test obtained a sig (2-tailed) result of <0.05, which is 0.00; this shows that H0 is rejected and H1 is accepted. Linear regression analysis aims to determine the influence of independent variables (X) in this study, inquiry-based Learning (X), on dependent variables (Y) with critical thinking skills (Y). Based on the table of Test Coefficients X to Y, there is a value of Unstandardized Coefficients (β), which can be explained by a double regression equation in this study.

Based on the table of Test Coefficients X against Y1, there is an Unstandardized Coefficients (β) value that can be explained by a double regression equation in this study. From the regression equation, the conclusions that can be explained are as follows: The constant value (α) of 10.682 with a positive sign states that if the variable X is considered constant, then the value of Y is 10.682; the value of the regression coefficient of the inquiry-based learning variable (X) is 0.082 with a positive sign stating if the level of X increases by one unit assuming the other independent variable is constant, then the ability to think critically will increase by 0.082.

Table 6. Independent T Test

Variable	Class	Phase	Sig. (2-tailed)
Critical Thinking Skills	Inquiry base learning	*Pre-test – Post-test*	0,000

The Multicollinearity Test is part of the classical assumption test (Normality and Heteroskedasticity) in multiple linear regression analysis to test whether the regression model found a correlation (strong relationship) between independent variables. A good regression model should not correlate independent facials or no symptoms of multicollinearity (Jumady & Lilla, 2021; Thompson et al., 2017). Multicollinearity of tolerance and VIF test decision making, according to Ghozali (2011), does not occur symptoms of multicollinearity if the tolerance value > 0.100 and the VIF (Variance Inflation factor) value < 10.00. Based on the results of the multicollinearity tolerance and VIF test obtained from variable, independent learning model (X) data.

Table 7. Test Coefficients X

Coefficients* Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statisstic	
		B	Std. Error	Beta			Tolerance	VIF
1	Inquiry based learning (X)	.065	.075	.096	.614	.522	.442	2.223

Table 8. Test Coefficients X against Y

Coefficients* Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statisstic	
		B	Std. Error	Beta			Tolerance	VIF
1	Inquiry based learning (X)	.191	.058	.269	1.085	.079	.446	2.298

Table 8 shows the results of testing inquiry-based learning (X) on critical thinking skills (Y2). If Ho: β3 = 0, this means that inquiry-based Learning does not have a positive effect on critical thinking skills (Y2). If H3: β3 > 0, this means that inquiry-based Learning has a positive effect on critical thinking skills (Y2). The first hypothesis in this study is that inquiry-based Learning (X) has a positive effect on critical thinking skills (Y2). Based on the

table of Coefficients X Test against Y2 above, it is known that the Significance value (Sig) of the inquiry variable is 0.079. Since the value of Sig. 0.079 > probability 0.05, it can be concluded that H3 is rejected and Ho is accepted. This means that there is no significant effect between inquiry-based learning (X) and critical thinking skills (Y).

The research results obtained are different from the results of research conducted by Duran & Dökme (2016). The results of their research revealed that the inquiry-based learning approach has a significant influence on students' critical thinking skills in science and technology courses. This research aligns the research results of Sutiani et al. (2021). In his research article, it is explained that implementing the learning model developed (inquiry-based learning) in teaching and learning activities is proven to improve students' critical thinking skills. The thinking ability of students is very good, where the achievements obtained range from 72-97%. Rahmi et al. (2019) also express something similar in their article, namely implementation of the inquiry learning model has a positive influence on learners' ability to think critically.

According to another study, the inquiry model helps children develop both their cognitive and critical thinking skills (Adnan et al., 2021). Critical thinking and process skills are inextricably linked in the context of learning through inquiry-based activities. Critical thinking cognitive processes like "inference" are demonstrated by a learner's ability to recognize and ascertain the components required to formulate conjectures and hypotheses, draw reasonable conclusions, take into account pertinent information, and draw conclusions based on data, reports, principles, evidence, judgment, belief, opinion, concept, description, question, or other form of representation (Prayogi & Verawati, 2020). The majority of the prior research has demonstrated that the inquiry-based learning paradigm is the most effective in enhancing students' critical thinking skills.

CONCLUSION

The research findings suggest a noteworthy insight into the impact of various learning models on students' critical thinking skills. In this study, the influence of simultaneous learning models on critical thinking skills (Y) was investigated. Surprisingly, none of the variables within variable X was found to be responsible for diminishing critical thinking skills. Similarly, when examining the effects of the Inquiry-Based Learning model (X) on students' critical thinking skills (Y), the research revealed no significant influence. Furthermore, the study also explored how students' critical thinking skills influenced their learning outcomes when applying different learning models. Through the examination of critical thinking skills and learning outcomes through independent t-tests, the results were significant. The p-value obtained, which was less than 0.05 (0.00), indicated a strong basis for rejecting the null hypothesis (H0) and accepting the alternative hypothesis (H1). This suggests that critical thinking skills indeed play a pivotal role in shaping learning outcomes.

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