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IMPLEMENTATION OF STEM LEARNING WITH A SCIENTIFIC APPROACH TO IMPROVING CRITICAL, CREATIVE THINKING, AND LEARNING OUTCOMES

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ABSTRACT

This research investigates the potential impact of implementing STEM learning with a scientific approach to improve critical thinking, creative thinking, and learning outcomes for Aviation Rescue and Firefighting cadets in the first aid course. Data analysis was performed using quantitative experimental and correlation analysis. The data was processed using IBM SPSS software with the Manova test, n-gain score, and correlation test. The sample in this research consisted of 45 cadets. The results of the MANOVA test show a significance value of 0.032 < 0.05, so the null hypothesis is rejected, and the alternative hypothesis is accepted. The n-gain scores of critical thinking show sixteen with medium criteria and seven with high criteria. The n-gain scores of creative thinking show seventeen with medium criteria and six with high criteria. The n-gain scores of learning outcomes show fifteen with medium criteria and eight with high criteria. The significance value of the correlation test is 0.000 < 0.05, so the null hypothesis is rejected, and the alternative hypothesis is accepted. This research concludes that STEM learning with a scientific approach influences critical thinking, creative thinking, and learning outcomes in the First Aid course. There is a correlation between STEM learning with a scientific approach and critical thinking, creative thinking, and learning outcomes in the first aid course.

Keywords: creativity; critical thinking; learning outcomes; scientific approach;STEM learning

INTRODUCTION

Studying science, technology, engineering, and mathematics (STEM) has recently improved students' understanding of foundational topics. Universities strongly emphasize creative thinking, practice and application, problem-solving, and teamwork to develop students while they learn. In cross-domain knowledge building in STEM, Idrizi et al. (2023) and Su et al. (2022) show that the discipline is evolving toward performing more multi- and interdisciplinary STEM education research and that STEM education research is becoming increasingly recognized as essential in education through publications and citations (Li et al., 2022). STEM education is growing in importance as a long-term investment (Le et al., 2022; Fairhurst et al., 2023). Students solve challenges in class as part of the STEM learning environment. To answer the issue, they draw on two or more STEM fields (Rusydiyah et al., 2021). The learning environment is impacted by STEM education (Roberts et al., 2018; Baucum & Capraro, 2021). How school management tools view STEM instruction and learning is crucial (Vennix et al., 2018; Hatisaru et al., 2020). International recognition has been accorded to the significance of dynamic and productive lear-

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ning environments for STEM fields (Mäkelä et al., 2022). Specific suggestions for enhancing inclusivity, accessibility, and STEM learning for neurodiverse children and teens will be provided by identifying the elements of informal STEM learning programs and the settings in which they have been found to produce favorable outcomes (Basu et al., 2021; Alexandre et al., 2022; Jenson et al., 2023). STEM learning modifies classroom methods or behaviors to add more context from the "real world" into STEM learning activities (Nation & Hansen, 2021; Hurley et al., 2024). Engaging with STEM experts is a crucial aspect of the educational process (Roberts et al., 2018; Yang et al., 2023). In response to the PISA report highlighting Indonesian students' low literacy and numeracy ability levels, the government has increased efforts to raise students' proficiency in these areas (Sari, 2022). To thrive and prepare for the information age, often known as the 21st century, students and teachers must take on various opportunities and challenges (Laksana, 2021; Burhan & Putri, 2022; Elitasari, 2022). Introducing innovation into the educational process is one technique to raise the caliber of human resources, particularly in vocational education. STEM-based learning is knowledge that can be used in vocational education. Students' weak creativity skills due to their lack of active participation in the learning process and their preference for teaching modalities that still rely heavily on lectures is another issue facing education today. To address this, creating a reliable, efficient, and useful STEM-based learning tool is essential (Ridha et al., 2022). Numerous data indicate that many educators in the Industry 4.0 era have not innovated their teaching methods. A solution to this problem must be found to prevent future issues. Among the numerous nations interested in STEM education is Indonesia. In 2019, numerous Indonesian universities began concentrating on STEM education, which is still relatively young in the country (Parmin et al., 2020). STEM education is an innovative approach that connects multiple scientific fields to foster critical thinking and creativity in students (Diana & Turmudi, 2021; Wardani & Ardhyantama, 2021; Haerani & Erna, 2022; Rafli et al., 2022). Teachers must get involved in the learning process because students are not as engaged using traditional learning techniques (Kurniawan, 2018; Cholis et al., 2020; Izzah et al., 2021; Nurmala et al., 2021; Nurya et al., 2021; Viyanti et al., 2021; Handayanto et al., 2022; Dewi et al., 2023). It is possible to measure higher-order thinking skills using a scientific method (Haenilah et al., 2021; Suprihatin et al., 2023). The scientific method produces superior learning outcomes than conventional methods (Maharani et al., 2020; Yafie et al., 2020). Students become more engaged in their education using the 5M scientific method (observing, questioning, collecting data, associating, and communicating) (Rahayu & Kuswanto, 2020; Gallagher et al., 2022). Applying scientifically based learning methodologies significantly improves employability abilities (Syafril et al., 2020). The search method is unquestionably the scientific methodology, sometimes known as the scientific approach (Aka & Mukmin, 2020).

A scientific strategy that enhances critical and creative thinking and improves learning outcomes is required to promote STEM learning. It is necessary to use a scientific method that significantly affects students' learning outcomes (Liana, 2020; Sukmana et al., 2022; Wardani et al., 2022). This scientific method is appropriate for educational applications (Sukmana et al., 2022). To fulfill the 5M (Observe, Try, Reason, Ask, Communicate) goals of national education, the 2013 curriculum requires a scientific approach (Wicaksono et al., 2020). The scientific method is a teaching strategy that allows students to investigate and expound on the subject matter they are studying. It also allows them to develop their skills through teacher-designed learning activities. Thus, learning can be active and autonomous for students who think critically and draw conclusions grounded in scientific principles (Aini, 2023; Priantono et al., 2023; Wahsun, 2023).

Students must master the 4Cs: critical thinking, communication, collaboration, and creativity to succeed in 21st-century learning (Hidayati et al., 2019; Tang et al., 2020; Weng et al., 2022; Muchson, 2023; Novalinda et al., 2023). One of the abilities of the twenty-first century is critical thinking (Astutik et al., 2020; Ristanto et al., 2020; Nussbaum et al., 2021; Huang et al., 2022; Almulla, 2023). Courses, programs, and syllabi at universities all incorporate critical thinking (Bellaera et al., 2021). It is necessary to gain new perspectives and practical advice on enhancing creative thinking skills, inspiring and enhancing learning results, and effectively demonstrating learning (Behnamnia et al., 2020; Barevičiūtė et al., 2023). Creativity and critical thinking are essential in pursuing education and future financial gain (Leest & Wolbers, 2021; Li et al., 2022; Mujanah et al., 2022).

Helping aviation accident victims is one of the skills cadets need. This competency can be achieved in the Level II PPKP Study Program by taking two credits for theory and one credit for

the Aviation First Aid course. Cadets take this training to learn medical crisis ideas and how to help aviation accident victims. The learning achievement of this course is providing first aid to victims of plane crashes and airport facility fires. In this course, cadets are expected to be able to handle emergency medical procedures correctly. Theoretical learning is conducted face-to-face in the classroom, and practical learning is carried out on the ARFF simulator as a simulation of safety assistance for aircraft fire victims. The right approach is needed in this practical activity so cadets can understand the material well. This scientific approach aims to enable students to handle a problem and find a solution. However, the emphasis is on something other than finding solutions but a scientific approach, namely in analyzing (processing and communicating). This scientific approach also makes students look for solutions from memorization and their brains (through reasoning) so that with these habits, students can become superior problem solvers in society.

One of the things that are highlighted is that STEM learning, where the demand is learning that can bring students to face the era of challenges of the 21st century through the right approach to explore the competencies of cadets so that they become ready and professional individuals in the world of work through 5M: 1) Observe; Cadets must be able to observe phenomena that occur carefully and in detail regarding first aid; 2) Ask questions; Cadets must have the courage to ask questions clearly and focus until they understand the essence of the problem in making decisions about rescue actions; 3) Try; Cadets must be able to try bravely on existing hypotheses, being sure that the victim will be helped; 4) Reason; Cadets must be able to analyze what steps must be taken appropriately to reduce the victim's pain; and finally, 5) conclusion, namely being able to make conclusions from all the phenomena that occur, the impacts and actions that must be taken as well as analyzing the results achieved as a review of next steps so that if a case occurs to a victim can take appropriate steps.

This scientific approach aims to enable students to handle a problem and find a solution. However, the emphasis is not on finding solutions but on the scientific approach, namely in analyzing (processing and communicating). This scientific approach also makes students not only find solutions from memorization but also find solutions using their brains (through reasoning) so that with these habits, students can become superior problem solvers in society. A scientific approach is urgently needed for cadets so that first aid competencies are met and graduate output can be well received in the job market. The facts that occur in the field when cadets carry out on-the-job training at several airports in Indonesia are that there are still many complaints from field supervisors regarding the lack of first aid competency possessed by cadets, which makes the author examine what cadets need to meet their competency to be accepted in the job market. A scientific approach is recommended to measure high-level thinking skills (Suprihatin et al., 2023). Ideally, an educational institution can take the right approach so that students receive knowledge and skills well.

STEM learning with a scientific approach in the first aid course allows cadets to observe, ask questions, gather information, associate, and communicate by applying practical techniques for saving aviation accident victims. The research equation (Bachri et al., 2023) uses the MANOVA test with the same number of variables, while the difference in this study is adding measuring the N-Gain score and the correlation. The research equation (Uslan et al., 2024) uses the MANOVA test to see effectiveness, while the difference is MANOVA in this research to see the effect. The researchers also measure the improvement with the N-gain score and look into the relationship with the correlation test.

First aid actions carried out correctly will reduce disability or suffering and save the victim from death. Still, if the action is not carried out well and correctly, it will worsen the condition resulting from the accident and even kill the victim (Anggraini et al., 2018; Noor, 2020; Singletary et al., 2020; Zarisfi et al., 2021; Apriani, 2022; Tse et al., 2023). Providing first aid to accident victims is crucial to prevent more severe injuries (Asdiwinata et al., 2019; Iwan et al., 2022; Kistan et al., 2022), increasing awareness through accident-related first-aid simulations (Rahayu et al., 2021). First aid is frequently needed on commercial airplanes, particularly on foreign trips (Donaldson & Pearn, 1996). The PKP-PK unit is responsible for rendering these services to assist with aviation mishaps, particularly those involving aircraft on the ground (Intas et al., 2021; Yogik, 2022; Safitri, 2022). Therefore, cadets must be adequately prepared with first aid skills. The Directorate General of Civil Aviation requires every member of the PK staff who is on duty to possess a license (Martono et al., 2019; Nugraha et al., 2021; Salim et al., 2021). Naturally, individuals deemed qualified are granted licenses acquired through aviation education establishments.

This research aims to see the influence, correlation, and improvement in critical thinking, creative thinking, and learning outcomes of first aid course cadets through STEM learning with a scientific approach. This research shows that STEM learning with a scientific approach influences critical thinking, creative thinking, and learning outcomes in the First Aid course. With a scientific approach, STEM learning can improve critical and creative thinking and learning outcomes in the First Aid course. There is a strong connection between STEM learning and a scientific approach to critical thinking, creative thinking, and learning outcomes in the First Aid course. This research contributes to providing information to educators on using STEM learning with a scientific approach.

METHODS

This research used two approaches: 1) experimental research to determine the impact and improvement, and 2) correlation analysis to identify patterns (O'dwyer & Bernauer, 2013). Experimental research aims to determine, in controlled settings, how different therapies affect other individuals (Brunstein, 2013). This research employed a quasi-experimental design. Cadets were the research subjects, and research subjects in particular groups had specific objectives. A quasi-experimental design was employed because controlling every relevant variable except a few was impossible.

In this research, respondents were divided into two groups. The first group was the experimental group, namely class PPKP 03 Alfa, and the second group was the control group, namely class PPKP 03 Bravo. Correlational research aims to determine the level of relationship between two variables without making any changes to the data that has been obtained. The variables in this research consisted of STEM as the independent variable (x), critical thinking as the first dependent variable (y_1), creative thinking as the second dependent variable (y_2), and learning outcomes as the third dependent variable (y_3). Data processing in this study used the IBM SPSS series 26 software.

To find the effect, the Manova test was used. Before carrying out the Manova test, researchers carried out a practical test with a normality test and a homogeneity test. Next, they carried out a hypothesis test with the Manova Test. Simultaneous hypotheses in this research contain the null hypothesis and alternative hypotheses. The null hypothesis states that STEM learning with a scientific approach does not influence critical thinking, creative thinking, and learning outcomes in the First Aid course. The alternative hypothesis states that STEM learning with a scientific approach influences critical thinking, creative thinking, and learning outcomes in the First Aid course.

Partially, the null hypothesis states that STEM learning with a scientific approach has no influence on critical thinking in the First Aid course. For the alternative hypothesis, STEM learning with a scientific approach influences critical thinking in the First Aid course. The null hypothesis states that STEM learning with a scientific approach does not influence creative thinking in the First Aid course. The alternative hypothesis states that there is an influence of STEM learning with a scientific approach on creativity in the First Aid course. The null hypothesis states that STEM learning with a scientific approach has no influence on learning outcomes in the First Aid course, and the alternative hypothesis states that STEM learning with a scientific approach influences learning outcomes in the First Aid course.

Table 1. First Hypothesis Research Design

Class	Pretest	Treatment	Posttest
Experiment	Y1	X	Y1
	Y2	X	Y2
	Y3	X	Y3
Control	Y1		Y1
	Y2		Y2
	Y3		Y3

To see the improvement, the N-Gain score was used. Researchers carried out prerequisite tests in the form of normality and homogeneity tests, then looked for the N-Gain value to see whether there was an increase. The N-Gain score was obtained from the posttest score minus the pretest score, the result of which was divided by the ideal score that had been reduced by the pretest score. The N-Gain value categories are as follows: high category if the score is more than 0.7, low category if the score is more than equal to 0.3 and less than equal to 0.7, low category if the score is less than 0.3. To see the correlation, the correlation test was used. Before carrying out the correlation test, researchers carried out practical tests using normality and linear tests. Next, testing the hypothesis used the correlation test. The hypotheses in this research consisted simultaneously and partially. Simultaneously, the null hypothesis states that no correlation exists between STEM learning and the scientific approach to critical thinking in the First Aid course.

In contrast, the alternative hypothesis states that there is a correlation between STEM learning and the scientific approach to critical thinking in the First Aid course. Partially, the null hypothesis states that no correlation exists between STEM learning and a scientific approach to creative thinking in the First Aid course. In contrast, the alternative hypothesis states that there is a correlation between STEM learning and a scientific approach to creative thinking in the First Aid course. Partially, the null hypothesis states that there is no correlation between STEM learning and a scientific approach to learning outcomes in the First Aid course, while the alternative hypothesis is that there is a correlation between STEM learning and a scientific approach to learning outcomes in the First Aid course. The researchers play a crucial role in interpreting the correlation coefficient found to be large or small. The following provisions can guide the interpretation:

Table 2. Correlation Coefficient

Coefficient Interval	Relationship Level
0,00 – 0,199	Very weak
0,20 – 0,399	Weak
0,40 – 0,599	Currently
0,60 – 0,799	Strong
0,80 – 1,000	Very strong

This research used 16 instruments: four STEM Learning with Scientific instruments, four improving critical instruments, four creative thinking instruments, and four cadet learning outcomes instruments. STEM indicators with a scientific approach include: Cadets can apply scientific concepts to solve real problems; Cadets can formulate clear research questions and testable hypotheses; Cadets can use various technological tools and software to support learning and STEM projects, and Cadets can work in a team to complete engineering projects, demonstrating good collaboration and project management skills. Indicators of critical thinking include: Cadets can analyze an argument by identifying its premises and conclusions, as well as assessing the strengths and weaknesses of the argument; Cadets can evaluate various proposed solutions based on clear criteria and choose the most effective solution; Cadets can identify logical errors in their thinking and correct them, and Cadets can construct a logical and cohesive argument, supporting it with relevant and compelling evidence. Indicators of creative thinking include: Cadets demonstrate the ability to develop and expand initial ideas continuously; Cadets demonstrate the ability to adapt to changing situations and develop flexible solutions; Cadets demonstrate creativity by creating solutions that have never been thought of before, and Cadets demonstrate the ability to add new elements or improve existing ideas to make them more valuable and applicable. Indicators of learning outcomes include: Cadets can explain the main concepts taught clearly and precisely; Cadets can carry out procedures or steps that have been taught correctly and efficiently; Cadets can analyze complex problems or situations; Cadets can identify key elements, and Cadets can convey ideas and information clearly and effectively, both orally and in writing.

The results of the validity of the instruments state that the significance value of all instruments is smaller than 0.05, so it can be concluded that all instruments are valid. The reliability results state that the Cronbach's Alpha value for STEM learning with a scientific approach is 0.624; the Cronbach's Alpha value for improving critical thinking is 0.631; the Cronbach's Alpha

value for improving creative thinking is 0.638, and the Cronbach's Alpha value for improving learning outcomes is 0.636. The Cronbach's Alpha values of the four variables are more than 0.6, so it can be concluded that the instrument is reliable. Normality data analysis used the Kolmogorov-Smirnov test, the homogeneity test used Levene Statistics and Box's Test of Equality of Covariance Matrices, and the multi-correlation test was conducted before the MANOVA test to see improvements with the N-gain score. To see the relationship with the correlation test, the data was analyzed using IBM SPSS 26.

RESULTS AND DISCUSSION

The influence of STEM learning with a scientific approach on critical thinking, creative thinking, and learning outcomes in the First Aid course can be seen through tests, including the Normality test. The significance value of critical thinking for the PPKP03A class = 0.169 > 0.05, so the data is average. The significance value of critical thinking for class PPKP03B = 0.280 > 0.05, so the data is average. The significance value of creative value for class PPKP03A = 0.111 > 0.05, so the data is average. The significance value of creative thinking for class PPKP03B = 0.253 > 0.05, so the data is average. The significance value of learning outcomes for class PPKP03A = 0.127 > 0.05, so the data is average. The significance value of learning outcomes for class PPKP03B = 0.271> 0.05, so the data is average. Meanwhile, in the homogeneity test, the significance value of critical thinking is 0.687 > 0.05, so the data variance is homogeneous. The significance value of creative thinking is 0.892 > 0.05, so the data variance is homogeneous. The significance value of learning outcomes is 0.677 > 0.05, so the data variance is homogeneous. In hypothesis testing, the results can be seen simultaneously in the following table:

Table 3. Manova Test

Effect		Value	F	Hypothesis df	Error df	Sig.
x	Pillai's Trace	.191	3.225b	3.000	41.000	.032
	Wilks' Lambda	.809	3.225b	3.000	41.000	.032
	Hotelling's Trace	.236	3.225b	3.000	41.000	.032
	Roy's Largest Root	.236	3.225b	3.000	41.000	.032

The significance value is 0.032 < 0.05, so H0 is rejected, and H1 is accepted. Partially, it can be seen in the following table:

Tabel 4. Test of Beetwen-Subjects Effects

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.
x	Critical Thinking	20.248	1	20.248	6.784	.013
	Creative Thinking	23.084	1	23.084	7.157	.011
	Learning Outcomes	20.307	1	20.307	6.261	.016

The significance value of critical thinking is 0.013 < 0.05, so H0 is rejected, and H1 is accepted. The significance value of creative thinking is 0.011 < 0.05, so H0 is rejected, and H2 is accepted. The significance value of learning outcomes is 0.016 < 0.05, so H0 is rejected and H3 is accepted

STEM learning with a scientific approach can improve critical thinking, creative thinking, and learning outcomes in the First Aid course, as seen from the test stages including the Normality test.

The significance value of the critical thinking pretest for the experimental class is 0.169 > 0.05, so the data is standard. The significance value of the critical thinking pretest in the control class is 0.280 > 0.05, so the data is normally distributed. The significance value of the critical thinking posttest in the experimental class is 0.169 > 0.05, so the data is normally distributed. The significance value of the critical thinking posttest in the control class is 0.087 > 0.05, so the data is normally distributed. The significance value of the creative thinking pretest in the experimental class is 0.111 > 0.05, so the data is normally distributed. The significance value of the creative thinking pretest in the control class is 0.253> 0.05, so the data is normally distributed. The significance value of the creative thinking posttest in the experimental class is 0.111> 0.05, so the data

is normally distributed. The significance value of the creative thinking posttest in the control class is 0.596 > 0.05, so the data is normally distributed. The significance value of the learning outcomes pretest in the experimental class is 0.127 > 0.05, so the data is normally distributed. The significance value of the learning outcomes pretest for the control class is 0.271 > 0.05, so the data is normally distributed. The significance value of the learning outcomes posttest in the experimental class is 0.127 > 0.05, so the data is normally distributed. The significance value of the learning outcomes posttest in the control class is 0.708 > 0.05, so the data is normally standard.

In the Homogeneity test, the significance value of the critical thinking pretest is 0.687 > 0.05, so the data is homogeneous. The significance value of the critical thinking posttest is 0.522 > 0.05, so the data is homogeneous. The significance value of the creative thinking pretest is 0.892> 0.05, so the data is homogeneous. The significance value of the creative thinking posttest is 0.673> 0.05, so the data is homogeneous. The significance value of the learning outcomes pretest is 0.677> 0.05, so the data is homogeneous. The significance value of the learning outcomes posttest is 0.697 > 0.05, so the data is homogeneous.

The correlation between STEM learning and a scientific approach to critical and creative thinking and learning outcomes in the First Aid course can be seen at several test stages, including Normality. The significance value of STEM is 0.081 > 0.05, so the data is normally distributed. The significance value of critical thinking is 0.141 > 0.05, so the data is normally distributed. The significance value of creative thinking is 0.059 > 0.05, so the data is normally distributed. The significance value of learning results is 0.141 > 0.05, so the data is linear and regular. The significance value of creative thinking on STEM is 0.636 > 0.05, so the data is linear. The significance value of critical thinking on STEM is 0.470 > 0.05, so the data is linear. The significance value of learning outcomes on STEM is 0.569 > 0.05, so the data is linear.

The correlation can also be seen from the hypothesis test in the table below:

Table 5. Correlation Test

	STEM	**Critical Thinking**	**Creative Thinking**	**Learning Outcomes**
STEM	1	.988**	1.000**	.994**
		.000	.000	.000
	45	45	45	45
Critical Thinking	.988**	1	.988**	.994**
	.000		.000	.000
	45	45	45	45
Creative Thinking	1.000**	.988**	1	.994**
	.000	.000		.000
	45	45	45	45
Learning Outcomes	.994**	.994**	.994**	1
	.000	.000	.000	
	45	45	45	45

The significance value of STEM on critical thinking is 0.000 <0.05, with a correlation value of 0.988. The significance value of STEM on creative thinking is 0.000 <0.05, with a correlation value of 1.000. The significance value of STEM on learning outcomes is 0.000 <0.05, with a correlation value of 0.994.

The influence of STEM learning with a scientific approach on critical thinking, creative thinking, and learning outcomes in the First Aid course. The normality test obtained significance values of 0.169, 0.280, 0.111, 0.253, 0.127, and 0.271. These values are more significant than 0.05, so the data presented is normally distributed.

The researchers carried out a homogeneity test resulting in significance values of 0.687, 0.892, and 0.677, which are more significant than

0.05, so it can be concluded that the data have homogeneous variance. Hypothesis testing uses MANOVA (Creswell, 2017); with a significance value of 0.32, which is smaller than 0.05, then H0 is rejected and H1 is accepted, which results in the simultaneous influence of STEM learning with a scientific approach on critical thinking, creative thinking, and learning outcomes in the First Aid course. This aligns with Gómez & Suárez (2020) that there is an influence of the learning climate on knowledge and critical thinking.

The researchers carried out a partial test with a test of between-subjects effects (Bacon-Shone, 2013), with the result of the significance value of critical thinking of 0.013, which is smaller than 0.05, then H0 is rejected and H1 is accepted, resulting in the influence of STEM learning with a scientific approach on critical thinking in the First Aid course. This is supported by Moghadam et al. (2023) that critical thinking influences the learning atmosphere in the classroom. The research results strengthen Guo et al. (2022) that epistemological beliefs indirectly influence scientific identity through critical thinking. If the significance value of creative thinking of 0.011 is smaller than 0.05, H0 is rejected and H2 is accepted. As a result, STEM learning with a scientific approach influences creative thinking in the First Aid course. As Kijima et al. (2021) state, adolescents experience greater creative self-confidence and positive perceptions of STEM. Besides that, Widiyatmoko et al. (2023) present a significant difference in creative thinking skills scores with self-education.

The significance value of learning outcomes is 0.016; smaller than 0.05, so H0 is rejected and H1 is accepted. As a result, there is an influence of STEM learning with a scientific approach on learning outcomes in the First Aid course. Wahono et al. (2020) show that STEM implementation in Asia is effective at a moderate level (0.69 [0.58, 0.81 of 95% CI]) in improving students' learning outcomes. This is supported by Wang et al. (2022) that learning that has been set well will get quality learning results. In line with Wei et al. (2024), up-to-date learning will influence learning outcomes.

With a scientific approach, STEM learning can improve critical thinking, creative thinking, and learning outcomes in the First Aid course. The normality test obtained significance values of 0.169, 0.280, 0.169, 0.087, 0.111, 0.253, 0.111, 0.596, 0.127, 0.271, 0.127, and 0.708. If the values are more significant than 0.05, it can be concluded that the data is normally distributed. The researchers, then, conducted a homogeneity test with significance values of 0.687, 0.522, 0.892, 0.673, 0.677, and 0.697. If the values are more significant than 0.05, the data variance is homogeneous. After passing the prerequisite tests, N-gain can be obtained (Smith et al., 1962). The results of the experimental class on the critical thinking variable are 0 in low criteria, 16 in medium criteria, and 7 in high criteria. The results obtained for the creative thinking variable in the experimental class are 0 with low criteria, 17 with medium criteria, and 6 with high criteria. For the learning outcome variable in the experimental class, the results are 0 in low criteria, 15 in medium criteria, and 8 in high criteria. This aligns with Sapeni & Said (2020) that case-based learning can improve learning outcomes. Khaddam et al. (2023) state a supportive learning climate will improve learning outcomes. Meanwhile, Ritonga & Zulkarnain (2021) show that STEM results can improve critical thinking skills. This is strengthened by Siswanto (2018) that STEM can increase students' creativity.

The normality test obtained a significance value for STEM 0.081, critical thinking 0.141, creative 0.059, and learning outcomes 0.141 greater than 0.05, so the data is normally distributed. For creative thinking on STEM, the significance value is 0.636. For critical thinking on STEM, the significance value is 0.470. For learning outcomes on STEM, the significance value is 0.569. Based on this data, the significance values of 0.636, 0.470. and 0.569 are more significant than 0.05, so the data has a linear model. This aligns with the correlation prerequisite tests in the form of normality and linearity tests (Roflin & Zulvia, 2021).

In the hypothesis test using the correlation test, the significant value of STEM for critical thinking is $0.000 < 0.05$ with a correlation value of 0.988, which resulted in H0 being rejected and H1 being accepted. So, there is a correlation between STEM learning and a scientific approach to critical thinking in the First Aid course. The correlation between STEM and critical learning is included in the level of a solid relationship. This is in line with Handayani (2020) that STEM learning has a strong relationship, giving rise to critical thinking. The significance value of STEM on creative thinking is $0.000 < 0.05$, with a correlation value of 1.000, which results in H0 being rejected and H1 being accepted. So, there is a correlation between STEM learning and a scientific approach to creative thinking in the First Aid course. The correlation between STEM and creative thinking is included in the level of a solid relationship. This aligns with Irwan (2023).

The significance value of STEM on learning outcomes is 0.000 < 0.05 with a correlation value of 0.994, which results in H0 being rejected and H1 being accepted. So, there is a correlation between STEM learning and a scientific approach to learning outcomes in the First Aid course. The level of correlation between STEM and learning outcomes is included in a solid relationship. Pambayun & Shofiyah (2023) present a significant relationship between students' attitudes towards STEM and learning outcomes.

The contribution of research to the field of airborne vocational science is to provide information to educators on how to achieve the demands of the 21st century for the 4C skills, namely critical thinking, collaboration, creativity, and communication, which every cadet must have. STEM learning emphasizes the integration of science with technology that can be applied in the natural world or community environment, which can be explored through a scientific approach with the 5M method, namely observing, trying, reasoning, asking, and communicating. First aid is one of the main subjects for cadets. In practical activities, cadets must understand their responsibilities as responders and apply first aid measures appropriately and quickly in aviation accidents. It is necessary to measure the STEM learning method with a scientific approach to see the influence, correlation, and improvement of critical thinking, creative thinking, and learning outcomes so that it can be a reference for lecturers in finding the right learning method to explore critical thinking, creative thinking, and learning outcomes in order to meet work demands in the 21st century era.

CONCLUSION

This research shows that there is an influence of STEM learning with a scientific approach on critical thinking, creative thinking, and learning outcomes in the First Aid course; STEM learning with a scientific approach can improve critical thinking, creative thinking, and learning outcomes in the First Aid course. The impact of this research can develop cadets' critical and creative thinking and get better learning outcomes. This research contributes to providing information to educators on using STEM learning with a scientific approach.

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