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Optimization of Essential Skills in 21st In Students Through STEM Integrated Research Based Learning

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ABSTRACT: The problem of the research is the low basic skills possessed by students, so that students have the potential to find it difficult to find work in accordance with their field. With the enactment of economic changes globally, the world of work, both nationally and internationally, provides requirements for prospective workers who will enter the workforce concerned to have essential skills in the 21st century. STEM implementation in research based learning aims to instill, grow and develop the basic skills needed in essential skills in the 21st century. This research will be conducted using experimental research methods with the data analysis technique used is the analysis of covariance (anacova) 1 way with 2 covariances. The sample of this research is 124 students majoring in mechanical engineering, Faculty of Engineering, State University of Malang. The result of the study is that there is a significant difference between the STEM integrated research based learning group and the conventional group controlled by the variable learning skills and the ability to innovate.

KEYWORDS: Ability to innovate, Essential Skill 21st, learning skills, Research Based Learning, STEM.

INTRODUCTION

The Central Statistics Agency [1] explains that unemployment originating from higher education is 7.65%. Unemployment in the educated unemployment category occurs due to a lack of mastery of basic skills needed at the national and international levels. The American Association of Colleges of Teacher Education [2] and [3] show that students who have graduated from college are very deficient in some basic skills and a large number of applied skills, including communication skills, critical thinking, problem solving, communication, etc. creativity, collaborating, using technology, and leadership and project management.

If this phenomenon is allowed to be ignored, unemployment originating from universities has the potential to not get a job at the next opportunity due to global changes that cause changes in the workforce. This has been conveyed by the [4] which states that changes in the current workforce in order to develop in the economy of life, requires collaboration of skills. So that unemployment originating from tertiary institutions with low basic skills mastery will continue to be left behind and replaced by workers who have basic skills needed at the national and international levels.

Thus, a learning model is needed that must be applied in universities to cultivate and develop essential skills in the 21st century in students. This is done to keep up with changes in the global economy. In an effort to meet new skills and keep up with these changes, educational institutions must play a major role in preparing students to have the basic skills needed so that the students concerned, after graduating from educational institutions, can find jobs [5].

Ananiadou & Claro [6] explain that in the 21st century, education is an obligation and becomes very important. This aims to provide assurance to students to have learning and innovation skills. The previous problem is the length of study for students to earn a bachelor's degree. Knight & Arnold [7] and Bound et al [8] state that the time required to obtain a bachelor's degree has continued to increase over the past 30 years. Complete College America [2] emphasized that 27% of bachelors graduated on time (4 years) at top universities and 16% non-superior universities with an average time to obtain a bachelor's degree of 4.9 years. This phenomenon that occurs needs serious attention, because it has an impact on the low selling point of the student concerned when compared to students who graduate on time [2][9-11].

The main source of the length of study lies in the thesis. Han [12] states that thesis writing plays an important role, so that it cannot be replaced by other teaching methods. Through a thesis, a comprehensive student's ability can be seen [13], as well as helping students to get academic degrees in various fields and different universities [14-19]. Meanwhile, before writing a thesis or a final research report, each student is required to write a thesis proposal which aims to determine the feasibility of his prospective research [16], however, making a thesis proposal is not easy [20].

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The solution to this problem is by implementing research based learning for students. The implementation of the learning model is effective in reducing the main problems in proposal preparation [21]. On the other hand, the activities contained in research based learning are also able to explore research ideas which can be converted into thesis titles [22]. Srikoon et al [23] added that the learning process was also able to construct essential skills in the 21st century.

The application of research based learning helps students complete their assignments so that they get a bachelor's degree. In an effort to assist students in getting jobs in the national and international scope armed with essential skills in the 21st century, science, technology, engineering, and mathematics (STEM) are needed. The STEM approach in learning is expected to produce meaningful learning for students through the systematic integration of knowledge, concepts and skills (Afriana et al, 2016). The benefits of implementing STEM in students include students being able to solve problems well, inventors, logical thinkers, innovators, independent, and high technology literacy [24]. Firnan [25] adds that the implementation of STEM is able to provide strong foundations for students in entering careers, especially in the fields of technological innovation and economic productivity.

METHODS

Research Design

This research will be conducted using experimental research methods with the data analysis technique used is the analysis of covariance (anacova) 1 way with 2 covariances.

Population and Research Sample

The population of this study were mechanical engineering students who had taken research methodology courses at the Faculty of Engineering, State University of Malang. The number of this population is 179 students. By using the Slovin formula, a sample of 124 students was obtained.

The sampling technique used was simple random sampling. The sample of 124 students is grouped into 2 (two), namely the experimental class with the implementation of integrated research based learning STEM is the class of the S1 Automotive Engineering Education study program with a total of 62 students, while the non-experimental class is the class of the S1 Mechanical Engineering Education study program with a total of 62 students.

Research Instruments

The instrument of this study used a closed questionnaire using a Likert scale rating, namely values 1-4. The questionnaire is aimed at control variables consisting of learning skills and ability to innovate and on the dependent variable, namely essential skills in the 21st century.

Research Data Analysis

The data that has been obtained from this study are then processed and analyzed in order to answer the problem formulation and research hypotheses that have been formulated. Data analysis used in this study is descriptive analysis, and one-way covariance analysis (anacova) with 2 covariances.

RESULTS AND DISCUSSIONS

3.1 Learning Skills

Learning skills data has 8 indicators consisting of finding information related to reading, concluding the content of the reading, correct spelling, correctness of note contents, neatness of notes, creativity in taking notes, being able to remember material that has been studied, and being able to answer questions related to the material that has been taught. Based on data obtained from 124 students of the Department of Mechanical Engineering, Faculty of Engineering, State University of Malang, which were divided into 2 groups. The first group is the conventional group and the second group is the STEM integrated research based learning group. In the conventional group the lowest score was 22, while the highest score was 44. In the STEM integrated research based learning group the lowest score was 29, while the highest score was 47. Below is the value data presented in the following table.

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Table 1. Results of Descriptive Analysis of Conventional Class Learning Skills

Statistic	Score
N	62
Mean	33
Median	32
Minimum	22
Maximum	44

Table 2. Results of the Descriptive Analysis of STEM Integrated Classroom L earning Skills for RBL

Statistic	Score
N	62
Mean	38
Median	38
Minimum	29
Maximum	47

Next is to do data grouping in class. The following is the frequency distribution in the conventional class.

Table 3. Frequency Distribution of Learning Skills in Conventional Classrooms

No	Interval	Class	%
1	39,25 - 44	Baik Sekali	16,2%
2	33,5 – 38,25	Baik	25,8%
3	27,75 – 32,5	Cukup	46,7%
4	22 – 26,75	Kurang	11,3%
	Total		100%

Table 4. Frequency Distribution of Learning Skills in STEM Integrated RBL Classrooms

No	Interval	Class	%
1	43,25 - 47	Baik Sekali	16,1%
2	38,5 – 42,25	Baik	37%
3	33,75 – 37,5	Cukup	33,9%
4	29 – 32,75	Kurang	13%
	Total		100%

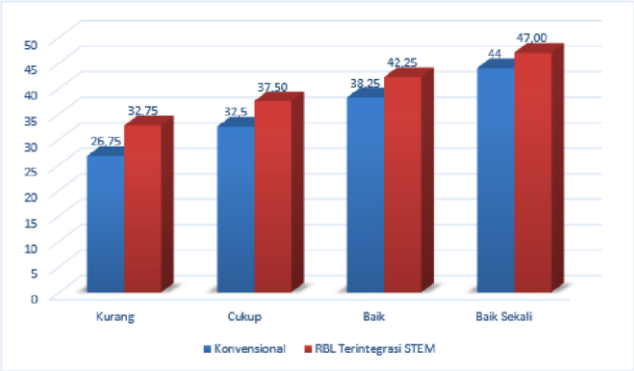

Figure 1. Differences in the Distribution of Learning Skills Interval between Conventional Classrooms and STEM Integrated RBL

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Figure 1 is a diagram showing the difference in the upper limit at each class interval. Based on Figure 1. It can be seen that the learning skills possessed by students in the integrated STEM research-based learning class are higher than the conventional class.

Ability to Innovate

The ability to innovate has 7 indicators consisting of openness to new experiences, flexibility in thinking, freedom in selfexpression, respect for fantasy, interest in creative activities, belief in one's own ideas, and independence in giving selfconsideration. Based on data obtained from 124 students of the Department of Mechanical Engineering, Faculty of Engineering, State University of Malang, which were divided into 2 groups. The first group is the conventional group and the second group is the STEM integrated research based learning group. In the conventional group the lowest score was 13, while the highest score was 44. In the STEM integrated research based learning group the lowest score was 13, while the highest score was 49. Below is the value data presented in the following table.

Table 5. Results of Descriptive Analysis of Conventional Class Innovation Ability

Statistic	Score
N	62
Mean	25
Median	23
Minimum	13
Maximum	44

Table 6. Results of the Descriptive Analysis of the Innovative Ability of the ST EM Integrated RBL Class

Statistic	Score
N	62
Mean	34
Median	33
Minimum	13
Maximum	49

Next is to do data grouping in class. The following is the frequency distribution in the conventional class

Table 7. Frequency Distribution of the Ability to Innovate in Conventional Classrooms

No	Interval	Class	%
1	37 - 44	Baik Sekali	11,3%
2	29 – 36	Baik	24,2%
3	21 – 28	Cukup	35,5%
4	13 – 20	Kurang	29%
	Total		100%

Table 8. Frequency Distribution of the Ability to Innovate in the STEM Integrated RBL Class

No	Interval	Class	%
1	40,75 - 49	Baik Sekali	20,9%
2	31,5 – 39,75	Baik	48,4%
3	22,25 – 30,5	Cukup	24,2%
4	13 – 21,25	Kurang	6,5%
	Total		100%

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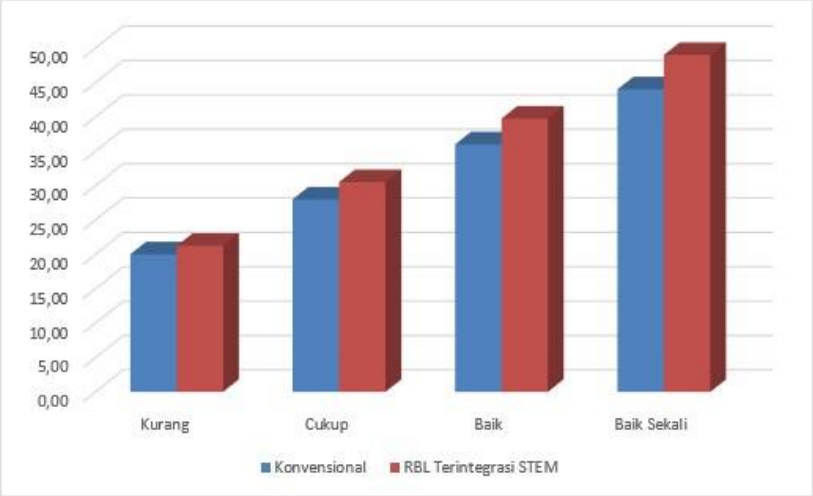

Figure 2. Differences in the distribution of the ability to innovate between conventional classrooms and STEM-integrated RBL

Figure 2 is a diagram showing the difference in the upper limit at each class interval. Based on Figure 4. It can be seen that the innovative ability of students in the integrated STEM research-based learning class is higher than the conventional class.

3.3 Essential Skill

Essential Skill has 4 indicators consisting of digital age literacy, inventive thingking, effective communication, and high productivity. Based on data obtained from 124 students of the Department of Mechanical Engineering, Faculty of Engineering, State University of Malang, which were divided into 2 groups. The first group is the conventional group and the second group is the STEM integrated research based learning group. In the conventional group the lowest score was 15, while the highest score was 40. In the STEM integrated research based learning group the lowest score was 15, while the highest score was 60. The following data values are presented in the following table.

Table 9. Results of the Descriptive Analysis of Conventional Class Essential Skills

Statistic	Score
N	62
Mean	25
Median	25
Minimum	15
Maximum	40

Table 10. Results of the Descriptive Analysis of the Essential Skill for the Integrated RBL Class STEM

Statistic	Score
N	62
Mean	45
Median	49
Minimum	15
Maximum	60

Next is to do data grouping in class. The following is the frequency distribution in the conventional class

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Table 11. Frequency Distribution of Essential Skills in Conventional Classes

No	Interval	Class	%
1	34,5 - 40	Baik Sekali	16,1%
2	28 – 33,5	Baik	22,6%
3	21,5 – 27	Cukup	29%
4	15 – 20,5	Kurang	32,3%
	Total		100%

Table 12. Frequency Distribution of Essential Skills in the STEM Integrated RBL Class

No	Interval	Class	%
1	49,5 - 60	Baik Sekali	54,8%
2	38 - 48,5	Baik	19,4%
3	26,5 – 37	Cukup	16,1%
4	15 – 25,5	Kurang	9,7%
	Total		100%

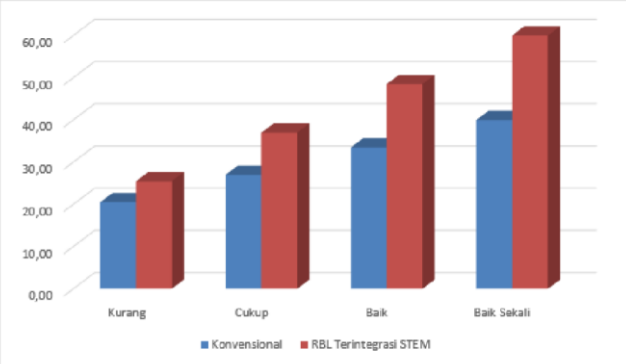

Figure 3. The Difference in the Interval Distribution of Essential Skills between Conventional Classes and STEM Integrated RBL

Figure 3 is a diagram showing the difference in upper limits at each class interval. Based on Figure 5. It can be seen that the essential skills of students in the integrated STEM research-based learning class are higher than the conventional class.

3.4 Normality test

The normality test in this study was carried out using the Kolmogorov-Smirnov formula with a significance level of 0.05. The basis for making a decision is that if the probability value is greater than 0.05, the distribution is declared normal. The following is a summary of the normality test results shown in Table 13.

Table 13. Normality Test Results

Variable	Asymp. Sig. (2 tailed)	Condition	Note
Learning Skills (X1)	0,056	Sig > 0,05	Normal
Ability to Innovate (X2)	0,486	Sig > 0,05	Normal
Essential Skill (Y)	0,093	Sig > 0,05	Normal

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Based on the table of normality test results, it was found that the three variables had a probability value above 0.05. So it can be concluded that each variable in this study is normally distributed.

3.5 Linearity test

Linear test aims to determine the pattern of each independent variable (X) on the dependent variable (Y). In the linearity test of this study, tests were carried out twice consisting of tests: (1) X1 and Y; (2) X2 with Y. This linearity test uses the test of linearity with a significance level of 0.05. Decision making in the linearity test is that if the significance value is greater than 0.05, it meets the linearity requirements. A summary of the linearity test results is shown in Table 14.

Table 14. Linearity Test Results

Relationship Model	Sig	Condition Note
X1 with Y	0,621	Sig > 0,05 Linier
X2 with Y	0,415	Sig > 0,05 Linier

Based on the Table of Linearity Test Results, the significance value in each relationship model shows the results are greater than 0.05 so that the relationship is declared linear.

3.6 Anacova 2 Covariance Test

The following is a data analysis of the STEM integrated research based learning group and the conventional group controlled by the variable learning skills and the ability to innovate.

Hypothesis testing related to the use of learning methods by controlling or controlling the covariance of learning skills and the ability to innovate can be seen from the results of the significance value. Based on Table 15, it is known that the significance value of 0.000 means the sig value <0.05 so it can be concluded that there is a significant difference between the STEM integrated research based learning group and the conventional group controlled by the variable learning skills and the ability to innovate.

Learning skills according to [26] are activities carried out by an individual to train himself to be able to optimize cognitive, affective and psychomotor aspects in learning something. Meanwhile, the ability to innovate is defined as the ability to be able to think critically, creatively, communicatively and collaboratively [27]. The presence of the 21st century with various demands, especially those who are skilled in learning and innovation, demands that students be equipped with these basic skills to continue life in this 21st century. Efforts to equip these students are by applying the STEM-based research method of learning. This learning method can be used as an alternative learning method for constructing essential skills in the 21st century [23].

3.7 Anacova Test 1 Covariance

The following is the data analysis of the STEM integrated research based learning group and the conventional group controlled by the learning skills variable.

Hypothesis testing related to the use of learning methods by controlling or controlling the covariance of learning skills can be seen from the results of the significance value. Based on Table 16, it is known that the significance value of the learning method is 0.000, which means that the sig value <0.05, so it can be concluded that there are differences in the essential skills of students who use conventional learning methods and STEM integrated research based learning, after controlling for covariance of learning skills.

Furthermore, to determine the effect of learning skills and differences in learning methods on essential skills obtained by students simultaneously, it can be seen from the significance figures in the corrected model section. Based on Table 16, it is known that the significance number is 0.000, which means that the sig value <0.05, it can be concluded that simultaneously learning skills and learning methods have an effect on student essential skills.

Essential skills are skills that every student must have. One part of essential skills is learning skills. This is very important to master, because all these basic skills strive to face every complex challenge from year to year [27]. To apply and optimize the learning skills of students, it is necessary to apply STEM-based research based learning. Afriana, et al [28] have proven that the integration of STEM in the learning method is able to make students continue to integrate their knowledge and abilities.

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3.8 Anacova Test 1 Covariance

The following is a data analysis of the STEM integrated research based learning group and the conventional group controlled by the variable ability to innovate.

Hypothesis testing related to the use of learning methods by controlling or controlling for the covariance of the ability to innovate can be seen from the results of the significance value. Based on Table 17, it is known that the significance value of the learning method is 0.000, which means that the sig value <0.05, so it can be concluded that there are differences in the essential skills of students who use conventional learning methods and STEM integrated research based learning, after controlling for covariance of innovation ability.

Furthermore, to determine the effect of the ability to innovate and differences in learning methods on essential skills obtained by students simultaneously, it can be seen from the significance figures in the corrected model section. Based on Table 17, it is known that the significance number is 0,000, which means that the sig value <0.05, it can be concluded that simultaneously the ability to innovate and learning methods affect students' essential skills.

Frydenberg & And one [29] explain that the ability to innovate is one of the skills needed to work in the 17th century. Given the importance of innovation skills, the right learning method to improve and optimize it is research based learning integrated with STEM. This is in accordance with the opinion expressed by [24] that with this learning method students will be able to become reliable innovators.

CONCLUSIONS

Based on the results of research data analysis and a discussion of the implementation of stem-integrated research based learning to improve students' essential skills in the 21st century, the following conclusions:

There is a significant difference between the STEM integrated research based learning group and the conventional group controlled by the variable learning skills and the ability to innovate

1. There is a significant difference between the STEM integrated research based learning group and the conventional group after controlling for covariance of learning skills.
2. There is a significant difference between the STEM integrated research based learning group and the conventional group after controlling for covariance of ability to innovate.

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