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Science Process Skills and Self-efficacy of Civil Engineering Students

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Abstract

The study aims to find out the relationship between science process skills and self-efficacy of Civil Engineering students in the Soil Mechanics course. The type of research is correlation by making observations and providing questionnaires. The research sample consisted of 53 students from the Civil Engineering Department. The instrument consists of a questionnaire to measure self-efficacy and an observation sheet to measure the skills of the science process. The data from the two tests were analyzed with Pearson product-moment correlation. The results showed a positive correlation between science process skills and student self-efficacy.

INTRODUCTION

Vocational education is a level of higher education that aims to prepare personnel who have expertise and skills in their fields [1]. Vocational education adheres to an open system (multi-entry-exit system) and multi-meaning oriented towards cultivation, empowerment, character building, and personality, as well as various life skills life skills [2]. Therefore, learning at polytechnics is more in the form of practicum and field observation than theory classes with a ratio of 60%: to 40%. This aims to prepare prospective Polytechnic graduates who are ready to enter the world of work.

Therefore, learning at polytechnics is more in the form of practicum and field observation than theory classes with a ratio of 60% to 40%. This aims to prepare prospective Polytechnic graduates who are ready to enter the world of work. Students must convince themselves that they will be able to complete lectures with all the obstacles that will be passed. This belief is called self-efficacy. In general, self-efficacy is an individual's belief in his or her ability to exercise a form of control over the individual's functions and events in the environment[3]. Furthermore, self-efficacy is an individual's belief in his ability to succeed in doing something, in this case, it is to participate in theoretical as well as practicum classes[4].

In addition to the lack of student participation in theoretical classes, the implementation of practicum itself often experiences obstacles, including the completeness of tools and materials, time constraints, lack of motivation from lecturers, the absence of clear practicum instructions[5], and a practicum atmosphere that is not conducive to [6]. Some of these obstacles will make students have low process skills because they do not experience the practicum activities that take place themselves. Furthermore, according to Darmayanti, the low skill in this process will affect student learning outcomes[7].

Several studies have been conducted to find out what are the influences caused by the condition of self-efficacy on school students and students. Students with high self-efficacy can master higher ability indicators than students with low self-efficacy[8]. Ghofur also found that students with high self-efficacy were able to master more of the literacy component than students with low self-efficacy[9]. It was also found that the results of the study that self-efficacy is positively related to student achievement[10]. Several studies have been conducted that self-efficacy affects the cognitive value of students and students. Therefore, researchers want to find out whether there is also a relationship between self-efficacy and student psychomotor values, in this case, science process skills.

RESEARCH METHODS

This research is correlation research by making observations and providing questionnaires to Civil Engineering students in the Soil Mechanics course. The research variables are self-efficacy as a free variable and science process skills as a bound variable. Self-efficacy is measured using a questionnaire sheet. Meanwhile, the value of science process skills is obtained from the results of observations of lecture activities. The collection of research data was carried out in the Course of Soil Mechanics I.

Questionnaire sheets to find out self-efficacy was given to 53 civil engineering students with a total of 15 questions. The questionnaire sheet is a modification of the questionnaire sheet used by the State in its research entitled "The Relationship of Self Esteem and Self efficacy to Physics Learning Achievement of Class X Science Students at SMAN 1 South Kuta"[11]. The questionnaire sheet has gone through the validation stage with a value of $r_i > r_t$ (0.215). The question item has also been tested for reliability with a value of $r_i > r_t$ and declared reliable.

Science process skills observation sheets are made using process skills components, namely formulating problems, formulating hypotheses, using tools and materials, observing, making tables, making graphs, inferring, communicating, and looking for relationships between variables. This component of science process skills is adapted to the subject matter of Soil Mechanics I. Observation sheets are filled by the observer by selecting points 1-5 according to the observed conditions. An example of an observation sheet is seen in table 1.

Table 1. Science Process Skills Observation Sheet Grid

No	Observation Components	Assessment Indicators				
		1	2	3	4	5
1	Students can formulate problem (make questions appropriately and follow the number of items expected by the lecturer regarding the topic discussed)	Students do not write down the formulation of the problem	Students write down the formulation of the problem but have no connection at all with the topic	Students write the formulation of problems related to the topic but are still wrong	Students formulate problems according to the topic but not according to the desired number of items	Students formulate problems according to the topic and according to the desired number of items
2	Students can formulate hypotheses	Students do not write hypotheses	Students write hypotheses but have no connection at all with the topic	Students write hypotheses that are related to the topic but are still wrong	Students formulate hypotheses according to the topic but not according to the desired number of items	Students formulate hypotheses according to the topic and according to the desired number of items
3	Students can use tools and materials	Students do not know the function of tools and materials (detected when the pre-test cannot answer questions) and	Students know the function of some tools (detected during pre-test) and cannot operate them	Students know the function of tools and materials but cannot operate them	Students know the function of tools and materials and can operate several tools	Students know the function and can operate the tool

	cannot operate them

The results of collecting self-efficacy data and science process skills are processed by calculating the number of scores of each student. Then proceed with calculating the average value, the standard deviation value, the maximum value, as well as the minimum value. In addition, it is necessary to sum the scores on each question item in the results of the distribution of self-efficacy questionnaires to find out the points that are considered difficult by students. A similar thing is done for observation indicators on the results of observations of science process skills on. Data that is considered prominent and extreme will be followed up by conducting interviews with students to find out the difficulties experienced during lectures.

The prerequisite tests carried out are normality tests, homogeneity tests, and linearity tests. The three tests were carried out on the value of self-efficacy and science process skills of each student. The normality test uses the Liliefors test through the Kolmogorov-Smirnov test in the statistical processing software. The distributed data is normal if the L_{count} < the L_{tabel}, and vice versa if the Lcount > the L_{tabel} then the data is abnormal. Another requirement that can be used is that if the sig value > 0.05 then the normally distributed data.

The homogeneity test is used to find out whether the variants of several populations are the same. The data has a homogeneous variance if the F_{count} < F_{tabel}. Another condition that can be used is if the significance of the value the > 0.05 then the data used is homogeneous. The last prerequisite test is the linearity test. The linearity test is used to test whether the relationship of research variables is linear or not. The linearity test is used to test whether the relationship of research variables is linear or not. The data is stated to have a linear relationship if the F_{hitung} < F_{tabel} or can be seen from the probability value of significance > 0.05.

If the criteria in the prerequisite test analysis have been met, then proceed with the calculation of the correlation analysis. This analysis was performed using the Pearson Product Moment correlation test. The purpose of this analysis is to find out how close the relationship between self-efficacy and the student's science process skills are. If the results of the correlation data calculation show a correlation value of > 0.000 or a significance value of < 0.05, it can be said that there is a relationship between self-efficacy and student science process skills. Conversely, the two variables are said to be unrelated if the correlation value = 0.000 and the significance value > 0.05.

RESULTS AND DISCUSSION

The data in this study were obtained by providing questionnaires and observations to Civil Engineering students in the Soil Mechanics course I. Statistical description of data on both variables, namely self-efficacy and student science process skills can be seen in Table 2.

Table 2. Statistical Description of Self-efficacy Data and Student Science Process Skills

No	Value	*Self-efficacy*	Science process skills
1	Average	23,6604	18,2076
2	Standard deviation	4,8752	3,5429
3	Minimum	15	11
4	Maximum	33	25

Based on the data in table 2, the average value of self-efficacy is 23,6604 with a standard deviation of 4,8752. The average score of student science process skills is 18,2076 with a standard deviation of 3,5429. The minimum and maximum self-efficacy scores obtained by students are 15 and 33. While the minimum and maximum scores of students in science process skills are 11 and 25.

The Relationship between Self efficacy and Science Process Skills

The data on the results of self-efficacy and science process skills were subsequently tested using correlation tests. Before conducting the correlation test, a prerequisite test, normality test, homogeneity test, and linearity test are first carried out. After that, correlation calculations are carried out using Pearson Product Moment.

The results of the normality test using the Kolmogorov-Smirnov one-sample test are shown in Table 3. Based on Table 3, student self-efficacy has a significance value of 0.200 or > 0.05 so that

the data is declared normally distributed. Science process skills data have a significance value of 0.200 or > 0.05 thus science process skills are also normally distributed.

Table 3. Normality Test Results Self-efficacy and Science Process Skills Kolmogorov Smirnov

Variable	Significance Value	Result
Self-efficacy	0,200	Normally Distributed
Science Process Skills	0,200	Normally Distributed

The second prerequisite test is the homogeneity test. The test is performed using statistical processing software. The results of the homogeneity test of student science process skills data based on self-efficacy are presented in Table 4. Based on the data from the homogeneity test results, the variance of the two variables tested is homogeneous. That is, the variable data of science process skills based on the variable self-efficacy have the same variants.

Table 4. Results of the Homogeneity Test of Self-efficacy and Student Science Process Skills

Variable	Significance Value	Result
Self-efficacy	0,931	Homogeneous Data
Science Process Skills	0,890	Homogeneous Data

The last prerequisite test is the linearity test. Testing is carried out to find out if a variable depends on another variable, in this case, to know if the skills of the science process depend on self-efficacy. The linearity test is carried out by calculation using SPSS. The results are presented in Table 5.

Table 5. ANOVA Linearity Test Results

Variable	Significance Value	Result
Science Process Skills * Self-efficacy	0,225	Linier

Based on the linearity test data in Table 5, it is known that the data is said to be linear if the linear deviation has a sig value of ≥ 0.05. Based on the data in the table, the deviation value is 0.225 or higher than 0.05, thus this data meets the criterion of linearity and there is a linear relationship between self-efficacy and the student's science process skills.

Table 6. Interpretation of the Correlation Coefficient

Correlation Coefficient	Interpretation
R≤0,20	Very weak
0,20<R≤0,40	Weak
0,40>R≤0,60	Mode rate
0,60>R≤ 0,80	Strong
0,80>R≤ 1	Very strong

After the prerequisite tests in the form of normality, homogeneity, and linearity tests have been met, then testing the relationship between self-efficacy and student science process skills is carried out. Table 6 shows the interpretation of the correlation coefficient. In this study, the relationship between self-efficacy and student science process skills will be adjusted to the level shown in Table 6. The value of the correlation coefficient of the relationship between the free variable and the bound variable consists of five levels, namely a very weak relationship if the value of the correlation coefficient is 0.20, a weak relationship if the value of the correlation coefficient is >0.20 and 0.40, a medium relationship if the value of the correlation coefficient > 0.40 and 0.60, a strong relationship if the correlation coefficient is >0.60 and 0.80, and a very strong relationship if it has a correlation coefficient of >0.80.

Table 7. Correlation Test Results between Self-efficacy and Science Process Skills

Variabel	Correlation	Significance	Result
Self-efficacy * Science Process Skills	0,515	0,000	There is a correlation between self-efficacy and student science process skills

In this study, the correlation test between self-efficacy and student science process skills was carried out using the Pearson Product Moment Correlation Test. The results of the analysis are

presented in Table 8. The data in Table 8 shows that the significance of the value is 0.000 or less than 0.05. The figure shows that there is a relationship between the skills of the science process and the self-efficacy of Civil Engineering students. Based on Table 8 it can also be known that both variables are positively correlated with the correlation coefficient R = 0.515. With a correlation coefficient of R = 0.515, it can state that the science process skills and self-efficacy of students tested with the Pearson Product Moment Correlation Test have a moderate relationship (moderate). Based on the value of R = 0.515, then the value of R_2 = 0.265, or equal to 26%. This figure shows that the self-efficacy factor has a determination of 26% in the process skills of Civil Engineering students, and 74% there are other factors related to students' science process skills.

Science process skills consist of two, namely basic skills and integrated science process skills. Basic skills of the scientific process, including observation activities, measurement, use of numbers, processing data, and classifying while integrated science process skills include controlling variables, formulating hypotheses, and experimenting[12]. Learning by integrating science process skills emphasizes the student's ability to discover for themselves the knowledge to understand laws, principles, and facts. This can happen because some of the components of the process skills include designing experiments, testing hypotheses, hypothesizing, predicting, inferring, classifying, measuring, and observing[13]. Science process skills are simultaneous cognitive and psychomotor activities [14]. Science process skills provide an interesting learning experience, especially in the development of mental abilities, such as critical thinking, decision making, and solving skills [13].

Students can carry out a series of lectures given by lecturers in both theory and practicum courses if there is high confidence in themselves. The belief or self-efficacy in question is the belief in the ability of the individual himself to complete the tasks and work given. Bandura defines self-efficacy as a belief in one's self-ability to organize and execute actions necessary to achieve the desired result [15]. From various opinions of experts, self-efficacy refers to the power of beliefs, for example, a person can be very confident, but eventually fail [16]. Self-efficacy is defined as a person's consideration of his ability to achieve the desired or determined level of work (performance), which will affect subsequent actions.

The course in the Department of Civil Engineering is a practicum theory course that requires students to use all existing science process skills, but the observation results show that the average student's science process skills are only 18.2076 with a standard deviation of 3.54. There are 9 observed indicators of science process skills with a range of values of 1-5 for each indicator. Based on the results of this observation, it can be stated that students still have science process skills that are far from a perfect score of 45. Harris also stated that there are several indicators of very low science process skills, namely identifying variables and defining variables operationally, creating data and graphs, and constructing hypotheses[13]. The low process skills of students are not only found in Indonesia but also in Nigeria. This is indicated by the average values of science process skills on each indicator manipulating (17.02%), calculating (14.20%), recording (13.60%), observing (12.00%), and communicating (11.40%)[14].

All actions and successes of students in the classroom are influenced by self-efficacy. This is in line with Herawaty's statement that the higher the self-efficacy possessed, the better the activities carried out in various tasks and responsibilities[17]. Self-efficacy is expected in the good category to affect students' science process skills. However, in reality, the average self-efficacy score of Civil Engineering students is only 23.6604 with a standard deviation of 4.8752. This score is still far from the perfect score of 75. The low value of self-efficacy was also found by some researchers both in students [16], college students[18], workers[19], and even teachers [17]. The value of self-efficacy will affect various aspects of both written and practical tasks.

The observations also showed that there was a positive relationship between science process skills and self-efficacy with a value of R = 0.515. The determination value is 26%, which means that self-efficacy affects 26% of civil engineering students' process skills in soil mechanics courses, and 74% there are other factors related to students' science process skills. These findings complement some existing research that self-efficacy affects commitment[14].

CONCLUSION

Based on the results of data analysis and discussion described in the results and discussion section, it can be concluded that the average values of self-efficacy and science process skills are 23.6604 and 18.2076 with a standard deviation of 4.8752 and 3.5429. Based on the results of the correlation test that has previously been carried out in a series of prerequisite tests, it shows a positive relationship between self-efficacy and science process skills with a correlation result of R = 0.515, with a significance value of 0.000. Self-efficacy is one of the factors that affect the science process skills of students of the Civil Engineering Department in the Soil Mechanics course with a determination value of 26%, while 74% is influenced by other factors.

This research shows that the higher the self-efficacy of students, the higher the process skills of students of the Civil Engineering Department in the Soil Mechanics course. The results of this study support assumptions and findings from previous studies which state that the self-efficacy possessed will support science process skills.

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