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Application of STEM on Motivation and Learning Outcomes in Chemistry

***Lely Kurniati, Kasmudin Mustapa, Afadil, Dewi Satria Ahmar**
Tadulako University, Jl. Soekarno Hatta No.KM. 9, Palu 94148, Indonesia
*e-mail: kurniatilely77@gmail.com

Abstract
This study aims to determine the effect of the application of STEM on motivation and learning outcomes of chemistry. This research is quasi-experimental design research. The sample of this study was 25 students of class XI IPA 1 as the Experiment class and Class XI IPA 3 with 25 students as the control class at SMAN 5 Palu. The research instrument was in the form of learning outcomes tests, motivation questionnaires. The percentage of student learning motivation questionnaire data analysis obtained in the experimental class was 80.29% while for the control class it was 55.55%. where the difference is 28.38%. Student learning outcomes were analyzed using SPSS Version 25.0, where the significance value of the t-test analysis was 0.001 < 0.005 so that it can be seen that H0 is rejected, or Ha is accepted. Based on the results obtained, there is an effect of the STEM approach on motivation and learning outcomes in chemistry.

Keywords: STEM approach, acid base, student learning motivation

Abstrak
Penelitian ini bertujuan untuk mengetahui pengaruh penerapan STEM terhadap motivasi dan hasil belajar kimia. Penelitian ini merupakan penelitian dengan desain eksperimen semu. Sampel penelitian ini adalah 25 siswa kelas XI IPA 1 sebagai kelas Eksperimen dan Kelas XI IPA 3 dengan 25 siswa sebagai kelas kontrol di SMAN 5 Palu. Instrumen penelitian berupa tes hasil belajar, angket motivasi. Persentase analisis data angket motivasi belajar siswa yang diperoleh pada kelas eksperimen sebesar 80,29% sedangkan pada kelas kontrol sebesar 55,55%. dimana selisihnya sebesar 28,38%. Hasil belajar siswa dianalisis dengan menggunakan SPSS Versi 25.0, dimana nilai signifikansi analisis uji t sebesar 0,001 < 0,005 sehingga dapat diketahui H0 ditolak atau Ha diterima. Berdasarkan hasil yang diperoleh, terdapat pengaruh pendekatan STEM terhadap motivasi dan hasil belajar kimia.

Kata Kunci: asam basa, pendekatan STEM, motivasi belajar siswa

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INTRODUCTION

Education is an effort to equip students to be able to have the abilities, attitudes, and skills needed in living their lives. To have this ability, educators are expected to be able to empower the potential of intelligence, emotional attitudes, and skills through the learning process. Ideally, effective learning positions students as learning subjects. Placement of students as learning subjects is the embodiment of a student-centered learning paradigm (Solichin et al., 2021). Developing students' understanding and appreciation of how integrated content, skills, and ways of thinking interact, including how they support and complement each other, is no easy task (Johnson, 2019).

Effective learning activities require educators (teachers) who are skilled in their fields or professionals. With professional teachers it will be conducive and effective because the purpose of education is basically to strive for the realization of a conducive and effective learning process. (Fauziah et al., 2021).

Students have a good understanding when they learn concepts by relating new information to prior knowledge, and they gain a more meaningful understanding about concepts. On the other hand, when students practice memorization, they can be expected to have problems understanding concepts and may acquire misconceptions (Gültepe, 2021).

Empirical science education increases students' self-confidence and motivation; help them learn about themselves; develop their problem solving, psychomotor and mental skills; provide meaningful learning; improve analytical thinking skills; and support the relationship between everyday life and science (Astiningsih & Partana, 2020). Chemistry basically includes two properties, namely chemistry as a product and chemistry as a process. Chemistry as a product includes a collection of knowledge consisting of facts, concepts, and principles. Chemistry as a process is concerned with how the concept was discovered (Purwanto et al., 2022).

Understanding concepts related to science, students need to be supported by experimentation, be actively involved, and establish a relationship between life, themselves, and the environment. Experiments not only help students learn more meaningfully, which will provide more permanent learning by contributing to their science process skills, but also help them become productive and creative individuals who are able to put theoretical knowledge into practice (Dori & Sasson, 2008).

Motivation can affect learning outcomes. With motivation, students will study harder, be more tenacious, diligent, and full of concentration in learning. Encouragement of motivation in learning is one thing that needs to be raised to learn at school. The role of motivation in learning is very important because it can affect many aspects related to student learning activities. Therefore, in implementing the 2013 curriculum, the assessment system is more comprehensive, namely cognitive, affective, and psychomotor aspects so that students are expected to be more motivated in learning (Pambudi, 2022).

The application of STEM requires students to be able to solve problems, create innovations, find, or design new things, understand themselves, do logical thinking and master technology. This education focuses on real world and authentic problems so that students learn to reflect on the problem-solving process. The STEM approach makes students have deep, dynamic, and creative insights, so they can create a superior generation. STEM is about contextual learning situated where students from vocational education institutions and teachers together build solutions and knowledge to solve problems. In addition, there is significant evidence from the use of the STEM approach, namely the level of mastery of science and mathematics can exceed predetermined standards (Fauzi et al., 2019).

At the implementation stage, STEM learning places science as the study of knowledge, technology is a medium or facility to support learning, engineering is a skill for planning or designing, and mathematics as a science related to calculations that facilitate learning (Sartika, 2019).

Learning motivation can influence students' success and setbacks in their studies. Research shows that many factors affect students' learning motivation. The purpose of this article is to describe how students conceptualize learning motivation. The categories of how students experience learning motivation are the importance of teachers, subjects, student characteristics and attitudes, learning outcomes, and support from friends and family as well as the environment (Boström & Bostedt, 2022).

Chemicals that can be applied with the STEM approach are acid-base materials because these materials are related to everyday life. Understanding the concept of acid base is also important. because the scope of the material is wide. By giving questions using the real world on acid-base material, it can prove that what is in theory is related to real life so that it can make students analyze every incident in the problem at hand.

Based on observations, SMAN 5 Palu has not implemented the STEM approach so that student scores at SMAN 5 Palu are still below the KKM, the learning process is more teacher-centered, and there are still many formulas that must be memorized. Learning activities of students' learning abilities and interests are very minimal, so chemistry lessons are considered difficult by students, so it is necessary to apply STEM which can increase student motivation and learning outcomes. This is a reference for researchers to conduct research entitled "Application of STEM on Motivation and Chemistry Learning Outcomes". This study aims to determine the effect of the application of STEM on motivation and learning outcomes of chemistry.

METHODS

The type of research used in this research is experimental research. This experimental study aims to examine the effect of a particular treatment on the symptoms of a particular group compared to other groups using different treatments. Based on the research objectives, this study used a quasi-experimental research design. This research is located at SMAN 5 Palu Jl. RE Martadinata, Tondo, Mantikulore Palu City, Central Sulawesi.

In this study, the population was students of class XI IPA SMAN 5 PALU, amounting to 125 students. The sampling technique is purposive sampling (sample considerations) by looking at the same number of students, seeing the low student learning outcomes. The sample in this study were students of class XI IPA 1, totaling 25 students as the Experiment class and Class XI IPA 3, amounting to 25 students as the control class at SMAN 5 Palu. Instrument is a tool used by researchers to measure research variables. The instruments used in this study were validation tests and questionnaires (Sugiyono, 2013).

Descriptive analysis was used to calculate the percentage. Aspects of motivation are needs, drives, and goals. Aspects that affect learning motivation are also moving, directing, supporting behavior, all of which are manifested by the existence of certain needs, drives and goals. The questionnaire used consists of 25 questions which include 5 indicators, namely indicators of attention, interest, activity, satisfaction and self-confidence. Each indicator consists of 5 questions and 5 answer choices (Mustapa, 2009).

Table 1. Interpretation of student learning motivation score

No	Achievement Level Score	Interpretation
1	85-100%	Strongly agree
2	69-84%	Agree
3	53-68%	Doubtful _
4	37-52%	Not quite agree
5	20-36%	Don't agree

Determination of the category of student learning motivation towards the application of the STEM Approach in the positive, neutral, and negative categories, according to the final indicator value taken from the highest score and the lowest score from the questionnaire score determined based on Table 2.

Table 2. Criteria for Indicators of Students' Learning Motivation Level

No	Achievement Level Indicator	Category
1	>60%	Positive
2	0.6	Neutral
3	<60%	Negative

RESULTS AND DISCUSSION

The results of this study include the results obtained during the teaching and learning process at SMAN 5 Palu in class XI IPA 1 as an experimental class and class XI IPA 3 as an experimental class with the same learning materials, namely acids and bases. Data analysis in this study is divided into two, namely descriptive analysis and inferential statistical analysis.

Table 3. Result data study student class experiment

Experiment class			
No.	Name	Pretest	PostTest
1	NNH	60	85
2	YS	40	80
3	MM	40	95
4	YS	15	85
5	SH	30	80
6	VV	20	75
7	NZ	35	60
8	NA	45	85
9	NY	35	75
10	RH	45	85
11	AW	60	95
12	YOUR	45	85
13	RT	35	85
14	HZ	40	95
15	MOBILE PHONE	45	60
16	BV	15	75
17	AU	50	80
18	AR	45	80
19	AB	20	70
20	NC	20	80
21	DM	25	70
22	AM	40	85
23	MI	35	80
24	JS	45	95
25	MR	30	90

Table 4. Result data study student class class control

Control class			
No.	Name	Pretest	Posttest
1	FM	25	50
2	ZL	20	80
3	SI	25	45
4	IM	35	55
5	ZA	50	70
6	AL	55	65
7	ST	40	80
8	SI	30	75
9	ER	25	55
10	IN	15	80
11	SS	10	50
12	YES	25	50
13	IN	30	65
14	EG	65	80
15	MA	45	90
16	SA	50	80
17	PR	30	70
18	IF	40	80
19	IN	45	70
20	DS	30	95
21	US	15	75
22	JU	45	70
23	KH	25	60
24	MA	30	65
25	UN	40	75

The ability of students' learning motivation was analyzed using descriptive analysis. The following is data on student learning motivation in the Experiment class and the control class (See Table 3 and Table 4).

Table 5. Student learning motivation data for experiment class and control class

Information	Test		Control	
	Before	After	Before	After
Total students	25	25	25	25
Lowest score	56	89	50	63
Highest score	77	123	72	83
Score maxium	125	125	125	125
% Average	53.72	83.93	50.59	55.55
Attitude	doubt	Agree	don't agree	doubt
Category	Negative	Positive	Negative	Negative

The results of descriptive analysis, the level of student motivation in the experimental class showed an agreeable attitude and was in the positive category, while the control class showed a doubtful attitude and was in the negative category. The percentage obtained in the experimental class is 83.93% while for the control class it is 55.55%. From the results of the questionnaire analysis after the learning was applied, the percentage obtained in the experimental class was higher than the control class where the difference was 28.38%.

Table 6. Statistics descriptive result

Descriptive Statistics					
	N	min	Max	Means	Std. Deviation
Pre-test Test	25	15	60	36.6	12,477
Posttest Trial	25	60	95	81.2	9,605
Pretest Control	25	10	65	33.8	13,485
Posttest Control	25	45	95	69.2	13,124
Valid N (by list)	25				

Based on the data on student learning outcomes in the table above , it can be is known that the posttest average of the experimental class was 81.20 and the control class was 69.20. Thus, the average posttest score of the class experiment with use more STEM approach tall of the class average control.

Analysis statistics inferential used to see influence application of STEM on Theory chemical that is Sour language. As for data processing using spss version 25 where study this conducted independent sample t-test.

Table 7. Normality test

Class	Data	Meaning	Information
XI IPA 1 test	*Pre-test*	0.200	Normal distribution
	Posttest	0.06	Normal distribution
XI IPA 3 control	*Pre-test*	0.058	Normal distribution
	Posttest	0.200	Normal distribution

The normality test is one part of the prerequisite data analysis test or the classical assumption test, meaning that before the actual analysis is carried out, the research data must be tested for the normality of the distribution. Good data is data that is normally distributed (Orcan, 2020) . Based on the results of the normality test, it was shown that the pretest and posttest data of the two groups presented by the students, the research sample, were normally distributed.

Table 8. Results test homogeneity class test and control

Variance Homogeneity Test					
		Statistics Levene	df1	df2	Signature.
Student learning outcomes	By Mean	2,929	1	48	0.093

Homogeneity test used to determine whether the data from the two class variants are homogeneous or not. Determining the homogeneity of the two classes taken determines the homogeneity of the two classes taken as samples (Abdulaal, 2021). Based on the table of homogeneity test results above, it can be seen acquisition score significant is 0.093 0.05 then based on the decision criteria withdrawal could decided that H0 is accepted and H1 is rejected, thus it can be concluded that the data groups have the same variance (homogeneous).

Table 9. Test results independent sample t-test

	Levene's Test for Equation of Variance
	Signature. (2-tail)
The same variance is assumed	0.001

The hypothesis was conducted to determine whether there were differences in learning outcomes between the experimental class and the control class. The data used in the hypothesis test came from the posttest data of the ex-experimental and control class students (Lubis et al., 2019) . Based on the table of results of the Independent Sample t-test, the value of sig. (2-tailed) is 0.001. The value of sig.(2-tailed) is 0.001 < 0.05, then based on the decision-making criteria in the hypothesis test, it is determined that H0 is rejected, and Ha is accepted, which means that there is an effect of learning outcomes on the application of the STEM approach to Acid-Base learning.

CONCLUSION

There was an effect of increasing student learning outcomes on the application of the STEM approach to acid-base learning in class XI IPA SMAN 5 Palu. The average posttest score for the experimental class was 81.20 and for the control class 69.20. This is also reinforced by the statistical data analysis of the t-test (hypothesis testing) using the computer-assisted version of SPSS version 25 with the Independent sample t-Test test, the results of which are sig. (2-tailed) the value is 0.002. The value of sig.(2-tailed) 0.001 <0.05, goo then based on the decision-making criteria in hypothesis testing, that there is an effect of increasing learning outcomes on the application of the STEM approach to acid-base learning . The results of the student motivation questionnaire analysis based on descriptive statistical calculations showed that there was an effect of the STEM approach on students' learning motivation where the difference between the experimental class and the control class was 28.38%.

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