The Use Of Stem-Based LKS In Biology Learning and Their Effect On The Motivation And Learning Outcomes Of Students Of Class XI MIA In Samosir District

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Abstract. This research was conducted to determine the use of STEM-Based Worksheets in Biology Learning and its Relationship with Motivation and Learning Outcomes of Class XI MIA Students in Samosir Regency. The research was conducted in March-April 2022. This study used a quasi-experimental research type with a qualitative approach. Based on the results of research conducted, the use of LKS can contain various activities and activities for students in the form of demonstrations and experiments. STEM-based teaching materials can improve student learning outcomes. Based on the research data, it is known that students' learning motivation in the experimental class shows an average score of 80.45 and the control class an average of 75.01 which is included in the high category of the two classes. In this case, there is an effect of STEM-based worksheets in Biology learning on students' learning motivation. Students who have high motivation will be positive about their learning outcomes. This is supported by student learning outcomes in the experimental class that the average score is 67.85 higher than the control class with an average of 52.01. This proves that there is a significant increase from the control class that does not use worksheets to the experimental class that uses STEM-based worksheets.

Keywords: STEM-Based LKS, Biology Learning, Motivation, Student Learning Outcomes

1. Introduction

Science is considered to have an important position in the development of the character of society and the nation because it has a very rapid development of knowledge and the implementation of science in other fields which is very useful, as well as the content of values and attitudes that support the development of students' abilities. Science education has an important role in preparing the nation's generation to enter the world of the future. Science learning is a knowledge construction process (science) through students' thinking activities so that in this situation students are given the opportunity to develop their knowledge independently through a communication process that connects their initial knowledge with the knowledge they will find.

AISTEEL 2022, September 20, Medan, Indonesia

DOI 10.4108/eai.20-9-2022.2324698

Biology as a branch of science that studies natural phenomena and their application to build technology that is useful in people's lives. Biology education plays a very important role in the achievement of various skills such as problem solving, collaboration skills, communication skills, communication skills, critical thinking skills, literacy, creativity, and creative thinking skills through learning and research to solve various problems in society.

The Covid-19 pandemic that we are currently facing can create a special attraction in biology learning related to the respiratory system material. Learning on the Respiratory System Material will specifically discuss the relationship between the structure of the tissue making up organs in the respiratory system in relation to bioprocesses and functional disorders that can occur in the respiratory process [45]. As many as 62.15% of students experienced misconceptions in the Respiratory System material. The factors causing this misconception include the students themselves, learning methods, teaching methods and context [9]. Based on this, we need a learning that can increase students' motivation and learning outcomes in studying this material.

Online learning during the Covid-19 pandemic reduced student interest in learning due to the absence of direct interaction between teachers and students [44] [19]. The quality of online learning determines students' interest in learning, meaning that the teacher's ability to use online learning methods has an influence on students' interest in learning [21]. During the Covid-19 pandemic, the decline in students' interest and motivation in learning was due to the quality of online learning itself, so it was necessary to implement new learning that was expected to be able to increase student interest and motivation to learn.

The low ability of science shows the low thinking skills of students so that students are categorized as still not having creativity in solving a problem. During the Covid-19 pandemic, the application of online learning only affected 35.3% of students' critical thinking skills [5]. According to [21] and [4] the application of the online learning model used has an influence on students' critical thinking skills.

The learning process can be said to be of high quality if the learning process runs smoothly, so that interesting teaching materials are needed for students, so that students are motivated to learn on their own (Rahmawati, 2016). One of the teaching materials that can support student learning activities in biology learning is the Student Worksheet (LKS). The use of LKS based on a scientific approach in learning during the Covid-19 pandemic can attract students' interest to be active and enthusiastic in learning, encourage students to become "researchers", and foster scientific, critical and analytical thinking skills [8]. There is a positive relationship between motivation and student learning outcomes, this is supported by [6] which explains that there is a significant positive relationship between interest in student biology learning outcomes.

One alternative that can be taken to improve the abilities and skills above is the integration of the STEM approach (Science, Technology, Engineering and Mathematics) into learning media, such as student worksheets. Morisson in [26] suggests several benefits of the STEM approach, among others, it can improve students' ability to solve problems, encourage students to become innovators, inventors, independent, logical thinkers, and have technological literacy. Various empirical evidences of the advantages of the STEM approach have been documented [13], [10], [33], [16], [31], [38]. The use of STEM-based worksheets in learning can improve critical thinking skills [10], [16], creative thinking skills [25], [31], [33],

collaboration skills and improve the level of concept understanding [10] which leads to increased student learning outcomes [10], [38].

LKS apart from being a medium or source of learning also has other functions including (1) Accelerating teaching and saving on the presentation of a topic; (2) Optimizing limited tools; (3) Helping students to be more active in the teaching and learning process; (4) Generating students' interest in learning if the worksheets are arranged neatly, systematically and easily understood by students; (5) Can facilitate the completion of individual, group or classical tasks because students can complete tasks according to their learning speed; (6) Can improve students' ability to solve problems [43].

According to [41] LKS has several functions as follows: 1) as a guide for students in carrying out learning activities, such as conducting experiments; 2) as an observation sheet, where student worksheets provide and guide students to write down observational data; 3) as a discussion sheet, where the student worksheet contains a number of questions that guide students to conduct discussions in the context of conceptualization; 4) as a discovery sheet, where students express their findings in the form of new things that they have never known before; 5) as a vehicle to train students to think more critically in teaching and learning activities; and 6) Increase students' interest in learning if learning activities guided through LKS are more systematic, colorful and illustrated and attract students' attention.

According to BSNP [7], one way to achieve competence in learning is to use worksheets that have been adapted to the characteristics of students in the subject, namely by applying learning which includes the processes of exploration, elaboration, and confirmation. LKS are prepared by taking into account three quality requirements, namely didactic aspects, construction aspects, and technical aspects as well as student interest in the developed LKS products.

[37] details the characteristics in the preparation of worksheets, including the following: 1) formulating competencies that must be mastered, 2) packaging learning materials into more specific units so that it makes it easier for students to learn the material, 3) providing examples and illustrations to support the clarity of the material. learning, 4) presenting assignments or examples of questions so that students can find out their mastery of the material they have, 5) presenting material according to students' conditions and environment (contextual), 6) using simple and communicative language, 7) providing information about references that support the material.

Biology learning that trains thinking skills in solving problems is guided by teachers so that students can be active in participating in learning and finding their own understanding related to learning materials. Problem solving activities characterize learning that develops creative thinking skills [26]. Therefore we need a media to support the learning process, one of which is Student Worksheets (LKS).

LKS or other designations also known as LKPD (Learn Worksheet) is one of the learning resource media developed by teachers as facilitators in learning activities. LKPD with a Science, Technology, Engineering and Mathematics (STEM) approach is equipped with STEM content such as science as a concept, science as a process, technology as the application of science, engineering as engineering science, and mathematics as a tool. Then LKPD is also made based on several components such as narratives, experiments, exercises, and knowledge information [1].

STEM-based worksheets are defined as printed teaching materials in the form of sheets of paper containing materials, summaries, and questions that integrate technology and engineering design concepts in the teaching and learning of science and mathematics in the school curriculum [39].

According to the NRC in [26], STEM learning needs to emphasize several aspects of the learning process including: (1) asking questions (science) and defining problems (engineering); (2) developing and using models; (3) planning and conducting investigations; (4) analyze and interpret data (mathematics); (5) using mathematics; computer information technology; and computational thinking; (6) building explanations (science) and designing solutions (engineering); (7) engage in evidence-based arguments; (8) obtain, evaluate, and communicate information. In addition to using the right learning approach, the use of teaching materials must also be appropriate so that students' thinking skills can be trained.

In learning activities, [30] states that motivation can be said as the overall driving force in students that causes learning activities and provides direction to learning activities. [12] argues that learning motivation is a change in energy in a person's personality which is characterized by the emergence of feelings and reactions to achieve goals.

So, based on the conclusions above, learning motivation is a condition or condition and encouragement that causes energy to feel happy and enthusiastic in carrying out learning activities. As for the factors that influence the learning motivation of students there are various kinds.

[46] divides motivation into two types, namely intrinsic motivation and extrinsic motivation by defining the two types of motivation as follows: Intrinsic motivation is a form of motivation to learn that comes from within a person and does not need external stimulation. While extrinsic motivation is a learning urge that comes from outside a person.

[14] states that the principles that can be applied to increase learning motivation are as follows.

Students will be more active if the topic to be studied is interesting and useful for them.

Learning objectives are clearly arranged and informed to students so that they know the learning objectives.

Students are always informed about their learning outcomes.

Giving praise and rewards is better than punishment, but sometimes punishment is also needed.

Utilize the attitudes, ideals and curiosity of students.

Try to pay attention to the differences in each student, for example differences in willingness, background and attitude towards a particular school or subject.

Try to meet the needs of students by always paying attention to them and arranging a good learning experience so that students have satisfaction and appreciation and directing their learning experience towards success, so that they have self-confidence and achieve learning achievement.

From the description above, it can be concluded that there are several principles to increase student learning motivation, namely if the topic to be studied is interesting and useful, the

learning objectives are clearly formulated, student learning outcomes must be notified, rewards are given for those who excel, take advantage of positive attitudes. Attitudes, ideals and curiosity of students, paying attention to their differences, and trying to meet the needs of students by paying attention to them.

Learning outcomes as an indicator of the achievement of learning objectives in the classroom can not be separated from the factors that affect the learning outcomes themselves. [34], mentions the factors that influence learning outcomes, as follows:

Internal factors are factors that exist within the individual who is learning, which includes physical factors and psychological factors.

External factors are factors that exist outside the individual's body which include family factors, school factors and community environmental factors.

According to [23] found that parental acceptance has a significant role on achievement motivation in students. The large role of parental acceptance of students' achievement motivation has an effective contribution. It can be concluded that students' achievement motivation when viewed from parental acceptance turns out to have a significant role, so that the greater the role of parental acceptance, the higher the level of achievement motivation in students.

According to [8] the use of LKS based on a scientific approach in learning during the Covid-19 pandemic can attract students' interest to be active and enthusiastic in learning, encourage students to become "researchers", and foster scientific, critical and analytical thinking skills. However, most of the worksheets used today do not facilitate students to develop their creative thinking skills. The worksheets contain brief material and questions that students have to do, although they can support students in learning, they are still not effective as seen from the low level of student activity and students have not shown their creative thinking skills. [13] found that worksheets developed with the STEM approach can improve students' critical thinking skills. [25] also found that worksheets with a STEM approach have been effective in training students' creative thinking skills. So it is hoped that the application of STEM-based worksheets can increase students' interest, motivation, and creativity during the pandemic which will also have an impact on improving the quality of learning and student learning outcomes accompanied by an increase in students' thinking skills.

Through the results of observations conducted online for two weeks via google form at 7 public high schools in Samosir Regency at the beginning of the odd semester to see student learning motivation in Biology learning carried out on state high school students throughout Samosir Regency, it was found that from 203 people respondents as much as 44.3% of students agreed that the subject matter of Biology is very abstract so it is difficult to maintain attention. As many as 61.1% of students disagreed, Biology assignments and questions given by the teacher were easy to complete. As many as 51.2% of students agreed, it takes luck to be successful in learning Biology. As many as 48.3% of students agreed that Biology learning material was more difficult to understand than expected.

Meanwhile, based on the results of observations of teaching interviews with teachers conducted with SMA Negeri teachers in Samosir Regency, it was found that out of 16 respondents, 40% of teachers stated that sometimes teachers feel confident that students will graduate after presenting the material. As many as 80% of teachers stated that sometimes teachers were disappointed in the results that students got after studying Biology. As many as

60% of students did not take notes after the material was presented. As many as 40% of teachers sometimes feel confident that students will pass the KKM some time after giving the material. As many as 30% stated always and 30% of teachers stated that students need luck in order to succeed in learning. And as many as 50% of teachers stated that they sometimes apply learning by giving worksheets to students. Departing from the real (real) conditions above, to overcome so that students are able to play an active role in learning, it is necessary to innovate in using several approaches, strategies and learning models. The learning model has a very important role in the success of education. The use of the right model will determine the effectiveness and efficiency of a learning process.

Based on the description above, the researcher is interested in conducting research on the Use of STEM-Based Worksheets in Biology Learning and Its Effect on Motivation and Learning Outcomes of Class XI MIA Students in Samosir Regency.

From the problems found in the background above, the problem can be formulated as follows:

How can STEM-based worksheets be implemented in biology learning at the State Senior High School Level XI MIA in Samosir Regency?

How does the application of STEM-based worksheets in biology learning affect the learning motivation of Class XI MIA students in Samosir Regency?

How does the application of STEM-based worksheets in biology learning affect the learning outcomes of Class XI MIA students in Samosir Regency?

In line with the formulation of the problem above, the purpose of this research is to find out:

STEM-based LKS can be implemented in biology learning at the State Senior High School Level XI MIA in Samosir Regency.

The effect of applying STEM-based worksheets in biology learning on the learning motivation of Class XI MIA students in Samosir Regency.

The effect of applying STEM-based worksheets in biology learning on the learning outcomes of Class XI MIA students in Samosir Regency.

2. Method

This research was carried out in class XI MIA State Senior High Schools throughout Samosir Regency in the even semester of the 2021/2022 academic year, namely in January-March 2022. The type of research used in this study was a quasi-experimental approach with a qualitative approach. [35] defines that experimental research is research that is used to find the effect of certain treatments on others under controlled conditions. A similar opinion was also expressed by [2] who defines experimental research as research that is intended to determine whether or not there is an effect of treatment on the subject under investigation. The way to find out is to compare one or more experimental groups that were given treatment with a comparison group that was not given treatment.

Nine sub-districts in Samosir Regency have eight public high schools. Selected 2 public high schools with 1 class each as an experimental class, namely classes taught with STEM-based worksheets. Based on the purpose of this study, the population in this study were students of class XI MIA SMA Negeri 2 Pangururan and SMA Negeri 1 Palipi. Determination of

treatment in this study using purposive sampling technique, namely the technique of determining the sample with certain considerations. Schools were determined based on the similarity in quality and number of classes that were considered equal, two public high schools with one experimental class and one control class each were found. The class that was selected as the experimental class was taught with STEM-based worksheets. The experimental class was given a pretest (pretest) and a final test (posttest) to determine the effect of student learning outcomes before and after treatment and used a questionnaire to determine students' learning motivation after treatment.

Experiments to study the effect of certain variables on other variables, through trials under special conditions that are deliberately created through cause and effect. This research involves several classes. The class that was selected before being given special treatment was given a test (pretest) and then again given a test (posttest) after being given special treatment, namely being taught using STEM-based worksheets. Then after being given special treatment, students who were taught using STEM-based worksheets were given a questionnaire to determine students' interest and motivation to learn.

The research design used for the purposes of the investigation is One Group Pretest-Posttest Design, which uses one treatment group by giving pretest and posttest with the following design model:

Table 1. Research Design One Group Pretest-Posttest Design

Pretest	Treatment	*Postest*
O_1	X	O_2

Information:

O_1 : Pretest before being given treatment.
O_2 : Posttest after being given treatment
X : The treatment of the experimental class is by using STEM-based worksheets

At the first meeting, a pretest was held to determine students' initial abilities and to determine understanding of concepts and student learning outcomes. Then students are taught with STEM-based worksheets. Then at the last meeting, a final test (posttest) was given.

Data collection techniques were carried out using a questionnaire and calculating the percentage of motivation. Questionnaire compiled based on assessments, corrections, and suggestions for improvement from experts (validators) or education experts.

To obtain the percentage can be calculated by the formula that has been proposed by [47] below:

$$P = \frac{\sum xi}{n} x\ 100\% \quad (1)$$

Formula description:

P = percentage
$\sum xi$ = student scores
n = maximum score

100% = constant

After obtaining the percentage, each student is classified according to his level of interest and motivation. Meanwhile, the classification of the questionnaire scores can be seen in the following table [48].

Table 2. Classification of Motivation Percentage

Benchmark Interval (%)	Interest Classification
81 – 100	Very High Motivation
66 – 80	High motivation
56 – 65	Moderate Motivation
46 – 55	Low Motivation
≤ 45	Very Low Motivation

The procedure adopted in this study consisted of two stages, namely as follows.

Preparation Stage

At this stage, the material to be taught is determined which is adjusted to the material that is currently running or being taught at school. Then prepare the learning tools that need to be prepared such as the Learning Implementation Plan (RPP) and STEM-based Student Worksheets (LKS). The learning tools are adapted to the application of STEM-based learning. The learning device is designed for 6 meetings. The learning tool is then validated by the validator. The results of the revision are used as improvements to be used during research. Data collection instruments were prepared to obtain information about students' motivation and learning outcomes. The instruments that have been compiled are then validated by the validator. The revised results adapted to the learning will be applied to several experimental classes. Learning tools in the form of lesson plans, STEM-based worksheets, test questions, and validated questionnaires will be distributed to teachers who teach in classes at predetermined sample schools. In this study, an observer is needed. Observers are tasked with observing the implementation of the learning approach and documenting the learning process.

Implementation Stage

The treatment will be carried out for 8 meetings. At the first meeting, a pre-test was held to determine understanding. Then students are taught the use of STEM-based worksheets for 6 meetings. During the treatment with the use of STEM-based worksheets, descriptive questions were included in the worksheets that were used to obtain data on student creativity during learning. Furthermore, at the last meeting, a post-test was given to determine the increase in student learning outcomes.

A motivation questionnaire was given to determine students' learning motivation after being taught using STEM-based worksheets. After learning using STEM-based worksheets is carried out, then questionnaires and tests are given to students to see the average value of students' motivation and learning outcomes which are measured based on the Likert scale (attitude scale) and objective assessment measurements in multiple choice questions, namely correct answers with scores. 1 and wrong answer with a value of 0.

Data processing is done by collecting data using pretest and posttest on learning outcomes, and interest, motivation and creativity questionnaires by looking at the normality of the data

using the Kolmogrov-Smirnov and homogeneity of the data using the Levene test. Tests for normality and homogeneity of data were carried out to determine the hypothesis testing used. In this case the normality test of the data is normal, the hypothesis testing is carried out by parametric measurements with independent sample t test (t test).

The steps for testing the normality and homogeneity of the data are as follows:

Normality Test

Testing the normality of each class to determine whether the pretest and posttest scores are normally distributed or not can use kolmogrov-smirnov. The steps for analyzing descriptive data and testing hypotheses are as follows [3]:

After knowing the mean, standard deviation, and variance, then determine the number of class intervals = 1 + 3,3 log n (n = many subjects/data)

Define range (r) = biggest data– smallest data

Determine the length of the interval (P)

$$P = \frac{\text{range}}{\text{many classes}} \quad (2)$$

Make a table listing the frequency of observations and the frequency of expectations

Determine the average

Varians (S^2) dan Standard deviation (SD)

Finding the Z-score value for the class boundary of the interval and finding the Z-O . Area

$$Z = \frac{\text{class limit} - \text{average value}}{S} \quad (3)$$

Homogeneity Test

Testing homogeneity to find out whether the pretest and posttest scores are homogeneously distributed or not by using variance or F test with Levene test, can use the formula with the following steps (Arikunto, 2013):

Looking for valur F:

$$F_{count} = \frac{\text{V. Biggest}}{\text{V. smallest}} \quad (4)$$

Degrees of freedom (db)

$$db_1 = n_1 - 1 \quad (5)$$

$$db_2 = n_2 - 1 \quad (6)$$

Determine the F value from the list

Determining homogeneity by comparing the Fcount value with the Ftable value based on the db value at the 1% confidence level or = 0.01. The stipulation is that if Fcount < Ftable the data is considered to have a homogeneous variance and Fcount > Ftable the data is considered to have a non-homogeneous variance.

Uji Hipotesis

Testing the hypothesis can be done using a formula with the following steps (Arikunto, 2013).

Finding the combined standard deviation

$$s = \sqrt{\frac{(n_1 - 1){s_1}^2 + (n_2 - 1){s_2}^2}{(n_1 + n_2 - 2)}} \quad (7)$$

Information :

S = Combined standard deviation
n_1 = The number of samples with large variance
n_2 = The number of samples with small variance
s_1 = big varian
s_2 = small varian

Finding the value of t

$$t = \frac{(\bar{x}_1 - \bar{x}_2)}{s\sqrt{\frac{1}{n_1} + \frac{1}{n_2}}} \quad (8)$$

Determine the degrees of freedom db = $n_1 + n_2 - 2$

\ Determine the value of t from the list

Determining the hypothesis by comparing the value of thit with the value of ttab based on db at a confidence level of 1% or = 0.01. The stipulation is that if thit < ttab then the data is considered to have no significant difference (Ho is accepted and Ha is rejected) and if thit > ttab then the data is considered to have a significant difference (Ho is rejected and Ha is accepted).

3. Research Results And Discussion

Research Results

The use of STEM-based LKS at State Senior High Schools in Samosir Regency is one of the teaching materials that can assist in the learning process for students, in which it contains a brief material, learning objectives, and work instructions or instructions, in the learning process and practicum/experiment to prove theory. concepts and a number of questions that must be answered by students so that students can expand and deepen the material learned by using the LKS. STEM-based worksheets developed with biology learning materials, especially the human respiratory system. Each student is required to participate actively to understand themselves about the subject matter studied through teaching materials. Based on these activities can make student learning outcomes better. By learning using STEM-based student worksheets (LKS), students do not only think abstractly, at the beginning of their learning they are given real problems that will be studied in teaching materials. Through the real problems given, students are given time to observe, observe, and solve the problem then the teacher confirms by asking questions. The use of STEM-based worksheets in the implementation of the Biology learning process is one of the most important parts that can have an influence on students' motivation and learning outcomes. This is shown from the learning activities that run

optimally seen from the willingness of students to ask questions, provide examples, and provide statements about the material being taught.

The Influence of STEM-based LKS on Learning Motivation of Class XI MIA Students in Samosir Regency

Students' learning motivation in the experimental class (STEM-based worksheets) showed that the lowest score was 56 and the highest was 94, with the mean and standard deviation being 80.45±6.704 and the data were not normally distributed (Z = 0.150; P = 0.000). Meanwhile in the control class, the lowest score was 57 and the highest was 97, with the mean and standard deviation being 75.01±9.068 and the data being normally distributed (Z = 0.125; P = 0.007). The results of the description of students' learning motivation in the experimental class are categorized as high and the control class is categorized as high.

The results of the data homogeneity test showed the variation of the data between sample groups in a homogeneous population (F = 0.010; P = 0.920) on the motivation variable of the experimental class. While the homogeneity of the control class motivation variable is that the sample in the population is homogeneous (F = 2.381; P = 0.127). Based on this, the data used were analyzed by parametric t-test. Data analysis with this technique shows that the use of STEM-based worksheets in Biology learning affects the learning motivation of students in class XI MIA in Samosir Regency (t = 111.014; P = 0.000).

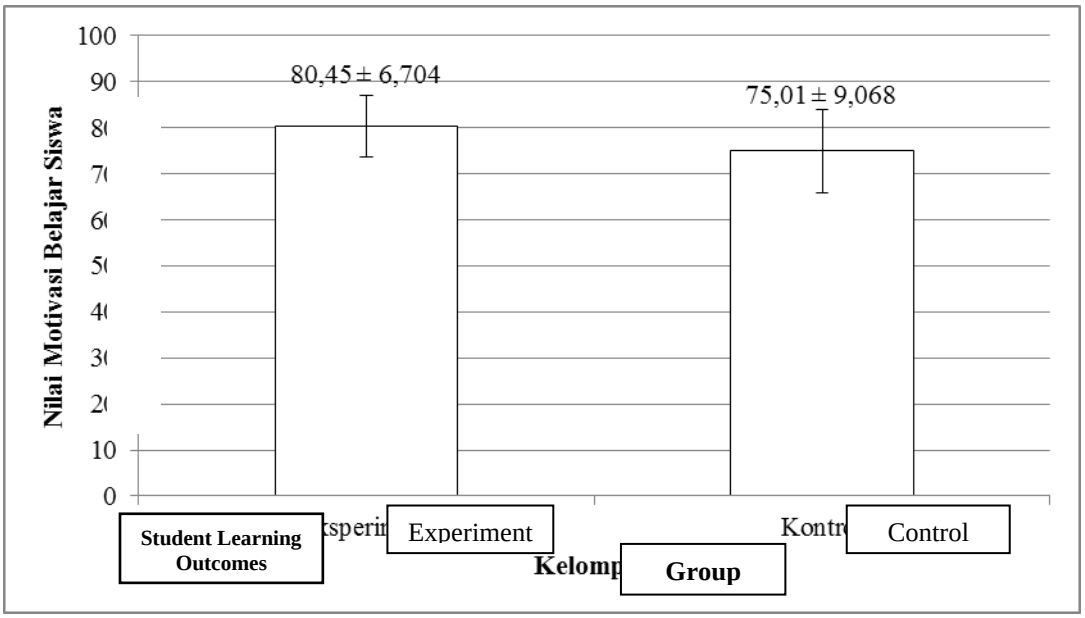

Figure 1. The effect of STEM-based worksheets on student learning motivation is significantly different with the probability value (P = 0.000)

Student learning motivation shows that there is a difference in the average value of motivation in the experimental class which shows an average value of 80.45±6.704 (X ±SB) which is higher than the learning motivation of control class students, namely the average value of 75.01±9.068 (X ±SB).

The Effect of STEM-based LKS on Student Learning Outcomes of Class XI MIA in Samosir Kabupaten

The results of the study on student learning outcomes in the experimental class showed that the lowest score was 35 and the highest was 95 with the mean and standard deviation of 67.85±12.098 and the data was not normally distributed (Z = 0.140; P = 0.001). Meanwhile in the control class the lowest score was 15 and the highest was 100 with the mean and standard deviation 52.01±19.001 and the data were normally distributed (Z = 0.084 ; P = 0.200). The results of the data homogeneity test showed the variation of the data between the sample groups in the homogeneous population (F = 0.035; P = 0.853) in the experimental class. While the results of the homogeneity test of the data in the control class showed variations in the data between sample groups in a homogeneous population (F = 0.842; P = 0.362). Based on this, it can be concluded that the data are normally distributed and homogeneous. Data analysis by t-test showed that the use of STEM-based worksheets in Biology learning had an effect on student learning outcomes in class XI MIA in Samosir Regency (t = 40,519; P = 0.000).

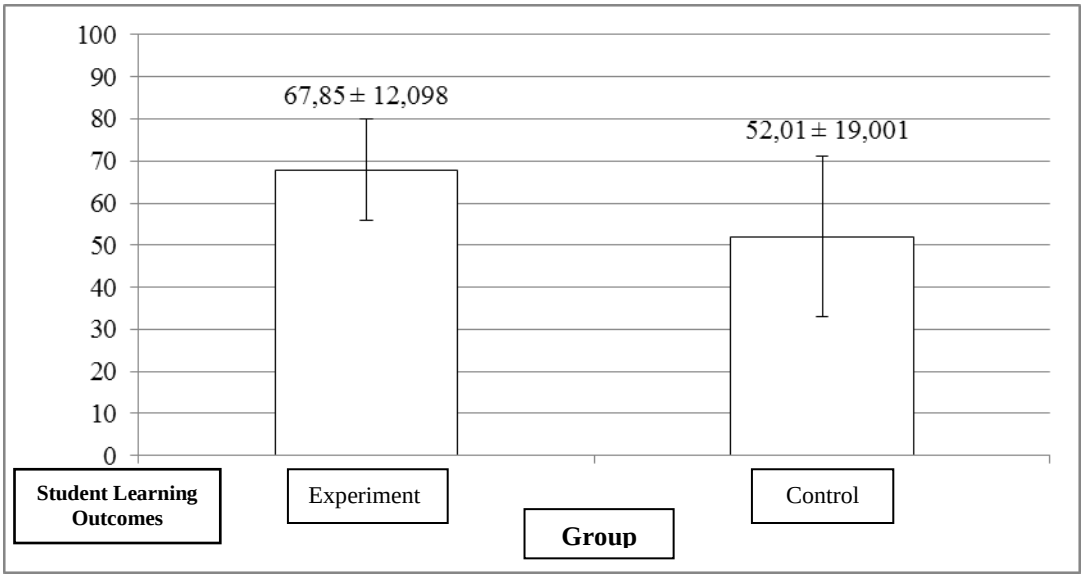

Figure 2. The effect of STEM-based worksheets on student learning outcomes is significantly different with the probability value (P = 0.000)

Student learning outcomes show that there is a difference in the average value of student learning outcomes in the experimental class and the control class. In summary, the experimental class showed an average value of 67.85±12.098((X ±SB) .higher than the student learning outcomes in the control class, namely the average value of 52.01±19.001 (X ±SB).

Discussion

Based on the results of research conducted on XI MIA students in Samosir Regency, the use of LKS can contain various activities and activities for students in the form of demonstrations and experiments, aimed at making students more active in learning so that students are able to

optimize their creative thinking skills, as is the case at school. SMA Negeri in Samosir Regency which has higher motivation than interest and creativity and student learning outcomes.

Creative thinking skills are very important for students to have. Because skills in creative thinking can be developed through a learning process using STEM-based worksheets, and can also develop skills in creative thinking, STEM-based teaching materials can also improve student learning outcomes. Teaching materials are one of the effective learning media used in the learning process. Teaching materials can help teachers interact and encourage students to optimize students' intellectual abilities. Teaching materials for a learning model can develop creative thinking skills and learning outcomes. Use of STEM-Based LKS Effectively increases motivation and learning outcomes of Class XI MIA biology in Samosir Regency. This is supported by [39] which states that students' creative thinking skills increase after using STEM-based worksheets. The increase in creative thinking skills is in the high category on the fluency and elaboration aspects, the medium category on the flexibility aspect, and the low category on the original aspect. The increase in learning outcomes of the experimental class was higher than that of the control class. Overall, STEM-based Student Worksheets are feasible and effective to use in learning and can improve students' creative thinking skills. Students will have high enthusiasm and motivation that is positive for their learning outcomes. The learning motivation that exists in students will increase because the curiosity to learn is so enthusiastic and the enthusiasm for learning tends to require a student to try harder to achieve the desired goals.

With high learning motivation, students will try hard to follow the learning as well as possible so that they are able to achieve the expected learning outcomes well. Learning by using LKS will run smoothly if it is supported by the availability of teaching materials and LKS for the subjects to be taught and have broad and in-depth knowledge about the learning and the quality in learning will be achieved if a student can demonstrate a high level of mastery of a material being taught. taught and learned. At the first meeting, students still tend to be inactive and not confident. When learning enters the core activity, students have begun to show an urge to work. The distribution of worksheets that are done in groups creates the desire and desire of students to be able to complete them on time. Giving awards can make students in their groups feel happy by clapping each other showing satisfaction with the results obtained [42]. It is clear that by applying the STEM approach in learning can generate desires and desires, drives and needs, and rewards for students in learning.

In the process of implementing learning, it can be illustrated that the valid and practical STEM-Based LKS for biology learning for Class XI MIA in Samosir Regency can prepare a good and effective learning implementation process. With an approach that uses STEM-based worksheets, students can take and apply what they learn in the classroom for work and for their future in the real world.

The educational, industry, and business communities must work as a team to develop curricula that will promote effective STEM implementation for the future and success of students. LKS or Student Worksheet is a teaching material that can help in a learning process, which contains a material briefly, and learning objectives, as well as instructions in doing a lesson by use.

STEM-based worksheets can be used as printed teaching materials in the form of worksheets containing a material, as well as summaries, and questions that integrate a concept with design on technology in the teaching and learning process in schools. A valid STEM-based LKS

shows something true where the learning process for students will be easier to understand and with the use of STEM-based LKS it can make it easier for students and teachers and is practical for learning biology Class XI MIA in Samosir Regency. This will make students more motivated in the process of implementing learning.

Based on the description above, the use of STEM-based worksheets in Biology learning is one solution that can be done to increase student motivation and learning outcomes. A series of learning activities with a STEM approach can trigger students' enthusiasm for learning so that students are encouraged to strive to achieve the desired learning goals [18]. The existence of motivation in learning will certainly help students complete their education well [22]. With the motivation of both motivation from within and motivation from outside can increase the desire to learn students. Therefore, teachers need to apply LKS with a STEM approach in learning, especially in Biology subjects.

Learning Motivation of Class XI MIA Students in Samosir Kabupaten

Based on the research data obtained that the student's learning motivation is known in the experimental class, it shows that the average score is 80.45 and the control class is 75.01 which is included in the high category of the two classes. In this case, there is an effect of STEM-based worksheets in Biology learning on students' learning motivation. Students who have high motivation will be positive about their learning outcomes. With the motivation to learn in students, learning outcomes will be able to increase because the curiosity of learning is so enthusiastic and enthusiastic.

Motivation is an internal factor of the students themselves in the learning process which in turn will affect student learning outcomes. The higher the motivation to learn, the higher the learning outcomes achieved by students. Learning motivation tends to require students to try harder to achieve the desired goals. With this high learning motivation, students will try hard to follow the learning as well as possible so that they are able to achieve the expected learning outcomes well.

Motivation in student learning is in the moderate category and the teacher's communication skills are in the quite effective category, however, that teacher communication has a positive and significant influence on motivation in student learning. To increase students' learning motivation, it is necessary to improve the effectiveness of teacher communication, student learning motivation needs to be improved and a conducive learning environment to help students' learning barriers. And the teacher provides learning motivation to students [32].

Motivation has an important influence in learning, namely encouraging students, so that students become active and interested because motivation supports efforts and keeps students (learning) going, motivation directs and controls goals, students complete a task, achieve specific desired goals, Motivation can make selective, where students can determine what activities will be carried out and how the tasks will be carried out. Thus, motivation serves as a priority determinant for student success, including success in learning. Means motivation to encourage or encourage students to improve learning achievement. Motivation is one of the absolute requirements in learning. which students who learn without motivation (or lack of motivation) will not succeed as much as possible. Therefore, students need encouragement to learn if students have the motivation to learn [36].

The method used should basically be in accordance with the subject being discussed. The subject matter of a multicultural society can be used by all methods but the concept that is

implanted must be right. To provide many examples, the LKS method needs to be given to students because the worksheets to be worked on are loaded with important concepts of the subject. Therefore, LKS plays a role in improving student learning outcomes. Therefore, the implementation in the learning process must be carried out continuously, objectively and systematically [15].

Currently, teachers use worksheets conceptually so that learning is difficult and less meaningful. In addition, during the pandemic, there are limitations in both time and effectiveness. Students need teaching materials that are easy to understand and allow them to learn independently according to their abilities [28].

The development of STEM-based digital modules is carried out to meet the needs of students and lecturers in order to create an alternative teaching material based on learning models that can improve the ability of students to learn independently. The STEM-based learning digital module developed is very valid with a value of 92.44% and practical (81.70%) to be used as an alternative teaching material that can be used in learning Operating Systems [40].

Learning Outcomes of Class XI MIA Students in Samosir Regency

Based on student learning outcomes in the experimental class, the average score was 67.85 and the control class with an average of 52.01. This is a significant increase from the control class that does not use worksheets to the experimental class that uses STEM-based worksheets. This is in line with research by [15] which states that the use of Student Worksheets (LKS) media can improve student learning outcomes. However, this is done using the implementation which is carried out in two cycles, namely cycle 1 and cycle 2. In the implementation, the learning outcomes test for the first cycle was obtained with a value of 79.00 and learning outcomes in the second cycle were 87.00. As has been explained, to support integrated science learning in accordance with the demands of the 2013 curriculum, it is also necessary to develop integrated teaching materials. The development of teaching materials can be done with the STEM approach considering that STEM learning is proven to be able to improve student learning outcomes. In addition, it is hoped that STEM learning can also improve creative thinking skills [24].

Good learning outcomes are expected with the characteristics of being able to above average, trying hard to succeed, trying to achieve high learning outcomes, believing in their abilities, tending to work alone, tending to be in groups with smart friends, likes/likes to study even when sick, complete tasks for the future, study goals for self-satisfaction, and tend to choose questions that are moderate in difficulty.

Learning outcomes can be known after an evaluation is held, which is expressed in the form of values. Based on this, it can be seen the high and low student learning outcomes. Student learning outcomes are influenced by several factors, both from within students (internal factors) in the form of intelligence, talent, and motivation, as well as factors from outside students (external factors) in the form of the family environment (parents), school and society.

The factors that influence learning achievement are internal factors (interest, motivation, level of intelligence, and learning methods) and external factors (family environment, school, and community). Statements of achievement motivation, interest, and parental attention to cognitive biology learning outcomes and student independence described above have a significant correlation between these variables. This thinking is based on many studies conducted in accordance with the discussion described previously, that there is a significant

relationship between achievement motivation, interest, parental attention with learning methods such as independent study and student achievement.

Students (LKS) based on Science Technology Enginering Mathematical (STEM) media on Sub Concept Concepts to improve students' creative thinking. The development of STEM-based worksheets was declared feasible to be used in the learning process. The results of product validation by four validators give an average very valid assessment. Student responses to LKS during small-scale and large-scale trials gave positive responses with percentages of 83.50% and 89%, respectively. The application of LKS has facilitated the improvement of students' creative thinking. Hypothesis testing proves that there is a significant difference between the pretest and posttest [28].

The use of guided inquiry-based worksheets has a positive influence on student learning outcomes in the two sample classes. Learning outcomes in the experimental class using student worksheets based on guided inquiry were higher than the control class using ordinary worksheets which were not concluded H0 was rejected and H1 was accepted at a significance level of 0.05. This shows that student learning outcomes using guided inquiry-based worksheets are significantly higher than student learning outcomes without using LKS-based [49]

4. Conclusion

Based on the results of research and discussion that have been described previously, the conclusions in this study are as follows:

STEM-based LKS which was developed based on a modification of the LKS material from one of the Unimed Biology lecturers as well as the validator of the instruments used in the research. The use of STEM-based worksheets in the implementation of the Biology learning process is one of the most important parts that can have an influence on students' motivation and learning outcomes.

There is a significant influence in the use of STEM-based worksheets in biology learning on the learning motivation of Class XI MIA students in Samosir Regency with a significance value ($P = 0.000 < 0.05$). Where there is a significant difference that the value of students' learning motivation in the experimental class obtained the average value is 80.45. While the value of students' learning motivation in the control class obtained an average value of 75.01.

There is a significant influence in the use of STEM-based worksheets in biology learning on the learning outcomes of Class XI MIA students in Samosir Regency with a significance value ($P = 0.000 < 0.05$). Where the significant difference is that the posttest score of student learning outcomes in the experimental class obtained the average value of 67.85. While the post-test score of student learning outcomes in the control class obtained an average value of 52.01.

Efforts to improve learning outcomes, one of which is by using STEM-based worksheets in Biology learning. If teachers and other positive sources of information such as student worksheets can be applied by providing good direction for students, then this can increase the active participation of teachers and students to increase motivation and learning outcomes.

Learning by using STEM-based LKS in Biology learning is one of the supporting factors to improve student learning outcomes and to form better attitudes of interest, motivation,

creativity. With the STEM-Based LKS learning method, it can improve learning achievement that can provide benefits for teachers or other teaching staff.

With this learning method, teachers can develop and improve creativity in using worksheets well for students so that students not only act as recipients of lessons through verbal teacher explanations or lectures, but students also participate in finding the core of the lessons described. in creative student worksheets. This supporting worksheet also plays an active role for teachers and students in improving learning achievement.

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