STEM-Based Learning in the Utilization of Ketapang Waste as an Alternative Energy Source and Processed Food in Science Subject Class 9 State of Junior High School 3 Blitar

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Abstract
STEM Learning is a concrete step toward preparing the next generation of leaders. This is because there are structured and systematic steps in STEM learning that lead students to problem-solving, implementing innovations and strategies, learning to be self-reliant and independent, learning how to live in teamwork that requires collaboration, and providing opportunities for educators to apply methodologies, approaches, models, and learning media that value and trigger student learning. The assumption is that learning is no longer teacher-centered, but rather student-centered so that students are more engaged in the process. Students 9A was chosen by purposeful sampling as the experimental class. The normal calculated utilizing the N-Gain test. This illustrates a move in learning results. The results of several tests used to illustrates the usefulness of learning media advances. The obtained values were t-count = -5.781, t-table = 0.05, and df = 29 is = 2.05. The mean value of the pre-test data and the average post-test data were substantially different because of the t-count (-5.781) t-table (-2.05). This difference indicates that the media used greatly affects student learning outcomes.

Keywords: STEM-Based Learning, Ketapang, Alternative Energy Source, Processed Food

Introduction

Ketapang Trees have ordinarily planted for shade or soil reinforcing. However, the plant eventually grows to be rather massive, with a huge canopy. There will be a lot of leaf and fruit waste when the leaves and fruit fall. The villagers of Blitar simply let it overflow as untreated waste. They are generally unaware of the numerous advantages of ketapang.

Distribution Naturally widespread in subtropical and tropical zones of Indian and Pacific Oceans and planted extensively throughout the tropics. Size Large tree 25–40 m (82–130 ft) tall. Habitat Subtropical and tropical maritime climates with annual rainfall generally 1000– 3500 mm (40–140 in); elevations below 300–400 m (1000–1300 ft). Vegetation Associated with coastal vegetation, especially strandline communities and beach forests including rocky shores and edges of mangrove swamps. Soils Adapted to a wide range of lighter textured soil types. Growth rate Fast in early years, about 2 m/yr (6.6 ft/yr). Main agroforestry uses Soil stabilization, coastal protection. Main products Nuts, timber. Yields Kernel yield is estimated to be about 5 kg (11 lb) per tree per year; timber yields can reach 15–20 m3 /ha/yr (215–286 ft3 /ac/yr) (estimate) (Thomson & Evans, 2006). it is quite strong and ductile, but not very durable. Red-brown Terminalia is the commercial name for this wood, which is used as a floor covering or veneer. This wood is utilised in the construction of boats as well as for house construction in Indonesia. The Ketapang seeds can be eaten raw or cooked, and they're claimed to be tastier than walnuts. The seeds' kernels are sun-dried to generate yellow oil that is up to half the weight of the original. Palmitic acid (55.5%), oleic acid (23.3%), linoleic acid, stearic acid, and myristic acid are among the fatty acids found in this oil.These dried seeds also contain protein (25%), sugar (16%), and various amino acids Anas (2012).

The benefits of ketapang are inversely proportional to the existing theory. A lot of waste leaves and ketapang fruit are scattered so that when it rains they drift into the river. Because the leaves and fruit of ketapang cannot be decomposed directly, this causes sedimentation of the river estuary.

Waxy substances were discovered in the ketapang leaves and the skin of the ketapang fruit, according to the findings of the researchers' observations. Apart from its waxy covering, ketapang fruit possesses an incredibly hard fruit shell that mimics that of a coconut. This is why the leaves and fruit of ketapang take a long time to decompose in nature. Briquettes are the right method of use, based on the texture of the ketapang leaves and skin. Briquettes are made by pressing and drying a mixture of ingredients into hard blocks. This method is commonly used for coal that has low calorific value or coal flakes to have additional selling value and benefits. Briquettes are used in industry and households. The material used for the manufacture of briquettes should have a low water content to achieve a high calorific value. The presence of volatile materials also affects how fast the rate of burning of briquettes, materials that have high volatiles will burn out faster.

The two ways of use in this case, namely ketapang fruit into ice cream and leaves & skin of ketapang fruit into briquettes, are an attempt to make a constructive contribution so that river sedimentation does not become an issue. Simultaneously, as a means of utilising learning resources connected to environmentally friendly energy and education in order to develop Indonesia's future human resources (HR) in the face of the industrial revolution, 4.0.

The existence of the fourth industrial revolution has accelerated the development of science and technology. Fundamentally, this circumstance has the potential to alter how people live, work, and interact. So this requires us to be more creative, active, dynamic, and innovative. In line with these advances, learning innovations are required in the realm of education to adapt the advancement of science and technology so that students' learning is more valuable. New innovations in expanding student-centered activities are also required. Student activities in this learning process provide the greatest opportunity to develop the skills, cognitive and affective aspects of students. students are given the opportunity to develop what is called the pillars of education development proclaimed by UNESCO, namely learn how to know, learn how to do, learn how to be, learn how to live together.To put it another way, we need to come up with new ways to teach students how to learn, how to be themselves and independent, and how to operate in a challenging team setting.

STEM

STEM (science, technology, engineering, and mathematics) is an educational development programme designed to educate students at all levels of education, as well as university graduates, to pursue careers in the fields of science, technology, engineering, and mathematics (STEM).

One of the actions that may be done is to give children treatment that will allow them to reach their maximum level of activity and inventiveness. Project-based learning can be integrated with STEM. In the context of learning mathematics, STEM project-based learning has the potential to provide meaningful learning, can train students' ability to solve problems through a project that is integrated with one or several other scientific fields such as science, engineering, and technology, in addition to providing experience to students. Students learn that mathematics has real-world applications and is all around them. Students' cognitive activities (cognitive outputs) in learning, which contain learning content that students are supposed to know, are the ultimate goal of STEM education.

This is in line with the statement of (Sarah & Rebecca, 2016) “that Education plays a key role in STEM engagement and in many cases can be the first exposure to STEM for many young children. Many avenues for promoting STEM engagement exist in early childhood, primary, and secondary education, including providing learning experiences through curriculum-related activities, relevance by incorporating real-world experiences, expertise by incorporating industry and research, and extension programmes and experiences, such as mentorships.

There is no universal definition of STEM. This term generally refers to the integration of four disciplines, namely science, engineering technology, and mathematics. STEM is described as “a distinct and complementary approach to knowledge and practice that has been shown to generate benefits for society”. However, there are also challenges in using terminology in STEM fields - with Science, Technology, or Engineering often being used interchangeably and without a clear definition. For this, we adopted the definition described by the Australia Education Council (2015), STEM education is "a term used to refer collectively to the teaching of the disciplines within its umbrella - science, technology, engineering, and mathematics - as well as a cross-disciplinary approach to teaching that increases students' interest in STEM-related fields and enhances students' problem-solving and analytical skills. From some of the descriptions above, STEM was created to integrate science, engineering, technology, and mathematics. In the learning process, these four things are a separate mosaic. Between one another is a component that is not interrelated. Then in other learning processes, it could be that these four components are an integrated part as a whole that can be a solution to a problem. In other words, STEM provides an integrative guarantee of skills for problem-solving and critical analysis.

Anne (2014) has revealed seven excellent qualities of STEM lessons. They are STEM lessons focus on real-world problems and issues. In STEM lessons, students tackle real social, economic, and environmental problems and seek solutions. The biggest “aha” STEM moment came when we moved into a new position and faced a class of science students who gave up on school. STEM lessons help students deepen their understanding of important science and math concepts. Anne (2016) STEM lessons are guided by the engineering design process to provide a flexible process that takes students from identifying problems or design challenges to creating and developing solutions.

STEM lessons immerse students in hands-on inquiry and open-ended exploration. In STEM lessons, the path to open learning ends, within limits (constraints generally involved things like available materials). Student work is direct and collaborative, and decisions about solutions are made by students. Students communicate to share ideas and redesign their prototypes as needed. They control their own ideas and design their investigations.

STEM lessons engaged students in productive teamwork. This becomes exponentially easier if all STEM teachers in a school work together to carry out teamwork, using the same language, procedures, and expectations for students. STEM lessons apply rigorous math and science content to your students' learning. In our STEM lessons, we have to purposefully link and integrate content from math and science courses. Plan to collaborate with other math and/or science teachers to gain insight into how course objectives can be interwoven in a given lesson. Students can then begin to see that science and mathematics are not isolated subjects, but could used together to solve problems. This adds relevance to their math and science learning. In STEM, students also use technology in appropriate ways and design their own products (as well as technology).

STEM lessons allow for multiple correct answers and reframe failure as an important part of learning. Sometimes we have to design our science laboratory so that all teams will replicate the same results or verify or disprove a hypothesis. Students study specific science content and the whole idea is to provide insight into cause and effect by manipulating variables. STEM classes, always provide opportunities for multiple answers and appropriate approaches. STEM environments offer rich possibilities for creative solutions. When designing and testing prototypes, teams may fail to solve problems but it does not matter. They are expected to learn from what went wrong, and try again. Failure is considered a positive step in the journey of finding and designing solutions.

Project-Based Learning STEM Learning

The STEM (Science, Technology, Engineering, and Mathematics) integration program in learning is a learning program that combines two or more fields of knowledge contained in STEM which includes Science, Technology, Engineering/engineering, and Mathematics (Laboy-Rush, 2010).

Ritz & Fan (2014) revealed that the application of STEM education has taken place in several countries, and each has various forms in terms of its application. In Indonesia, the integration of STEM as a learning approach is not yet very popular. Even so, the concept of integration between scientific fields has begun to appear voiced in our educational curriculum, including in the 2013 curriculum. indicates the need for integration of various fields of science in a particular field of study, and this is in line with the concept of STEM integration. Table 1 below describes the definition of STEM literacy according to the National Governor's Association Center for Best Practices (Asmuniv, 2015). In project-based learning designed in this study, the STEM integration used includes three fields, namely mathematics, technology, and engineering/engineering.

The technology raised relates to the use of various Information and Communication Technology (ICT) devices, namely computer and internet media. The engineering field that was raised was related to one productive subject, namely web design and programming, and the mathematics field raised the topic of statistics. In its realization, project-based STEM learning that will be carried out follows the general project-based learning syntax, namely: (1) determining basic questions, (2) preparing project plans, (3) compiling schedules, (4) monitoring, (5) test results, (6) experience evaluation (Kemdikbud, 2013).

Research Questions:

The statement of the problem in this paper is:

1. How is the use of Ketapang waste as an alternative source of environmentally friendly energy in STEM-based learning for science subjects at State of Junior High School 3 Blitar in grade 9?
2. How to improve learning outcomes on the use of Ketapang waste as an alternative source of environmentally friendly energy in STEM-based learning in science subjects at State of Junior High School 3 Blitar in grade 9?

The Objectives

1. Describe the use of Ketapang waste as an alternative source of environmentally friendly energy
2. Increase in learning outcomes by using Ketapang waste as an alternative source of environmentally friendly energy

Benefits for students:

1. Gain new experiences and are expected to contribute to the improvement of their learning.
2. Train to solve problems with a scientific approach based on STEM learning.

Benefits for teachers:

1. As a reference material to improve professional abilities, and STEM learning using ketapang to diversify environmentally friendly energy sources into alternative learning to improve student achievement.
2. As a reference material to increase teacher awareness in improving the quality of learning that is tailored to the objectives, materials, characteristics of students, and learning conditions.

Benefits for school

The results of this study are expected to be used as input in efforts to improve the quality of education.

Methodology

STEM Learning is a concrete step in an effort to prepare the next generation of superiors. This is because in STEM learning there are structured and systematic steps that lead students to make problem solving, implement innovations and strategies, learn to be self-reliant and independent, learn how to live in a team work that demands collaboration, while providing opportunities broad scope for educators to apply methodologies, approaches, models, and learning media that value and trigger all students' skills to maximize their skills, attitudes, and knowledge. The implication is that learning that takes place is no longer teacher-centered, but student-centered so that they are more active in the learning process. Based on this description, researchers are interested in researching "STEM-Based Learning in the Utilization of Ketapang Waste as an Alternative Energy Source and Processed Food in Science Subjects Class 9 State of Junior High School 3 Blitar".

The one group design quasi-experimental research method was carried out at State of Junior High School 3 Blitar in February-August for the 2021. The population in this study was grade 9A (30 students) as the experimental class which was selected by purposive sampling.
The instruments used consist of:
(1) Student Response Questionnaire
(2) STEM-Based Student Worksheet
(3) Learning outcomes test consists of 10 multiple choice questions
(4) Student and teacher response questionaires to the implementation of STEM Learning.

To see the effect of the STEM Learning model on students' learning outcomes, a hypothesis test calculation or two-average difference test was carried out to find out there was a significant difference between the pre-test and post-test scores obtained by the experimental class. Hypothesis testing using parametric statistical test paired sample t-test (t-test paired sample), the decision is if the value of sig. <a, with a = 0.050 then Ha is accepted. The t-test (t-test) was carried out after the analysis prerequisite test, namely the normality test and homogeneity test were met.

Results and Discussion
Practical Applications of Learning Innovations Evaluation Results consist of six aspects: Essential Questions, Design a Plan for the Project, Create a Schedule, Progress of the Project, Assess the Outcome, Evaluate the Experience. As shown in table below

Table 1: Analysis of the Results of Practical Applications of Learning Innovations Evaluation Results

Group	Aspects						**% Score**
	Essential Questions	Design a Plan for the Project	Create a Schedule	Progress of the Project	Assess the Outcome	Evaluate the Experience	
Hertz	4	5	4	3	3	3	73 %
Newton	3	4	4	3	4	3	70%
Joule	4	5	5	4	4	3	83%
Einstein	5	4	5	4	5	4	90%
Hawking	5	5	4	3	3	3	77%
Hooke	4	4	5	5	5	4	90%

Based on the criteria, the results of the final observations are:

1. Hertz group, 73% is in the good category
2. Newton's group, 70% is in the good category
3. Joule group, 83% is in the good category
4. Einstein's group, 90% very good
5. Hawking group, 77% is in the very good category
6. Kelvin group, 90% is in the very good category

Student Responses and Student Learning Outcomes

Student responses are intended to get a comprehensive picture of students' opinions about the use of STEM-Based Learning in the Utilization of Ketapang Waste in the learning process.

The recapitulation of student responses is presented in the following table 2. Based on the final results of the student recap in the Table 2, the average student response is 3.42. By paying attention to the range of score intervals, it can be classified as very suitable criteria for use, which is in the range of scores from 3.25 to 4.00.

Student learning outcomes are obtained from pretest cognitive scores and posttest cognitive scores. The difference between the scores obtained can be determined using the N-gain equation as follows:

$$\text{N-gain} = \frac{S_{postest} - S_{pretest}}{S_{maksimum} - S_{pretest}}$$

Tabel 2: Recapitulation of Student Responses

No	Statement	Responses				average
		SS	S	TS	STS	
I.	**The Interests of STEM-Based Learning in the Utilization of Ketapang Waste**					
1	Design/shape Actually and interesting.	4	3	2	4	3.25
2	Attractive view	4	3	2	4	3.25
II.	**Ease of Use of STEM-Based Learning in the Utilization of Ketapang Waste**					
3	STEM-Based Learning in the Utilization of Waste Ketapang is easy to use inside and outside the classroom	4	4	2	4	3.50
4	The worksheet instructions for each experiment are easy to understand	4	3	2	4	3.25
III.	**The Role of STEM-Based Learning in the Utilization of Ketapang Waste in Learning**					
5	Attract students' attention.	4	4	2	4	3.50
6	Help to accelerate understanding in the learning process.	3	4	3	3	3.25
7	Clarify the presentation of the message so that it is not verbalistic (in the form of written or spoken words).					4
8	Overcome space limitations.	4	4	4	4	3.5
9	Learning is more communicative and productive.	4	4	2	4	3.25
10	Learning time is more conditioned.	4	4	2	4	3.5
11	Eliminate student boredom	4	3	3	2	3
12	Increase the level of activeness/involvement of students in learning activities.	4	4	3	4	3.75
	Means					**3.42**

Table 3: Decision-Making Criteria with SPSS17:

1. If the significance value is greater than 0.05, it is said that the variance of the two population groups is the same (homogeneous)
2. If the significance value is less than 0.05, then it is said that the variances of the two population groups are not the same (not homogeneous)

Pre_Test and Post_Test

	N	Mean	Std.Deviation	Std.Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
1.00	30	71.33	10.7	1.96	67.3	75.3	40.00	95.00
2.00	30	85.83	8.71	1.59	82.5	89.0	65.00	100.00
Total	60	78.58	12.14	1.56	75.4	81.7	40.00	100.00

Test of Homogeneity of Variances
Pre_Test and Post_Test

Levene Statistic	df1	Df 2	Sig.
.465	1	58	.598

Conclusion In the homogeneity test obtained Sig.0.598> 0.05 it is said that the variance of the two population groups is the same (homogeneous).

Table 4 : Data Difference Test Results using T - Test

Paired Samples Statistics

	Mean	N	Std.Deviation	Std.Error Mean
Pair1				
Pre_Test	71.33	30	10.74	1.96
Post_Test	85.83	30	8.71	1.59

Paired Samples Correlations

	N	Correlation	Sig.
Pair1 Pre_Test &Post_Test	30	-.021	.910

		Paired Differences				T	df	Sig.(2-tailed)
				95% Confidence Interval of the Difference				
	Mean	Std.Deviation	Std.Error Mean	Lower	Upper			
Pair1 Pre_Test-Post_Test	-14.50	13.97	2.55	-19.72	-9.27	-5.78	29	.000

Paired Samples Test

The average difference test between pre-test and post-test with paired sample t-test. The results obtained are t-count = -5.781, table at =0.05 and df = 29 is = 2.05. Because t-count (-5.781) < -t-table (-2.05), the mean value of the pre-test and post-test data was significantly different. This difference shows that STEM-Based Learning in the Utilization of Ketapang Waste was affects student learning outcomes.

Results and discussion

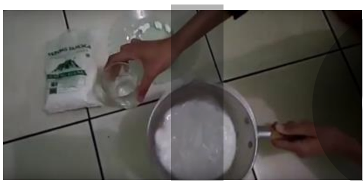
The results analyzed are the activities of teachers and students during the learning process and the achievement of students

1) Ketapang charcoal briquettes

Ketapang

stripping

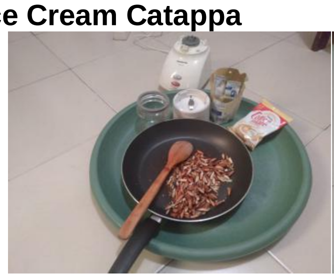
Material Collection



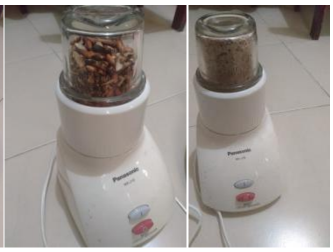
Charcoal making process Starch Flour Dough Making

Printing and Drying

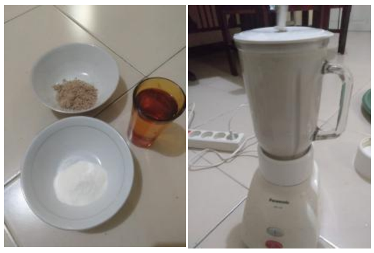
2) Ice Cream Catappa



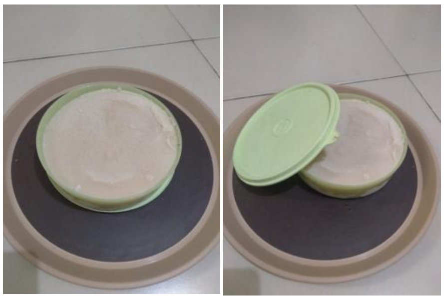
Ingredients for Ice Cream



Refining roasted ketapang



Blend creamer, water and ketapang



Result

Achievement of Minimum Completeness Criteria (MCC)

Based on the scores for each indicator on the Daily Test I and Daily Test II obtained by the students, it can be stated the number of students who achieved the MCC as shown in Table 5 below.

Table 5: Frequency of Students with Scores More Equal to 60 on Daily Test I for Each Indicator

No	Indicators	The number of students who achieve a score equal to 60	Percentage (%) of students who achieve a score equal to 60
1	Get to know environmentally friendly technology materials	19	63,15
2	Determine environmentally friendly energy sources/renewable energy sources	29	97,36
3	Determine non-renewable energy sources	13	44,73
4	Determine the application of the use of environmentally friendly energy sources	13	44,73

In the table above, the achievement of MCC based on indicators can be described as follows:

In indicator 1, the number of students who have achieved MCC is 19 students, as well as indicator 2, the number of students who have this achievement is 29 students. In indicators 3 and 4, the MCC achievement of students is the same, namely 13 students, this is because students are less careful in carrying out the learning process.

Table 6 : Frequency of Students Who Have Scores More Equal to 60 on Daily Test II for Each Indicator

No	Indicator	The number of students who achieve a score equal to 60	Percentage (%) of students who achieve a score equal to 60
1	Determine materials in the surrounding environment that can be used as environmentally friendly energy sources	27	89.47
2	Designing experiments on processed materials in the surrounding environment that can be used as environmentally friendly energy sources	28	92.10
3	Making processed materials in the surrounding environment that can be used as an environmentally friendly energy source	24	78.94

In the table 6 above, the achievement of MCC based on indicators can be described as follows:

In indicator 1 the number of students who have the achievement of each indicator is 27. While in indicator 2 the number of students who have the achievement of indicators is 28 students, While in indicator 2 the number of students who have the achievement of indicators is 24 students.

2. Action Success

To determine the increase in student learning outcomes can be seen from the following frequency distribution table.

Table 7 : Frequency Distribution of Base Scores, Daily Test I and Daily Test II.

Interval of Learning Outcomes Score	Frequency Baseline	Score Frequency of Daily Test I	Frequency of Daily Test II
10 – 19	0	0	0
20 – 29	0	0	1
30 – 39	0	0	1
40 – 49	0	0	0
50 – 59	16	12	0
60 – 69	10	5	2
70 – 79	1	8	7
80 – 89	0	5	9
90 – 100	3	0	10
$\sum f$	30	30	30
Number of students reaching MCC	14	18	28
% of students reach MCC	47.36	60.52	92.10

From the table 7 above, it can be seen that at intervals of 40-69 from the basic score to the daily test I and daily test II there was a decrease in the frequency of students who got low scores. In the 70-100 interval from the basic score to the daily test I and the daily test I to the daily test II, there was an increase in the frequency of students getting high scores, so it can be said that there was an increase in learning outcomes.

There were still many students who could not understand the steps of PjBL Laboy and Rush learning, for example in the step of working on the Student Worksheet which was done individually, many students still collaborated with their close friends. This shows that low self-confidence.

In general, mistakes made by students in working on worksheets are the lack of accuracy of students in understanding the intent of the activity steps contained in the worksheet. Hence, they can't anwers the proper. In the Daily Test I, most of the students were less careful in carrying out the learning process according to the PjBL Laboy and Rush syntax. don't have the proper understanding in understanding the subject matter.

A few of the shortcomings in conducting demontrations as exemplified by the teacher, making conclusions with the teacher and doing follow-up works out at each subject matter are getting way better at each subject matter. The observation sheet can be seen that student activities are growing into the second cycle until the end of the second cycle, student activities are usually said to be good, and show progress. The weakness in this study is that observers are less able to play an honest role in filling out the teacher's activity column, so it can be seen at every meeting of the teacher's observation criteria that each indicator does not show a difference in the results at each observation meeting, according to the researcher before the observer carried out his duties the researcher as an individual being observed had given direction. in agreement with the pointers contained within the exercises of students and researcher can record in concurring to what the researcher watched within the learning process. This results in the observation sheet working properly.

In general, from the action analysis, the number of students who reached the MCC set by the school increased after taking the action. The results of the analysis obtained in this study by applying the PjBL STEM learning model in the utilization of processed ketapang as an effort to diversify environmentally friendly energy sources to improve science learning outcomes for grade 9 at State of Junior High School 3 Blitar showed that the number of students who reached the MCC after the action was on the daily test I. and Daily Test II is higher than the number of students who reach the MCC on the basic score (before the action). Thus, the results of this action analysis support the action hypothesis, namely PjBL STEM learning in the use of processed ketapang as an effort to diversify environmentally friendly energy sources can improve science learning outcomes for grade 9 at State of Junior High School 3 Blitar.

Conclusion

Based on the description of the analysis and learning outcomes, it can be concluded as follows:

Student has experiences how to use of Ketapang waste as an alternative source of environmentally friendly energy in STEM-based learning for science subjects at State of Junior High School 3 Blitar in grade 9.PJBL STEM learning using STEM-Based Learning in the Utilization of Ketapang Waste can improve student learning outcomes of State of Junior High School 3 Blitar.STEM PJBL using STEM-Based Learning in the Utilization of Waste Ketapang has effectiveness in improving science learning outcomes on the use of Ketapang waste as an alternative source of environmentally friendly energy in STEM-based learning in science subjects at State of Junior High School 3 Blitar.

Recommendation

For teachers who want to develop and use STEM-Based Learning in the Utilization of Learning Waste, there are several recommendations as follows.

1. Making STEM-Based Learning in the Utilization of Ketapang Waste needs to be designed more neatly to increase the interest and interest of students in studying learning materials and competencies to be achieved.
2. Development of STEM-Based Learning in the Utilization of Ketapang Waste needs to be well planned by integrating models, methods, learning approaches according to the conditions and environment of students.

References

Anas, B. (2012). *Pertelaan Jenis Pohon Arboretum*. Jakarta: Kementerian Kehutanan Balai Penelitian Teknologi Agroforestry.

Anne, J. (2016). http://aplusala.org/best-practices-center/2016/08/05/why-real-world-stem-ed-matters/ 7 Reasons Why Real-World STEM Education Matters to Alabama Students.

Anne, J. (2014). Six Characteristics of a Great STEM Lesson - Education Week. [online] Available at: https://www.edweek.org/tm/articles/2014/06/17/ctq_jolly_stem.html. Available_at:https://www.chino.k12.ca.us/site/handlers/filedownload.ashx?moduleinstanceid=31637&dataid=62417&FileName=Six%20Characteristics%20of%20a%20Great%20STEM%20Lesson%20-%20Education%20Week%20Teacher.pdf. [accessed on 30 april 2021]

Asmuniv. (2015). Pendekatan Terpadu Pendidikan STEM Upaya Mepersiapkan Sumber Daya Manusia Indonesia Yang Memiliki Pengetahuan Interdisipliner Dalam Menyongsong Kebutuhan idang Karir Pekerjaan Masyarakat Ekonomi ASEAN (MEA), PPPPTK BOE/VEDC Malang (online) Tersedia di http://www.vedcmalang.com/pppptkboemalang/indekx.php/menuutama/listrik elektro/1507-asv9. accessedon 30 april 2021.

Australia_Education_Council.(2021)._http://www.scseec.edu.au/site/DefaultSite/filesystem/documents/National%20STEM%20School%20Education%20Strategy.pdf.Retrieved_from_http://www. scseec.edu.au

Kemendikbud. (2013). *Pedoman Pendampingan Implementasi Kurikulum 2013 bagi Pengawas Sekolah, Kepala sekolah dan Guru Inti*. Pusbangtendik Kemendikbud. (online): http://kur2013.vedcmalang.or.id. accessed on 30 april 2021. accessed on 30 april 2021

Laboy – Rush, D. (2010). Integrated STEM Education through project-based-learning. [online] accessed from https://www.learning.com/stem/ whitepaper/ integrated-STEM- through project-based-learning. accessed on 30 april 2021.

Ritz, J.M. and Fan, S. (2014). STEM and Technology Education: Inernational State of The Art. *International Journal of Technologyand Education*, 25 (4): 1-23.

Sarah. and Rebecca. (2016). Engaging Of The Future of STEM. Canberra: Chief Executive Woman (CEW) Ltd

Thomson, L.A.J. and Evans, B. (2006). Terminalia catappa. Species Profiles for Pacific Island Agroforestry. www.traditionaltree.org