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Development of science learning module with science technology society (STS) approach combined with problem based learning (PBL) model

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Abstract
This research was conducted to develop teaching materials in the world of education. Teaching materials developed is a module, then this module is developed using an approach and model that is very in accordance with the characteristics of students, so that students not only accept a concept but can apply it in their daily lives especially in the life of society. This research was conducted at SMP Negeri 3 Tondano, Minahasa North Sulawesi Indonesia with a sample of 20 students, namely class VIII A. This research is a type of 4-D model research consisting of 4 stages, namely define, design, Develop. Disseminate. Validation results of the development of teaching materials in the form of modules developed obtained a score for the material 98.92%, and for the media obtained a score of 90.75%. The results of the module trial obtained a score from the student response questionnaire of 99.06%, the average grade after using the learning module that has been developed (posttest) 94.50% with an increase in student learning outcomes by 43.00% with very decent qualification criteria. So after the teaching material is produced in the form of modules that have been tested and declared valid so that it is feasible, practical and also effective to be used in learning.

Keywords: development of science learning module, science technology society (STS), problem based learning (PBL)

Introduction

Sains can be interpreted as knowledge whose truth has been empirically tested through scientific methods. In particular, science learning aims to master the concepts of science that are applicative and meaningful for students through science learning activities (Toharudin, *et al.*, 2011:47) [9].

Benjamin Bloom explained that the applied learning (science learning) there are 4 types of knowledge, namely factual, conceptual, procedural and metacognitive. To be able to achieve learning goals, it is necessary to formulate goals that are tailored according to the cognitive dimension of remembering, understanding, applying, analyzing, evaluating and creating (Anderson & Kathwohl, 2001).

The main problem faced by the world of education in developing the potential of learners is the problem of the learning process. The learning process that occurs in the classroom takes precedence over the acquisition of cognitive abilities, learners are more required to memorize lessons that without being asked to understand and connect the lessons they learn to be applied in daily life, so that when students graduate from school they are good at theory, but are not able to apply them (Ratna, *et al*. 2015) [7].

To solve the above problems, there are many models that can be used by teachers to support the delivery of materials to be delivered to students. One of them is by using learning materials whose delivery can be collaborated with learning models.

Based on the observations made by researchers during ppl at SMP Negeri 3 Tondano, Minahasa, North Sulawesi Indonesia the teaching materials used are only package books, there are no other teaching materials, so students only receive information from one book and the information the teacher provides. The package books available are also limited so students need other teaching materials such as Modules. Learning on addictive substance material tends to be theoretical so that students are less optimal in Understanding interconnected and complex concepts. In the learning process, teachers also lack the approach of Community Science Technology and Problem Based Learning (PBL) model, which makes it easier for students to understand the material delivered.

One alternative solution is the development of teaching materials in the form of modules that are expected to empower critical thinking skills and attitudes about the student environment. The modules developed will be oriented towards an approach and learning model, so that with this integration can make it easier for students to accept the concepts obtained and can also apply in everyday life.

Learning Science Technology Society (STS) emphasizes the concepts of science and technology in people's lives and fosters a sense of social responsibility of students to the role of science and technology that takes place in society (Yager & Akcay, 2008) [10].

In science teaching and learning activities, students need teaching materials that can package materials neatly, creatively and based on student life, so that students can understand, convey and apply science comprehensively. Modules developed in addition to using an approach will also be oriented towards a learning model.

The selected learning model must reflect systematic steps that contain the understanding that the steps taken by the teacher in the learning process are neatly and logically arranged so that the goals set are achieved. One of the learning strategies that can be used is to apply problem-based learning or Problem Based Learning (PBL). The PBL learning model is one of the learning models used to stimulate students' high-level thinking in real-world problem-oriented situations (Rusman, 2012) [8].

Arends (2007) states that there are three outcomes obtained by learners taught with Problem Based Learning (PBL)

namely: (1) inkuiri and problemsolving skills, (2) learning adult role behaviors, and (3) skills for independent learning).
In this study students were asked to work on real problems found in their daily lives, with a view to crafting their own knowledge, developing self-reliance and confidence.

Research Methodology
This research is a research and development R & D (Research and Development) that develops Learning Devices. Research and development method is a research method used to produce a particular product and test the effectiveness of the product. The research carried out was the development of teaching materials in the form of science learning modules smp grade VIII on additives and addictive substances.

Research Measures
Definition Stage
Activities in this stage are preliminary analysis, student analysis, material analysis, assignment analysis, and specification of learning objectives.

a. Front-end Analysis
b. Learner Analysis
c. Task Analysis
d. Concept Analysis
e. Analysis of Learning Objectives (Specifying Instructional Objectives)

Design
After getting problems from the definition stage, the design stage is then carried out.
1. Criterion-test construction
2. Media selection
3. Format Selection
4. Initial design

Development Stage (develop)
This stage of development aims to produce revised modules based on the input of supervisors, experts and trials to learners.
a. Review of supervisory lecturers I and II
b. Expert appraisal
c. Product Trial (development testing)

Diseminate
The purpose of this stage is to disseminate the module. In this study, only limited dissemination was carried out, namely by disseminating and promoting the final product of the module in a limited way to science teachers and students at SMP Negeri 3 Tondano, Minahasa North Sulawesi

Research Instruments
1. Questionnaire
Questionnaires are used to collect information on the needs of students and teachers, as well as student responses to modules currently circulating. Response questionnaires are used at the product trial stage to find out the practicality of the modules developed.
2. Validation Sheet
Nieveen & Plomp (2007: 26) stated that the criteria for assessing the quality of teaching materials are based on three aspects, namely: validity, practicality and effectiveness. Expert validation is used to obtain expert or professional judgement.

Test
The test is used to determine the improvement of meter mastery achieved by students before (pretest) and posttest.

Data Collection Techniques
1. Validity Test Data
Validity test data obtained from research instruments in the form of validation sheets given to expert validators.

2. Effectiveness and Practicality test data
Effectiveness test data obtained from research instruments in the form of test details. Effectiveness test data is used to find out if the resulting product can deliver results as expected. Meanwhile, practicality test data was obtained from student response questionnaires that were shared after the learning process. Practicality test data is used to find out if the resulting product can give results as expected or not.

Data Analysis Techniques
Data analysis is the process of systematically finding and compiling data obtained from interviews, field notes and documentation, by organizing data into categories, describing into units, synthesizing, arranging into patterns, choosing which ones are important and which to learn, and making conclusions so that they are easy to understand by yourself and others.
1. Validity Data Analysis
a. Calculate the average score of each component by using a formula:

$$P = \frac{\text{Jumlah skor hasil pengumpulan}}{\text{Jumlah skor kriteria}} \times 100\%$$

Description
P = Feasibility Presentation

b. Calculate the average score of each component

The validity category according to Suharsimi Arikunto is as follows:

Table 1: Eligibility Criteria

Value	Criteria
P > 80%	Very Feasible
61%< P 80%	61%< P 80%
41% <P 60%	41% <P 60%
20%< P ≤ 40%	Less Worthy
P ≤ 20%	Very Less Worthy

Description: P= the average eligibility of all validators. (Suharsimi Arikunto, 2008)

Analysis of Practicality Data
The practicality of the teaching materials developed is analyzed through student response data that has been shared and filled by the learner after the learning is carried out.

Student Response
The response of learners can be known by providing questionnaires about the module design and the contents of

the module after the learning process is carried out.

Effectiveness Data Analysis

The effectiveness of teaching materials developed is analyzed through data on student learning outcomes after learning using science modules with The Science of Community Technology (STM) approach and in learning is used Problem Based Learning (PBL) model.

Achieved Learning Outcomes

The effectiveness of teaching materials developed is analyzed through measurement data of students' learning outcomes. The achievement of learning outcomes is directed towards individual achievement. Students are said to succeed (complete) if they get a score greater than or equal to the kkm (75) (≥KKM).

Table 2: Student Mastery Level

Value	Description
0 ≤ TPS < 40	Very low
40 ≤ TPS < 60	Low
60 ≤ TPS < 75	Are
75 ≤ TPS < 90	High
90 ≤ TPS ≥ 100	Very high

Description: TPS = student mastery level (Yamasari, Y. 2010)

Research and Discussion Results

1. **Define into** 5 stages, namely initial analysis, student analysis, material analysis, task analysis, and specification of learning objectives. In the initial analysis stage based on observations and interviews conducted by researchers with science teachers in schools, it was obtained information that in science learning, both teachers and students only use printed books provided in school, and teachers also do not have the ability to make teaching materials, so that in learning teachers are still central and as if to be the only source of knowledge that causes learners to be passive in the classroom and low ability of learners to solve problems in learning. Therefore, teachers need to use models and approaches that can make learners actively involved in learning especially able to practice what they can during learning in the environment where they live, so that learners are not only able to accept concepts in school but can also apply in their daily lives. Analysis of learners obtained from the academic ability of different learners, the age of learners 13-14 years, and in the class of learners already use Indonesian, but often also use the language daily. Analysis of observation assignments in schools where research, tasks given to learners have not been able to get students to solve problems especially on additives and addictive substances. Material analysis conducted by researchers in accordance with the content standards set by the Government in the 2013 curriculum, namely additives and addictive substances. Analysis of learning objectives specifications is adjusted to the Basic Competencies (KD) listed in the 2013 curriculum.
2. **Design Stage,** into 4 parts, namely the preparation of tests in which also carried out the preparation of instruments as a tool of data retrieval, media selection, selection of formats and initial design. Preparation of tests in the form of tests before learning and tests after learning activities. In addition to preparing the test researchers also made the instrument as a data-taking tool consisting of teaching material assessment instruments, response questionnaires, and validation sheets. The selection of media chosen by researchers is print media in the form of modules because the development process is easier than other media. In the selection of formats, modules created with the format of The Science of Technology Community (STM) approach, and for learning models that will be used in learning, namely problem based learning (PBL) models. The initial design of teaching materials in the form of Modules consists of Cover/ Cover, Preface, Table of Contents, Core Competencies, Basic Competencies, Achievement Indicators, Integration Section, Module Usage Instructions, Learning Materials, Summary, Problem Exercises, Library Lists, Question Training Answer Keys, Glossary and Author Résumé.
3. **Development Stage (Develop), divided** into 3 stages, namely review by Supervisory Lecturers I and II, Expert Assessment for teaching materials that have been developed. At the review stage of supervisors I and II, the results of the initial draft (Draft I) were given input from the supervisor, namely adding material from international journals / research on additives and addictive substances. The revised draft (draft II) was validated by four experts, two material experts and two media experts.

The results can be seen in the table below

Table 3: Material Expert Validation Results

Validator	Score achieved	Maximum Score to be achieved	Validation Criteria
Validator I	138	140	98,57%
Validator II	139	140	99,28%
Average			98,92%

The table above is the results of expert test material on products produced by researchers and obtained validation criteria results with a presentation of 98.92% and expressed with very feasible criteria.

Table 4: Media Expert Validation Results

Validator	Score achieved	Maximum Score to be achieved	Validation Criteria
Validator I	79	92	85,86%
Validator II	88	92	95,65%
Average			90,75%

The table above is the results of expert test material on products produced by researchers and obtained validation criteria results with a presentation of 90.75% and expressed with very feasible criteria.

Product Development Trial

Teaching materials that have been declared feasible to be used are then tested in grade VIII A SMP Negeri 3 Tondano, Minahasa North Sulawesi Indonesia with the number of students as many as 20 people.

1) Student Response Questionnaire Results

Table 5: Student Response Questionnaire Validation Results

Respondents	Score achieved	Maximum score to be achieved	Validation Criteria
20	1275	1280	99,60%

Based on the student response data produced above, it can be concluded that students give a positive response to the teaching materials developed.

2) Learning Outcomes Test

The learning test is given to the learner to find out the level of mastery of the learner to the material that has been given. Test analysis is used to determine the level of achievement of learning outcomes and how effective the modules have been developed

Table 6: Statistics table of pretest and Post Test values

Descriptives				
			Statistics	Std. Error
Pretest	Mean		51.50	2.927
	95% Confidence Interval for Mean	Lower Bound	45.37	
		Upper Bound	57.63	
	5% Trimmed Mean		51.67	
	Median		50.00	
	Variance		171.316	
	Std. Deviation		13.089	
	Minimum		30	
	Maximum		70	
	Range		40	
	Interquartile Range		20	
	Skewness		.007	.512
	Kurtosis		-1.067	.992
Post	Mean		94.50	1.535
	95% Confidence Interval for Mean	Lower Bound	91.29	
		Upper Bound	97.71	
	5% Trimmed Mean		95.00	
	Median		100.00	
	Variance		47.105	
	Std. Deviation		6.863	
	Minimum		80	
	Maximum		100	
	Range		20	
	Interquartile Range		10	
	Skewness		-.887	.512
	Kurtosis		-.240	.992

Table 6 shows that there is a 43.00% increase between petest and posttest values. In the pretest table the average value of learners is 51.50%, the highest value obtained is 70 and the lowest value is 30 with arange of 40 values. While the average value of learners' learning outcomes on additives and addictive substances using modules that have been developed and in learning is also combined with problem based learning (PBL) model is 94.50%. The highest value is 100 and the lowest value is 80 with a range of 20 values.

Table 7: Frequency and percentage of students' learning outcomes

Interval					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	80	2	10.0	10.0	10.0
	90	7	35.0	35.0	45.0
	100	11	55.0	55.0	100.0
	Total	20	100.0	100.0	

Table 7 is the result of interval data analysis using Spss 22 application, obtained data that students in class 8A of 20 students obtained grades above KKM. And it can be said that learning using science modules with Community Technology Science (STM) approach and using Problem Based Learning (PBL) model is successful because students have achieved complete grades.

Table 8: Description of the completed learning outcomes of learners

Value	Category	Frequency	Percentase
0-75	Incomplete	0	0%
76-100	Complete	20	100%

The table above shows that learners gain a good understanding of the material presented using the modules developed. This can be seen with 20 students completed with a score of 76-100 as much as 100% and 0% of students who are not complete.

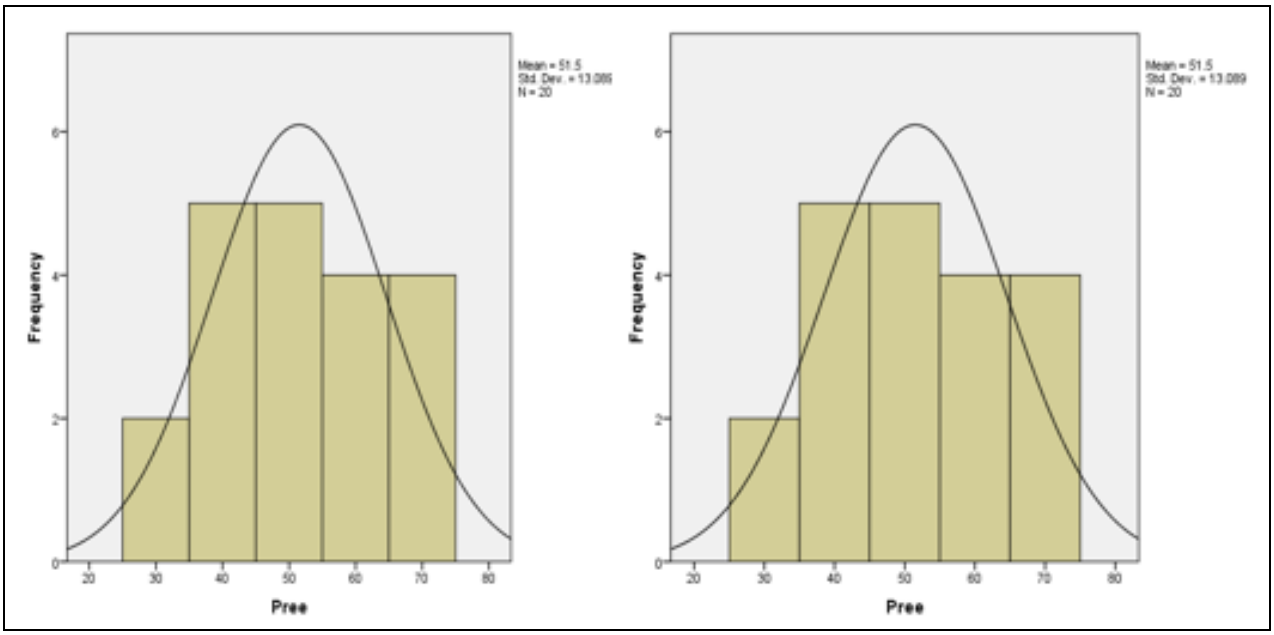

Fig 1: Pree Test Scores and Post Tests

The results of this study are also relevant to research that has been done by previous researchers, although no one has yet researched on the development of science learning modules with the Approach of Public Technology Science (STM) combined with the Problem Based Learning (PBL) model. The research conducted by Gissela K, Ferny T, and Meike Paat (2020) [5] with the title Problem Based Learning Worksheet Development to Improve Student Learning Outcomes at SMP Negeri 1 Poigar. The results obtained from this study are the data obtained are analyzed descriptively and using analysis of comparative tests (Analyze Compare Means) with $\alpha = 0.05$. The product validation results of learning media experts are included in the criteria very well with a value of 86.95% and the validation results of learning materials are included in the criteria are very good with a value of 92%. The results of field test analysis showed that good learning products are used in the implementation of class learning that can be seen through the improvement of average student learning outcomes before and after the implementation of learning. Another study was also conducted by Rahmia (2017) [6] with the title Development of Model Science Learning Module Susan Loucks-Horsley, based on the results of this study obtained the results that the module developed belongs to a very valid category by looking at an average value of 3.6 by pointing to the table of validity criteria ($3.5 \leq V < 4$). Furthermore, the effectiveness of the module based on the test of learners' learning results, namely from 28 students, 25 students were declared complete (graduated) and 3 learners were declared incomplete (did not pass). Based on the results of the research, it can be concluded that the module developed can be said to be valid and effectively used in the learning process. Another study was also conducted by Arnelia Dwi Yasa (2018), this researcher developed stm-based thematic modules (Science, Technology and Society), in this study obtained validation results by media experts showed that the average percentage of module validity is 85% which means that student modules are quite valid and can be used with revisions. The validity percentage of student modules by linguists is 93% which means the module is very valid. The results of the test of the module's attractive value get a percentage of 89% which means the module is very interesting. In the questionnaire given to students there was also no negative advice on the module.

Conclusions and Implications

This research is a type of research to develop teaching materials in the form of science learning modules with the approach of Science Technology Society (STM) on additives and addictive substances. Based on the validation results that have been done by validators, it can be concluded that teaching materials in the form of science learning modules are declared very feasible / valid with a value for the material of 98.92%, and for the media obtained a value of 90.75%. Based on the trial of teaching materials for students in grade VIII A at SMP Negeri 3 Tondano, Minahasa North Sulawesi Indonesia it can be concluded that the teaching materials developed are practical and effective judging from the results of student responses that have been filled by students by 99.06%, and the average value obtained before using teaching materials that have been developed (pretest)is 51.50%, and the average value after using teaching materials that have been developed (posttest) 94.50% with an average increase in value of 43.00%. Student learning completed 100% with the highest score obtained 100 and the lowest score obtained 80 with a range of 20 grades.

Based on the conclusion the following implications are obtained: Teaching materials that have been developed in this research have met the criteria of good quality so that it can be implemented by teachers, especially students to help students in self-learning for additives and addictive substances. Teaching materials in the form of science learning modules with a Community Technology Science (STM) approach can also be developed for other materials that are considered suitable with the approach and also the Problem Based Learning (PBL) learning model so as to make students more motivated to solve problems and also not only accept or gain knowledge, but can also implement in the life and environment of learners.

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