



thermochemistry

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Innovation based learning contextual for thermochemistry topic in senior high school

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Abstract:

The implementation and development of teaching materials purposed to find the topic based on the criteria of National Education Standard Agency (BSNP). The student learning outcomes increase in thermochemistry topic based on the modules contextual. The population in this study were all students of class XI MIA SMAN 2 Percut Sei Tuan consists of 4 classes, while the students of each class were \pm 35 people. The sample used in this study consists of two classes randomly selected. The first class as the experimental which given learning module as a contextual-based teaching materials, however the control class was given without it. The instrument used assessment BSNP that shared to 1 teacher and 2 lecturers. The test used multiple-choice with 20 questions that were valid and reliable. As a prerequisite for testing, the hypothesis of learning outcomes both groups of samples were tested for homogeneity using programs *Microsoft Excel*. The results of the study showed that teaching materials met BSNP criteria that content = 4.16; language = 4.14; presentation = 4.04; Integrity = 4.18 by lecturer. Furthermore, the data achieved of content = 4.32; language = 4.21; presentation = 4.20; integrity = 4.13 by teacher. There are valid criteria and no need revision. The tests performed two sample groups were homogeneous. Hypothesis testing is done by using Paired *Sample T-Test* with SPSS 21. The hypothesis test concludes that the chemical learning outcomes of students uses teaching materials contextual-based module is higher than the student learning outcome without it in the thermochemistry module.

Keywords:

contextual; module teaching materials; outcomes learning

Introduction

In chemistry learning students' interest is very small, this is because students have different learning speeds, the contents of the book are less motivating, students have their own learning styles, and the material delivered is less associated with everyday life so students' learning experiences are small (Dartin, 2011; Tarigan, 2015). Therefore, efforts to improve the quality of chemical learning are currently being carried out, included the improving the quality of teaching materials.

Modules are learning materials that can encourage and give students the opportunity to learn independently and to study appropriately in accordance with students' abilities. Modules are chosen to help contextual based learning because students can build their own knowledge according to their abilities. The advantages of using modules

in learning are that student motivation can be improved, student assignments can be identified quickly, student learning outcomes can be adjusted to students' abilities, and it is more effective and efficient in learning (Novilia et al. 2017).

In addition to teaching materials, models and learning methods also play a role in achieving learning goals. The right learning model and method to make students actively involved in learning, namely with a contextual approach (*Contextual Teaching Learning*) which in essence wants more meaningful learning activities by connecting chemical learning with students' daily lives (Silaban & Simangunsong, 2015; Manalu et al. 2016; Silaban, 2017). Learning using a contextual approach in it contains seven components which consist of constructivism, modeling, finding, asking questions, learning society, real assessment, and reflection. The contextual approach can give students the opportunity to construct new knowledge with the experiences they have. With a contextual approach students are also invited to

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discover their own chemical concepts, so they are able to understand more deeply what they have found (Retnasari et al. 2016).

In some previous studies conducted by Ulfa (2016), states that the use of learning modules can improve learning outcomes or increase students' interest in learning material. Vaino's et al. (2012) reported that the student motivation (N = 416) was significantly higher related to modules contextually specifically designed compared to previous chemistry lessons. According to Matondang (2016) on the development of contextual-based teaching materials on thermochemical subjects in high school showed that student learning outcomes using innovative modules are higher than using the original textbook.

Based on previous research described above, it can be seen that learning using modules can improve student learning outcomes. In this study, the authors developed a contextually based module on the topic of thermochemistry. The development of the Thermochemical Module is based on the BSNP 2006. The module development procedure consists of needs analysis, design, validation, trial and revision. The purpose of enrichment of the thermochemical module is to find the feasibility and effectiveness of Thermochemical Modules to improve yield based on the percentage of feasibility accessed.

Materials and Methods

This research was conducted at school SMA Negeri 2 Percut Sei Tuan in 2017/2018 academic year. The sample of this research consisted of 30 students of XI-MIA 1 as the class experimental which given learning module as a contextual-based teaching materials, and 30 students of XI-MIA 1 as the control class was given without it. The experimental design of this research was Pre-test - Post-test Control Group Design which is showed on Table 1.

Table 1
Research design

Group	Pre-test	Treatment	Post-test
Experimental	T ₁	X	T ₂
Control	T ₁	Y	T ₂

X represents learning using the Thermochemistry Module based on contextual learning, and Y represents learning without using the Thermochemistry Module based on contextual

learning. T₁ is pre-test before using Thermochemistry Module, and T₂ is post-test after using Thermochemistry Module.

The instrument used the assessment Thermochemistry Module is BSNP questionnaire that shared to 1 teacher and 2 lecturers. The cognitive test was collected. The test instrument was trialed to 28 SMA Negeri 1 Percut Sei Tuan students. Based on the trial, 24 questions were found to be valid and the Kuder & Richardson (K-R-20) reliability coefficient score for the instrument was 0.87. The data were analyzed with descriptive quantitative analysis technique. Data of paired sample t-test and gain score from students' pre-test and post-test results were used for analysis. The Thermochemistry Module is effective when there is a difference between pre-test and post-test scores based on paired sample t-test and gain score result. The gain score can be measured with this formula:

$$\% g = \frac{\text{posttest score} - \text{pretest score}}{\text{maximum score} - \text{pretest score}} \times 100 \quad (1)$$

Meltzer (2002) said that gain score has three criteria, which are explained in Table 2.

Table 2

Gain score criteria

$g \leq 0,3$	Low
$0,3 < g \leq 0,7$	Medium
$g > 0,7$	High

The research procedure to find the influence of the Thermochemistry Module to increase students' cognitive learning outcomes is explained below:

1. The development of the Thermochemistry Module and research instrument;
2. Validity test of the thermochemistry module and research instrument to know their feasibility;
3. Trial of test instruments;
4. Trial of the thermochemistry module in experimental class (XI-MIA 1 SMA Negeri 2 Percut Sei Tuan); and
5. Test of students' cognitive learning outcomes to find the influence of the the thermochemistry module to increase students' cognitive learning outcomes.

The hypotheses are H₁: The increase student learning outcomes using the Thermochemistry Module based on contextual learning is higher than student learning outcomes without using the Thermochemistry Module based on contextual learning. H₀: The increase student learning

outcomes using the Thermochemistry Module based on contextual learning is lower than student learning outcomes without using the Thermochemistry Module based on contextual learning. Hypothesis test was used to find the influence of the Thermochemistry Module to increase students' cognitive learning outcomes. The hypothesis will be accepted if sig. (2-tailed) < $\alpha = 0.05$.

Results

Standardization of thermochemistry module

The results of the analysis, the assessment carried out by three expert validators consisting of two lecturers from UNIMED FMIPA Department of Chemistry and one chemistry teacher at SMA Negeri 2 Percut Sei Tuan. Thermochemistry Module for high school/ MA class XI get the average shown in Table 3 and Table 4. Based on Tables 3 and 4, it can be seen that the respondents gave positive opinions of the development results the Thermochemistry Module and valid did not need revisions.

Table 3

Results of standardization by lecturers

Criteria	Mean	Validation Criteria
Content	4,16	valid and no need revision
Language	4,14	valid and no need revision
Presentation	4,04	valid and no need revision
Integrity	4,18	valid and no need revision

Table 4

Results of standardization by teacher

Criteria	Mean	Validation Criteria
Content	4,32	valid and no need revision
Language	4,21	valid and no need revision
Presentation	4,20	valid and no need revision
Integrity	4,13	valid and no need revision

The increase in students' cognitive pre-test and post-test scores

The aim of this research is to find the influence of the Thermochemistry Module which has been previously developed. The influence of the Thermochemistry Module is showed by an increase in the pretest to post-test scores. The paired sample t-test analysis result and the gain score analysis of students' cognitive test (pre-test and post-test). The students' cognitive pre-test and post-test scores shown in Fig 1. Based on Fig 1, it can be seen that there is an increase in student learning outcomes both in the experimental class and in the control class. The post-test value can

increase due to given of teaching on thermochemical subject material in the experimental class and the control class.

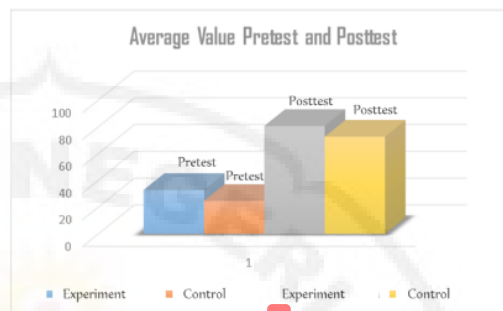


Fig 1. Average value pretest and posttest

The paired sample t-test result

The influence of the Thermochemistry Module to increase cognitive learning outcomes was also determined by paired sample t-test. The aim of paired sample t-test is to find the difference of students' learning outcomes. Paired sample t-test analysis result calculated using SPSS 21 for Windows program based on students' cognitive pre-test and post-test scores shown in Table 5.

Tabel 5.

Paired sample t-test results

	Paired Differences				t	df	Sig. (2-tailed)	
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower				Upper
Pair 1 Experiment - Control	.074	.112	.020	-.032	.116	3.618	.001	

Based on Table 5, it is known that Sig.(2-tailed) < α is 0,001 < 0,05 so H1 was accepted. It can be concluded that there was the increase student learning outcomes using the Thermochemistry Module based on contextual learning is higher than student learning outcomes without using the Thermochemistry Module based on contextual learning.

The students' cognitive gain score results

The influence of the Thermochemistry Module was not only determined by paired sample t-test analysis result, but also gain score analysis result. The gain scores for students' cognitive pre-test and post-test scores are displayed in Table 6. Based on Table 6, the percentage of increase in chemistry learning outcomes of students in the

experimental class of 71.16%, while in the control class an increase of 63.74%. The increase chemistry learning outcomes of students in the experimental class with a high category while in the control class with a medium category.

Table 6

Gain score results

Class	Criteria	Mean	% Gain	Category
Experiment	%g < 30 = Low;	0,7116	71,16 %	High
Control	30 < %g < 70 = Medium; %g > 70 = High	0,6374	63,74 %	Medium

Discussion

The discussion of the study showed that teaching materials met BSNP criteria that Content = 4.16; Language = 4.14; Presentation = 4.04; Integrity = 4.18 by lecturer. Furthermore, the data achieved of Content = 4.32; Language = 4.21; Presentation = 4.20; integrity = 4.13 by teacher. There are valid criteria and no need revision. The tests performed two sample groups were homogeneous. Hypothesis testing is done by using *Paired Sample T-Test* with SPSS 21. The hypothesis test concludes that the chemical learning outcomes of students uses teaching materials contextual-based module is higher than the student learning outcome without it in the thermochemistry module.

This is in accordance with previous studies states that the use of learning modules can improve learning outcomes or increase students' interest in learning material and was significantly higher related to modules contextually specifically designed compared to previous chemistry lessons (Situmorang, 2014). Meanwhile, the authors found some difficulties while doing this research. The first difficulty was time management when implementing the Thermochemistry Module on the trial subjects (Febaliza & Yulis, 2018). The second difficulty that the students were not familiar with chemistry learning contextual (Manalu et al. 2016). Based on the authors' observations in SMA Negeri 2 Percut Sei Tuan, Thermochemistry topic was taught using the exercises item model; in addition the students only used book from school as required by the Curriculum 2013.

Conclusion

Based on the research results and discussion, it can be concluded that the research showed that teaching materials thermochemistry module met

BSNP criteria that content = 4.16; language = 4.14; presentation = 4.04; Integrity = 4.18 by lecturer. Furthermore, the data achieved of content = 4.32; language = 4.21; presentation = 4.20; integrity = 4.13 by teacher. There are valid criteria and no need revision. Based on the processing of existing data, the student learning outcomes obtained using the teaching materials contextual-based thermochemistry module is higher than the student learning outcome without thermochemistry module.

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