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MICRO SCALE KIT MEDIA DEVELOPMENT BASED ON 5E INSTRUCTIONAL MODEL TO PRACTICE STUDENTS SCIENCE PROCESS SKILLS GRADE XI HIGHER SCHOOL ON THERMOCHEMISTRY MAIN SUBJECT

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Abstract

Practical activities are a part that cannot be separated from chemistry learning. To maintain the performance of chemistry learning through practical, micro-scale kit media was developed to help the practical implementation in the classroom. Therefore, this research aims is to develop a kit which is valid, practice, and effective. This type of research used development refers to methods of Research and Development (R&D) Borg and Gall. Kit that have been reviewed and validated then tested on 12 students of eleventh grade senior high school. The results showed that the Kit feasibility based on validity content and construct with an average percentage 89.63% include very appropriate category. Kit feasibility based on practicality aspects in terms of student responses obtained percentage between 91.67%-100% include very practical category. Kit feasibility based on aspects of effectiveness obtained from the posttest students science process skills with improving N-gain indicated that 91.67% of students completed with gain score 75% of students included in high category and 25% of students include in enough category. It can be concluded that the micro-scale Kit media based on 5E Instructional Model to practice student's science process skills feasible based on the aspect of validity, practicality, and effectiveness
Key Word: Kit Media, 5E Instructional Model, Science Process Skill

INTRODUCTION

Chemistry is a part of the natural sciences that acquired and developed based on experiments to find the answers of the questions of what, why, and how about the phenomena of natures, especially related to the the composition, structure, properties, transformation,dynamics and energetics [1]. Chemistry can not simply be taught through theory, but also necessary to taught the skills realm with direct experience in the field through planned laboratory activities. Therefore, students are expected to: processing, reasoning, and comunicating in the concrete and abstract realm associated with the development of what they have learned in school independently, and be able to use the method according to the rules of science.

However in reality, the practical learning at SMA Muhammadiyah 1 Malang have problems such as practical implementation depends on the materials, availability of time and tools, and habituation of students in using tools in the laboratory to help resolve issues rated less [2]. This is also supported by the interview results with chemistry teacher,. known that laboratory facilities in SMA N 1 Driyorejo still lacking. The availability of tools and chemicals are limited in number so that the practical implementation is still very rare. Additionally, time limit and expensive costs of equipment and materials also become problems in carrying out practical work.

Based on the explanation above, knowing that several problems faced by schools to carrying out practical work, such as lack of facilities of tools and materials, the tendency of costs that allocated by the school as a supporting activity was insufficient because the cost of equipment and materials are expensive, and the availability of time to carry out practical is limited so that practical implementation is still lacking.

Regardless of completeness laboratory conditions, education should be continue to be held without having to wait for the completeness of facilities. Therefore, to maintain the continuity of learning through practical chemistry in particular, need to develop alternative chemistry lab media which is called micro-scale Kit media for learning chemistry can take place optimally. It is important for the teacher/school for the following reasons: First, the micro-scale Kit media is an effort to overcome the limitations of the tools and materials needed in the lab. Teachers can utilize existing resources around the school and residence for developing micro-scale Kit media. Second, this micro-scale Kit media can overcome the limitations of cost with minimal use of materials and equipment that utilize existing resources so that it can also enhance the creativity of teachers and students. Third, the Kit media has a design that is practice and easy to use so it does not take long time to prepare [3].

With the micro-scale Kit media is expected to assist teachers in attempt chemistry learning process in schools. This is in accordance with the opinion that Kit learning can help schools meet the educational standards set by the National Education Standards Agency (BSNP), which are completes the furnishings, equipment, or media learning in school [4]. In addition, the use of Kit in learning is dynamic, which can be used for experiments in the laboratory or can also be used for learning activities in the classroom so that the experiment can continue.

The practical learning has a role in the development of science process skills of students. The application of science process skills simultaneously with the development of a scientific attitude that supporting students knowledge process is possible in practical activities, so that in learning chemistry, lab has a very important position.

Based on the explanation above, the micro-scale Kit media based on the 5E Instructional Model can be used to practice science process skills of students. These 5E effectively improve the concept understanding of students, develop students' science skills, increase motivation to learn science, as well as instill reasoning and scientific attitude of students [5]. 5E Instructional Model engaging students through the following steps: (1) students involved in asking questions, (2) students seek answers to questions by making hypotheses, planning, designing, conducting experiments, and recording the experimental data, (3) students make explanations based on trial data to answer questions, (4) students describe, extend, or apply their findings in a new context, and (5) students evaluate the process and results of their experiments in a variety of ways. Steps in this 5E emphasize students to discover concepts through laboratory experiments using the scientific steps, so that appropriate to practice students' science process skills [6].

METHODOLOGY

The method used in this research is Research and Development (R&D) by Borg and Gall [7]. The implementation of this research and development to be carried out restricted only to the four steps based on the method of R&D, namely, research and Information collecting, planning, develop preliminary form of product, and preliminary field testing.

The preliminary field testing subjects in this study were students of class XI IPA 4 SMAN 1 Driyorejo as many as 12 students by using one group pretest posttest design research. The instrument used in this study include: analysis and validation media sheet, pretest and posttest science process skills sheet, and student questionnaire responses.

Data analysis techniques used to assess every aspect related to the media kit are: Feasibility validity obtained from the average percentage of the validator assessment, where Kit as feasible and valid if the percentage of every aspect of ≥ 61%. Practicality aspect is obtained based on the questionnaire responses of students after using a Kit which media said practical if the acquisition of a percentage practically every aspect of the positive and negative questions in the instrument ≥ 61%. Eligibility percentage formula:

$$P(\%) = \frac{\sum score\ data\ collection}{Criterium\ score}\ x100\%$$

Table. 1. Interpretation Score

Percentage (%)	Categories
0- 20	Very Poor
21 - 40	Poor
41 - 60	Enough
61- 80	Good
81- 100	Very Good

The effectiveness obtained based on the pretest and posttest students science process skills where the students considered to be complete when the individual scores obtained in the posttest results ≥75. Data score of students' science process skills were analyzed using the following formula:

$$Science\ Process\ Skills\ Score = \frac{Obtained\ Score}{maximum\ total\ score} \times 100$$

Then the data was interpreted into the range of knowledge and skills competency scores in the following table.

Table 2. Score Range of Knowledge and Skill Competences

No	Score Range	Predicate
1	93-100	A
2	84-92	B
3	75-83	C
4	≤75	D

[1]

Furthermore, the media is considered effective if the criteria score of students' science process skills were measured using the N-gain score is enough and high.

$$N - gain = \frac{S_{post} - S_{pre}}{S_{maks} - S_{pre}}$$

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Process skills in term classical are considered to be good if the number of students who achieve mastery ≥75%.

Table 3.Criteria *N-gain score*

No	Value <g>	Criteria
1	≥0,7	High
2	0,7>g≥0,3	Enough
3	<0,3	Low

[8]

This means that there are 75% of students who score science process skills posttest ≥75.

$$Classical\ Completeness = \frac{number\ of\ student\ complete}{number\ of\ all\ student} x\ 100\%$$

RESULT AND DISCUSSION

The products that resulted from this research was the micro-scale Kit on Thermochemistry subject. Micro-scale Kit is the equipment manufactured and packed in boxes of teaching units, which resemble a series of test equipment process skills in Thermochemical subject and equipped with a manual uses. Kit product specifications are as follows:

(a) Box Kit made of plastic material with a length: 36 cm x width: 18 cm x height 12 cm.

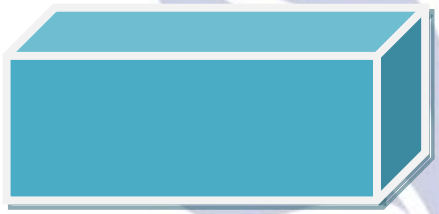

Figure 1. Kit Box

(b) Set of tools and materials in a kit consisting of a calorimeter apparatus, thermometers, measuring cups, beakers glass, test tubes and pipettes. While the material consists of a solution of NaOH 1M, HCl 1M, CuSO4 1M, $C_2H_4O_2$ 0.8 M, NH_4Cl 0.5 M, and distilled water. Solid materials consisting of Zn, Mg, $NaHCO_3$, $Ba(OH)_2$, $CO(NH_2)_2$, NaOH, and $CaCO_3$.

Figure 2. Tools in Kit

This kit has some advantages as follows:

a. Kit is focused at one material Thermochemistry with equipment that can be used for a wide range of practical, making it easier for teachers and students to learn Thermochemistry

Figure 3. Materials in Kit

b. Kit has resistance to water, weather, and humidity making it easier to stored and maintained.
c. Cost needed in the manufacture of kit is minimized so that the school does not have to worry about learning is obstructed due to the lack of tools and materials facilities.
d. Equipped with a guide book which is accompanied by a specification of the equipment / materials, usability tools / materials as well as Material Safety Data Sheet (MSDS) of the materials used, as well as the 5E Instructional Model-based worksheets that allows students and teachers to use the kit easier.

Validity

Media can be said to be eligible for use in the learning process according to Nieveen includes three aspects of validicity, practicality, and effectiveness [9]. Based on these aspects then, the results of the feasibility Kit includes the results of the feasibility in terms of validity, practicality, and effectiveness. The results of the validation assessment by the validator kit can be seen below:

Table 3.validation Assessment Result

Rated Aspect	V 1	V 2	V 3	Percentage (%)	Criteria
Relevant to the teaching materials	4	4	5	86.67	Very Appropriate
Worksheet conformity with 5E Instructional Model	4	4	5	86.67	Very Appropriate
Language	4	4	5	86.67	Very

Rated Aspect	V 1	V 2	V 3	Percentage (%)	Criteria
					Appropriate
Tools resistance	4	5	5	93.33	Very Appropriate
Worksheet conformity with component of sciences process skills	4	5	5	93.33	Very Appropriate
Accuracy of measurement (only for measuring instruments)	4	4	5	86.67	Very Appropriate
Safety for students	4	4	5	86.67	Very Appropriate
Aesthetics	4	5	5	93.33	Very Appropriate
Kit box	4	5	5	93.33	Very Appropriate
Average				89.63	Very Appropriate

Kit can be declared valid if they are in good or very good categories, namely the acquisition of the percentage of ≥ 61%. Based on Table 4, the results of the validation Kit on every aspect are very Appropriate with percentage of> 80%, while the average overall aspects of otherwise very Appropriate with a percentage of 89.63%.

Validity, according Nieveen includes validities content and construct. A media development should be based on the present state of knowledge. Therefore, the validity of the content consists of four main aspects related to the applicable curriculum includes: (1) the relevance of the media with learning materials; (2) worksheet conformity with the 5E Instructional Model, (3) worksheet conformity with the process skills component, and (4) language.

Media that are feasible and can be used in learning, must proper with the applicable curriculum, good content, structure and depth [10]. Based on the assessment criteria, Kit media must have relevance to teaching materials. This is because the media is used to help students understand the chemistry concepts being studied. Therefore, Kit media should display the phenomenon takes to learn these concepts [3].

Assessment of construct validity has the aim to determine the suitability of the media kit with the uses of media in learning and instruction or direction with aspects: (1) tools resistance, (2) Accuracy of measurement, (3) the safety for students, (4) aesthetics, (5) Kit box. Kit Media is designed as good as possible so that more favored by students. It can attract students' motivation to learn to use the Kit. This is in accordance with the opinion of Briggs that the media used to deliver a message from sender to receiver so that it can stimulate the mind, feelings, concerns, and interests of students in a way that learning occurs [11].

An instructional media will be used by many students, so the media should have a resistance that includes resistance to weather and temperature, to heat, so that the measurement accuracy of the measurement results will not have irregularities, although often used [3]. Besides tools and materials in the media, should be made as safe as possible, with the use of small concentration and small-scale materials. Therefore, the feasibility Kit based on the aspect of validity is otherwise very appropriate with a percentage of 89.63%.

Practicality

Practicality is assessed based on the results of questionnaire responses of students after using the micro-scale media Kit based 5E Instructional Model. Media Kit can be said to get a good response when the percentage of students who answered positively ≥ 61%. Thus, the media kit can be used as a medium of learning in the learning process. Here is the data of student questionnaire responses:

Table 5. Students Responses Result

Rated Aspect	Answer	%	Criteria
The Kit appearance in my opinion is interesting	Yes	8.33	Very practical
	No	91.67	
Kit makes me interested in studying thermo chemistry materials	Yes	100	Very practical
	No	-	
During practicum activities the Kit's	Yes	-	Very practical

Rated Aspect	Answer	%	Criteria
media tools are difficult to use and poorly functioning	No	100	
Kit is not easy to store because it requires a large place	Yes	-	Very practical
	No	100	
This Kit helps me understand thermochemstry materials	Yes	100	Very practical
	No	-	
The instructions in the practicum guide book are hard to understand	Yes	91.67	Very practical
	No	8.33	
I became more active in learning after using Kit	Yes	100	Very practical
	No	-	
I am motivated in learning by using Kit	Yes	100	Very practical
	No	-	

Based on Table 5 above, it is generally known that the percentage of student questionnaire responses for each criterion ≥61%, so the Kit developed can be used in teaching and learning as a learning media. Based on these results, media-based micro-scale Kit based on 5E Instructional Model to practice science process skills of students said to get a positive response.

Students gave positive remarks to the media,that according to them with this Kit, giving them a chance to learn directly by doing practical work and further introduce and clarify for them the working principle of the thermometer and the calorimeter. Besides it, giving the task at worksheet also help them better understand the material. Students were delighted with their learning by practice in the given material Thermochemistry. Students also gain new experiences with activities to formulate the problem, make their own hypotheses, determine the variables and test hypothesis experimented with trial procedures which they design themselves. This is because so far they have never done learning with these steps.

Based on the results of student responses, 100% of students stated that they become more active in learning. Media in education serves to increase students' motivation that allows students play an active role during the learning process. By using the appropriate media and varied education can overcome the passivity of learners. In this case the media is usefull for: stimulating learning, allowing a more direct interaction, allowing students to learn according to their ability and interest [11]. Based on the above, the feasibility Kit based on aspects of practicality otherwise very practical with percentage between 91.67%-100%.

Effectiveness

Effectiveness judged on the last characteristic that researchers obtain the desired result, then the media is said to be effective. In this research, Kit declared eligible based on aspects of effectiveness in terms of the of students' science process skills.

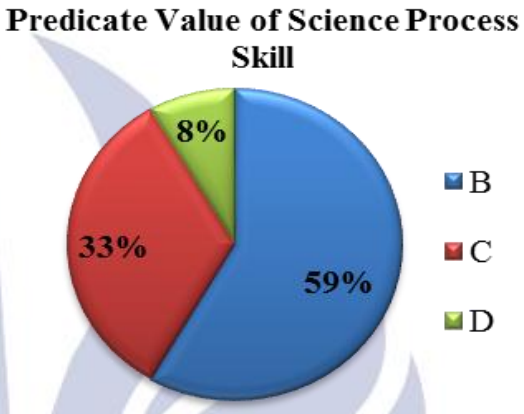

Figure 4. *Posttest* Result Diagram

Based on Figure 4, it can be seen that the media Kit is effectively used as a media of learning. Based on the results of the posttest, the students declared complete 91.67% where 59% of students or seven students have predicated B, 33% of students or three students predicated C, and 8% or one students predicated D which mean not completed. This incompleteness may because student never practiced science process skill by the teacher before, so they still new with this kind of learning.

Each student also has different cognitive development and it resulted in different science process skill result. Others factor might because student les motivated and consider that the learning was not interesting enough. Student not giving attention to the teacher explanation even using Kit, so it lead to the low result in science process skill.

Learning by involving students in an experiment carried out activities for students to gain experience and be directly involved in thermochemistry learning. So students do not just hear the teacher talk about the exothermic and endothermic reactions, calorimeter, the heat of reaction and counteraction but students are encouraged to directly experiment. In the use of

media Kit, students in the experimental group were given appropriate tool material covered. Students conduct their own experiments with supervised by teachers. After the experiment is completed, discussed the new joint drawn final conclusions or trial while teachers provide appropriate Activity Sheet material covered [12].

Improvement of student learning outcomes after using the Kit, then analyzed using analysis of N-gain. N-gain represents the difference between the pretest and posttest. N-gain indicates an increase in students' science process skills after using Kit. Here is the data increasing students' science process skills using N-gain analysis.

Based on the diagram, it showed the results of student learning improvement after using Kit. As many as 25% of students includedin the enough categoryand 75% of students included in the high category.

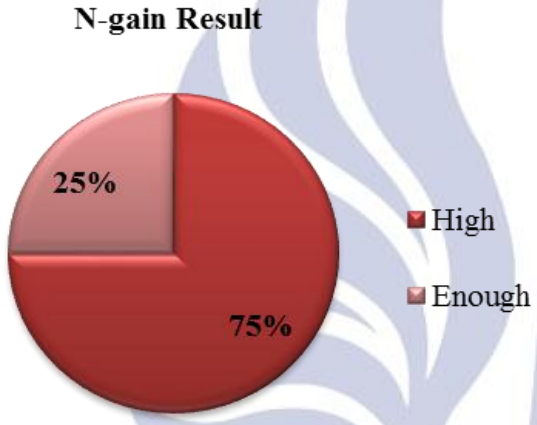

Figure 5.N-*gain* Result Diagram

Thus, the micro-scale Kit based on the 5E Instructional Model in Thermochemistry subject can be said effectively used as a media of learning chemistry.

CLOSURE

Conclusion

Based on the results of research and discussion that has been described in previous chapters, it can be concluded that the micro-scale Kit based on 5E-Instructional models were developed to be eligible as a media of learning in Thermochemical material, with details as follows:

1. Micro-scale Kit based on 5E Instructional Model in Thermochemical subject are valid in terms of content and construct validity with average percentages of 89.63% and is included in the very Appropriate category
2. Micro-scale Kit based on 5E Instructional Model in Thermochemical subject are practical declared by practicality obtained from students' responses with an average percentage between 91.67%-100% and is included in the very practical category
3. Micro-scale Kit based on 5E Instructional Model in Thermochemical subject are effective declared by the effectiveness derived from the results of the posttest science process skills of students with student improvement 75% in high category and 25% of student in enough category.

Suggestions

Suggestions are given for further research are as follows:

1. In this study the research just did until preliminary Field Test, to gain more information on the use of micro-scale Kit based Instructional 5E model, the application needs to be done with the number of students who more or in the actual class.
2. Indicators drilled science process skills can be added or changed according to the needed of existing curriculum, the basic competencies and learning objectives to be achieved
3. Kit based on 5E Instructional Model is effectively to practice student sciences process skills, so it also can to practice others skills that needed by the student

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