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# Students' Difficulties on Science Learning with Prototype Problem-Solving Based Teaching and Learning Material:

## A Study Evaluation of Development Research

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***Abstract*—This research intended to develop a prototype of teaching and learning materials on natural science topic of junior high school. The development of learning materials was conducted by using Dick and Carey's Research & Development model. Teaching and learning materials are included syllabus, lesson plan, worksheet, student's book, test of learning outcome. This study is a deep evaluation to find weakness of prototype from the student's perspective and enhancements to make it better. Research subjects were 32 junior high students taken by simple random sampling. Data collection technique was observation of student's activity and evaluation of worksheets. The instruments included questionnaire, observation sheets and students' worksheets. The result showed that the semi-summative evaluation of the prototype was success to create a feasible prototype. Teachers can apply well, but students had a bit of difficulties. It was concluded that the weakness of the teaching and learning material prototype from the viewpoint of the students are activities work to do problem solving strategies on the experiment. The teaching and learning material prototype still needs to be enriched in terms of operational definitions of concepts, the tools, and tool laboratory functions as well as a glossary.**

***Keywords*— Problem Solving, Science Education, Teaching and Learning Material, Students' Difficulties**

## I. INTRODUCTION

Research and development is intensively engaged experts in an effort to solve the problems in education. Great zest by experts is due to research and development has an advantage rather than other type of research design. The main advantages of the development of research is the findings of the study, which is a product. This product is a concrete response to the gap between everyday educational issues with the desired expectation [1].

Today has been widely circulated reports of research and development to improve students' 21st century skills. Development research on model development research on media, development research on the material, and development research on assessment crammed into table of contents of education journals. The trending topic is a product development aims to enhance students' problem solving skill.

All kinds of study lead to the product in the form of teaching and learning material. Each of these researchers claim that product development is a reliable product. Theoretically, the quality of a product development results judged by the validity, practicality, and effectiveness [2]. Education experts began to be skeptical. The problem that arises is the result of the development of product quality is often questionable [3]. Concrete problem is the product of development tends not as good as the quality of the test results. Especially when used by other users, in addition to researchers. The result of the use not uncommon to have a gap between the qualities of the test report with the results of user satisfaction.

This is a real indication that the product research development though it was classified as valid, practical and effective, still have weakness. There are weaknesses of prototype that misses from researcher's view. The weakness could also not be detected by the reviewer, both at the time of the validation test or try out phase.

Referring to the fact, the best evaluator of a product is the consumer. The main consumer in the world of education is students. Opinion Students are very necessary to be considered. The response can describe the problems, obstacles or weaknesses of a product that may miss from investigators or expert assessment. This can happen because the reality can be very different at field, between theory and practice, as well as between one place and in other places.

One of the many results of the latest development is teaching and learning material for [4]. This teaching and learning material is still a prototype. The products were declared valid, practical and effective. As with other products of RnD this science material of teaching and learning needs to be evaluated in more depth from a consumer standpoint.

Solutions in response to public skepticism, more in-depth study needs to be done on the weakness of products. More in-depth evaluation study is intended to find a weakness of teaching and learning material that may not have been discovered during the creation of the prototype.

Based on the above illustration, the problem of the study is stated as "What is the weaknesses of teaching and learning material prototype from the students' perspective?

## II. METHOD

The development of teaching and learning material was conducted by using Dick and Carey's R & D Model. This study is a follow-up evaluation studies to find the weaknesses of teaching and learning material prototype that may not be detected before. Evaluation study was conducted in class VII B SMPN 1 Banjarmasin consisting of 32 students. Data collecting instruments of this research are observation sheets, evaluation of worksheet and questionnaire.

Purpose of this study is to find weakness of the prototype from the student's perspective and enhancements to make it better. As explained [2] :

> *"Formative evaluation serves different functions, or – in other words – is aimed at different quality criteria (or combinations of these) in the various development cycles, each being a micro cycle of research with its specific research/evaluation question and related research evaluation design."*

The development research incorporates systematic educational design processes, as illustrated in Fig. 1.

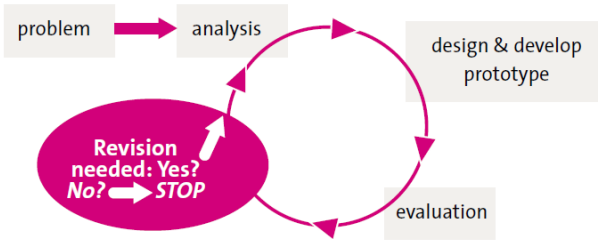


Fig. 1 Iterations of systematic design cycles

Investigations were carried out from the standpoint of students through observation toward student's activity and opinion.

## III. RESULTS AND DISCUSSION

The observation toward the teachers' and students' activities during the learning process generates the percentage of achievement of activities for each step of the students' learning activities. The results are used to determine students' learning activities by using teaching and learning material for students. Results of the assessment of students' activities through observation sheet are shown in Fig. 2.

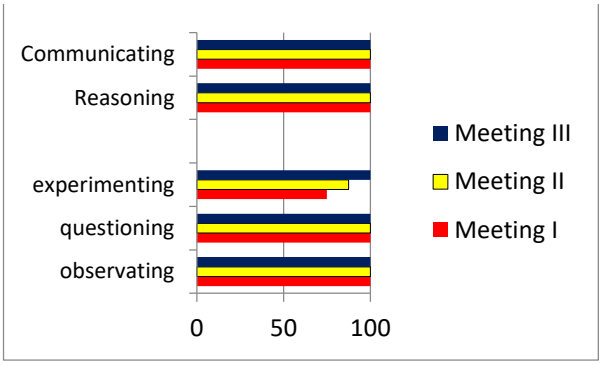


Fig. 2 Students' activities

Fig. 2 shows that the students are still having difficulties in conducting experiments. The contents of the experimental activities refer to conducting problem-solving. Based on field observations, the students are often not confident or not confident at the time they wanted to do the experiment or solve problems. They tend to hesitate and often ask questions.

This phenomenon occurs naturally in the learning environment of problem-solving. A research report by [5] on the activities of students' problem solving, shows that the studets are often found to be passive and hesitate in trying to solve the problem. The students became silent and did not know what to do. This is exacerbated by passive students who were slightly embarrassed to ask the teacher when they did not understand about the learning activities. They tend to be asked by a friend in the group. Passive students are more open to the group of their friends. This passive behavior makes experimental activity not run smoothly.

A cause of the students' passive behavior during this experimental activities is due to their weak ability in cognitive process. They have difficulties in carrying out the planned activities. They still seem not to be familiar with the problem-solving plans on grains of certain knowledge. Problem-solving experiment activities rely on the students' cognitive process. They need cognitive process in order to conduct experiments.

According to Gagne's theory, the students solve problems through several stages of cognitive processes. Phases of cognitive processes include *discrimination, concrete concept, defined concept, and finding the rules of problem* [6] Discrimination, concrete concept, defined concept, and setting of rules are requirements for someone to solve the problem.

The process of linking knowledge occurs at the stages of making the concept concrete, discriminating, defining concept of the problem and finding of the rules of the problem on the students periodically at each meeting. The first two abilities of

the students to solve the problem are the making the concept concrete and discriminating. Discriminating is the ability to provide inter-stimulus responses that are same or different. An example of discrimination is that the hard object is different from soft one. making the concept concrete is the ability to show visible properties of an object. An example of concrete concept is color of wood.

Ability in making the concept concrete and discriminating occurs when students understand the problem in steps of identifying the problem. Both of these abilities do not make students' difficulties due to take place automatically when they are exposed to the object or matter. The result of the ability of making the concept concrete and discriminating is a form of factual knowledge and some knowledge on the concept.

A 'rule' is a regularity in special situations. This rule is a kind of provision that connect objects to other objects. These objects have properties of interdependence. The process of finding the rule of the problem requires upon ability to connect knowledge. The process of linking knowledge occurs more actively when the students apply the rules. Examples of rules, if the fire is ignited dry wood will burn. Objects that are connected to those rules are dry wood and fire. Rules or provisions that connects the two objects is: if it is burn if fire is ignited fire toward dry wood.

In order to sharpen the analysis of the weaknesses of the experimental activities, supporting data are presented. Based on the following data, cognitive process skills still shows the students' weaknesses. Supporting data and cognitive assessment data of the students in problem solving process are presented in Figure 3.

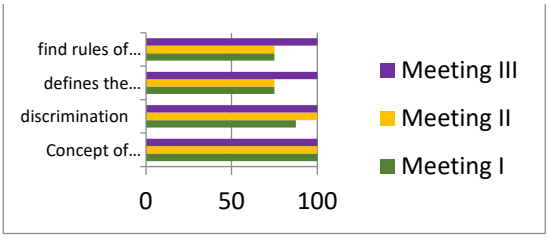


Fig. 3 Students' cognitive process

The Fig. 3 shows indeed the students still have difficulties to define concepts in problems of learning. The weak concept of prerequisites dominated by students led them to be difficult in determining the steps to be taken in the experiment.

Reference [7] found out that the understanding of prior knowledge can help the students to accurately construct knowledge. Combination of prior knowledge and conceptual knowledge can support the students' scientific activity. Investigations can only be done if they understand what they want to investigate. The combination of prior knowledge and conceptual knowledge, enables the students to understand the problem. Furthermore, provide more opportunities for them to conduct a series of investigations. This is because a key aspect of the investigation is that the students understand the question tested [8]

Beads of knowledge that has not been understood by the students relates to the information in the lab equipment and concepts of prerequisite. Class VII is an amateur practitioner, even than the interview obtained information that the majority of students stated that for the first time officially in a lab practicum. This situation makes students not familiar with lab equipment.

Another obstacle is that the prerequisite concepts are still weak. Prerequisite knowledge or prior knowledge is still insufficient such as in knowledge of the physical and chemical properties and the introduction of practical tools and functions.

Components of teaching and learning materials that interact directly with students in which the definition of the concept is related to the students' book. So this weakness becomes the aspects that needs to be corrected in the prototype. Deficiencies found in this study is the content of students' book and students' worksheets. These learning and teaching materials still need to be enriched in terms of operational definitions of concepts, and equipment and its functions within the lab.

Based on a review on the students' book and worksheets, not many operational definitions are found. Then the improvements that can be done is to add information about the operational concepts, and equipment and its functions in the form of a glossary. Based on Indonesian dictionary, word 'glossary' is a list of words and their explanations.

In fact, the operational definitions of the prior knowledge are sufficiently covered in the students' book. This is in contrast against the results of the evaluation that the students are still difficult to understand the concept of prerequisite. It makes sense that it can happen due to the words and information about the prior knowledge within the resource remains elusive for the students. Furthermore, it is because the students still have poor vocabularies, insufficient knowledge from elementary education. Seventh grade junior high school students have just graduated from elementary school, and therefore the words presented should be those that are appropriate with their age.

Revision on the content of students' book is conducted by adding information on the operational concepts, equipment and its functions in the lab, and improving the sentence structures on the content of the prior knowledge. Improvements are covering blended words and brief words, unambiguous words and standard words. Not a word absorbed from a foreign language was vain.

Words absorbed from foreign language is difficult for students. Reference [9] analyzes that when students are dealing with unfamiliar words they will experience double troubles. If the language used is difficult to understand, they will interpret it in two stages. The first stage is to understand the language and translate it into an understandable language. The second stage is to interpret it. Words such as centrifugation, evaporation, sublimation and chromatography are unfamiliar words for the students and should be changed into the more familiar ones. For example, 'a centrifugation

method of separating a mixture' is more easily understood by the students if it is referred to rotation

Other improvement includes the writing of teaching material and content. This improvement covers the writing of chemical symbols made according to the rules of scientific writing, the establishment of foreign terms to be replaced with the appropriate Indonesian rule terms. Fixed content includes the explanation on separation of mixtures made simpler, addition of images in accordance with the concept of separation of distillation, examples of distillation solution made more easily recognized by the students in everyday life

This revision is a highly recommended treatment. Reference [10] in a research report, treatment with enriching the content of a book can stimulate students' interest in reading. When the students' reading interest increase, they can more easily build understanding and compile the necessary information.

When a qualified student understands he will know what to do and realize what is being done. This will reduce the intensity of asking and improve performance in learning activities. The next effect is that students can overcome difficulties in experimental activities.

## IV. CONCLUSION

The most problems in learning process using this teaching and learning material prototype were in the students' activities. Most students are still passive when doing experimental activities. Based on the result and discussion it can be concluded that the weakness of teaching and learning material prototype is in the content that still needs to be enriched in terms of operational definitions of concepts, the laboratory equipment and its functions as well as the word glossary.

## REFERENCES

[1] S. Hadi, "Penelitian Desain Pendidikan: Mendekatkan Teori dengan Praktis," in *Conference Proceedings Pendidikan IPA*, Banjarmasin, 2016.

[2] T. Plomp, "Educational Design Research: An Introduction," in *An Introduction to Educational Design Research*, Enshede, The Netherlands, SLO, 2013, pp. 11-50.

[3] B. Muhammad and S. Saparahayuningsih, "An attitude and character instructional development based on Curriculum 2013 in elementary school," *Creative Education*, vol. 7, pp. 269-277, 2016.

[4] I. K. Sadiqin, "Pengembangan Perangkat Pembelajaran Berbasis Model Problem Solving untuk Meningkatkan Keterampilan Memecahkan Masalah dan Hasil Belajar Siswa pada Topik Perubahan Benda-Benda di Sekitar Kita di Kelas VII Sekolah Menengah Pertama," Unpublished Master Thesis, Banjarmasin, 2016.

[5] S. L. Wismath and D. Orr, "Collaborative learning in problem solving: a case study in metacognitive learning," *The Canadian Journal for the Scholarship of Teaching and Learning*, vol. 6, no. 3, pp. 1-19, 2015.

[6] R. W. Dahar, Teori-Teori Belajar & Pembelajaran, Jakarta: Erlangga, 2011.

[7] L. H. Barrow, "Helping student construct understanding about shadows," *Journal of Education and Learning*, vol. 1, no. 2, pp. 188-191, 2012.

[8] N. R. Council, "A Framework for K-12 Science Educatin Practice, Crosscutting Concepts and Core Ideas," National Academy Press, Washington DC, 2012.

[9] T. Sulaiman, A. Hassan and R. Baki, "Readiness of year 1 students to learn science process skills in English: a Malaysian experience," *International Journal of Instruction*, vol. 2, no. 1, pp. 17-26, 2009.

[10] J. T. Gutharie, A. Wigfield, N. M. Humenick, K. C. Perencevich, A. Taboada and P. Barbosa, "Influences of stimulating task on reading motivation and comprehension," *Journal of Edcation Research*, vol. 99, no. 4, pp. 232-245, 2006.