The Development Stoiciometry Module Based On POGIL and Unity of Sciences

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Abstract. The development of POGIL-based chemistry modules and the unity of science carried out because there is a dichotomy of science among academics, learning media is not yet loaded with UOS and accommodates student activities, and learning media are not in accordance with student learning styles. Therefore the purpose of this study is to produce a POGIL-based module and loaded with UOS. The development model used is a 4-D developed by Thiagarajan provided to define, design, develop and disseminate. The developed module is validated by material and media experts. The results of the validation of material experts 90.62% are valid categories and the results of the validation of media experts are 88.75% valid categories. The module openness test results from an average of 87.68%, namely Independent / Free. The results of student responses to the use of modules amounted to 86.72% with a very good category. Thus POGIL and UOS-based chemistry modules can be used as student learning resources.

1. Introduction

Islam as a religion in accordance with human nature encourages adherents to learn all the sciences without discriminating between religion and science, even Islam states that science and religion are both sourced from the Almighty[1]. However, until now there is still assumption in society and academics that the religion and science are two entities that cannot be reconciled. It means that indirectly there has been a dichotomy of science, but in fact all knowledge comes from God[2]. The Unity of Sciences (UoS) paradigm is a solution to change this assumption. This paradigm states expressly that all sciences synergize with one another and lead to one goal which is to know the God[3]. The integration of knowledge does not necessarily change the paradigm of students, but it requires a process. Therefore, the integration of knowledge should be implemented in the learning process in order to reduce the dichotomy of science and increase student interest in learning.

The learning process is a process that involves interaction between lecturer-student and communicative reciprocity that takes place in an educational setting to achieve learning goals[4]. The learning process involves the media as one of its components. The media of learning provide experience to students in encouraging learning motivation, clarifying and facilitating complex and abstract concepts to be simple, concrete and easily understood[5].

The use of learning media can increase new desires and interests, generate motivation and stimulation of learning activities, and bring psychological influence on students[6]. Learning media should be adapted to student learning styles[7][8]. It aims to increase student interest and learning outcomes. The
data obtained showed that students of Chemistry Education in Semester 2 were 60.88% with visual learning styles, 16.90% with auditory learning styles, and 22.22% with kinesthetic learning styles. So, the learning resources that suitable for students of Chemistry Education in Semester 2 are the learning media that facilitate visual learning styles and complemented by student activities. It is the printed media and one them is module. Modules are learning units that are designed to be used by students independently[9], modules are different from textbooks because the module preparation is more student-oriented (learner oriented), written in simple language, interesting and arranged in such a way as if the module is a "teacher" for students[10]. Modules must accommodate guided inquiry activities and questions used to improve critical thinking skills, problem solving, reporting, metacognition and individual responsibility. Based on the survey, critical thinking ability of students of Chemistry Education in Semester 2 is still low. This is because the learning process is limited to equipping students with the ability to remember and understand, they have not been involved in the ability of analysis, synthesis and reflective thinking about problems. This learning situation makes them inactive in learning and low ability to find concepts. The learning process with discovery can improve thinking skills[11]. The development of thinking skills is very important in learning because it can equip students to address the life problems they face. Therefore we need a module that can guide and direct students in the discovery of concepts or POGIL (Process-Oriented Guided Inquiry Learning), POGIL can help students more responsible for their assignments, learning by using higher-order thinking skills, improving performance skills towards subject matter and develop positive relationships with other students[12]. Based on the description above, the researchers conducted research by developing learning media based on POGIL and UoS module as media and learning resources.

2. Method

This research is a 4-D Research and Development model that developed by S. Thiagarajan (1974)[13] covering the stages of define, design, develop and disseminate. Define phase is carried out to dig up information and determine the needs in the field and collect information relating to the possibility of products to be developed. The design phase is carried out to design the module prototype based on the results of the needs analysis at the define stage. The develop phase is carried out to produce modules that have been revised by experts[14]. At the develop stage an expert validation consists of validation of material and media, and Product Trial to determine the user's response to the module developed. The study was conducted at UIN Walisongo Semarang, with research subjects of Chemistry Education students taking Basic Chemistry courses. In this study, data collection was carried out to obtain the quality of the modules developed. Data collection is done by observation, interviews, questionnaires and documentation. Data obtained from the results of the study were processed with data analysis techniques. Data analysis techniques used in this study include module validation, module readability test and user response questionnaire.

3. Result and Discussion

The result of this research is a chemistry learning modules product based on POGIL and UoS on stoichiometry material. POGIL can change the stigma that stoichiometric material which is identical to calculations containing complicated formulas and concepts becomes easy to learn by students, this is because POGIL allows students to explore, discover concepts and application of concepts in stoichiometry material. In addition, the module that was developed also contained content of unity of sciences that integrate chemistry and religion with the proposition of the Qur’an, so students know that science is basically a unified originating from the Creator. So as to reduce the dichotomy of science among academics.

3.1. The Result of The Expert Validation

Expert testing is done by validating the initial design to the expert to determine the module's suitability. This expert test was conducted by 2 validators. The validator who validates this module is Lis Setyo Ningrum, M.Pd. and Nur Alawiyah, M.Pd. Module validation includes module content, POGIL content and unity of sciences Basis. The module eligibility assessment is carried out using an
assessment instrument, which is a validation sheet that contains several aspects and indicators that have been determined. The validator in addition to providing grades also provides input and suggestions on the modules developed. Inputs and suggestions given by each validator are then used as a reference in making revisions to improve the prototype of the product being developed. Validation test results can be seen in Table 1.

| No. | Components                     | The Score of Validator Criteria |
|-----|--------------------------------|---------------------------------|
|     |                                | I     | II    | mean |               |
| 1.  | Content eligibility            | 88%   | 92%   | 90%  | Valid          |
| 2.  | Language                       | 90%   | 90%   | 90%  | Valid          |
| 3.  | Presentation technique         | 90%   | 100%  | 95%  | Valid          |
| 4.  | POGIL content                  | 90%   | 90%   | 90%  | Valid          |
| 5.  | Basis Unity of Sciences        | 87%   | 93%   | 90%  | Valid          |

Based on Table 1 shows that each validator in the module validation test includes the contents of the module, the POGIL content and the Unity of Sciences Base are Valid. This can be seen from using POGIL content in the modules presented in Figure 1. POGIL is an inquiry-oriented learning model that is student-centered[15], allowing them to be actively involved cooperatively in the learning process[16]. POGIL content (POGIL Activity) which consists of exploration, concept discovery and application helps students find their own concepts and POGIL stages make students feel happy and quickly understand / discover material concepts. An effective module is a module that does not only contain material content, but also includes student activities that involve cognitive, analytical, rational, logical processes and invites students to think reflectively and critically about problems[11]. POGIL Activity makes students more responsible for their assignments, learns by using higher-order thinking skills, improves performance skills on subject matter and develops positive relationships with other students[12]. In addition to POGIL content, the module is also based on Unity of Sciences (UoS) as presented in Figure 2. This content is expected to reduce the dichotomy that occurs in students, so this content integrates directly to submissions in the stoichiometry chapter. So students are able to understand the relationship of chemistry with other sciences because all sciences work together and lead to one goal, namely to know the Creator[3]. The unity of science paradigm also contains ideas to dialogue between rational and religious in a unified and harmonious system[17].

![Figure 1. POGIL Activity](image1.jpg)

![Figure 2. Unity of Sciences Content](image2.jpg)
3.2. The Module Readability Result

Modules are valid then implemented in a limited way to find out the readability of module that based on POGIL and the unity of science in stoichiometry material and student responses to the module. Module readability analysis is carried out through the overlap test (Klos technique). This analysis was conducted to determine the quality of module that based on POGIL and the unity of science in stoichiometry material in the well read category or not. The results of the readability test data analysis showed that the average module readability result was 87.68%, Independent / Free. It means that the module developed does not need revision. The results of module that based on POGIL and the unity of science are presented in Table 2.

3.3. The Results of The Response to The Module

Beside the readability test, students also provide responses when the trial is limited by filling out a questionnaire of aspects of student responses. The results of the questionnaire analysis showed that students' responses to the modules that developed were on average Very Good (85.45%). beside to the overall response, an analysis of the response results was carried out in every aspect including aspects of ease in understanding modules, learning independence, learning activeness, interest in modules, module presentation, module usage, unity of sciences, and POGIL. The response of students stating that the module on the basis of unity of sciences provides new knowledge to students that actually science is one and centered on Allah SWT, students are more interested because in the module integrates chemistry with verses of the Quran and Hadith and students are more interested to study with this module because chemistry is associated with other fields of science that can you understand chemistry better. Thus the module that based on POGIL and the unity of science can be used as student learning resources. The results of the student response questionnaire to the module are presented in Table 2.

### Table 2 The Analysis Result of Module Readability and Student Response

| No. | Respondents | Module Readability | Student Response |
|-----|-------------|--------------------|------------------|
|     |             | True Answer        | %score | Score | % | Categories |
| 1   | M-1         | 20                 | 86,95  | 115   | 88,46 | Very good |
| 2   | M-2         | 18                 | 78,26  | 113   | 86,92 | Very good |
| 3   | M-3         | 22                 | 95,65  | 117   | 90,00 | Very good |
| 4   | M-4         | 21                 | 91,30  | 111   | 85,38 | Very good |
| 5   | M-5         | 19                 | 82,60  | 110   | 84,62 | Good |
| 6   | M-6         | 20                 | 86,95  | 116   | 89,23 | Very good |
| 7   | M-7         | 21                 | 91,30  | 107   | 82,31 | Good |
| 8   | M-8         | 22                 | 95,65  | 114   | 87,69 | Very good |
| 9   | M-9         | 20                 | 86,95  | 116   | 89,23 | Very good |
| 10  | M-10        | 19                 | 82,60  | 115   | 88,46 | Very good |
| 11  | M-11        | 21                 | 91,30  | 101   | 77,69 | Enough |
| 12  | M-12        | 19                 | 82,60  | 98    | 75,38 | Enough |
| Mean|             | 87.68%             |        |       | 85.45%| Very good |

4. Conclusion

The module that based on POGIL and the unity of science on stoichiometry based on the average validation of material and media assessments are 90.62% and 88.75%. It means that the modules developed are valid. The module readability test results are 87.68% with the Independent / Free category so that the modules do not need to be revised. In addition, student responses to module that based on POGIL and the unity of science in the Very Good category with an average percentage of questionnaire results was 85.45%. So this module is feasible to be used as teaching material. A wide scale implementation is needed to test the effectiveness of the module, especially its relation to student critical thinking skills, because the POGIL stage enables students to use higher order thinking skills.
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