

# Development of Socio-Scientific Issues Based Reaction Rate Module And Science Literacy Oriented

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**Abstract.** One the efforts that can accelerate the achievement of student scientific literacy is the development of teaching materials. Socio-scientific issues based teaching materials involve use of scientific topics/ issues that intentionally require students to engage in dialogue, discussion and debate. This study aims to determine validity, practicality, and effectiveness of developed socio-scientific issues based on module. This research was conducted using the R&D research method. The results showed that the socio scientific issues based module on the reaction rate material developed was declared to be very valid with an average kappa moment value of 0,93 very high category. The practicality test was declared very practical by lecturers and students with an average kappa moment value of 0,93 very high category. Based on the test results, the module is declared effective with an N-Gain valua of 0,82 high criteria

**Keywords:** Development, Module, Socio Scientific Issues, Science Literacy

## 1 Introduction

The development of science and technology has a huga influence on all aspects including the field of education. Many innovations in the world of education have been carried out by utilizing sceince and technology developments such as the emergence of methods, learning media, learning resources and information that can now be accessed easily and utilized in learning activities [1]. One of the innovations that can be done to improve the quality of learning is todevelop teaching materials which are the main support in learning activities. Existing teaching materials still focus on the content dimension rather than the process and context dimensions [2]. Science learning currently emphasizes understanding the concept of matter, without connecting it to the functions of life such as as its relation to the environment and society. This is thought to be the cause of low scientific literacy in Indonesia. The use of appropriate teaching materials in science learning is expected to increase students understanding of the nature of science and ultimately increase students scientific literacy. Therefore, quality teaching materials are needed in order to create a more effectivenesscience learning process. In accordance with its

essence, science learning should be able to use the environment and environmental issues as a vehicle to build scientific literacy. The learning approach based on contemporary social issues is known as the socio scientific issues (SSI) approach. SSI approach is able to stimulate intellectual, moral and ethical development as well as awareness about the relationship between science and social life [3]. In its implementation, SSI involves the use of scientific topics/issues that intentionally require students to be involved in dialogue, discussion and debate. In line with this opinion, states that learning using socio scientific issues and the use of technology can result in a more effective learning process, knowing what to consider in practice and understanding how to reflect on what is learned [4]. This provides an opportunity for students to discuss and debate issues of SSI controversial, their critical thinking skills will increasingly improve [5]. Based on the background, it is necessary to conduct research, namely "Development of socio scientific issues based reaction rate module and science literacy oriented". The purpose of this research is to produce a valid, practical and effective reaction rate module.

## **2 Method**

The 4-D model includes 4 stages, namely the stage of definition, development, design, and dissemination [6]. Thiagarajan analyzed five activities carried out at the define stage namely: front-end analysis, learner analysis, task analysis, concept analysis, and specifying instructional objectives. At the design stage in four activities, namely: constructing criterion-referenced test, media selection, format selection, initial selection. At the development stage in two activities, namely: expert appraisal and developmental testing. At the disseminate stage in three activities, namely: validation testing, packaging, diffusion and adoption.

This research was conducted at the Department of Chemistry, Faculty of Mathematics and Natural Sciences, Medan State University. The population in this study were all chemistry students who took basic chemistry courses consisting of five classes. The sample in this study is one class of the population taken purposively. Data collection techniques in this study were carried out with instrument feasibility sheets, questionnaires and learning outcomes tests. The data analysis technique uses the moment kappa formula for the results of questionnaire and N-Gain formula for learning outcome test.

## **3 Result and Discussion**

At the define stage, analyze any problems contained in the lecture process by conducting front-end analysis through interviews with course lecturers, student analysis through interviews with students, concept analysis by analyzing core competencies and basic competencies, task analysis by analyzing learning indicators and specifications goals by analyzing the learning objectives on the reaction rate material.

At the design stage, a test is prepared which aims to determine the students' scientific literacy skills for learning chemistry, especially the reaction rate material. The test is structured and developed based on a grid with cognitive levels of C4, C5 and C6. The format used in the developed module is the typeface using Calibri for the title and Cambria for the content of the module, the spacing between rows is 1.5 with column and paper formats adjusted to the UNESCO format, which is 15.5 x 23 cm. The initial design of the module is arranged

sequentially consisting of a cover, foreword, introduction, table of contents, instructions for using the module, SSI components, basic competencies and competency targets, and concept maps. Then proceed to the module content section which is in accordance with the learning stage of the socio-scientific issues approach, namely 1) approach and problem analysis, 2) problem clarification, 3) continuing social issues, 4) discussion and evaluation, and 5) meta-reflection. The closing section consists of a summary, evaluation questions, glossary and bibliography.

At the development stage, validation and practicality tests are carried out which aim to produce valid and practical modules. After the module based on socio-scientific issues is designed by producing draft 1, then validation is carried out to the expert team or validator. The module was revised according to suggestions and input from the validator by producing a draft module 2. Followed by an assessment by the lecturer of basic chemistry courses and students.

Material expert validation was carried out to 3 validators who were chemistry lecturers. Validation using a validation sheet in the form of a questionnaire as many as 28 statements with a score range per item 1-5. The results of the assessment of each validator were analyzed using kappa moments to determine the level of validity of the developed module. The resulting kappa moment data can be seen in Table 1 below.

**Table 1.** Material Expert Kappa Moment Analysis Results

Assessment Aspect	Moment Kappa			Average	Category
	Exp 1	Exp 2	Exp 3		
Curriculum Suistability	0,87	0,87	0,93	0,89	very high
Material accuracy	1	0,92	1	0,97	very high
Clarity of evaluation in the module	0,92	1	1	0,97	very high
Material presentation accuracy	1	1	1	1	very high
Conformity with language rules	0,93	1	0,93	0,95	very high
Conformity with the development of critical thinking skills and scientific literacy	1	0,84	1	0,95	very high
Conformity with Socio-Scientific Issues	0,84	1	0,84	0,89	very high

In the table it can be seen that from the seven assessment criteria assessed by each material expert, the average kappa moment value was 0.95 with a very valid category. In the results of the material expert assessment, suggestions and input were also obtained from each validator which had been revised by the author.

Media expert validation was carried out to 3 validators who were chemistry lecturers. Validation using a validation sheet in the form of a questionnaire as many as 19 statements with a score range per item 1-5. The results of the assessment of each media expert were analyzed using kappa moments to determine the level of validity of the developed module. The kappa moment data obtained can be seen in Table 2 below.

**Table 2.** Media Expert Kappa Moment Analysis Results

Assessment Aspect	Moment Kappa			Average	Category
	Exp 1	Exp 2	Exp 3		
Cover	0,89	0,78	0,89	0,85	very high
Layout	0,89	0,93	0,85	0,89	very high
Pictures and illustrations	0,93	0,93	1	0,95	very high
Colour	1	1	0,67	0,89	very high

In the table, it can be seen that from the four assessment criteria assessed by each media expert, the average value of the kappa moment was 0.90 with a very valid category, so that from the results of the kappa moment of material and media experts, the average kappa moment for validity was obtained. 0.93 with a very valid category. This shows that the chemistry module based on socio-scientific issues and oriented to scientific literacy that has been developed is feasible to use with a very valid validity category.

Furthermore, an assessment was carried out on 5 lecturers of basic chemistry courses to determine the practicality of the module based on socio-scientific issues and oriented to scientific literacy that was developed. The assessment uses a practicality questionnaire of 12 statements with a score range per item 1-5. Aspects of assessment by lecturers include aspects of ease of use, estimated learning time, and benefits. Based on the results of the assessment by the lecturer, the average value of the kappa moment was 0.96 with a very practical category. After the module is declared valid and practical, then a trial is carried out on students by conducting a pretest and posttest and distributing student response questionnaires. based on three assessment criteria obtained from student responses to the developed module, the average kappa moment value is 0.93 with a very practical category.

Then pretest and posttest were carried out to students before and after using the developed module which aims to see the effectiveness of the module. the results of the pretest and posttest were analyzed using n-gain. Based on the results of the analysis, the N-Gain value is 0.82 with high criteria, so it can be concluded that the module based on socio-scientific issues has a high effectiveness for improving students' scientific literacy skills. According to [7] indicators of scientific literacy include identifying valid scientific opinions, conducting effective literature searches, understanding elements of research design, making precise charts of data, solving problems using quantitative skills, including basic statistics, understand and interpret basic statistics, and make inferences, predictions, and conclusions based on quantitative data. Science literacy-based learning can make students more active so that they can improve their learning outcomes [8].

In the disseminate stage, modules based on socio-scientific issues and scientific literacy are distributed in hardcopy and file form. The modules are distributed to students and lecturers who teach basic chemistry courses. Modules are also distributed through the SIPDA platform as an LMS (Learning Management System) used by students in lectures.

## 4 Conclusion

Based on results and discussion described, the authors can draw the following conclusions: (1) test the validity of the chemical module based on socio-scientific issues and scientific literacy oriented on the reaction rate material which is stated to be very valid with an average kappa momen value (k) 0,93 very high category (2) the practicality test of the chemistry module based on socio-scientific issues and scientific literacy oriented on the reaction rate material was declared very practical by lecturer with an average kappa moment value (k) 0,96 with a very high category and got a very high response, both of students with an average value of kappa moment (k) 0,93 very high category (3) the test of the effectiveness of the chemical module based on socio-scientific issues and scientific literacy oriented on the reaction rate material was declared to be very effective with the N-Gain test result of 0,82 with high criteria.

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