Validity of a Chemistry Learning Module Based on Socio-Scientific Issues

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A B S T R A K

Penelitian ini bertujuan untuk menentukan validitas dan persentase kelayakan modul pembelajaran kimia berbasis socio-scientific issues oleh ahli materi dan media. Metode yang digunakan dalam penelitian ini adalah penelitian dan pengembangan (R&D) menggunakan model 4D oleh Thiagarajan. Modul ini divalidasi oleh 2 ahli materi dan 2 ahli media. Instrumen yang digunakan untuk mendapatkan data validasi adalah angket penilaian ahli. Data dianalisis menggunakan teknik analisis deskriptif kuantitatif. Nilai validasi oleh ahli material yang diperoleh adalah 57.5, dan kelayakannya dapat dikategorikan sebagai 'sangat baik'. Persentase kelayakan dari penilaian ahli materi yang diperoleh adalah 89.84%. Nilai validasi oleh ahli media adalah 61.50, dan kelayakannyanya dapat dikategorikan sebagai 'sangat baik'. Persentase kelayakan dari penilaian ahli media yang diperoleh adalah 96.09%.

A B S T R A C T

This paper aims to determine the validity and eligibility percentage of socio-scientific issues-based chemistry learning module by material and media experts. The method used in this research was Research and Development (R&D) using the 4D model by Thiagarajan. The module was validated by two material experts and two media experts. The instrument used to obtain the validation data was an expert assessment questionnaire. The data were analyzed using quantitative descriptive analysis techniques. The validation value by material experts was 57.5, and its eligibility can be categorized as 'very good'. The percentage of eligibility from the material expert assessment obtained was 89.84%. The validation value by media experts was 61.50, and its eligibility can be categorized as 'very good'. The percentage of eligibility from the media expert assessment obtained was 96.09%.

1. INTRODUCTION

Learning modules are learning materials that contain learning objectives, learning materials or substances, and evaluations that are arranged systematically to help students achieve specific learning objectives (Rahdiyanta, 2016). Printed modules are modules where the material is presented on sheets of paper and does not use the help of technology (Yuliani et al., 2021). Modules are one of the teaching materials that can provide students with the opportunity to learn at their own pace (Sofiana & Wibowo, 2019). Based on observations that have been made, it was found that there are quite complete learning resources, such as textbooks, enrichment books, reference books, and other learning sources such as newspapers, magazines, and internet access. However, the presence of a socio-scientific issues (SSI) based learning module as teaching material is still not available.

SSI are social issues related to science that are controversial and unethical in nature, where there is more than one possible solution that requires moral and ethical judgment (Zeidler et al., 2002). To solve SSI problems, we should consider the social and scientific aspects, so the problem can be solved objectively (Cian, 2020). Learning based on SSI concept mapping can improve students' scientific performance (Su, 2021).

To be able to develop an SSI-based learning module, the module should contain material that has SSI characteristics, including science-based issues, issues involving opinion formation, issues that are often reported in the media, the issue of having incomplete information due to insufficient scientific evidence, and issues involving local, national, or global problems (Ratcliffe & Grace, 2005). To develop students' skills

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in dealing with SSI, students should be able to identify an environmental problem, develop a solution by applying knowledge, and put the solution into practice (Garrecht et al., 2020).

This study aimed to determine the validity and eligibility percentage of the SSI-based chemistry learning module by material and media experts. The validity of this module by material experts was reviewed from the aspects of content, language, presentation (BSNP, 2006; Ulumudin et al., 2017), and module characteristics (Rahayu, 2019; Rahdiyanta, 2016). Meanwhile, the aspects validated by media experts are the format, cover design, content design, and print quality of the module. (Rahdiyanta, 2016; Ramadhani & Mahardika, 2015).

2. METHOD

The method used in this research was Research and Development (R&D) using the 4D model by Thiagarajan (1974). In this research, the SSI-based chemistry learning module was validated by material and media experts. The module was validated by two material experts and two media experts. Product validation analysis is used to determine the eligibility of the learning module. The data were analyzed using quantitative descriptive analysis techniques.

The instrument used to obtain the validation data was an expert assessment questionnaire. The questionnaire used was a Likert scale, as shown in Table 1. The questionnaire also provides space for experts to provide input to improve the quality of the SSI-based learning modules being developed.

Tabel 1. Assessment Category for Product Validation

Description	Score
Very Poor	1
Poor	2
Good	3
Very Good	4

The result of product assessment then was calculated using the following formula:

$$\bar{M} = \frac{\Sigma x}{n} \qquad (1)$$

with,
$\bar{M}$ = average of total score,
Σx = was total score, and
n = total items.

The scores were converted into 5 categories which were described in Table 2.

Tabel 2. Category of Product Eligibility

No	Score Range	Category
1	$\bar{M} > 54.4$	Very Good
2	$44.8 < \bar{M} \leq 54.4$	Good
3	$35.3 < \bar{M} \leq 44.8$	Acceptable
4.	$25.6 < \bar{M} \leq 35.3$	Poor
5.	$\bar{M} \leq 25.6$	Very Poor

Te eligibility percentage based on expert assessment can be calculated using the formula bellow:

$$\text{Percentage} = \frac{\text{Total Score Obtained}}{\text{Maximum Score}} \qquad (2)$$

with, total score obtained was from scores given by the experts, and the maximum score was from maximum scoring (4) times the number of items (16 items).

3. RESULT AND DISCUSSION

Result

Expert assessment was carried out to determine the eligibility of the SSI-based chemistry learning module. Material expert validation is an assessment of the learning module regarding the eligibility of the

material in the SSI-based learning module that has been developed. The material validation assessment questionnaire consists of four aspects, namely content, language, presentation (BSNP, 2006; Ulumudin et al., 2017), and module characteristics (Rahayu, 2019; Rahdiyanta, 2016). The result of material validation by experts is shown in Table 3.

Tabel 3. Result of Material Validation by Experts

No.	Indicators	Average Value
	Content	
1	Compatibility of the material presented with basic competencies.	4
2	Accuracy and compatibility of the data or information in the material presented.	4
	Language	
3	Use appropriate language.	3
4	Accuracy in the use of terms.	2.5
5	Easy to understand.	3
6	Does not contradict values, norms, and SARA (ethnicity, religion, ancestry, and group of people) issues.	4
	Presentation	
7	Attractive cover appearance.	3.5
8	Compatibility of images and illustrations with the material presented.	3.5
9	Compatibility of the size and type of letters used.	3.5
10	Good paper quality and print results.	4
	Module Characteristics	
11	Self-instructional: can be used independently.	3.5
12	Self-contained: contains the material in its entirety.	3.5
13	Stand-alone: stands alone without relying on other teaching materials or other learning media.	4
14	Adaptive: able to adapt to the advancement of science.	4
15	User-friendly: easy to use.	4
16	The module contains controversial issues.	3.5
	Total Score	57.5
	Category	**Very Good**

From the data in Table 3, it was shown that the validation value by material experts was 57.5 and its eligibility can be categorized as 'very good'. There are several indicators that got a perfect score of 4, namely compatibility of the material presented with basic competencies; accuracy and compatibility of data or information on the material presented; does not contradict values, norms, and SARA (ethnicity, religion, ancestry, and group of people) issues; good paper quality and print results; stand-alone: stands alone without relying on other teaching materials or other learning media; adaptive: able to adapt to the advancement of science; and user-friendly: easy to use. The lowest score obtained was 2.5 for indicator accuracy in the use of terms. The percentage of eligibility by the material expert was 89.84%. It was obtained from a total average score (57.5) divided by a maximum score (64).

The eligibility of the media in the SSI-based chemistry learning module that has been developed was assessed through media expert validation. The media validation assessment questionnaire consists of four aspects, namely module format, cover design, content design, and quality of print (Rahdiyanta, 2016; Ramadhani & Mahardika, 2015). The result of media validation by experts is presented in Table 4.

The data in Table 4 showed that the validation value by media experts was 61.50, and its eligibility can be categorized as 'very good'. Almost all indicators got a perfect score; 11 out of 16 items got a score of 4. These indicators were harmonious cover layout appearance; harmony of colors, images, and typography in the cover design. The percentage of eligibility by the media expert was 96.09%. It was obtained from a total average score (61.50) divided by a maximum score (64).

Experts also provide suggestions for improving the chemistry learning module. Suggestions given by material experts are shown in Table 5. The data shown in Table 5 contains suggestions from experts to improve the quality of the module. For material aspects, the module was revised based on input from experts, such as on writing indicators, adding material, and improving sentence writing. In terms of media appearance, the thing that has been improved is changing the cover image according to input from experts.

Tabel 4. Result of Media Validation by Experts

No.	Indicators	Average Value
	Module format	
1	Use a proportional column format.	3.5
	Cover design	
2	Harmonious cover layout appearance.	4
3	Harmony of colors, images, and typography in the cover design.	4
4	Appropriate size of the title, author's name, and illustrations.	4
5	Precise selection of illustrations according to the material discussed.	3.5
6	The font on the cover is easy to read.	4
	Content design	
7	The size of the illustrations in the module is proportional.	4
8	The font used in the module content is easy to read.	4
9	Select a proportional font size.	4
10	Accurate use of letter variations such as boldface, italics, capital letters, or lowercase letters.	4
11	Appropriate use of color in text letters.	4
12	Consistent use of letter variations throughout the learning module.	4
13	Use consistent spacing.	3.5
14	Use a consistent typing layout.	4
	Quality of print	
15	Compatibility of selecting paper type for printing module.	3.5
16	The binding quality of the module is strong.	3.5
	Total Score	61.50
	Category	**Very Good**

Tabel 5. Improvement Suggestions from Experts

No.	Suggestions
	Material Experts
1	Writing indicators doesn't need to use a subject.
2	We need to add material about the differences between solutions, colloids, and suspensions.
3	There was an unfinished sentence.
4	It was recommended to make complete and good sentences.
	Media Experts
1.	On the cover, the Erlenmeyer image should be replaced with other images related to colloids, for example, milk, pudding, etc.

Discussion

The development process of the chemistry learning module based on socio-scientific issues was based on theory developed by Thiagarajan (1974). The process went through several stages, namely define, design, development, and dissemination. In the development stage, material and media expert appraisals were carried out. The material experts rated the developed SSI-based chemistry learning module as a 'very good' with an eligibility score of 89.84%. The media experts also rated the developed module as a 'very good' with an eligibility score of 96.09%. In the questionnaire assessment sheet, the experts also write suggestions as module evaluations. Module evaluations are used as a tool to improve the module, such as technical writing (Dapat et al., 2023)

Students often have difficulty understanding learning material, but by using learning modules, modules can help students learn and improve student learning achievement. (Wahab et al., 2018). Learning modules can help students understand learning material because they contain material that connects the relationship between knowledge and daily life (Dewi & Primayana, 2019). Meanwhile, learning modules that are self-paced and flexible are effective in increasing self-efficacy (Ihyembe et al., 2021).

Using SSI-based learning modules has many advantages, including improving decision-making skills, creative thinking skills, critical thinking skills, and scientific literacy (Alfitriyani et al., 2021; Dalaila et al., 2022; Masing & Aminatun, 2022; Pursitasari et al., 2022; Zhang et al., 2023). SSI-based learning modules can encourage students to consider problems from multiple perspectives, increase the use of compensatory methods to measure competitive solutions, and enable them to accurately assess the quality of their own decisions (Zhang et al., 2023). SSI-based modules, which are integrated with SSI aspects, can improve

students' creative thinking skills (Pursitasari et al., 2022). The use of SSI-based modules makes students understand the learning material better and makes it easier for them to understand the lesson material (Sofiana & Wibowo, 2019).

4. CONCLUSION

It is concluded that the chemistry learning module based on socio-scientific issues that has been developed is valid to use. The validation value by material experts was 57.5, and its eligibility can be categorized as 'very good'. The percentage of eligibility from the material expert assessment obtained was 89.84%. The validation value by media experts was 61.50, and its eligibility can be categorized as 'very good'. The percentage of eligibility from the media expert assessment obtained was 96.09%. Further research testing the readability and response of practitioners to the SSI-based learning modules that have been developed needs to be carried out. Apart from that, it is also necessary to test the effectiveness of the learning module, for example, its effect on students' decision-making.

5. ACKNOWLEDGE

6. REFERENCES

Alfitriyani, N., Pursitasari, I. D., & Kurniasih, S. (2021). Biotechnology module based on sociosaintific issues to improve student's critical thinking ability through online learning. *Jurnal Pendidikan Matematika Dan IPA*, *12*(1). https://doi.org/10.26418/jpmipa.v12i1.43179

BSNP. (2006). *Instrumen penilaian tahap I buku teks pelajaran pendidikan dasar dan menengah*.

Cian, H. (2020). The influence of context: Comparing high school students' socioscientific reasoning by socioscientific topic. *International Journal of Science Education*, *42*(9). https://doi.org/10.1080/09500693.2020.1767316

Dalaila, I., Widiyaningrum, P., & Saptono, S. (2022). Developing e-module based on socio-scientific issues to improve students scientific literacy. *Journal of Innovative Science Education*, *11*(3).

Dapat, L., Alda, R., & Bacus, R. (2023). Evaluation of flexible learning module on new literacies for preservice teachers. *International Journal of Information and Education Technology*, *13*(3). https://doi.org/10.18178/ijiet.2023.13.3.1842

Dewi, P. Y. A., & Primayana, K. H. (2019). Effect of learning module with setting contextual teaching and learning to increase the understanding of concepts. *International Journal of Education and Learning*, *1*(1), 19–26. https://doi.org/10.31763/ijele.v1i1.26

Garrecht, C., Eckhardt, M., Höffler, T. N., & Harms, U. (2020). Fostering students' socioscientific decision-making: exploring the effectiveness of an environmental science competition. *Disciplinary and Interdisciplinary Science Education Research*, *2*(1). https://doi.org/10.1186/s43031-020-00022-7

Ihyembe, D., Stager, K., Deavenport-Saman, A., Yang, J., Imagawa, K. K., & Vanderbilt, D. L. (2021). Navigating school-based special education services: A self-paced virtual learning module. *MedEdPORTAL : The Journal of Teaching and Learning Resources*, *17*. https://doi.org/10.15766/mep_2374-8265.11108

Masing, F. A., & Aminatun, T. (2022). Developing an SSI-based learning model of android module to improve critical thingking skills of students. *Jurnal Pembelajaran dan Biologi Nukleus*, *8*(3). https://doi.org/10.36987/jpbn.v8i3.3226

Pursitasari, I. D., Alfitriyani, N., & Kurniasih, S. (2022). Enhancing students' creative thinking skills through biotechnology module based socio-scientific issues. *Jurnal Penelitian Pendidikan IPA*, *8*(2). https://doi.org/10.29303/jppipa.v8i2.1438

Rahayu, S. (2019). Socio-scientific issues (SSI) in chemistry education: enhancing both students' chemical literacy & transferable skills. *Journal of Physics: Conference Series*, *1227*(1). https://doi.org/10.1088/1742-6596/1227/1/012008

Rahdiyanta, D. (2016). Teknik penyusunan modul. *https://staffnew.uny.ac.id/upload/131569341/penelitian/teknik-penyusunan-modul.pdf.*

Ramadhani, W. P., & Mahardika, I. K. (2015). Kegrafikaan modul pembelajaran fisika berbasis multirepresentasi. In *Seminar NasionaL Fisika dan Pembelajarannya*.

Ratcliffe, M., & Grace, M. (2005). Science education for citizenship : Teaching socio-scientific issues. *British Educational Research Journal*, *31*(6).

Sofiana, S., & Wibowo, T. (2019). Pengembangan modul kimia socio-scientific issues (SSI) materi reaksi reduksi oksidasi. *Journal of Educational Chemistry (JEC)*, *1*(2). https://doi.org/10.21580/jec.2019.1.2.4382

Su, K. D. (2021). Implementation of SSI concept mapping as a dynamic learning environment to enhance students' scientific performance. *Journal of Baltic Science Education*, *20*(6). https://doi.org/10.33225/JBSE/21.20.969

Thiagarajan, S., Semmel, D. S., & Semmel, M. I. (1974). instructional development for training teachers of exceptional children. Washinton DC: National Center for Improvement Educational System. *Education Resources Information Center (ERIC)*.

Ulumudin, I., Mahdiansyah, M., & Joko, B. S. (2017). *Kajian buku teks dan pengayaan: Kelengkapan dan kelayakan buku teks kurikulum 2013 serta kebijakan penumbuhan minat baca siswa*.

Wahab, A., Mahmud, A., & Tiro, M. A. (2018). The effectiveness of a learning module for statistical literacy. *New Educational Review*, *53*(3). https://doi.org/10.15804/tner.2018.53.3.16

Yuliani, E., Wiji, W., & Mulyani, S. (2021). Review of learning modules in chemistry education. *Journal of Physics: Conference Series*, *1806*(1). https://doi.org/10.1088/1742-6596/1806/1/012207

Zeidler, D. L., Walker, K. A., Ackett, W. A., & Simmons, M. L. (2002). Tangled up in views: Beliefs in the nature of science and responses to socioscientific dilemmas. *Science Education*, *86*(3). https://doi.org/10.1002/sce.10025

Zhang, W. X., Hsu, Y. S., Ho, Y. T., & Liu, C. C. (2023). Effects of a SSI-based learning module on students' decision-making abilities. *Journal of Research in Education Sciences*, *68*(1), 167–198. https://doi.org/10.6209/JORIES.202303_68(1).0006