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DEVELOPMENT OF ELECTRONIC MODULE BASED ON SOCIO SCIENTIFIC ISSUES (SSI) ON THE TOPIC OF COLLOID

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ABSTRACT
21st century learning in the era of Society 5.0 demands innovation and optimal utilization of technology. This study aims to develop an electronic module based on socio scientific issues (SSIs) on the topic colloid using the Flip PDF Professional application is valid and practical. The electronic module was validated by three material experts and three media experts from FMIPA UNIMED lecturers. The practicality test was conducted by one chemistry teacher and 22 students of SMA Negeri 1 Rantau. This study uses the Research and Development (R&D) method with 4D development procedures which include "Define, Design, Develop, and Diesseminate. Data collection used scoring sheets and response questionnaires with a kappa moment scale. The results of the feasibility assessment by material expert validators were 0.87 with a very high category and media expert validators were 0.85 with a very high category. Practicality by teachers is 0.78 with high criteria and students' response is 0.83 with very high criteria. Based on the research results, it can be concluded that the electronic module based on SSIs on the topic of colloid is feasible to use, practic, and get a positive response from users to the electronic module that has been developed.

Keywords: *Electronic module, socio scientific issues, colloid.*

1. INTRODUCTION
The era of globalization had a broad impact on various aspects of life, including education. Currently, the world of education has great demands to prepare students to have superior human resources so that they can adapt to the era of Society 5.0 to be able to think critically, constructively, and innovatively (Indarta et al., 2022). Education Society 5.0 is a society that can utilize current technology as a solution to overcoming an educational problem to improve the quality of human resources that are no less intelligent than other countries.

Education not only aims to improve students' competence in scientific concepts (knowledge aspect), but also to produce young people who have the ability as agents of change with character and culture in facing future challenges (Rahmawati, 2018). One of the chemistry subjects found in SMA class XI IPA is colloid. Colloids are learning materials that contain facts, concepts, and procedures, and are theoretical and memorized that students must master. The colloidal system material requires students to be able to create and explain the uses of colloidal systems related to everyday life (Pusparini et al., 2018).

The results of interviews conducted by researchers with chemistry teachers and students at SMA Negeri 1 Rantau obtained information that at the school the teacher used teaching materials in the form of textbooks and student worksheets in the learning process. Interviews conducted with students of class XII IPA 1 obtained the conclusion that students have difficulty in understanding colloidal material which tends to be memorized, so student interest in learning is still low and students have not used teaching materials integrated with the socio scientific issues (SSIs) approach in colloid learning.

Electronic modules combine the use of technology that can expose active, creative, effective, and fun learning that can increase students' enthusiasm to want and feel at home reading books whenever and wherever students are. To be able to encourage learners to complete and maximize learning abilities independently (Suyasa & Divayana, 2018). One of the applications used in creating an electronic module is Flip PDF Professional. Flip PDF Professional is a feature-rich flipbook maker that has a page edit function. It can create interactive book pages by inserting multimedia such as images, videos from YouTube, MP4, audio videos, hyperlinks, quizzes, flash and more (Denisa and Hakim,2021).

Electronic modules as independent learning resources for students need to be supported by learning approaches to train students' skills in critical thinking to solve various problems in everyday life. One approach that matches these characteristics is the SSIs approach which can make students' perspectives on a problem generate new ideas (Mahanani et al. 2020). Based on the results of research conducted by Sismawarni et.al (2020) the use of socio scientific issues approach can open students' scientific reasoning so that it can stimulate students to think critically. Research on the development of module teaching materials on oxidation-reduction reaction materials with the SSIs approach that has been developed can increase student interest in learning. The chemistry learning that was carried out showed a change in student perceptions, which initially considered chemistry not close to life to consider chemistry close to life (Sofiana and Wibowo, 2019).

2. LITERATURE REVIEW
2.1 Electronic Modules
Electronic modules are teaching materials in the form of modules that are displayed in electronic format which are expected to increase the interest and motivation of students by involving the display of images, audio, video and animation. Electronic modules

utilize a wide selection of software applications designed with attention to learning and learning principles (Asmiyunda et al., 2018).

According to (Herawati and Muhtadi, 2020) electronic modules are modules in digital form, consisting of text, images, or both that contain digital electronic material accompanied by simulations that can and should be used in learning. Electronic modules are innovative media that can increase student interest in learning. A learning process to be able to improve the achievement of learning outcomes needs to be supported by the right learning guide. Therefore, a learning guide that can activate students in learning is needed. Among the learning guides that allow for the improvement of student learning outcomes and prioritize active student independence is the electronic module.

Thus, electronic modules are teaching materials that can explain something in a language that is easily accepted by students according to their level of knowledge. Electronic modules are teaching materials in digital form that are packaged as a whole and systematically, in modules containing a set of learning experiences that are planned and designed to help students learn to independently master specific learning objectives.

2.2 Socio Scientific Issues (SSIs)

SSIs are issues that describe social problems in society related to the conceptual, procedural, or technological context of science. Socially controversial topics or issues that have a scientific component often include other disciplines and interests (politics, economics, ethics etc.) and involve the evaluation of moral and ethical aspects (Martini et al., 2021).

SSIs are the deliberate use of science-related topics, which are controversial, dilemmatic and unstructured, so that students can engage in dialog, discussion and debate. These topics have additional elements that require moral or ethical reasoning (Astarina et al., 2019).

The SSIs approach is a learning approach that examines facts, phenomena or events based on social issues related to science that exist in society. These issues are controversial because they are viewed from various perspectives such as cultural, social, political, moral and ethical. This approach aims to stimulate intellectual, moral, ethical development and awareness of the intersection of science and social life (Çalık and Wiyarsi, 2021).

Thus, SSIs are defined as a learning approach that includes controversial social issues and relates to science conceptually, procedurally and technologically. The involvement of social aspects in socio-scientific issues can provide opportunities for conflict between scientific reasoning and social perspectives which in learning can provide the capacity for students to develop moral reasoning and critical thinking skills to solve problems related to existing issues. In addressing a problem, learning about SSIs always involves knowledge and skills.

2.3 Stages of SSIs

Electronic modules using the SSIs approach are electronic learning modules that integrate disciplines related to intellectual, moral, ethical and awareness of the relationship between science and social life. Contextual learning with SSIs can improve students' creative thinking. The development of SSIs based module teaching materials is expected to help students understand the chemistry studied contextually and be able to influence students in making decisions on social problems that occur in the surrounding environment (Sofiana and Wibowo, 2019).

According to (Sismawarni et al., 2020) SSIs learning is learning that produces human resources who can apply their knowledge to solve social and economic problems in the surrounding environment. This learning also examines facts, phenomena, or events based on social issues related to science that exist in society. Socioscientific issues are open-ended so that students think at a higher level to solve various problems that exist in everyday life.

The following table shows the stages of SSIs based learning according to (Sadler, 2011):

Table 1. Stages of SSIs approach

Stages	Description
Problem Approach and Analysis	This stage raises issues or problems that exist in the community or explores events that occur around students. The source can be obtained from articles, news or own experience. The topic is then associated with the material to be learned so that students are expected to realize the importance of understanding the material.
Problem Classification	This stage motivates students to make direct observations.
Continuing Social Problem Issues	At this stage other social issues are given that are still related to the material. Then after the issue is displayed, students are given questions that can stimulate students to dare to express any existing problems.
Discussion and Evaluation	This stage presented a question aimed at increasing students' courage to make decisions regarding alternative solutions carried out to overcome problems from previous related social issues.
Metareflection	At this stage, a self-reflection column is presented which aims to ask learners to think back (reflect) and summarize the entire learning process that has been carried out.

3. METHODS

The research method used in this study is a research and development (R&D), 4D model from Thiagarajan with steps (Define, Design, Develop and Disseminate). The defining stage is carried out to examine the problems that occur in classroom learning. From the study of these problems, student learning needs can then be formulated to support the learning process (Thiagarajan, S. et, al. 1974). The initial analysis was carried out by interviewing chemistry teachers and students of class XII IPA 1 to find out the basic problems and conclude learning needs. The design stage is carried out by compiling electronic modules

including media selection and format selection using Flip PDF Professional to produce an initial product design.

The "develop" stage is carried out product trials to determine the feasibility of the designed electronic module products. Product validation involved 3 material experts, namely 3 UNIMED chemistry education lecturers, and 3 media experts each chemistry lecturer, physics education lecturer and science education lecturer FMIPA UNIMED. After the validation process by experts, the product was tested for practicality by the chemistry teacher of SMA Negeri 1 Rantau. After the product is revised, the next stage is the disseminate stage. This stage was carried out by disseminating the electronic module to students of class XI IPA 1 SMA Negeri 1 Rantau, totaling 22 students. Student response questionnaires were distributed to measure the impact of using electronic modules in the classroom. The instruments used are the validity questionnaire, practicality questionnaire and student response questionnaire. The data were obtained from the questionnaire in the form of answer choices in the form of a 5 Likert scale. Then analyzed using Cohen's kappa formula below.

$$Kappa\ moment\ (k) = \frac{\rho_o - \rho_e}{1 - \rho_e}$$

Description:
K = kappa moment indicating product validity
ρ_o = realized property
ρ_e = unrealized proportion
Assessments that have been analyzed using Cohen's kappa moment can be decided based on the kappa moment as in Table 2.

Table 2. Decision Categories based on Kappa Moments (k)

Interval	Category
0.81 – 1.00	Very high
0.61 – 0.80	High
0.41 – 0.60	Medium
0.21 – 0.40	Low
0.01 – 0.20	Very low
<0.00	invalid

(Bouslogh & Watters, 2008)

4. RESULTS & DISCUSSION

The define stage aims to find out what are the problems in teaching and learning activities by conducting interviews with chemistry teachers, student analysis, task analysis, concept analysis and goal analysis (Amdayani et al. 2022). The results of interviews with teachers stated that students in the teaching and learning process used many learning methods such as question and answer, demonstration, discovery learning, and simple practicum. In addition to various learning methods, the learning resources used are textbooks and student worksheets. However, the learning resources used have not integrated SSIs.

Furthermore, student analysis was conducted. Based on the results of the interview, it can be concluded that students' ability to accept and respond to learning materials is different, so students' interests and enthusiasm are lacking. Next, conduct task analysis, concept analysis and goal analysis. In this case the learning material is colloids with four sub topics consisting of: (1) types of colloids, (2) properties of colloids, (3) making colloids and (4) the role of colloids in everyday life. In analyzing learning objectives, core competencies and basic competencies were analyzed.

The design stage consists of media selection, format selection and initial design. The media used in the making is Flip PDF Professional which is interactive and easy to add types of animation to the flipbook. Just by dragging, dropping or clicking, we can insert YouTube videos, hyperlinks, animated text, images, and audio and flash them into the flipbook. The format of the electronic module developed is adjusted to the criteria of being interesting to read, namely the selection of fonts, colors and features in processing words in the form of Microsoft Office Word. The researcher's initial design began by designing the module systematically from the beginning of learning using the SSIs stage into the topic of colloids.

In the opening or cover section, researchers developed a cover design using the Canva application and PNG form. The cover design of the electronic module can be seen in Figures 1 and 2 cover, introduction, and table of contents.

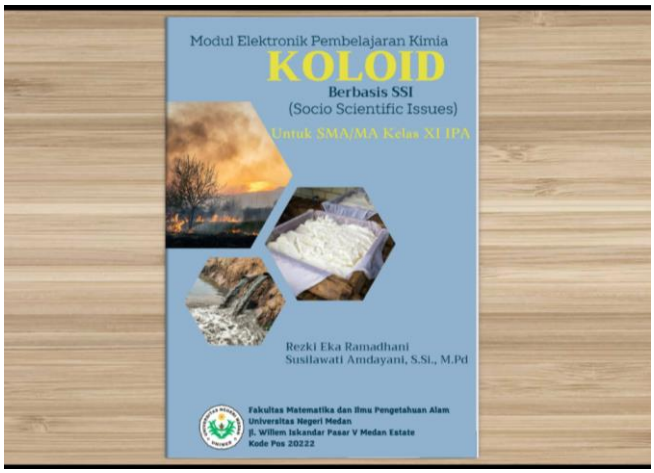

Figure 1. Electronic module cover design

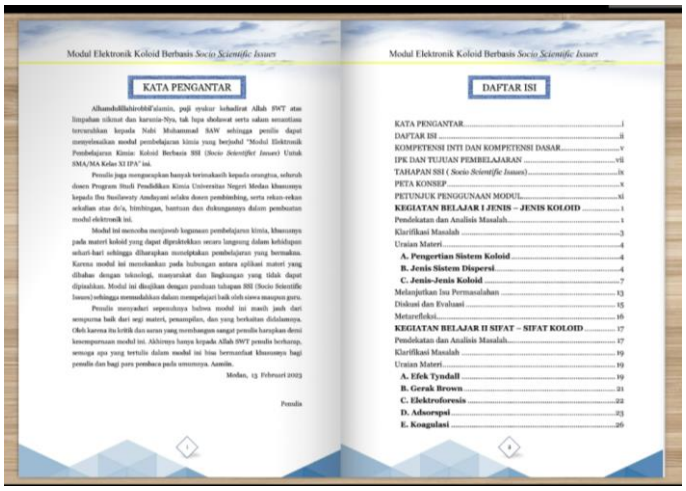

Figure 2. Design of introduction and table of contents

Based on figure 1 and figure 2 covers and pages in the making of the module blue and yellow colors are chosen to build and strengthen the writing so that it is easily accepted. the choice of blue will give a confident impression or a pleasant color and yellow

accents will give a cheerful and fast impression that can increase student interest in learning.

The content part of this electronic module consists of the material description, SSIs' stages consisting of problem approach and analysis, problem clarification, continuing problem issues, discussion and evaluation, and reflection.

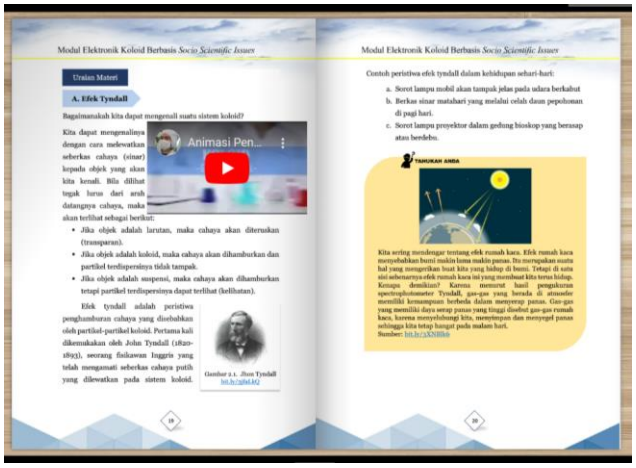

Figure 3. Material description

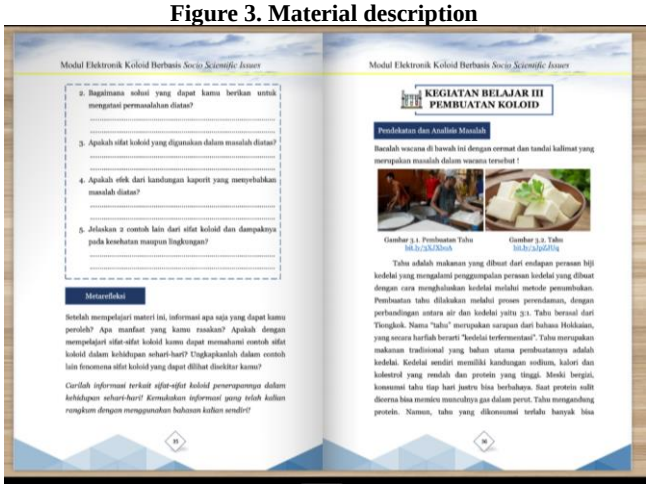

Figure 4. Stage of SSIs

In Figure 3, it explains the nature of colloidal properties starting from understanding and examples in everyday life. It also explains the problems caused by the greenhouse effect and its impact in life which is an example of the Tyndall effect. Furthermore, in Figure 4, the approach and analysis of the problem of making tofu with formalin is given. colloidal properties of coagulation are utilized in the manufacture of tofu.

The final part of this electronic module contains the periodic table of elements, a bibliography, and an author biography.

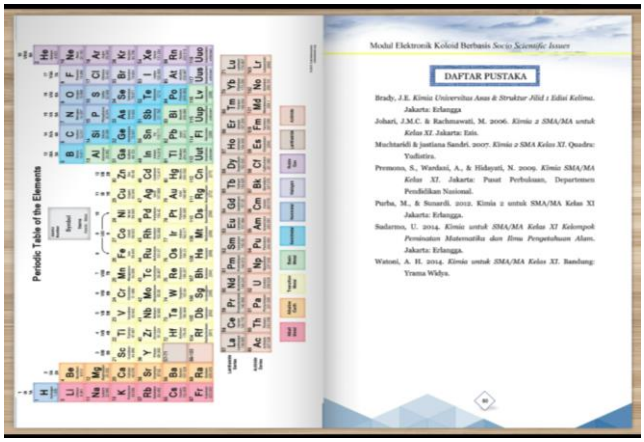

Figure 5. Periodic table of elements and bibliography

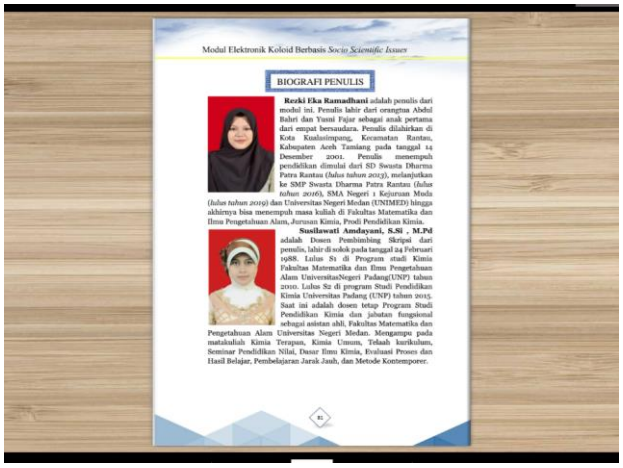

Figure 6. Biography

In figure 5 and figure 6 there are chemical elements that can be general information in learning chemistry. the bibliography is included so that it is not only made based on the original thoughts of an author but references from various thoughts and biographies of the author so that you can get to know the author through his life history.

The "develop" stage consists of material experts, media experts, practicality by teachers and student responses to electronic modules as follows:

4.1 Validation of Material Experts

Material expert instrument validation is carried out to obtain instruments that are valid and feasible to use in assessing electronic module products. The results obtained from the assessment of material experts on aspects of curriculum suitability, material accuracy, clarity of evaluation, presentation of material and language rules are 0.87 with a very high category. From all aspects assessed by the validator, this research instrument is said to be feasible to use with revision with the assessment can be seen in in Table 3.

Table 3. Material expert validator analysis results

No.	Aspect	Mean score (*k*)

		Interval	Category
1.	Curriculum suitability	0.92	Very high
2.	Topic accuracy	0.84	Very high
3.	Clarity of evaluation in electronic modules	0.84	Very high
4.	Appropriateness of topic presentation	0.88	Very high
5.	Conformity with language rules	0.88	Very high
Mean: 0.87			

4.2 Validation of Media Experts

Media validation was conducted to measure the feasibility of electronic modules from the media aspect. The three media experts filled out the instrument sheet to assess the overall quality of the media. Media validation consists of four aspects, namely the cover, writing, images and illustrations and colors presented in Table 4 below:

Table 4. Media expert validator analysis results

No.	Aspect	Mean score (*k*)	
		Interval	Category
1.	Cover	0.79	High
2.	Writing	0.82	Very High
3.	Pictures and illustrations	0.85	Very High
4.	Colors	0.92	Very High
Mean: 0.85			

The results of media validation with an average of 0.85 with a very high category indicate that the electronic module media based on SSIs on colloidal material is said to be "Worthy". However, there are corrections to the presentation of electronic modules in terms of color selection to be considered again.

4.3 Practicality by Teacher

On the practicality instrument by the teacher, there are aspects of design and content, benefits, and time efficiency. The average obtained is 0.78 with a high category and is said to be "Practical" to be used as a chemistry learning resource for teaching and learning activities in the classroom. The electronic module can be used without revision, the assessment of the validator can be seen in Table 5.

Table 5. Results of practicality analysis by teacher

No.	Aspect	Mean Score (*k*)	
		Interval	Category
1.	Design and content	0.78	High
2.	Benefits	0.80	High
3.	Efficiency of time	0.75	High
Mean: 0.78			

4.4 Student Responses to the Electronic Module

After being validated by material expert validators and media experts as well as practicality by teachers on electronic modules-based SSIs on the topic of colloids. Then it was declared feasible to use, then the next non-test instrument was distributed to 22 students of class XI MIA 1 SMAN 1 Negeri Rantau by knowing the students' response to the electronic module product developed with the SSIs approach on colloidal material. Given 6 aspects in the questionnaire consisting of electronic modules, clarity of writing, clarity of images, covers, color composition, and benefits as in following Table 6.

Table 6. Results of student response analysis to the electronic module

No.	Aspect	Mean score (*k*)	
		Interval	Category
1	Electronic module	0.81	Very high
2	Clarity of writing on electronic modules	0.83	Very high
3	Clarity of images on electronic modules	0.85	Very high
4	*Cover*	0.81	Very high
5	Color composition	0.81	Very high
6	Benefits	0.85	Very high
Mean 0.83			

With a good student response with an average assessment of 0.83 with a very high category, it shows that electronic modules can be a good and interesting learning resource for students and teaching and learning activities in the classroom.

5. CONCLUSION

This research produces products in the form of electronic modules using the SSIs approach to colloid material for class XI IPA which has been produced has a feasible, practical category and received positive responses from students with a very high category. Material experts assessed the feasibility of electronic modules at 0.87 with a very high category. Media experts assessed the electronic module with a feasibility of 0.85 with a very high category. Then the practicality by the teacher assessed 0.78 with a high category and the response of students assessed 0.83 with a very high category. The 4D research and development (R&D) model produced a product in the form of an electronic module using the SSIs approach on colloid material for class XI IPA which was developed and feasible to use. Then the practicality by the teacher assessed 0.78 with a high category and the response of students assessed 0.83 with a very high category. The 4D research and development (R&D) model produced a product in the form of an

electronic module using the SSIs approach on colloid material for class XI IPA which was developed and feasible to use.

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