The Validity of Colloid e-Module Based STEAM Integrated with Socio-scientific Issues

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Abstract: The Validity of Colloid e-Module Based STEAM Integrated with Socio-scientific Issues. The need for chemistry teaching materials with technological nuances has become a priority learning resource in the current "freedom of learning" era. This study aimed to produce validity of colloid e-module based STEAM integrated with socio-scientific issues. The method used was research and development (R&D) with the ADDIE model (Analysis, Design, Development, Implementation, Evaluations). In this study, the ADDIE stage was only limited to the development stage, namely validity. The validity test was carried out by four raters consisting of two chemistry lecturers and two chemistry teachers. The data obtained were processed using Aiken's V formula. The results of this research are showed that: (1) The validity of colloid e-module in the media aspect obtained the average value of the Aiken' V index is 0.88 with a high category (2) The validity of colloid e-module in the aspect of content obtained the average value of the Aiken 'V index of 0.90 in the high category. It can be concluded that the colloid e-module based on STEAM integrated socio-scientific issue developed is valid. The next stage will be able to be implemented to find out the effectiveness of e-modules and the response of students during chemical learning.

Keywords: Validity, Colloid E-Module, STEAM, Socio-scientific Issues

Abstrak: Validitas e-Modul Koloid Berbasis STEAM Terintegrasi Socio-scientific Issues. *Kebutuhan bahan ajar kimia yang bernuansa teknologi menjadi sumber belajar yang diprioritaskan di era "merdeka belaja "sekarang ini. Penelitian ini bertujuan untuk menghasilkan validitas e-modul koloid berbasis STEAM (Science, Technology, Engineering, Art, and Mathematics) terintegrasi socio-scientific issues yang valid. Metode yang digunakan adalah penelitian dan pengembangan (Research and Development/R&D) dengan model ADDIE (Analysis, Design, Development, Implementation, Evaluations). Adapun dalam penelitian ini tahapan ADDIE hanya dibatasi sampai tahap development yaitu validasi. Uji validasi dilakukan oleh empat orang rater yang terdiri dari dua orang dosen kimia dan dua orang guru kimia. Data yang diperoleh diolah dengan menggunakan formula rumus Aiken's V. Hasil penelitian menunjukkan bahwa: adalah sebagai berikut: (1) Validitas e-modul pada aspek media diperoleh nilai rata-rata indek Aiken' V 0,88 dengan kategori tinggi (2) Validitas e-modul koloid pada aspek konten diperoleh nilai rata-rata indek Aiken'V 0,90 dengan kategori tinggi. Hal ini dapat disimpulkan bahwa e-modul koloid berbasis STEAM terintegrasi socio-scientific issues yang dikembangkan valid. Tahap selanjutnya akan dapat dilakukan implementasi untuk mengetahui keefektifan e-modul dan respon peserta didik selama pembelajaran kimia.*

Kata kunci: *Validitas, E-Modul Koloid, STEAM, Socio-scientific Issues*

▪ **INTRODUCTION**

Technological advances have played an important role in influencing academics in every field. (Baber, 2021). The use of technology indirectly helps education practitioners in facilitating the learning process, thus creating effective and efficient education (Widiyono & Millati, 2021). The existence of technology as a learning facility can also be said as a form of learning independence momentum, where it can reform conventional education that looks rigid (Yamin & Syahrir, 2020).

The concept of freedom of learning is an idea that provides freedom for education practitioners such as teachers and learners in determining the existing teaching and learning system (Abidah et al., 2020). On the other hand, the concept of learning independence is a policy program issued by the Ministry of Education and Culture to provide freedom of thought for institutions, teachers, and learners in being creative and innovative (Widiyono & Millati, 2021). Therefore, teachers expect to be able to adapt and improve their competence in various areas of technology in planning learning that is interesting fun, and meaningful for students.

In line with the concept of free learning, the condition of the Covid 19 pandemic also has required teachers and learners to maximize technology as an online learning medium (Muflih et al., 2019). According to Samir Abou El-Seoud et al., (2014) online learning (e-learning) had significantly evolved over the years as a form of educational technology. Online learning is a teaching and learning process that utilizes advanced digital media based on information &communication technology (Agarwal & Pandey, 2013).

Based on the results of observations and interviews that had conducted at SMA 1 Negeri Kendal against chemistry teachers during online learning (Distance) it is known that the condition of students' learning resources is quite concerning. It is seen where during online learning students do not have a chemistry handbook while learning resources are only obtained from the internet, PPT (PowerPoint Presentation) slides provided by teachers, and videos from youtube. The same thing was also experienced by SMA Mataram Semarang students where the learning resources used only depend on reference sources from the internet and links provided by teachers so that learners do not have a special guidebook structured with learning objectives. Related to that the use of learning resources should need to be considered to manage critical thinking activities and student character and facilitate students during the teaching and learning process.

E-module is part of the product of technological development oriented to teaching materials that can be used as a support in the learning process (Hamid et al., 2017) The use of e-module in chemistry learning can make it easier for students to understand the level of chemical representation, namely microscopic, submicroscopic, and macroscopic. According to Mamun et al., (2020) understanding of chemical representations can be learned through photo forms, static graph diagrams, dynamic simulation animations and videos, and textual forms, such as instructions, instructions, question information, words, and others. Related to that e-module can display a number of these forms in a topic.

The existence of the E-module can certainly be a new step in transforming conventional teaching material into digital. On the other hand, this step certainly cannot be separated from the competence of teachers towards the use of strategies, models, methods, or approaches during the learning process. Therefore, to offset the utilization of these technologies, there need to be efforts that teachers can make in supporting the

learning process, namely by applying stem (Science, Technology, Engineering, and Mathematics) approaches. (Akaygun & Aslan-Tutak, 2016)

The STEM approach has evolved into STEAM, where not only aspects of science, technology, engineering, and mathematics are emphasized, but also elements of Art that assist aspects of art in interdisciplinary learning into critical areas of mathematics, science, and art together through technological design thinking with investigative processes (Stroud & Baines, 2019; Belbase et al., 2021). In addition, aspects of art provided a frame of reference for students in understanding how and why they enjoy learning so that it can affect students' were interested during learning (Hunter-Doniger, 2019). According to Quigley et al., (2019) aspects of art also had fenced important characteristics of the overall discipline of STEAM to mimic real-world issues and problems. This is supported by Haesen (2019) who stated that STEAM had presented to learners in the form of exclusive problems. It can be concluded that the multidisciplinary science contained in STEAM has the potential for students to improve their competence in solving problems in the real world.

Learning strategies in the context of social life need to be applied to students, thus triggering students in real-world problem-solving. Socio-scientific issues present as learning strategies that can provide opportunities for individuals or groups of students to deal with conflict conditions related to science and social life (Dawson & Venvile, 2010) In addition, SSI-based learning presents social issues that describe the context, conceptual, procedural, or technological science as a form of moral reasoning in decision making (Shinta et al., 2020). Given the above, socio-scientific issues can support the STEAM approach by providing students with real-world case studies where students invite students to engage in controversial topics facing the surrounding community (Johnson et al., 2020; Won et al., 2021).

Colloid topic in chemical learning is closely related to social life where the problems of social life can be found in various fields (such as agriculture, industry, water, and health). Therefore, researchers developed teaching materials related to colloid e-module based STEAM integrated with socio-scientific issues that can be used as a supporting medium during chemical learning.

▪ **METHOD**

This research made Research and Development a research method. This research method was used to develop e-module based STEAM integrated with socio-scientific issues. The development of this colloid e-module referred to the ADDIE model developed by Dick and Carry. This model consisted of five stages of development, namely analyze, design, development, implementation, and evaluation. This research is limited to the development stage. The development stage is carried out after several previous stages are fulfilled, namely the analyzing and design stages.

This research procedure completed several actions that are passed, namely, the analysis of needs (Analys); design, preparation &creation of e-module (Design) as well as validation and revision of e-module (Development). Need analysis is carried out through observation and interviews from several teachers and students related to the need for an e-module. After that, the design of the preparation, and the creation of an e-module based on the results of observation and interview related to the needs of an e-module. After the e-module is arranged, validation and revision are carried out through the validator to obtain a valid e-module. Validators in this study consisted of two lecturers and two chemistry teachers who are experts in their fields. Validators perform validity

tests of e-modules on media and content aspects. Suggestions and criticisms given by validators will be used as improvement material in perfecting the e-module so that it is ready for use for the next stage (implementation).

The data collection techniques in this research used quantitative descriptive analysis techniques. The instrument used is a validation sheet to obtain data from the validator related to the e-module created. The validation sheet used a questionnaire with a rating scale of 5. Data obtained from validators is analyzed using Aiken's V formula. The use of this formula is based on the validator's assessment (n) rater of the related item to the extent to which the item represents the construct measured. Aiken's V formula is as follows.

$$V = \frac{\Sigma s}{[n(c-1)]} \qquad \text{(Retnawati, 2016)}$$

V : rater agreement index on item validity
s : r-lo
n : number of assessment panels
lo : lowest validity assessment number (1)
c : highest validates rating rate (5)
r : a number is given by a rater

The Aiken coefficient criterion"s V is known if the achievement rate of Aiken's V Index ≤ 0.4, then valid is categorized as a less; If $0.4 < V \le 0.8$, then valid is categorized as a medium; if $V > 0.8$, then valid is categorized as a high.

Tabel 1. Aiken's V Validity Coefficient Criteria

Interval	Valid Category
≤ 0,4	Less
$0,4 < V \le 0,8$	Medium
$0,8 < V$	High

Source: Retnawati, (2016)

▪ **RESULT AND DISCUSSION**

Development research certainly can not be separated from various stages that must be passed. This stage determines the quality of the product to be developed. This research used the ADDIE (Analysis, Design, Development, Implementation, &Evaluation) model as a stage in development research. However, this research is only done until the development stage. The purpose of the study was to produce a valid steam-based colloidal e-module.

Analysis

The analysis stage is carried out by researchers to gather information as the first step in product development. There are three analyses carried out in this research: needs analysis, student characteristic analysis, and material analysis. Based on the results of observations and interviews with students it had known that students do not have structured teaching materials during learning, thus students need a type of module teaching material (Needed analysis). In addition, students tend to like teaching materials that contain animations, images, audio, and videos with an attractive appearance. (Explored the characteristics of the students). The material analyst had done by reviewing

the facts, principles, and procedures of the colloid topic. The results of the analysis found that colloid topic in chemical learning was closely related to social life in areas such as agriculture, industry, water, and health. Thus it can be a medium for students in overcoming social issues.

Design

The design stage in this research is carried out to obtain a design that suits the needs of students in the analysis stage. At this stage, researchers designed a learning scenario that is by the STEAM-SSI approach. In addition, the learning device is based on the competence of colloidal material. The design of the e-module starts by involving software including Corel Draw, Microsoft Word 2010, and Flip PDF Professional. Microsoft Word 2016 application is used as early applications to structure systematic presentations in each activity, such as introduction/ opener, content, and cover. The Corel draw application is used to design a cover and create images/animations that support colloid-topic. The professional flip PDF application is used to present some of the images, animations, videos, audio, and links needed on the e-module (Nisa et al., 2020). In addition, flip pdf professional also provides several final formats that support online and offline use such as (.app), (.fbr), (.exe), and (.html) (Nurhidayati et al., 2018). The design of the cover of the product that has been developed can be seen in **Figure 1.**
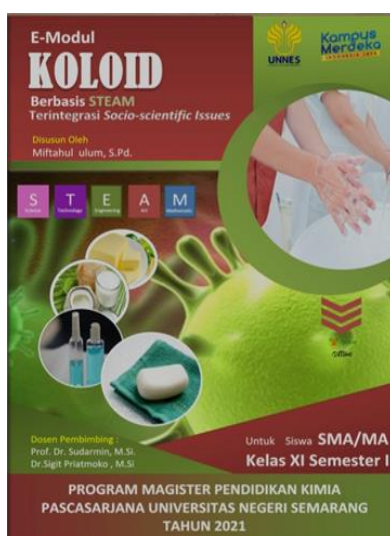

Figure 1 E-module cover design

Development

The development stage will review related validity tests conducted by validators. Validity testing is conducted to produce steam-based colloid e-module (Science, Technology Engineering, Art, and Mathematics) integrated socio-scientific issues with valid categories. If the validation process has not obtained a valid status, then validity will continue to be done until it obtains valid results.

Instrument data were obtained from the filling carried out by a validator consisting of two chemistry teachers and two chemistry lecturers on the validation of media aspect and content aspect. The data is then analyzed using Aiken's V formula to find out the validity of both aspects. Here is the data from the analysis using Aiken's V formula for aspects of media and content (material).

1. Media Validation Data Analysis

Media validation is done to measure the media of products made in terms of validity. Validation of this media was done by four validators who are experts in their fields. Three indicators must be assessed by the validator including, the presentation of the e-module, the feasibility of the graph, and the quality of the e-module display. The results of the assessment conducted by validators on the three indicators, then analyzed with the formula Aiken's V. The results of media validation analysis by validators can be known through **table 2**.

Table 2. Media Validation Analysis Results

No	Indicators assessed	V	Category
1	Presentation of e-Module	0.88	High
2	Feasibility of e-Module Graphing	0.89	High
3	e-Module Display Quality	0.88	High
Total		0.88	High

Information V= Index Aiken's V

Based on the results of media validation analysis obtained the average value of index coefficients from several indicators. The acquisition of Aiken's V index value on the presentation indicator is 0.88 with a high validity category. This indicates that the e-module meets the quality standards of the e-module presentation indicator. This research presented a colloid e-module in electronic form that can be accessed on a laptop and mobile phone (Look at **figure 2**.). E-module are presented online through links that students can access during learning activities. According to Shinta et al (2020), the use of online learning resources can increase students' effectiveness, interactivity, and active independence in learning. On the other hand, e-module was also present offline with the aim that students can access without the need for an internet network. Offline e-module presents in pdf format where it can also be accessed via laptops and mobile phones. But offline e-module cannot access features that require an internet network.

Figure 2. e-Module display in a mobile phone and laptop

The average Aiken's V index on the graphing indicator was obtained at 0.89 with a high validity category. This showed that the size, layout, typography, leather illustration, e-module design are clear and attractive thus helping to increase students' interest during learning. This was supported by the results of Aiken's V (V) index on the display quality indicator also showing high validity with a value of 0.88. This means that the appearance, design, layout, and illustrations on the e-module already show that interesting e-module is used in colloidal learning.

2. Content Validation Analysis

Validation of content is done by involving four raters or validators. The purpose of content validation is to measure the content of products created in terms of validity, the results of content validation analysis/content by validators can be known through **table 3**.

Tabel 3. Content Validation Analysis Results

No.	Indicators assessed	V	Category
1	Content Feasibility	0.92	High
2	Language	0.91	High
3	Presentation Technique	0.88	High
4	STEAM-*Socio-scientific Isuues*	0.88	High
	Total	0.90	High

The content feasibility indicator obtained an average Aiken'V value of 0.92 with a high valid category. This means that the feasibility of content related to colloidal material in the e-module has met the conformity with core competencies (KI) and basic competencies (KD). In addition, the evaluation issue presented has also met the conformity with critical thinking indicators. This means the accuracy and updating of linear e-modules with the needs of learners in facing problems in the context of social life (Socio-scientific issues).

The language indicator obtained an average Aiken's V (V) index of 0.91 with a high valid category. This indicates that the use of language in e-modules has met the rules of good and correct Indonesian. The rules of Indonesian in the writing of scientific works can not be separated from the use of standard language. The use of standard language that is communicative, clear, and simple can affect students' learning interests. According to Mukhlis et al., (2019), the standard language was a variety of languages that are widely applied by people in the world of education. This e-module has fulfilled the use of the term with rules Indonesian and/or technical terms that have been used in chemistry.

Presentation techniques in content validation earn an average Aiken's V index of 0.88 with a high valid category. This can be seen from the presentation that has been systematic from the opening to the closing. The existence of presentation techniques can help students in facilitating understanding as well as the concept of the colloid topic in the e-module during the learning process.

The STEAM-SSI indicator on the e-module obtained an Aiken's V average value of 0.88 with high validity. This means that the colloid e-module has met the concept of STEAM approach integrated socio-scientific issues (SSI). The STEAM approach is a form of approach in which elements of art are added to the STEM approach. Related to that this colloid e-module was developed using STEM-SSI stages adopted from Siribunnam et al., (2019). This stage consists of several stages including, identifying problems, (2) generating information from multiple perspectives (3) developing possible solutions (4) creating a model solutions/product (5) testing/evaluating the solutions/product (6) making an informed decision. The STEM-SSI stage indirectly invites students to think critically, creatively, and selectively in the manufacture of products as solutions in solving social problem issues. The stages in this e-module are equipped with displays involving several images, videos, and links related to colloidal material and social issues in real life.

The STEAM-SSI approach is applied in e-module to assist students in enhancing critical thinking skills in scientifically reviewing colloid topics. This is evident from the social issues presented in the e-module which triggers students to think critically scientifically. Related to that Won et al., (2021) and Choi et al., (2021) also apply the STEAM-SSI approach with research materials related to climate change. According to Won et al., (2021), the STEAM-SSI approach can assist students in improving competence and seeking resolutions related to climate change issues and their impact in a global context. In addition, the results of research conducted by Choi et al., (2021) student climate literacy in aspects of perception and action improved substantially after applying STEAM-SSI. Thus, it can be concluded that the STEAM-SSI approach applied in e-module can assist students in improving critical thinking skills illegally during learning.

Based on the total average value of Aiken's V on media validation and content validation with 0.90>0.8 and 0.88>0.8, respectively, it can be interpreted as a colloid e-module based STEAM integrated with socio-scientific issues on the aspect of media and valid content in high categories. Nevertheless, validated colloid e-module still required improvement or revision as per the validator advice, to produce a perfect e-module. Based on validator suggestions, the improvement of the e-module is summarized into several points, including 1) improving the appearance of video and image layout on e-module 2) improving video quality on e-modules, 3) adding social issues at the identified stage with relevant issues 4) Improving verbs on IPK (Achievement Competence Indicator) 5) Add reason-answers in every multiple choice of questions.

▪ **CONCLUSION**

Based on the results of research related to the validity test of e-modules developed against media aspect and content aspect obtained Aiken's V value with a high validity category. It can be concluded that the steam-based colloidal module integrated with socio-scientific issues is valid at the development stage as teaching material for chemical learning in the era of independent learning. The next stage will be implemented to test the effectiveness of e-module and student responses in chemistry learning.

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