JURNAL PENDIDIKAN KIMIA
ISSN: 2085-3653| e-ISSN: 2549-3116
Vol. 14 | No. 1 |28 - 38| April | 2022
https://doi.org/10.24114/jpkim.v14i1.32948

Development of e-module based on local wisdom to improve science literacy and reading literacy

Legian Setyorini*, Sri Haryani and Endang Susilaningsih

Chemistry Education Study Program, Postgraduate, Universitas Negeri Semarang, Semarang 50237, Indonesia
*Corresponding author: LS, legiansetyorini@students.unnes.ac.id

Received: 21 February 2022 **Revised:** 09 March 2022 **Accepted:** 05 April 2022

ARTICLE INFO

Keywords:
E-module
Local wisdom
Reading literacy
Spice drinks
Science literacy

ABSTRACT

This research is motivated by (1) the results of reading literacy and science literacy in PISA, which is still low, and (2) technology and cultural-based learning media have not been developed by private high school chemistry teachers in Semarang. This research aims to develop a feasible E-module based on the local wisdom of spice drinks that can improve reading literacy and learners' science literacy. This research is a research and development with a 3-D model, which includes defining, designing, and developing. This study collects data through observation, questionnaires, and testing. The research instruments used are material expert validation sheets, multimedia expert validation, observation sheets, and instruments about reasoned multiple choice. The study subject was eight students of XI MIPA Kebon Dalem high school. Expert validation results of the material showed 92.85% (very valid). The validation results of media experts showed 85.71% (valid). E-modules are declared effective because there is an increase in the completion of learners' learning outcomes after using E-modules. E-Module based on local wisdom of spice drinks can visualize the factors that affect the rate of reaction material. So, it can be concluded that E-modules based on local wisdom spice drinks developed are worth using to improve learners' reading and science literacy.

1. Introduction

Since 2000, the Programme for International Student Assessment (PISA) has been administered in OECD and non-OECD member nations, including Indonesia. Indonesia's goal in participating in PISA studies is to know the strengths and weaknesses of Indonesian learners in skills and knowledge in the fields of mathematics, science, and reading and to find out the achievements of Indonesian learners at the international level (Hawa & Putra, 2018). Although Indonesia has participated since the implementation of the first PISA, the results achieved by Indonesian learners are far from satisfactory (Sasongko et al. 2016).

The percentage of reading literacy results of Indonesian learners who were at level 1 with a score below 407.47 in PISA from 2009 to 2018 was 53.4% in PISA 2009; 55.2% in PISA 2012; 55.4% in PISA 2015; and 69.9% in PISA 2018. From 2009 to 2018, it shows that there was an increase in the

percentage of learners who were at level 1, which was 16.5%, meaning the reading literacy ability of Indonesian learners continued to decrease from 2009 to 2018 (OECD, 2019).

Indonesia's PISA score in science literacy from 2000 to 2018 ranked Indonesia as one of the countries with a low science literacy ranking (Narut & Supardi, 2019). In 2009, Indonesia was placed 60th out of 65 countries that participated. Indonesia fell to 64th place out of 65 participating countries in 2012. Indonesia moved up to 62nd place out of 70 participating countries in 2015 (Nofiana & Julianto, 2017). One of the causes contributing to Indonesian students' low scientific literacy compared to students in other nations is the gap between science concepts taught in school and real-life situations (Fibonacci et al. 2017). Therefore, various efforts to improve the mastery of science literacy are needed. The critical factors in improving science learning are teaching books (Maturradiyah & Rusilowati, 2015) and designing a learning program using local potentials in their respective regions (Sumarni et al. 2017).

Reading literacy is a language skill involving high-level thinking activities that require readers to be critical in understanding reading materials and associate reading content with life problems and observations of various phenomena (Izadi & Behtash, 2016). Science literacy is the ability to engage in issues related to science and with the idea of science as a reflective citizen (OECD, 2018). With literacy skills, learners become better prepared to face real-life problems and challenges in 21st-century learning (Hassanzadeh, 2019). Literacy skills are regarded as one of the basic foundational for lifelong learning (Wildová, 2015).

One of the goals of Curriculum 2013 is to develop a learning experience that provides a broad opportunity for learners to master the competencies necessary for life in the present and future. And still build their abilities as heirs to the nation's culture and people who care about the problems of today's society and government (Yunus & Alam, 2015). Through education, diverse cultural values and excellence from the past are introduced, examined, and developed into an individual's, society's, and nation's culture, depending on the era in which the learners live and develop (Silaban, 2017; Silaban, 2021). Culture, art, and local wisdom in the surrounding community can stimulate the curiosity and creativity of learners (Nurhayati et al. 2021).

The application of learning based on local wisdom can improve the ability of content, context, and science processes (Nofiana & Julianto, 2018; Sumarni, 2018). The study results prove that a science learning model based on local wisdom can increase student creativity and learning outcomes (Pamungkas et al. 2017). Linking local wisdom in science learning aims to get a real learning experience in daily life and instill a sense of love for the noble values of culture (Rahmatih et al. 2020). Thus, an educator must stimulate learners by using local culture and wisdom as a medium for learning and technology as an intermediary (Nurhayati et al. 2021).

Facing this era of automation and cyber technology combined, teachers must be adaptive and use technology to develop learning in schools. In 21st-century learning, the student must apply information, media, technology, learning skills, and innovation (Effendi & Wahidy, 2019; Pratiwi et al. 2019). Indonesian education must adjust to the needs and trends of the developing world community in preparing learners facing the 21st century by changing their curriculum, academic facilities, and learning content (Peña-Ayala, 2021). One of them is integrating technology in learning media that use android and allows unlimited learning by time and place with exciting applications, namely E-modules (Muzijah et al. 2020). Electronic modules, or e-modules, are virtual modules consisting of text, images, or both containing digital electronic material accompanied by simulations that can and are suitable for learning (Herawati & Muhtadi, 2018; Munthe et al. 2019; Lukman et al. 2022).

The local wisdom raised in this study is the culinary spice drink from several stalls on Menteri Supeno and Kalialang street. Making spice drinks, namely ginger spice and Wedang Uwuh, was a lot of applying the concepts of science literacy, especially in reaction rate material. The characteristics of the reaction rate material are abstract, so they require visualizations that can describe events in

real terms. To visualize the material factors that affect the rate of the reaction more clearly, it takes learning resources that are contextual to everyday life (Putri & Muhtadi, 2018).

Based on discussions with various private high school chemistry teachers in Semarang. It is known that there are currently no teachers who use E-modules based on local wisdom to improve reading literacy and science literacy. Research on the development of E-modules based on local wisdom needs to be done to provide an overview to teachers in learning based on local wisdom. So that the material, especially reaction rate material, becomes more contextual and can improve the reading and science literacy of learners.

Based on the background and problems above, this study aims to develop feasible e-modules based on local wisdom of spice drinks and visualize material factors that influence reaction rates and improve learners' reading and science literacy through culture. The benefits of research, namely the development of E-modules based on local wisdom spice drinks, are expected to be a source of reference and understanding for teachers in efforts to create technology-based learning media with local wisdom approaches and can be used as an alternative learning medium in improving reading literacy and science literacy in reaction rate materials.

2. Methods

The research was done at SMA Kebon Dalem Semarang class XI MIPA on rate reaction material for the 2021/2022 academic year. This research includes development research. Development research is how a new product is created, or an existing, accountable product is improved (Sukmadinata, 2011). This development research design uses modifications of Thiagarajan's 4D model, namely 3D, which includes defining (define), design (plan), and development (develop) (Khaldun et al. 2019).

The development of E-modules based on the local wisdom of Spice drinks began with the reconstruction stage of science. The steps in the reconstruction of indigenous knowledge into scientific science are as follows: (1) Discussions and interviews about tools, materials, and manufacturing processes; (2) Direct observation during the process of making ginger spices and wedang uwuh; (3) Study literature (books or research journals) related to spice drinks; and (4) Reconstructing indigenous knowledge to scientific knowledge.

The data was collected by observation, testing, and response questionnaires. Interviews with Semarang private high school chemistry teachers were used as the observation approach. A brief description of the technical analysis of data used in this study is as follows.

2.1. Validity of E-modules

Validation of this E-module is based on aspects of assessment such as the validity of materials and media. This e-module is validated by media and material validators. The results of each validator are then averaged (Table 1).

Table 1. Validity Level (Putra et al. 2017)

Percentage (%)	Category
90 - 100	Very Valid
75 - 89	Valid
65 - 74	Enough
55 - 64	Invalid
0 - 54	Very invalid

2.2. Effectiveness of E-modules

The effectiveness of E-modules is known from the learning outcomes of learners described based on pretest and posttest. The test was given by posing ten reasoned multiple-choice questions to learners in learning tests and problem instruments. In each question, students had to choose the multiple-choice and why they chose that answer. Students write the reason in the space given. The full score is given for the right answer and reason. Student grades are obtained by calculating all scores (Table 2).

Table 2. Possible student answers

Student answers	Student reason	Max score
right	right	10
right	false	5
false	right	5
false	false	0

Table 3. Content Validity Level

Score	Category
29 –35	Very Valid
22 – 28	Valid
15 – 21	Enough
7 –20	Invalid

To validate the contents of the ten reasoned multiple-choice questions taken through expert judgment using FGD techniques involving practitioners in the field, namely two chemistry teachers. For FGD purposes, arranged validation sheet about the quality of the instruments reviewed from the material aspect, construction, and language. The validation sheet also consists of a column about the things criticized and the input given from those criticized. Table 3 can be used to see the validity of the E-modules' content.

3. Results and Discussion

The research procedure is carried out through three major stages: the defining, designing, and development stages.

3.1. Define Stage

The aim of the defining stage is to define and establish terms and conditions in the development of E-modules. Activities in this stage include initial analysis through interview questionnaires. From the initial analysis results, some chemistry teachers in private schools in Semarang have not yet developed E-modules based on local wisdom to improve reading literacy and science literacy.

3.2. Design Stage

After getting problems from the definition stage, the design stage is carried out. This stage aims to create an initial design of e-modules based on local wisdom that will be developed based on the results of the defining stage. The steps taken in this stage begin with reconstructing the indigenous knowledge. Reconstruction begins with interviews and direct observations conducted in three locations, namely: (1) Wedang Rempah Mbah Din on Kampung Tematik Jawi, Kelurahan Kalialang, Kecamatan Gunungpati, Semarang; (2) Wedang Rempah Mbah Jo at Jl. Menteri Supeno I/2 Semarang No.1, Mugassari, Kecamatan Semarang Selatan; and (3) Wedang Rempah Mbah Warno at Jl. Menteri Supeno I Mugassari, Kecamatan Semarang Selatan.

After further reconstruction, the analysis of the chemistry syllabus of the 2013 curriculum was carried out. At the syllabus analysis stage, the decline of the Competency Achievement Indicator (IPK) of Basic Competence (KD), the preparation of the problem based on the grid of questions that have been designed. Next, compiles an E-module based on local wisdom.

3.3. Development Stage

This stage of development aims to produce e-modules that have been revised based on validation and inputted by validators. Steps in the development stage are as follows:

3.3.1. Expert Validation

This expert validation validates the content of chemicals and media on the E-module before the posttest. Two material experts and two media experts validated E-modules to determine whether the E-module developed is worth using. Validation aims to determine the correctness and feasibility of the E-module. The making of product improvements will use inputs and suggestions from the validator. Based on the validation results from experts, the material obtained a score of 92.86% (Figure 1), which included the very valid category. From the media, experts got a score of 85.71% (Figure 2) which belongs to the valid category.

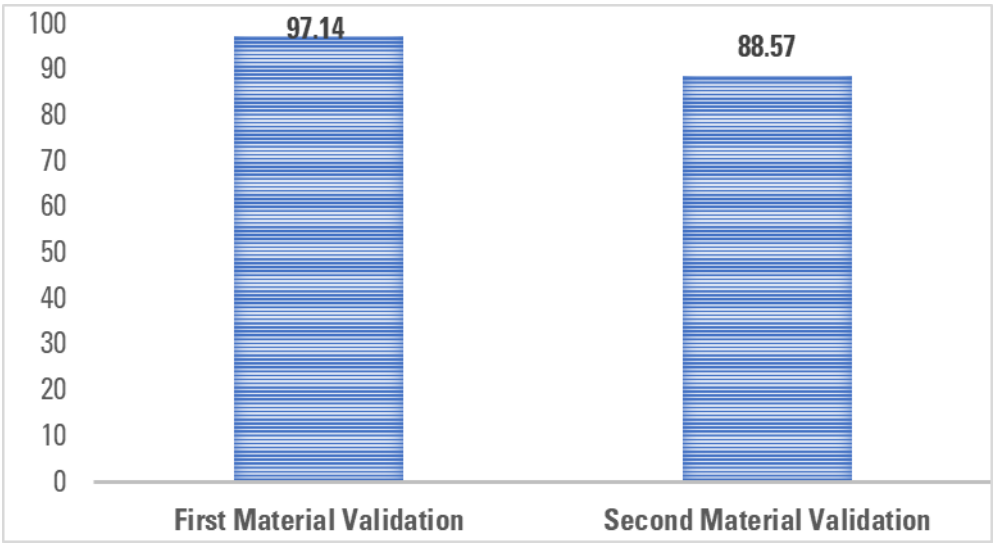

Figure 1. Material Expert Results

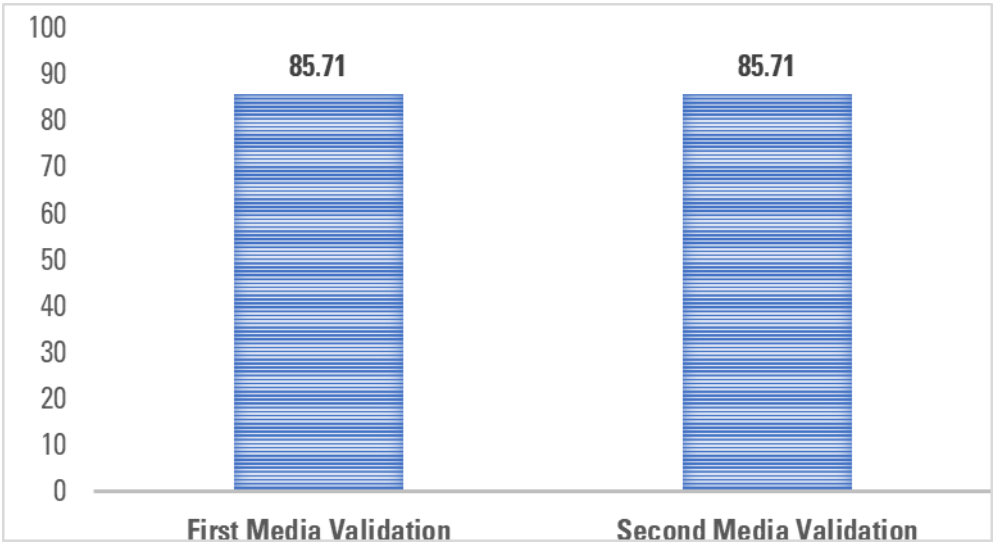

Figure 2. Media Expert Results

3.3.2. Product Revision

This stage involves making final adjustments to the E-modules developed to create the final product. The design of the E-module based on the local wisdom of Spice drinks design before and after revision is in Figure 3-5. The improvements made were improvements in the cover to make it more attractive and improvements in questions to make them easier to understand.

a b

Figure 3. The E-module's Cover Before Revision (a); After Revision (b).

a b

Figure 4. Question number 1 and 2 Before Revision (a); After Revision (b).

The E-module based on the local wisdom of Spice drinks could visualize the factors that affect the reaction rate. In making the ginger drink, first, we must be pounding the ingredients. Cinnamon bark used is in small size, not large sheets of bark. This collision and small size are done so that the surface area is larger and faster extraction occurs (Figure 6).

In making spice drinks, we must add hot water and boil the Caesalpinia sappan. Rising temperature in a chemical reaction can increase the kinetic energy, so the substances react faster

(Figure 7-8). The old leaves were used to make spice drinks, such as salam leaves, pandan leaves, and mint leaves. Old leaves contain a greater concentration of essential oils, so the number of particles is getting more and more, which causes the faster the reaction (Figure 9).

a b

Figure 5. Question Number 3 to 5 Before Revision (a); After Revision (b).

Figure 6. The Surface Area Factor

Figure 7. The Temperature Factor

Figure 8. The Temperature Factor

Figure 9. The Concentration Factor

3.3.3. Pretest and Posttest

After the draft E-module is revised, a trial is conducted to find out the application's result and the effectiveness of the product. The effectiveness has got from the student improvement learning outcomes through the pretest and posttest scores. Based on the results of content validation from experts, the first teacher scored 28, which belongs to a valid category. The second teacher gave 27, which belongs to a valid category.

The pretest was given before using the developed E-module, and the posttest was given after using the E-module. The students did a pretest first to see their initial abilities, then continued with the rate of reaction material learning activities using the revised E-module based on local wisdom. The lesson consisted of one face-to-face meeting and one online meeting. After the second meeting, the students did the posttest. One student or 13% of learners completed with a result ≥ 67 from the pretest results obtained. The results of the posttest got 88% of learners who obtained above the minimum completion. The completeness of students learning outcomes is shown in Figure 10. This research used a total sampling technique therefore all students were used as samples.

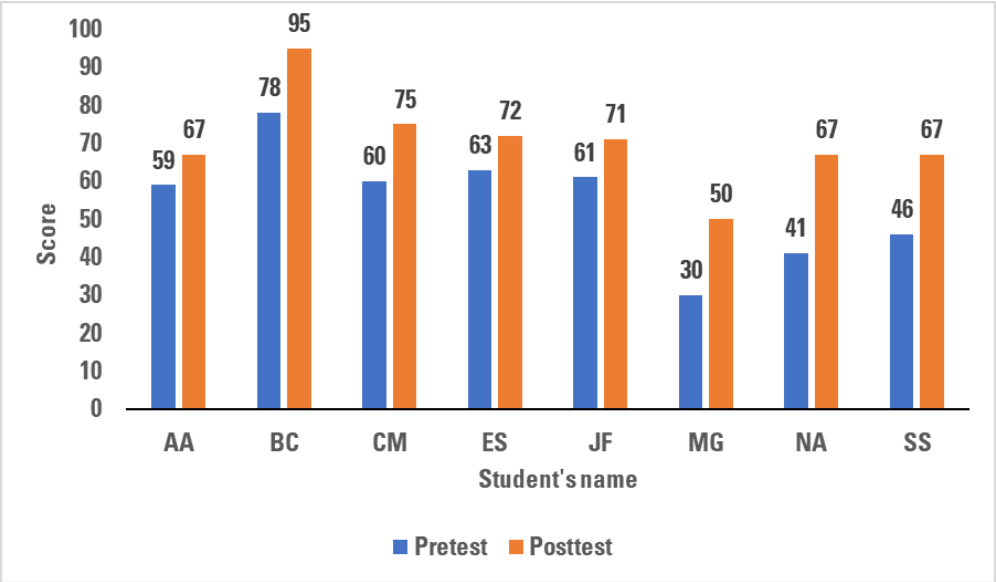

Figure 10. Students' Learning Outcomes

According to Figure 10, while some learners receive grades below the minimum required for completion, the posttest result for all learners has increased compared to the pretest result. The minimum score is 67. The data for assessing learning outcomes came from the pretest and posttest findings, which were then analyzed using paired t-test statistics. A normality test was performed before the t-paired data test as a precondition for the paired t-test.

Table 4. Normality Test Results

		Kolmogorov-Sminov[a]			Shapiro-Wilk		
	Class	Statistic	df	Sig.	Statistic	df	Sig.
Score	Pretest	.237	8	.200	.952	8	.734
	Posttest	.264	8	.106	.882	8	.196

The significant value from the normality test result is 0.734 for the pretest and 0.196 for the posttest. It is shown in Table 4. The normality tests showed that the data were normally distributed, with the significant value of each data being more than 0.05. It shows that the data obtained can be used in a paired t-test. The Results of the t-paired test are shown in Table 5.

Table 5. Results of the t-Paired Test

Paired Differences									
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig.(2-tailed)
Pair 1	Pretest-posttest	-15.750	6.453	2.282	-21.145	-10.355	-6.903	7	.000

A significant difference between the pretest and posttest is shown by a signification (2-tailed) value of 0.000 < 0.05. It demonstrates that e-modules based on local wisdom have a significant impact on improving students' reading literacy and science literacy.

4. Conclusion

E-modules based on the local wisdom of Spice drinks developed is feasible and worth using to improve learners' reading and science literacy. It can be seen with increasing learning outcomes after using E-modules based on the local wisdom of Spice drinks. Based on the reconstruction of science results, the Spice drink E-module can visualize factors that affect the reaction rate and can be an alternative learning medium in helping teachers and learners utilize technology to learn and instill a love for local culture.

Acknowledgment

The researchers like to express gratitude to all participants, particularly students from class XI MIPA SMA Kebon Dalem Semarang, for their contributions and participation in this study.

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