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Development of Electronic Magazine Teaching Materials for Key Determination and Cladograms in Ethnobotany and Phytochemical Studies

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A B S T R A C T

Background: The use of teaching materials in learning can improve learning results. It requires exciting teaching materials whose material is by the essential competencies to be achieved. One of the teaching materials that can be used is an electronic magazine. This study aimed to determine the validity, practicality, and potential effects of the use of teaching materials on study results. In the critical material of determination and cladogram. **Methods:** Development research was carried out using the 4D model, with the research subjects of class X students at SMAN 2 Palembang. **Result:** (1) the validity was 100% from material experts, 89% from linguists, 75% from media experts; (2) practically is known that the NRS is 91% of students and 98% of biology teachers; (3) the N-gain test obtained a score of 0,64 with the medium potential category to improve learning outcomes in the realm of knowledge, while for the skills of students, they were able to make and present cladogram. **Conclusion:** Teaching materials in electronic magazines are declared valid, practical, and have sufficient potential to improve study results.

Pengembangan Bahan Ajar Majalah Elektronik untuk Penentuan Kunci dan Kladogram dalam Studi Etnobotani dan Fitokimia

Kata kunci:
Etnobotani;
Kladogram;
Kunci determinasi;
Majalah Elektronik;

A B S T R A K

Background: Penggunaan bahan ajar dalam pembelajaran dapat meningkatkan hasil belajar. Bahan ajar yang digunakan harus menarik dan memiliki materi yang sesuai dengan kompetensi dasar yang hendak dicapai. Salah satu bahan ajar yang dapat digunakan adalah majalah elektronik. Tujuan penelitian untuk mengetahui kevalidan, kepraktisan, dan efek potensial bahan ajar terhadap hasil belajar pada ranah pengetahuan dan ketetampilan. **Metode**: penelitian pengembangan dilakukan menggunakan model 4D, dengan subjek penelitian, yakni peserta didik kelas X di SMAN 2 Palembang. **Hasil:** (1) kevalidan bahan ajar mendapat skor 100% dari ahli mater, 89% dari ahli bahasa, dan 75% dari ahli media; (2) kepraktisan bahan ajar memperoleh nilai respon 91% dari peserta didik dan 98% dari guru biologi; (3) uji N-*gain* didapatkan skor 0,64 dengan kategori berpotensi sedang untuk meningkatkan hasil belajar pada ranah pengetahuan, sedangkan untuk keterampilan peserta didik mampu membuat dan menyajikan kladogram. **Kesimpulan:** bahan ajar berbentuk majalah elektronik dinyatakan valid, praktis, dan cukup berpotensi dalam meningkatkan hasil belajar.

Introduction

Industrial revolution 4.0 is familiar to our ears, where there is a development in digital systems, artificial and virtual intelligence in this era. This development is influential in almost all fields, including the field of education. Education itself is a means to produce quality human resources. Therefore, the government is currently working to overhaul the curriculum by emphasizing Science and Technology as we know that the application of technology to the learning process has only been made about one year ago due to the pandemic situation that the government was forced to change the learning pattern that was initially implemented face-to-face to online. This means that inevitably, technology must be integrated into the learning process, including influential components in it. One component that can affect the quality of learning and its use can improve learning outcomes is teaching materials. Teaching materials used in schools during face-to-face learning are printed teaching materials, such as LKS, package books, modules, and others. While currently,

learners are required to learn through online learning media. To support the online learning process requires electronic teaching materials. This is because teaching materials have several advantages, namely (1) the material can combine several types of teaching materials into one, such as audio, audiovisual, and multimedia; (2) practical and easy to carry everywhere because it is stored in a device; (3) may present movements to clarify material of an abstract nature; (4) can be presented with a colourful display (Sriwahyuni, Risdianto, & Johan, 2019). Therefore, to find out the need for electronic teaching materials, researchers conducted questionnaires in one of the State High Schools in Palembang City.

Through the spread of questionnaires conducted in one of the high schools, namely SMA NEGERI 2 Palembang, it is known that teachers use teaching materials in the form of package books provided from schools and LKPD downloaded from the internet and edited as needed, in addition, the teacher explained that the most elusive material by learners is the key to determination and cladogram. In line with the questionnaire results distributed to participants in several high schools in Palembang city, it is known that 35% of learners have difficulty remembering scientific names, making the determination key and cladogram. If teachers use teaching materials during online learning, a video that does not follow the content is incomplete. Material that becomes difficult for learners is one of the competencies that must be mastered. This can be seen in Permendikbud No. 37 of 2018. Therefore, the right solution must be found to overcome this difficulty.

A teacher who is a facilitator can help learners to understand the material. This is in line with the opinion of Mu'minah (2017), who stated that teachers as facilitators can be learning advocates that help learners in solving problems and helping them in understanding the material. One solution that can be done is to develop teaching materials. The teaching materials developed can be a source of learning for learners. The use of teaching materials is one of the factors that play a role in the learning process, and can affect the quality of learning and improve learning outcomes (Arsanti, 2018; Alperi, 2019; Sagita, 2019; and Pramana, et al., 2020). Rahayu, Harjono, & Gunawan (2019), added that using teaching materials can make the learning process more effective and affect the quality of learning. Therefore, the use of teaching materials is essential in the learning process.

The teaching materials developed should be interesting, colorful, contain short, clear, and solid material to facilitate learners in learning and understanding the material. One of the teaching materials that match these characteristics is a magazine. Nur (2014) explained that magazines can have been covered as an attraction, contain more images/ photos, and have longer actualization value. Astuti et al. (2019), explained that images loaded with teaching materials can make it easier for teachers to convey material and make it easier for learners to understand the material during the learning process, especially during online learning that takes place today. Based on data obtained from the Statistik Central Agency in 2019, it is known that smartphone users continue to increase from year to year until reaching 63.53%. This means that we can utilize the sophistication of technology for the benefit of learning, one of which is to distribute teaching materials in the electronic form to learners.

As a driver of teaching materials, teaching materials require a learning model. According to Fitriah (2015), teaching materials should be combined with appropriate strategies, methods, or learning models. Based on the results of RPP analysis, it is known that biology teachers at the high school use a discovery learning model. Discovery learning is a model where the learning step makes learners discover concepts and principles through their mental processes (Mansur & Bare, 2019). While based on the results of the questionnaire, it is known that learners have difficulty remembering scientific names, making determines keys and classes. Learners will be more accessible if given direction during the learning process.

In Permendikbud Number 22 of 2016, four models are recommended in the learning process: inquiry. According to Sari et al. (2019), the guided inquiry model has a syntax that directs learners ranging from inductive to deductive steps. This means that the guided inquiry model will help learners from the beginning to the end of the activity. Learners can determine the key to determine and create a cladogram. Research conducted by Putri et al. (2016), Iswatun et al. (2017), Bera (2019) showed that guided inquiry models could improve learning outcomes and science process skills. In addition, the key to determination and cladogram related to plants should contain examples of plants that are generally used by the community in everyday life, one of the studies that discuss plants used by the community in everyday life is ethnobotany.

Research conducted by Handini, Kasrina, & Irawati (2018) shows that teaching materials containing ethnobotany studies deserve to be used in teaching materials. In addition, to increase knowledge in teaching materials also need to contain additional information. The material that will be contained in teaching materials focuses on plants, then provide researchers with information related to phytochemical content in plants. Jambak, Hadiarti, & Fadhillah (2019) research shows that phytochemicals should be used as material in teaching ingredients because they can be supplements. Based on the description, the researcher will develop teaching material in an electronic magazine for essential determination and class X cladogram.

Methods

This research will be conducted at SMA Negeri 2 Palembang class X, with the type of research and development (R&D) using the 4D development model (define, design, development, and decimate) from Thiagarajan (1974). The development that will be done is the development of teaching materials.

Participant

The sample in this study were class XI IPA 1 and 2 learners, class X IPA 4 and 6 learners, and class X biology teachers.

Instrument

The instruments used are questionnaire sheets used for needs analysis, assessment of validity from experts, the practicality of users, namely learners and teachers. At the same time, potential effects for the realm of knowledge are measured using tests in the form of electives, while skills use product assessment sheets.

Research procedure

In the initial stage (define), researchers disseminate questionnaires and literature studies and analyze teaching materials used by teachers. After that the researcher goes into the stage (design) where the researcher makes a problem, chooses teaching materials, and designs teaching materials. Phase three (development) researchers ask experts to measure the validity of the teaching materials developed. The last stage (disseminate) of researchers at this stage will be tested to find out the potential effects of teaching materials. After a trial and the results are known, the product will be disseminated through the www.flipsnack.com http://www.flipsnack.com site. If you have enough time, the researcher will do the diffusion stage.

Data Collection and Data Analysis

The data in this study is 2, namely the initial and final data. The initial data is collected using the questionnaire sheet while the final data is data obtained from the results of research and development, namely using the questionnaire of validity and practicality, as well as potential effects using test techniques and products. Here are the criteria for validity, which can be seen in Table 1, the practicality of Table 2, and the potential effects in Table 3. Skills assessment uses product assessment that refers to the assessment guidelines of Permendikbud No. 104 of 2014.

Table 1. Wisdom Based on Tegeh et al. (2014)

Percentage (%)	Category	Information
90 – 100	Very Good	No revision needed
75 – 89	Good	Revised as necessary
65 – 74	Good enough	Enough revisions
55 – 64	Less	Many revisions
0 – 54	Bad	Totally revised

Table 2. Practicality Based on Teacher and Student Response Value Criteria Using Wicaksono, (2014)

Value Range	Information
0% ≤ NRS < 20%	Very weak
20% ≤ NRS < 40%	Weak
40% ≤ NRS < 60%	Enough
60% ≤ NRS < 80%	Strong
80% ≤ NRS < 100%	Very strong

Table 3. Potential Effects for the Realm of Knowledge Using Hake, (1999)

Value Range	Information
N-*gain* ≥ 0,7	High
0,3 ≤ N-*gain* < 0,7	Enough
N-*gain* < 0,3	Low

Results

The products developed in the study are ethnobotany plant electronic magazine teaching materials used to determine cladograms and phytochemicals in class X. The results obtained from this study are valid, practical, and potential effects of teaching materials on learning outcomes in the realm of knowledge and skills. Here are the results of the study.

Validity Test of Magazine-Shaped Teaching Materials

The validity of magazine-shaped teaching materials is obtained through expert assessment. Assessment is done to get advice and criticism as a guideline for the improvement of teaching materials. Expert opinion is essential during the progress because before testing the potential effects, the product must be valid based on expert assessment. Three experts are used to assess teaching materials, namely material experts, languages, and media. Here are the results of expert assessments of materials and media presented in Table 4.

The above assessment results show that the expert assessment of the material is 100% with an outstanding category, so it does not need to be revised. The language obtained a total achievement of 89% with a suitable category, which means several parts in the sentence and words in the teaching material need to be improved, while the media gets a total achievement of 75%.

Table 4. Results of Expert Assessment of Materials, Languages, and Media

Expert	Total	Category	Information

of	Achievement (%)		
Material	100	Very Good	No need for revision
Language	89	Good	Revised as necessary
Media	75	Good	Revised as necessary

Fatmawati (2016) explained that products rated in the category are sufficient to be good to be used. When viewed from the assessment above, the media is the minor aspect of the three. Therefore, researchers do quite a lot of revisions, especially in the appearance of magazines to magazine contents. After improving the language and media sections, researchers again asked for advice and criticism to improve teaching materials. Once it is felt, teaching material in electronic magazines can be used for practical tests and potential effects, as for the newness of the electronic magazine developed. The magazine uses plant data from ethnobotany studies as examples and phytochemicals as supporting information and electronic magazines based on guided inquiry models.

Practicality of Magazine-Shaped Teaching Materials

The practicality test of teaching materials is carried out to find out the practicality of teaching materials in the form of magazines according to users, namely learners and teachers and make improvements based on advice from users. Here are the practicality test results presented in Table 5.

Table 5. Practicality Test Results

User	%NRS	Information
Students	91%	Very strong
Teacher	98%	Very strong

Based on the results of the practicality test above it is known that learners provide response scores of 91% and teachers 98% with powerful categories. This means that learners and teachers positively respond to teaching materials in electronic magazines as teaching materials for teachers and learning resources for learners.

There are several improvement suggestions given by learners including, the appearance of the cover and background, size and typeface, and material. Some improvements are made based on the advice given, but some are not improved because it is felt to have been following basic competence and the format of teaching materials.

Potential Effects of Magazine-Shaped Teaching Materials on Learning Outcomes

Potential effect tests are conducted after the product is declared valid by the validator and tested through several trials to learners, ranging from preliminary, quantitative, and final testing. The purpose of testing the potential effects of teaching materials is to determine the difference in learning outcomes before and after using teaching materials developed against learning outcomes. Potential impacts are calculated using the N-gain formula. The value of potential effects is obtained from the pretest and posttest for the realm of knowledge and create a cladogram to find out the influence of teaching materials on learning outcomes in the realm of skills.

The potential effect test conducted to class X learners is known that the acquisition of N-gain score is 0.64 with enough categories, which mean that teaching materials in the form of electronic magazines are quite potential in improving learning outcomes in the realm of knowledge, while in the realm of skills learners are asked to create a cladogram. The results showed that as many as 17 students could create a cladogram with details of 3 learners getting A grades, seven people getting B+ grades, and seven more people getting B grades.

Many obstacles were encountered during this test, including signal difficulties and constrained learning facilities such as the availability of gadgets and quotas, causing learners who only follow the first or second meeting. There are even learners who do not follow the first and second meetings at all. In addition, a less conducive learning environment becomes one of the obstacles during the learning process. As family members speak to learners, noise coming from outside the house, poor learning positions, such as studying in the living room and above the bed, are disturbances in the learning environment.

According to Jannah & Sontani (2018), learning facilities significantly affect the success of the learning process and learners' academic achievement. Rustiana & Chalifah (2012) also added that the learning environment affects learners' process and learning outcomes, where learners who have a less conducive learning environment will affect the learning concentration of learners. Setyani & Ismah (2018) explained that learning concentration is vital in the learning process because attention can make it easier for learners to understand the material and concepts and answer the given questions appropriately to achieve learning goals. Otherwise, this will affect learning outcomes.

During online learning, it is crucial to ensure the availability of adequate facilities for learners. If facilities are inadequate, then schools can help facilitate the needs of learners. In addition, teachers must also have the ability to teach learners during online learning because doing online learning is more complicated than doing face-to-face learning.

Conclusion

Based on the validity test, the product is declared valid through expert assessment, practical according to users, namely teachers and learners, and quite potent in improving learning outcomes in the realm of knowledge

and the realm of skills learners can create present a program.

Suggestion

1. This teaching material is suitable for use in schools where the majority of learners who have the availability of facilities, such as gadgets, quotas, and a conducive learning environment
2. It is expected that other researchers can use this teaching material to see the consistency of the potential effects of teaching materials on learning outcomes.

Declaration statement

The authors reported no potential conflict of interest.

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