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DEVELOPMENT OF MICROALGA DIVERSITY MODULE AS A BIOLOGICAL LEARNING MEDIA TO IMPROVE LEARNING OUTCOMES OF X GRADE HIGH SCHOOL STUDENTS IN PROTISTA MATERIAL

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Abstract
Microalgaeis a biological material that has an abstract nature, meaning that it cannot be directly observed by the five senses and must use certain tools to see it. The objectives of this study were: 1. Producing biology learning media in the form of modules, 2. Knowing the practicality of the module based on the activities and responses of students, 3. Knowing the effectiveness of using modules based on the achievement of indicators and 4. Knowing the feasibility of the module of microalgae diversity as a learning medium biology to improve the learning outcomes of class X high school students on protist material. This research method uses development research or R & D with the development model of Borg and Gall, 1983. The results of the study based on the N-gain value showed that the experimental class got a higher score than the control class and had moderate effectiveness. Based on the validity test conducted by 3 validators, the results stated very valid so that it was suitable for use as a learning medium.

Keywords: learning media, microalgae, module

Introduction

Protists are a kingdom in plant taxonomy. Protists are divided into 3 groups, namely plant-like protists, animal-like and fungal-like protists. Plant-like protists are referred to as algae or algae. Algae have a macroscopic size (Macroalgae) and a microscopic size (Microalgae). Microalgae are often referred to as phytoplantons and are the largest contributor to all photosynthetic activities that occur on earth. About 70% of phytoplankton absorbs CO2, fills the air atmosphere with O2 and also helps the life cycle in the food web in aquatic life (Japa, 2018).

Plant-like protists are grouped into 7 divisions, namely, Chrysophyta, Euglenophyta, Rhodophyta, Pyrrophyta, Phaeophyta, Chlorophyta and Bacillariophyta. However, not all 7 divisions are included in the microalgae (microscopic algae) group. Several divisions that are included in microalgae and are unicellular, namely, Bacillariophyta (Diatomae), Pyrrophyta (Dinoflagellata), Euglenophyta and Chlorophyta (Japa, 2018).

Microalgae as one of the aquatic biota that can carry out photosynthesis. The ability of these microalgae will produce organic and inorganic substances so that microalgae are dubbed as primary producers of waters. In addition, microalgae are water bioindicators that can measure whether or not the aquatic environment is polluted. The more microalgae in a waters, the lower the air pollution level and vice versa. Microalgae have limited survival in waters which are influenced by the presence of physical, chemical and biological factors. Physical factors include sunlight, temperature, water brightness, and salinity. Chemical factors include pH and dissolved oxygen. Biological factors include the nutritional needs of microalgae (Fitrialisma, 2018).

Microalgae learning material in the subject of protists is included in a separate curriculum, which is found in basic competencies (KD): 3.6, namely, presenting data on the identification of kingdom protists based on the observed characteristics (Japa, 2018). Microalgae is one of the biology learning materials that has an abstract nature, that is, it cannot be directly observed by the five senses and must use certain tools to see it. Therefore, microalgae material can be said to be material that is difficult for students to understand (Octovi, 2015). So it is necessary to have teaching materials or learning media as a support in increasing knowledge and information about microalgae.

Modules are written learning media in printed form with a systematic arrangement containing learning objectives, learning materials adjusted to core competencies (KI) and basic competencies (KD), instructions for independent practice activities, and evaluation activities or exercises to test students' understanding of the material (Daryanto, 2014).With the use of modules, students get convenience and benefits in the form of feedback, increased learning motivation, reduced remedial activities, and completeness of subject matter with directed learning objectives (Khasanah, 2017).

Making printed modules must be creative, innovative and challenging in order to provide enthusiasm and high curiosity for students. As said (Octovi, 2015) the learning process which is challenging will make students more active and can improve their learning outcomes well. The benefits of making printed modules can be used to compare the results of improving student learning. If students use print-based learning media, the subject matter becomes easier to understand, read and designed according to the learning needs of students. In addition, print media is very practical and inexpensive (Hafsah, 2016).

Based on research (Agatha, 2019), protist material, especially microalgae, is less attractive materialstudents because of the many classifications and understanding of concepts that make it a rote material. This is evidenced by the results of observations which state that 66.7% of students state that protist material is material that is difficult to understand and understand, this is supported by the difficulty of students in grouping protists based on the observed characteristics. So it is necessary to have learning media such as modules in printed form in which interesting and innovative materials are arranged in order to meet the needs of students.Research (Sutaman, 2015) also says that to teach protist material, teaching materials or learning media are needed that attract students to be motivated to learn and have an impact on their learning outcomes. Modules are the right learning media because they have many advantages that contain learning instructions, achievement competencies, learning materials, practice questions, work instructions and feedback.

Another advantage of choosing this print module as a learning medium to be developed includes adaptive, self contained, stand alone self instruction, and user friendly which makes this module different from other learning media (Ataji, 2019). In addition, this microalgae learning module has never conducted development research, most researchers develop protist module in general. In addition to this module having advantages, this module also has advantages for the teacher, namely that it can provide ample opportunity and time to pay attention to students individually and can measure the level of learning outcomes of students. (Fitriana, 2017).

Therefore, this study aims to; (1) Producing learning media in the form of modules, (2) Knowing the practicality of the module based on the activities and responses of students, (3) Knowing the effectiveness of using modules based on the achievement of indicators and (4) Knowing the feasibility of the microalgae diversity module as a biology learning media to improve student learning outcomes SMA class X on protist material.

Method

The research method used is development research or R & D (Research and Development) using the development model of Borg and Gall, 1983 (Suryanda, 2016). This model was chosen because it aims to design a product and produce it as a learning medium, in this case a module which is then tested, evaluated, and refined to produce learning media products that are effective, efficient and of course quality and useful (Puspita, 2019).

The Borg and Gall development model consists of 10 steps, but due to the limitations of this study the researcher only uses 7 stages out of 10 existing stages (wibowo, 2018), that is, (1) data / information collection; (2) research planning, (3) initial product development (Design), (4) validation testing & limited trial implementation, (5) revision of limited trial results, (6) implementation of main field trials; and (7) revision of the results of the main field trials (Effendi, 2016). Haryanto (2015) states that open research is free to determine and choose which steps will be used and appropriate for its development research.

This research was conducted at SMA Qur'an Insan Pratama, Parahu Village, Sukamulya District, Tangerang Regency, Banten Province. In this study, there were research subjects who were divided into 2 classes. The control class as the first class and the experimental class as the second class. Each class has 20 students who come from class X IPA at SMA Qur'an Insan Pratama.

The data collection techniques used were; (1) expert validation sheet and material validation sheet for biology teachers, and (2) cognitive test results made in the form of multiple choice totaling 10 questions.

The data analysis technique used consists of:

1. Data analysis for expert validation. This data analysis obtained results in the form of a validator's assessment of the given media. Validator answer sheets are made based on categories which can be seen in table 1 (Abdias, 2019).

Table 1. Expert Validation Criteria for Microalgae Diversity Module

Score	*Criteria*
$1,00 < x < 1,75$	*Not Valid*
$1,75 < x < 2,50$	*Less Valid*
$2,50 \leq x \leq 3,25$	*Valid*
$3,25 < x \leq 4,00$	*Very Valid*

Source: (Ratumanan & Laurens, 2006)

2. Calculation of the average value, according to (Abdias, 2019) if you want to know the final value of the assessment items, then the number of assessment scores obtained is divided by the number of respondents who have answered the questionnaire. Mathematically it can be stated:

$$X = \frac{\Sigma x}{n}$$

Information:
X = *Average value*
Σx =*total assessment score*
n = *Number of respondents*

To see the effectiveness of the microalgae diversity module, a gain test (N gain) was carried out, which is a test to determine student behavior after the learning process of the protist material has increased or not. Systematically, the gain score can be written:

$$Gain = \frac{\bar{X}\ skor\ postest - \bar{X}\ skor\ pretest}{skor\ maks - \bar{X}\ skor\ pretest}$$

The results obtained from the N-gain will then be interpreted as shown in table 2.

Table 2. Standardized N-gain Criteria

No.	*N-gain result*	*Criteria*
1	*g <0.3*	*Low*
2	*0.3 ≤ g <7*	*Moderate*
3	*g> 0, 7*	*High*

Source: Hake (1999)

The results obtained were then carried out statistical analysis by testing the posttest, pretest and N-gain values in the control and experimental classes. There are several stages of statistical tests that will be carried out, namely, normality test, homogeneity test, and t test (Independent sample T test) using the SPSS 16 application. The significance level in this hypothesis test is 0.05 or 5%. The results of the decision to test the hypothesis if sig. (1-tailed) <0.05 then H0 is rejected and H1 is accepted (Hartati, 2016).

Findings and Discussion

Research on the development of instructional media in the form of a module of microalgae diversity uses a 7-stage R&D model from Borg and Gall which will be described as follows:

Data / Information Collection

The data or information collection stage is the first step in module development. This stage process includes literature studies, field surveys, product needs analysis, and analysis of the curriculum used (Yektyastuti, 2016). The results of literature studies are in the form of module definitions, the characteristics of learning modules as a medium for improving student learning outcomes, and the content of the module material is in accordance with the applicable curriculum (Hawarya, 2014).

The field survey was conducted at SMA Qur'an Insan Pratama Kab. Tangerang. Biology learning in this school uses lecture methods and practice questions with teacher and student handbooks as learning support. However, in certain materials, especially microalgae, students' books are lacking in terms of material and question exercises, so students need learning media in the form of modules as additional information and material.

Needs analysis is based on field surveys that learning biology of protist material can be supported by using learning media in the form of learning modules in order to facilitate student learning systems to improve learning outcomes. The curriculum analysis was carried out based on Core Competencies (KI) and Basic Competencies (KD) based on the 2013 curriculum.

Research Planning

The research planning stage is a product planning to be made. The first thing that is done is to determine the content of the learning material to be included in the module and determine the stages of the learning process such as introduction, KI-KD, objectives, materials, independent practice tests, and practice questions as evaluation (Ditama, 2015).

Early Product Development

The initial stage of product development is to develop a product to be produced in the form of a learning module. This step starts from the module preparation stage and prepares its components such as an assessment instrument for material and media experts, then prepares a learning module, carries out editing and gives it to examiners (Yasa, 2012).

Validation Test & Limited Trial Implementation

The validation test stage is a step in assessing the product being made whether it is feasible to be tested or not. After stage 3 is completed, the module validation test is carried out by 3 high school biology teacher validators as media experts and material experts. The results of this study can be seen in table 3.

Table 3. Validity Test Results by 3 Material & Media Expert Validators

No.	*Assessment Aspects*	*Validator*			*Average*	*Category*
		1	*2*	*3*		
1.	*Technical*	*3.71*	*3.55*	*3.74*	*3.67*	*Very valid*
2.	*Didactic*	*3.64*	*3.72*	*3.94*	*3.76*	*Very valid*
3.	*Construction*	*3.54*	*3.72*	*3.77*	*3.68*	*Very valid*
Total Average					*3.70*	*Very valid*

Based on the results of the module validation test in Table 3, it can be seen that the technical, didactic and construction assessment aspects have met the requirements well. It can be seen from the average technical requirements that are 3.67 with the very valid category, the average didactic requirements 3.76 with the very valid category, the average construction requirements 3.68 with the very valid category and the overall average of the 3 aspects is 3.70 which is in the very valid category.

The technical, didactic and construction requirements that have been met include, first, technical requirements based on assessment indicators, namely, suitability of the cover with the module title, suitability of module content layout, suitability of writing and letters in the module, and module appearance in the form of images and colors that attract interest. learners. Didactic requirements are based on assessment indicators, namely, the material according to the applicable curriculum and being used, the material taught in the module is in accordance with the concept, the suitability of the module material with the learning objectives, and increasing the effectiveness of learning. The construction requirements are that the sentences in the module must be clear and do not cause multiple meanings, the language is easy to understand and interactive, the compatibility between the material and the content of the learning module and the clarity of instructions and the writing format.

Based on the three conditions above with very valid results, this module is declared fit for use, meaning that the product development in the form of this module can be continued to the next stage (Masykur, 2017).

Revised Trial Results are Limited

The feasibility of a product is inseparable from the revision of the validator in the form of suggestions and input for module improvement. to revise the modules made (Sari, 2017). Suggestions and input from the validator include (1) requiring a longer time allocation, (2) adding practice questions to the competency test at the end of the module (3) lack of information regarding the related article, (4) using words that are not simple or difficult for students to understand and (5) there is no glossary in this module.

Implementation of Main Field Product Trials

At this stage the main product is tested to determine the response of students that the learning module made is practical and effective or not. Testing the main product in 2 ways, namely the control class test and the experimental class test. The test results can be seen based on the posttest and pretest values of the N-gain which can be seen in table 4. By knowing the N-score results, the researcher can find out the students' initial and final abilities.

Table 4. The mean value of Pretest, Posttest and N-Gain

Class	***Pre-test***	***Post-test***	***N-gain***	***Category***
Control	*58.5*	*68.5*	*0.18*	*Low*
Experiment	*58.5*	*83.0*	*0.60*	*Moderate*

Based on table 4, it can be seen that the mean score of the control class at pretest was 58.5 and for the posttest it was 68.0. Both are in the low category because the N-Gain value is <0.3, which is 0.18. While the average score in the experimental class for pretest was 58.5 and for posttest was 83.0. Both are in the medium category because the N-Gain value is> 0.3 and <0.7, which is 0.60.

Revision of The Main Field Product Trial Results

After testing the field products, the results show that the learning media in the form of modules that have been developed have the appropriate category to be used and realized to students as a tool in conveying messagesand reference sources for students to learn. (Christiyoda, 2016). Based on the results of the recapitulation of the initial ability statistical test (pretest), it can be seen through the normality and homogeneity test in table 5.

Table 5. Pretest Data Normality Test Results

Kelas		Shapiro-Wilk		
		Statistic	df	Sig.
Pretest	Kon	,929	20	,147
	Eks	,925	20	,122

Due to the small data generated (n = 20) then using Shapiro-Wilk. Based on the results of the Shapiro Wilk test, the control class got a significance value of 0.147 (sig.> 0.05), it was concluded that the data were normally distributed. While the experimental class got a significance value of 0.122 (sig.> 0.005), so the conclusion is that the data is normally distributed. So the Shapiro-Wilk test states that the test results of both classes are normal.

Furthermore, statistical tests were carried out using SPSS 16 to propose research hypotheses. The research hypothesis for statistical test pretest data is:

H0: There is no significant difference between the initial ability (pretest) with the control class and experimental class students.

H1: There is a significant difference in results between the initial (pretest) ability with the control and experimental class students.

Table 6. Pretest Data Homogeneity Test Results

Pre Test

Levene Statistic	df 1	df 2	Sig.
,206	1	38	,652

Based on table 6, it is known that the homogeneity test using the Levene test has shown a significant value for the control and experimental classes of 0.652 (sig.> 0.05). So it is concluded that the data variance of the control and experimental class students' scores is homogeneous (Oktaviani, 2014).

To find out the difference in N-gain scores, the t test (Independent t-test) was carried out, the results of which are listed in table 7.

Table 7. Statistical Test Results Independent t-test (t test)

		Sig.	Sig. (2-tailed)
Post Test	Equal variances assumed	,156	,000
	Equal variances not assumed		,000

Based on table 7, the Sig. Leven's Test for Equality of Variances is 0.156 (Sig.> 0.005). This means that the data variance between each group in the control and experimental classes is homogeneous. So that it can be interpreted in the table of the output results from the t test (Independent Sample Test) above refers to the score in "Equal Variances Assumed".

From the results of the output above in the "Equal Variances Assumed", it is known that the Sig. (2-tailed), namely 0.000 (Sig <0.005), so it can be concluded that H0 is rejected and H1 is accepted, that is, there is a significant (significant) difference between the mean value of the control class and the experimental class (Sujarweni, 2014).

Based on the results of the normality test with the Kormogorov Smirnov test and the homogeneity test with the Levene test, it shows that the data that has been obtained is normally distributed, meaning that the data variance is homogeneous.

If the results of the trial of this main product are not yet perfect, it will be used as material for improvement to perfect this product to become a learning module that students like and are interested in. Students' learning ability on microalgae material can be measured using 10 multiple choice test questions. After testing the results of the pretest scores in the control class and the experimental class got the same percentage value, namely 58.5%, but different from the posttest results in the control and experimental classes. The posttest mean score for the control class was 68.5% while the experimental class was 83%. So it can be seen that the microalgae learning module helps students to improve their biology learning outcomes.

There is an increase in student learning outcomes because the module contains pictures of microalgae with each different division and attracts students' attention. This module is also equipped with simple ways of working and practicum activities so that it helps students to understand the microalgae material more deeply (Sukmadinata, 2012). Based on the statement from Duda's research (2019) the existence of practicum can improve student learning outcomes in the aspects of skills and knowledge that have been done. This microalgae module will provide encouragement and stimulation to students to complete their assignments well because students feel motivated to learn so that their learning outcomes increase (Ariana, 2020).

Conclusion

From the results and discussion that has been described above, the researcher can conclude that the development of the microalgae diversity module as a biology learning medium for class X SMA students has conducted validation tests and direct trials to students. The results have shown that the experimental class group gets superior scores than the control class. So that this learning module is suitable for use in school.

Based on the results of the author's conclusions above, the authors suggest that the learning modules that have been created can still be developed extensively both in terms of material and learning activities therein.

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