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Research Article

Developing genetic learning module based on blue eyes phenomenon in Buton Island, Southeast Sulawesi

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ABSTRACT

The existence of learning resources based on local phenomena is presumed to be able to optimize genetic learning processes. The purposes of this study were (1) to produce module based on the blue eyes phenomenon occurred in Buton Island for genetic material in senior high school and (2) to find the quality of the module produced. This study used research and development (R & D) based on Borg & Gall model which was limited to seventh step. The research involved three validators, six students in initial field-testing step, and 70 students in main field testing. The data collection technique used was questionnaire. The data obtained were calculated as percentages of module quality. The results of the material validation, media validation, and practitioners were 96.52% (very valid); 82.40% (very valid); and 83.75% (very valid), respectively. In addition, the student responses to the module was 22.13% (good). In conclusion, this module can be used as a learning resource for senior high school students in genetic learning.

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INTRODUCTION

Genetics is one of the most abstract and complex concepts in biology (Altunoğlu & Şeker, 2015). Many students have difficulty understanding the concept of Genetics (Kılıç, Taber, & Winterbottom, 2016; Topçu & Şahin-Pekmez, 2009). These difficulties become increasingly complicated because of some learning conditions that do not support the student in learning genetics concept optimally. One of these conditions is the learning that still textbook-oriented. This condition leads to the presentation of examples of genetic phenomena is limited as contained in standard textbooks. Moreover, genetic learning has not used many methods, multi-media, multi-learning resources, or multi-modules. Less innovative of learning processes as well as learning sources cause many students to be less able to obtain optimal academic achievement (A. M. Hudha, 2018; Atok Miftachul Hudha, Amin, Sumitro, & Akbar, 2018).

Emerging genetic phenomena in genetic learning can be developed through genetic phenomena from the surrounding environment which can be traced genetically through various methods of genetic research. Disclosure of phenomena from the surrounding environment through research and other studies will be very useful for the development of genetic learning resources. Moreover, the use of natural phenomena as learning resources can direct learning to be more contextual. Such a condition can optimize the achievement of learning objectives that have been designed (Davtyan, 2014; Suryawati & Osman, 2018). Furthermore, phenomenon-based learning can direct students to understand the real events that occur around them (Symeonidis & Schwarz, 2016). Therefore, providing real phenomena-based learning resources plays an important role in student learning success.

The presence of high-quality learning resources can facilitate and help students to improve their understanding about the concept they learned as well as to improve their learning outcomes (Nuroso & Siswanto, 2012; Rahayu & Sudarmin, 2015; Wenno, 2010; Zuriah, Sunaryo, & Yusuf, 2016). The learning resources are also expected to bridge the initial knowledge that students have with new knowledge that will be learned (Oleson & Hora, 2014). One learning resource that can be used for learning is teaching materials in the form of modules (Prastowo, 2013). According to Bahri, Syamsuri, & Mahanal (2016), the existence of modules in the learning process can provide learning resources that contain material, methods, and methods of evaluating systematically designed to help students achieve learning competencies. The importance of the module was developed as a teaching material in genetic learning supported by (Ardiansyah, Corebima, & Rohman, 2016), that teaching materials in the form of modules need to be developed, because students need easy-to-understand teaching materials, supplemented with pictures, containing the latest findings related to learning material, and there is a glossary containing terms in the field of genetics.

On Buton Island, there are interesting genetic phenomena to study, namely the presence of some blue-eyed people. Some of these blue eyes people include members of the Dala family in Kaimbulawa Island Siompu Village, South Buton District, and Mr. Faisal Amorale's family in Boneatiro Village, Kapuntori District, Buton Province of Southeast Sulawesi. The blue eyes on Buton Island come from the descendants of white Europeans who visited Buton Island in the 16th-Century so that the local genetic phenomenon of the Buton Island community is interesting to study and potentially developed as a learning resource for human heredity.

Based on the results of reflection on genetic learning so far and paying attention to various life phenomena that exist in the surrounding environment, it is necessary to conduct genetic research based on local potential or local phenomena to support the development of genetic learning resources. For the results to be used optimally, the results of these studies are packaged as learning resources that can be learned independently by students to support existing learning resources.

Some previous researchers have developed local phenomenon-based learning resources. Some of these local phenomena, among others, are the phenomenon of inheritance of rhesus blood groups in patients with mental retardation in Gunungkidul (Abdulatip, Suratsih, Henuhili, & Rahayu, 2015) and inheritance pattern of cretinism in Wonosobo (Antasari, 2017). On the other hand, studies that have tried to develop modules based on blue eyes phenomena on Buton Island have also never been done. Based on the description that has been described, it is necessary to do research on the utilization of the results of genetic research based on the potential of local genetic phenomena. The results of such genetic research are then packaged in the form of learning modules to support the development of the ability to identify feasibly, and potential local genetic research issues in Buton Island, Southeast Sulawesi Province.

METHOD

The Borg and Gall model (Borg & Gall, 1983) was chosen as the research and development (R&D) model in this study. These steps of development are carried out, namely: 1) Research and data collection. At this step, information about the phenomenon of blue eyes is collected through field research activities; 2) Planning the educational product. The planning step in this research includes planning the indicators, formulating objectives, designing, and preparing modules; 3) Develop a preliminary form of the product. The initial module products will be produced in this step; 4) Initial field testing. In this step, the limited initial field test activity was conducted. The small group trials were conducted by involving six high school students of class XII, namely 3 students from SHS 1 Bau-Bau and 3 students from SHS 4 Bau-Bau through filling in 15 questions on student responses to the module questionnaire 5) The first revision of the main product. The responses and suggestion from students in step 4 were used as the basis for product revision; 6) Main field testing. In this study, field testing step was carried out by involving 70 students from two schools, namely 36

students of SHS 1 Bau-Bau and 34 students of SHS 4 Bau-Bau; 7) Operational product revision. The last step carried out in this study was to revise the module based on the data obtained from the main field-testing step.

The type of data collected in this study was qualitative data. Questionnaires were used as data collection instruments. Types of questionnaires used i.e. student response questionnaires as well as validation questionnaires by material experts, media experts, and education practitioners. The data collected was then analyzed by calculating the percentage. To determine how students respond to the modules that have been developed, the collected data was calculated using a Formula (1) developed by Widoyoko (2012). The results of these calculations were then classified based on the categories presented in Table 1. On the other hand, the validity of the module was based on a range of scales resulting from the assessment of experts and education practitioners. The results of the calculation were then matched with the categories in Table 2. These categories are based on Riduwan (2009).

$$\text{Interval distance} = \frac{\text{Highest score-lowest score}}{\text{Sum of interval classes}} \quad (1)$$

Table 1. Classification of student responses to the learning module

Sum of scores	Attitude
25.3 -30.0	Totally agree
20.5 – 25.2	Agree
15.7 – 20.4	Fair
10.9 – 15.6	Disagree
6.0 - 10.8	Totally disagree

Table 2. Criteria for validity

Scoring Scale	Criteria	Notes
81- 100	Totally valid	Without revision
61 – 80	Valid	Without revision
41 – 60	Fair	With revision
21 – 40	Invalid	With revision
0 – 20	Totally invalid	With revision

RESULTS AND DISCUSSION

The existence of modules based on local phenomena is one way to optimize biology learning process. In this study, a module based on the blue eye phenomenon has been developed. The developed module has been tested on students in initial field-testing step. Student response data that has been collected is presented in Table 3. Based on Table 3, students' attitudes towards modules that have been developed are in the "agree" category (23.13). The results show that students give a positive (agreed) response to the learning module developed, meaning that the module was categorized as good, acceptable to students and can be tested in a larger group. Among the 15 items of statements given to students, the language used in the module was easy to understand. However, the module must be pursued to be interesting, so as to encourage the motivation of students to study biology. Moreover, some students still lack understanding of the sentences in the module and some of them do not understand the material. This condition was quite reasonable because the sentence presented was too scientific to be used among students, so it was necessary to simplify the sentence. Even so, the average student response to the module tested reached 73.78, which means the module being tested was classified as valid and does not need to be revised.

Furthermore, the development module is validated by material experts. Data from the validation results from the material experts are presented in Table 4. Based on Table 4, the module was stated as "very valid". In more detail, material experts stated that both content and language, the module was good. The advice from material experts was the module will be better if it contains concept maps. According to Yunita, Sofyan, & Agung (2014), the use of concept maps has a positive impact on the learning process. Learning modules that contain concept maps are very effective in helping students understand material concepts meaningfully (Rahmi, 2017). The other advice was the module cover design and illustrations should be revised. According to Ardiansyah et al. (2016), illustration is a determining factor for readers in understanding the content of the material presented. Furthermore, Agustina (2015) stated that the book cover design greatly influenced students' reading interest.

Table 3. Students' responses in the limited experiment

No	Statements	Σ	%
1	I think that the design of the biology learning module is very interesting	24	80.00
2	I pay little attention to the design of this module, the most important thing for me is the contents of the module	23	76.67
3	I think the cover design has an initial appeal and describes the content or material delivered.	25	83.33
4	I find it difficult to understand the sentence in the module	16	53.33
5	I believe the images presented in this module can add to my understanding of related material and concepts	23	76.67
6	The glossary (explanation) helps me in defining biological terms	27	90.00
7	I think that the shape and size of the letters are proportional	24	80.00
8	The text used does not cause double meaning to me	21	70.00
9	I argue that the language used is simple and communicative and easy to understand	27	90.00
10	This text in the biology learning module makes me not understand the material in this module	14	46.67
11	I believe with this biology learning module; it helps me make it easier to learn biology	23	76.67
12	I am not interested in studying biology with this module	11	36.67
13	The evaluation sheet in the biology learning module helps me learn biology	24	80.00
14	The material in this module conveys the potential of local phenomena on Buton Island as a source of learning	25	83.33
15	This module contains the message and values of local wisdom of the people of Buton Island that are important for biology based local phenomena	25	83.33
		23.13	**73.78**

Table 4. Recapitulation of data from the material expert validation

No	Aspect	Sub aspect	Total Scores	Max Score	%	Description
1	Material	Completeness of material	15	15	100	Very valid
		Material accuracy	10	10	100	Very Valid
		Material support activities	15	15	100	Very valid
		Material update	5	5	100	Very valid
		Supporting students' scientific competencies	9	10	90	Very valid
		Suitability of scientific systems	9	10	90	Very valid
		Development of thinking skills and abilities	5	5	100	Very valid
		The material stimulates students to find out	5	5	100	Very valid
		Potential local phenomena in matter	10	10	100	Very valid
		Local religious values in the material	10	10	100	Very valid
2	Language	The material stimulates students to find out	4	5	80	Valid
		Potential local phenomena in matter	4	5	80	valid
		Local religious values in the material	10	10	100	Very valid
		Total	**111**	**115**	**96.52**	**Very valid**

Modules were also validated by media experts. The results of the validation from the media expert are presented in Table 5. Based on Table 5, it can be concluded that the developed module was declared "very valid" by media experts. The results of the assessment from the media expert obtained quite high scores, which amounted to 82.4%. The percentage showed that this learning module can be used in learning even though it still required a little revision. Suggestions obtained from the media expert were related to module completeness and general layout. Suggestions provided by media experts are in line with the information expressed by Ardiansyah et al. (2016). The suggestion stated that students need an Indonesian language module that is easy to understand, equipped with pictures that support learning material, contains the latest findings related to learning material, and displayed glossary that explains the terms in the field of genetics.

Table 5. The data from media expert validation results

No	Sub-aspects	Total Score	Max Score	%	Indicate
1.	General delivery organization	10	10	100	very valid
2.	Presentation considers meaningfulness and usefulness	10	10	100	very valid
3.	Developing a knowledge formation	15	15	100	very valid
4.	General layout	12	20	60	fair
5.	Completeness of the learning module	51	65	78.48	valid
6.	Variations in delivery	5	5	100	very valid
	Total	**103**	**125**	**82.4**	**Very valid**

The subsequent validation process was carried out by education practitioners. The measured aspects include material, presentation, and language. Data from the validation results are presented in Table 6. Validation results from education practitioners showed an average score of 83.75 in a very valid category. This indicates that the module can be used even though it requires revisions in several parts. Suggestions obtained from practitioners are mainly on enriching practice questions and independent assignments (Conway, Johnson, & Ripley, 2010; Moazami, Bahrampour, Azar, Jahedi, & Moattari, 2014; Riley et al., 2017; Zeanah, Berlin, & Boris, 2011). Enrichment of training questions given to students can improve students' understanding of the material and improve student learning outcomes (Verowita, Murni, & Mirna, 2012).

Table 6. Results of validation of education practitioners

No	Aspects	Sub-aspects	Teacher of SHS 1 Bau-Bau			Teacher of SHS 4 Bau-Bau		
			Total Score	Max Score	%	Total Score	Max Score	%
1	Material	Completeness	12	15	80	12	15	80
		Accuracy	9	10	90	10	10	100
		Material Support Activities	14	15	93.33	14	15	93.33
		Update	5	5	100	4	5	80
		Students' Scientific Competencies Support	8	10	80	8	10	80
		Suitability of scientific systems	8	10	80	8	10	80
		Development of thinking skills and abilities	4	5	80	4	5	80
		The material stimulates students to find out and explore	4	5	80	4	5	80
		Potential of local phenomena in materials	9	10	90	9	10	90
		Local wisdom and values embedded in the Materials	9	10	90	10	10	100
		General Organization	8	10	80	8	10	80
		Presentation considers meaningfulness and usefulness	9	10	90	8	10	80
2	Presenta-tion	Developing a knowledge formation	12	15	80	15	15	100
		General layout	16	20	80	16	20	80
		Completeness of the learning module	46	65	70.77	49	65	75.38
		Variations in delivery	4	5	80	4	5	80
		Language rules	4	5	80	4	5	80
3	Language	Language clarity	4	5	80	4	5	80
		Language compatibility	8	10	80	8	10	80
		Average Scores		**83.37**			**84.14**	

Overall, the modules developed based on the "blue eyes" local phenomenon developed in this study was valid. Modules that have gone through the revision stage can be used as additional material for the main teaching material in biology learning, especially in the Human Heredity concept. This research-based module is expected to help students understand the concept of inheritance and to find out local phenomenon-based genetic research activities on Buton Island.

Preparing learning module is an effort to prepare learning material. The presence of learning material is an essential factor in the learning process (Orlich, Harder, Callahan, Trevisan, & Brown, 2010). Moreover, learning using modules will encourage independent learning (Bruckermann, Ochsen, & Mahler, 2018; Bubnys, 2019; Nardo, 2017; Rossiter, 2013; Sofroniou & Poutos, 2016). As stated by Oka (2010), independent learning is an active and participatory learning method for each individual who is not bound by the presence of teachers at class meetings and the presence of schoolmates.

Furthermore, the modules developed in this study facilitate contextual learning. The module content is based on local phenomena that can be found in the environment around students. Learning that could present real examples in explaining abstract concepts will help students better understand the concept. In addition, contextual learning is also reported to be able to have a positive impact on students (Nasution & Rezeqi,

2015; Suryawati & Osman, 2018). Through this kind of learning, students will become more aware of the concepts they are learning.

CONCLUSION

In this study, a module based on the blue-eyed phenomenon owned by several families on Buton Island has been developed. Students give a positive response to the learning module developed (73.78%). Furthermore, the validation results from material experts, media experts, and education practitioners were 96.52%; 82.4%; and 73.78%, respectively. Overall, the developed module was included in the category of 'very valid' with a slight revision so that it can be used as a reliable learning resource. Further research related to other local phenomena is needed if research-based learning modules are to be used more widely.

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