Developing of fish anatomy learning module based on local wisdom in Ngebel Lake, Ponorogo, East Java

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Research Article

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ABSTRACT

The use of local wisdom as learning resources has been widely known to be able to create meaningful learning. The purposes of this study were to 1) produce module based on freshwater fish anatomy as local wisdom in Ngebel Lake, Ponorogo and 2) find the quality of the module produced. The Research and Development (R&D) was designed based on the Thiagarajan model which consisted of defining, designing, developing, and disseminating stages. The data were collected using interview guidelines, validation sheets, and students' response questionnaire. The validation results of the media, material, and language experts showed that the module was very valid with the percentages were 86.5%, 88.2%, and 85.3% respectively. In addition, the student responses reached 87.9% (very good). In conclusion, the fish anatomy learning module based on local wisdom is appropriate to be used as learning resource.

INTRODUCTION

The natural environment can be used as a learning resource (Cundill & Rodela, 2012; Drew & Mackie, 2011). It does not only emphasize the realm of knowledge, but also empowering the psychomotor and affective domains of students (Al Sabei & Lasater, 2016). The learning process emphasizes active and independent learning (Greene et al., 2019; Mora, Signes-Pont, Fuster-Guilló, & Pertegal-Felices, 2020; Rayens & Ellis, 2018). Learning resource does not only come from a teacher, yet it also provided by the students' environment (Ciolan & Ciolan, 2014; Steele, Hives, & Scott, 2016). Then, the learning objectives can be directed at implementing the concept of learning on environmental problems to develop affective and psychomotor students.

Learning resources are one part of the learning process that supports the achievement of learning objectives (Jeong & Hmelo-Silver, 2010; Suwarni, 2015). The use of appropriate learning resources can enhance conceptual understanding. The learning process using real life-oriented can facilitate the concept of

thinking. Consequently, utilizing the environment as learning resources can improve the student's concept understanding (Istiani & Retnoningsih, 2015; Raub, Shukor, Arshad, & Rosli, 2015; Triyani, Putra, & Alimah, 2019). Besides, learning resources that are following the teaching materials can make it easier for students to construct their knowledge so that the concepts learned can produce long-term memory (Rufii, 2015; Schumm & Bogner, 2016). The use of contextual learning resources from the surrounding environment will be more easily recognized by students (E. M. Bergman et al., 2013; Pedrosa-de-Jesus, Moreira, Lopes, & Watts, 2014). Students can face a real-life problem that exercises their senses to see and do so that learning is considered more interesting (Obergriesser & Stoeger, 2020). Thus, the use of the surrounding environment as learning resources can make it easier for students to remember concepts (Raub et al., 2015) and improve their emotional quotient and learning achievement (T.-C. Huang, Chen, & Chou, 2016) so that the learning becomes more meaningful.

On the other hand, the Animal Anatomy course, one of the basic science which studies the structure of animal organs, is considered difficult for students. It is because they have to understand anatomical terms and structure of the animal comprehensively. Many students argue that anatomy is a static and difficult science (Azer & Azer, 2016; E. M. Bergman et al., 2013; Ivanusic, Cowie, & Barrington, 2010; Kurniawan, Suharjito, Diana, & Witjaksono, 2018). A comprehensive understanding of anatomy concepts has not been fully experienced by students. Some research showed that students' motivation and learning achievement is low in this course. The difficulty in studying this course encourages the need for innovative learning strategies with a student-centered learning approach (Conradty & Bogner, 2019; Jacobs & Renandya, 2019; Simons, Beaumont, & Holland, 2018; Thuneberg, Salmi, & Bogner, 2018). This innovative learning is supported by the existence of adequate learning resources, one of which is a lecture module. Based on the observations, it was found that the modules that have been used by students in Universitas PGRI Madiun, Indonesia, have several weaknesses, namely: (1) not yet able to create a comprehensive concept understanding; (2) the pictures presented have not been able to connect the concept to the students' prior knowledge; (3) there has been no discussion the overall concept; (4) some examples of animals displayed in the module are not in the student's environment; and (5) the evaluation cannot provide a clear description of the students' conceptual understanding. Depends on these facts, it is necessary to improve and optimize Animal Anatomy course learning activities by using better and more effective modules.

The effective modules as learning resources can be developed based on real objects that come from the students' environment (Bruckermann, Ochsen, & Mahler, 2018; Martiningsih, Lisdiana, & Susilowati, 2019; Nilasari, Djatmika, & Santoso, 2016). The learning process in the Animal Anatomy course using modules can support more independent learning. The interaction between animal anatomy and the environment can be developed in the module so that learning becomes more meaningful for students. This contextual-based module can accommodate students' affective related to environmental awareness and preserve local traditions. The material in the module can be developed based on environmental observations, such as in the animal habitat in Ngebel Lake, Ponorogo, East Java.

Ngebel Lake is a natural lake on the slopes of Mt. Wilis with a diversity of freshwater fish. Communities around Ngebel Lake develop it as a tourist area and local fish farming. The local tradition of the Ngebel community is Larung Sesaji, a religious act with animism and dynamism in which myth and magic remain attached to the Javanese in Ngebel Village. It is always held regularly every first Suro night (Javanese calendar) and this tradition as a local cultural heritage that is still maintained until today. The *Ngongok* fish (*Hampala macrolepidota*), an endemic fish in this lake, is one type of preparation used in the Larung Sesaji tradition. Also, this fish is a daily consumption for the local community. However, the diversity of freshwater fish and the features of Hampala fish as endemic fish in Ngebel Lake are not well known. The potential of biodiversity in Ngebel Lake, especially the diversity of freshwater fish, can be used as a learning resource.

The use of environmental conditions as a learning resource develops students' analytical skills to link their prior knowledge with new knowledge to be learned (Schumm & Bogner, 2016; Sechi, Borri, De Lucia, & Celmins, 2018). Students' thinking ability will be well constructed (Cutter-Mackenzie & Edwards, 2013; Steele et al., 2016; Whiley, Witt, Colvin, Sapiains Arrue, & Kotir, 2017). Several researchers have developed contextual-based modules in learning. The results showed that contextual-based modules can improve learning outcomes (Martiningsih et al., 2019), empower students' process skills, build discovery attitudes in students, increase involvement in experimental activities, and increase student interest in learning (Thuneberg et al., 2018). Contextual-based modules can stimulate students' cognitive to associate their knowledge with everyday life situations (E. M. Bergman et al., 2013). Students will design to more active in looking for information because the material in the module is familiar to them. Therefore, research and development of contextual-based modules based on local wisdom of freshwater fish biodiversity in Ngebel Lake are necessary. The results are projected in the form of an Animal Anatomy module related to freshwater fish diversity. The module compiled has contextual specifications by displaying pictures and explanations of local fish diversity obtained from

Ngebel Lake and an explanation of Larung Sesaji tradition. The integrated presentation of the diversity of local fish anatomy and the tradition is the uniqueness and excellence of this module. By developing a module based on local wisdom, it is expected that the module can be used as an alternative recommendation for learning sources to optimize the learning achievement and increase the respect of Indonesian culture.

METHOD

The Research and Development (R&D) was designed based on the Thiagarajan model which consisted of defining, designing, developing, and disseminating stages (Thiagarajan, Semmel, & Semmel, 1974). Each stage is described in more detail as follows.

Defining stage

1. Problem identification was using observation in the Animal Anatomy course (include the learning module used) in three areas in East Java, i.e. Madiun, Ponorogo, and Ngawi.
2. Identification of the needs of students and lecturers module by using questionnaires.
3. Analysis of the curriculum to obtain information related to learning outcomes, learning objectives, and evaluation.
4. Interview with the community Ngebel Lake related to the tradition of Larung Sesaji and the endemic freshwater fish species in the Ngebel Lake, as well as the benefits of endemic fish in the Larung Sesaji tradition.
5. Identification of various types of endemic fish in Ngebel Lake that are used in the Larung Sesaji tradition.
6. Documentation of the research results on the diversity of freshwater fish in Ngebel Lake.

Designing stage

1. Arranging the module design, including designing the cover, preparing the content (description of endemic fish and the local wisdom in Ngebel Lake), managing the endemic fish anatomy pictures, and checking the grammar.
2. Developing the applied learning strategy, namely experimental learning.
3. Preparing the learning tools (material, media, and evaluation tools).
4. Compiling questionnaire of the students' responses to the module.

Developing stage

1. Validating the module by the experts, namely: media, material, and language expert, using validation sheets. The media validity criteria are described in Table 1.
2. Generating revisions based on comments from the experts to develop valid contextual-based modules.
3. Conducting initial developmental testing of the module (small scale), then testing it on a large scale.
4. Implementing the modules to students to see the effectiveness and feasibility of the module.

Table 1. Criteria for the validity of teaching materials

No	Percentage	Category
1	85,1% - 100%	Very valid, or can be used without revision
2	70,1% - 85%	Valid, or can be used but requires minor revisions
3	50,1% - 70%	Invalid, it is recommended not to use, as it needs major revisions
4	0,1% - 50%	Invalid, or may not be used

Disseminating stage

In the disseminating stage, the module is published through seminar forums. Then the module also disseminates for other institutions, especially for a biology study program or natural science study program.

RESULTS AND DISCUSSION

Defining stage

The observation results in the previously taught module showed that the material presented had no contextual pictures and no explanation of the various types of freshwater fish. The questionnaire results

showed that students had difficulty understanding the fish anatomical concepts. They also did not recognize the diversity of local freshwater fish. This fact was also supported by the low percentage of student who has understood the fish anatomical concept (60%). This is due to the anatomic language used in the previous module that was difficult to understand and it was not accompanied by a clear fish anatomical picture. Students could not compare the anatomy of one fish organ with another. Students did not know the types of freshwater fish found in the surrounding environment. Based on these analyses, it could be concluded that the module used in the Animal Anatomy course has not utilized the surrounding natural environment. Even though, the natural environment is the authentic learning resource, such as Ngebel Lake.

Endemic fish found in Ngebel Lake are fish used in the Larung Sesaji tradition. The diversity of freshwater fish that live in Ngebel Lake and the character values in the Larung Sesaji tradition were not yet utilized in learning activities. Students were not familiar with the existence of fish found in the surrounding natural environment and did not understand the local traditions of the area. This is an important condition to be improved in learning in higher education to develop their environmental awareness. According to B. G. Bergman (2016), environmental awareness is related to environmental attitude. Moreover, environmental attitudes interact with students' cognitive knowledge. Based on the results of community interviews around the Ngebel lake, the endemic fish species used in the Larung Sesaji tradition was Hampala fish. At the defining stage, identification and documentation of the types of fish found in the Ngebel Lake were carried out. These results were used to develop a contextual-based module. Contextual modules make college students able to study independently, learning is more meaningful (Hartini, Misbah, Helda, & Dewantara, 2017; Y.-M. Huang & Chiu, 2015; Koh, 2017; Martiningsih et al., 2019; Nilasari et al., 2016; Schumm & Bogner, 2016).

Designing stage

At this stage, a fish anatomy learning module based on local wisdom was arranged. The uniqueness of the module design lies in the linkage between the material and local wisdom traditions. The explanation of the fish anatomy is strengthened by the use of pictures of fish existing in the Ngebel Lake. The cover design and module content are shown in Figure 1.

Figure 1. The cover (a) and the first chapter (b) of fish anatomy learning module based on local wisdom. In the each chapter consists of students' learning outcome, learning objectives, and indicators.

One of the indicators of student achievement is to describe the anatomy of the endemic fish used in the Larung Sesaji tradition. The integration of local wisdom causes the module to be more contextual than the fish anatomy module in general. It can be a form of environmental education that have an impact on students' environmental attitudes (Oerke & Bogner, 2013), environmental awareness (Ningrum, Nandi, & Sungkawa, 2018), and environmental behavior (B. G. Bergman, 2016; Gould, Ardoin, Thomsen, & Wyman Roth, 2019; Morse, Carman, & Zint, 2019). The module explains the anatomy of the fish accompanied by pictures obtained from Ngebel Lake (see Figure 2). One of the materials related to fish anatomy discusses the diversity of fish structures found in Ngebel Lake. Several types of freshwater fish found in Ngebel Lake are

Osphronemus goramy, *Oreochromis niloticus*, *Cyprinus carpio*, *Clarias batrachus*, *Puntius javanicus*, *Pangasius pangasius*, *Colossoma macropomum*, *Hypostomus* sp., and *Hampala macrolepidota*.

Discussion on fish diversity includes morphological diversity based on the characteristics of scales, fins, mouth shape, gills, digestive tract, reproductive tract, blood circulation, and lateral line which is equipped with pictures (see Figure 2). The anatomical material in the module is present with comparative discussions. The discussions include the fish skeletal system, fish muscle system, fish nervous system, fish circulatory system, fish lymphatic system, fish respiratory system, fish digestive system, fish urogenital system, fish endocrine system, and fish sensory nervous system. In each system is completed with relevance pictures. The end of each discussion is completed with questions as an evaluation that can develop higher-order thinking skills.
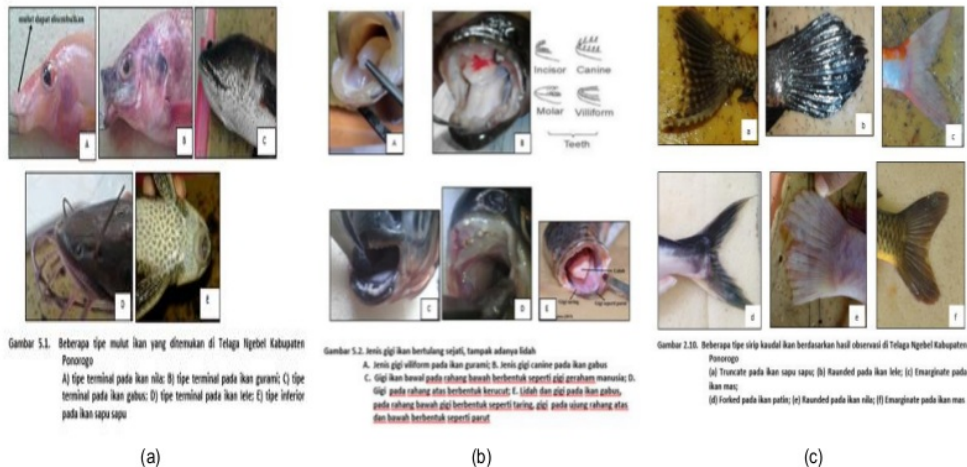

Gambar 5.1. Beberapa tipe mulut ikan yang ditemukan di Telaga Ngebel Kabupaten Ponorogo
A) tipe terminal pada ikan nila; B) tipe terminal pada ikan gurami; C) tipe terminal pada ikan gabus; D) tipe terminal pada ikan lele; E) tipe inferior pada ikan sapu sapu

Gambar 5.2. Jenis gigi ikan bertulang sejati, tampak adanya lidah
A. Jenis gigi villiform pada ikan gurami; B. Jenis gigi canine pada ikan gabus
C. Gigi ikan bawal pada rahang bawah berbentuk seperti gigi geraham manusia; D. Gigi pada rahang atas berbentuk kerucut; E. Lidah dan gigi pada ikan gabus, pada rahang bawah gigi berbentuk seperti taring, gigi pada ujung rahang atas dan bawah berbentuk seperti parut

Gambar 2.10. Beberapa tipe sirip kaudal ikan berdasarkan hasil observasi di Telaga Ngebel Kabupaten Ponorogo
(a) Truncate pada ikan sapu sapu; (b) Rounded pada ikan lele; (c) Emarginate pada ikan mas;
(d) Forked pada ikan patin; (e) Rounded pada ikan nila; (f) Emarginate pada ikan mas

(a)   (b)   (c)

Figure 2. The content of the module shows pictures of fish morphological characteristics obtained from Ngebel Lake, including the mouth shape (a), teeth (a), and caudal fins (c).

Development stage

The module design results are then validated by experts in the development stage. Expert appraisals are consist of media expert, material expert, and linguist. The validation results are presented in Table 2. The validation results from the media expert showed that the module was in a very valid category (86.5%) with several notes for module improvement. Module improvements include: (1) a more attractive packaged module design to clearly depict fish anatomy based on local wisdom; (2) fish pictures must use fish obtained from Ngebel Lake; (3) there is an explanation regarding the potential of Ngebel Lake and Larung Sesaji tradition; and (4) adding an explanation of the anatomy of the Hampala fish as endemic fish in Ngebel Lake.

Table 2. The validation results from experts

No	Criteria	Media Expert (%)	Material Expert (%)	Language Expert (%)
1	The module design is interesting because it illustrates the content and suitable presentation of modules for learning design.	82	86	84
2	The content/material is accompanied by an explanation, pictures of the structure of freshwater fish are presented contextually.	87	91	86
3	The contents/material can stimulate students to find out more about a topic.	86	87	86
4	The language is easy to understand.	85	86	84
5	Presentation of learning evaluation that can develop thinking ability and skills.	84	85	85
6	The presentation of the freshwater fish anatomy module at Ngebel Lake can develop local wisdom values.	95	94	87
	Mean score	**86.5**	**88.2**	**85.3**

Similar to media experts, the same category was obtained from material experts (88.2%) and linguists (85.3%). In general, the expert appraisal results show that the module is very valid to use and has an

explanation of the potential and uniqueness of Larung Sesaji tradition. The module is presented contextually using the endemic fish of Lake Ngebel. Based on the results of community interviews, Hampala fish is used in the Larung Sesaji ceremony at Ngebel Lake which is carried out every first Suro night (Javanese calendar). This is a traditional ceremony as a form of public gratitude for God's salvation. The offerings at the Larung Sesaji traditional ceremony are in the form of *buceng* or *tumpeng* (cone-shaped rice) which consists of various fruits, vegetables, and other agricultural products (Yuliamalia, 2019). The procession is accompanied by Javanese *gamelan* (traditional Javanese musical instrument) and *reog* (traditional Javanese dance). One of the crops offered is the Hampala fish that believes as legendary fish in Ngebel Lake and only found in this lake. Based on the legendary story of the origin of Ngebel Lake, there are moral values that have been developed, namely help each other, not being greedy, not insulting others, and always being grateful for God's grace.

The module is equipped with pictures of fish objects with contextual explanations. The presentation of material and evaluation can develop students' curiosity and thinking skills. Besides, it is also equipped with local wisdom values that motivate students to preserve cultural traditions in their environment. A similar statement from Aliman, Budijanto, Sumarmi, and Astina (2019); Ningrum et al. (2018); Ramdiah, Abidinsyah, Royani, Husamah, and Fauzi (2020); and Sujinah, Mu'ammar, Affandy, and Supriyanto, (2019) that local wisdom-based learning can influence students' understanding and environmental awareness. This is also supported by the results of the students' response questionnaire which is presented in Table 3. It revealed that the module is feasible to use (in a very valid category). Students feel enjoy learning the anatomy of freshwater fish because the module is equipped with pictures of fish that the students already know it. The module also complete with anatomical terms that easy to understand. The module that is provided with local wisdom material on Larung Sesaji in Ngebel Lake, makes students motivated to learn freshwater fish anatomy. The evaluation in the module is easy to understand and 85.1% of students state that the module can present the local wisdom values of Telaga Ngebel.

Table 3. Student responses to the modules in the limited test

No	Criteria	∑	%
1	In my opinion, the module design is very interesting because it precisely describes the contents of the module.	84	89.4
2	I can easily study the contents of the module because the presentation of the material is arranged in a structured manner.	82	87.2
3	I can understand the contents of the material easily, because the module is equipped with explanations, and the pictures are presented contextually so that they are easy to understand.	81	86.2
4	The language used in the module is easy to understand, communicative, and accompanied by images to describe difficult anatomical terms.	86	91.5
5	The evaluation is presented clearly, it is easier for me to study the contents/material of freshwater fish structures and the endemic fish of Ngebel Lake.	83	88.3
6	The module contains the values of local wisdom around Ngebel Lake.	80	85.1
	Mean score	**82.6**	**87.9**

Furthermore, the results of the module trial in small groups showed that the average value of students' conceptual understanding was 82.3 (above the minimum standard). This shows that the anatomy learning module based on local wisdom has a positive impact on students' understanding. As Ningrum et al. (2018) explained, local wisdom-based learning affects students' understanding. Learning using modules encourages students to learn independently because they can construct their knowledge at any time (Serrat et al., 2014; Setiyadi, Ismail, & Gani, 2017; Thang & Koh, 2017). Students can understand the concept of fish structure because the module is equipped with pictures with appropriate explanations. Students become more active and motivated to understand the material.

The same result occurred in large-scale trials, the average value of students' understanding of concepts was above the minimum standard (85.6). The success of learning anatomy structures requires a balance between memorization, understanding, and visualization (E. M. Bergman et al., 2013; Serrat et al., 2014). From this module, students easily learn the morphological and anatomical structure of freshwater fish. The anatomical structure of freshwater fish is easy to understand by the students because the fish object in the module is the result of observations in the Ngebel Lake area. Fish anatomy learning becomes more meaningful because of the integration of the local wisdom-based module. According to Ganguly (2010) learning using modules that are designed contextually based on living objects can improve students' understanding of concepts. The module content is developed based on local wisdom found in students' environments. Hartini et al. (2017) assert that local wisdom is an important and effective material used in learning to attain the intended moral values.

Students can get to know the character values of the local wisdom of Larung Sesaji in Ngebel Lake and can understand the concepts of freshwater fish. Learning using animal anatomy modules designed with real examples in explaining abstract concepts will help students understand concepts. The contextual learning resource can promote students' comprehension (Martiningsih et al., 2019; Ningrum et al., 2018; Raub et al., 2015; Triyani et al., 2019). Contextual modules based on local wisdom can also produce the values of the community's local wisdom. Learning by integrating fish anatomy concepts with local wisdom can improve understanding of learning material because students are already familiar with fish objects found in their environment.

CONCLUSION

The fish anatomy learning module based on local wisdom in Ngebel Lake, Ponorogo, East Java has been developed and is suitable for use as a learning resource. The results of the validation of the media, material, and language experts indicated that the module was very valid with the respective percentages of 86.5%, 88.2%, and 85.3%. Besides, student responses reached 87.9% (very good). Learning using modules that are constructed contextually based on environmental phenomena can be a possible option to improve students' understanding of concepts and their environmental awareness.

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