The development of learning resources through Benthic species study in mangrove ecosystem Reuleung Leupung for invertebrate zoology learning

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Abstract. This study aimed at developing learning resources through the use of bottom water biota aquatic Mangrove Ecosystem Reuleung, Leupung, and to analyse the composition of biota bottom waters as a source of learning of invertebrate zoology of the students of Undergraduate Program in Biology Education. The research was conducted from July to September 2017 in mangrove ecosystem area of Reuleung Leupung, Indonesia. Two lecturers and three laboratory assistants from Syiah Kuala University and Ar-Raniry Islamic University participated in this study. Data on aquatic biota species as a learning resource was analysed by using percentage formula, while the dominant level of marine biota was analysed by using dominance formula. The results showed that the amount of aquatic biota used ranged from 3.13% to 93.75% and the composition of the use of each species ranged 0.03 to 0.94. It can be concluded that bottom biota which has the highest percentage as learning resource used in study is Moluska Phylum from Class Gastropoda, while Phylum Crustacea from class is widely used in learning is the Malacostraca Class. The composition bottom biota as a learning resource in Invertebrate Zoology learning is low to high.

1. Introduction
Zoology Courses is a course in the Department of Biology Education at FKIP Syiah Kuala University and in FTK UIN Ar-Raniry Darussalam Banda Aceh. This course studies various animals that do not have vertebrae on their bodies, including Porifera Phylum, Coelenterata, Platyhelminthes, Nemathelminthes, Annelids, Molluscs, Crustaceans, Mandibulates, Rotifers, Small Phylum, and Echinodermata Phylum [1].

Invertebrate Zoological Learning conducted in accordance with the curriculum of Biology Education Studies Program, implemented in theory and practice. The implementation activities are theoretically conducted in the lecture hall, which has been arranged according to space, time and lecturers who take care of the course. While the practice is done in the laboratory by using various preparations and animal specimens that belong to Invertebrates so that the learning process that is done through the approach of theory and approach of the lab work well and get the results in accordance with the curriculum expectations.

Specimens and animal preparations used in learning as learning media in learning activities, consist of terrestrial fauna and aquatic fauna obtained from the various habitats of each species of the animal.
One group of animals as aquatic fauna used as a learning resource for learning in the lecture hall and in the practicum room is the bottom biota of the waters.

Benthic is a waters fauna that occupies the bottom of the waters, including biota crawling, sticking or immersing in freshwater waters, brackish, and salt waters, especially at the bottom of waters and in water bodies [2]. Freshwater, brackish and saltwater (marine) waters are widely used as aquatic biota habitat in various regions of the world [3], especially in the tropics and one of them is the waters of Payau Reuleung Leupung River of Aceh Besar Aceh Province.

Phylum studied in the study of Invertebrate Zoology courses [4], generally using the example of species either in the form of drawings or biota as other learning sources derived from other place. Even examples of species used in the learning process in each class, order, family, genus, species, and various subspecies emerge only in the form of images originating from the literature or from other sources. This condition may emerge as obfuscation to students as learners to recognize the species of the animal, because the animals shown as examples are rarely found in their environment.

Invertebrate Zoology Learning Courses at Syiah Kuala University and at Ar-Raniry Darussalam State Islamic University Banda Aceh still use animal samples from various kinds of literature as learning resources. Many animals are used as a source of learning so far in each phylum based on existing literature books, with animal samples from other places and examples of animals shown differently from examples of animals that exist in the student environment. This can lead to an example of a learning resource for each phylum or concept conveyed in the lesson still far from the curriculum expectations.

The learning process in each course according to the curriculum provision is expected that the animal samples presented in the learning of each phylum, are sourced from the learner's environment. The use of learning resources derived from the environment of these learners is expected that learners can more easily recognize animals systematically presented in the learning of each concept of learning.

Mangrove ecosystem Reuleung District Leupung Aceh Besar district is one of the living areas of various animals belonging to Invertebrates and Vertebrata. Invertebrates found in this area according to Sarong et. al [4] including mangrove shells Geloina erosa, Faunus ater, Turritella terebralia, and Saccrostrea Filum sp from Moluska, Macrobranchium sp., Ucha sp., And Scylla sp. member of the Phylum Crustacea [5]. Besides, [6] research conducted found 12 species of 6 phyla, and research [10] which found 10 species of 7 phyla. While Vertebrate contained in the mangrove ecosystem Reuleung Leupung is Valamungil sp., Lutjanus sp., Chanos chanos, and Varamus sp.

Mangrove ecosystem area Releung Leupung Aceh Besar district has been widely used as a research area by students [7]. Reuleung Leupung mangrove area is easy to reach by students because the location can be reached by public vehicles, private vehicles and not far with the campus of Syiah Kuala University and the Campus of the Ar-Raniry State Islamic University of Darussalam, Banda Aceh.

Observing the condition of mangrove ecosystem area of Reuleung Leupung Regency of Aceh Besar with various species of Invertebrate and Vertebrata, of course, this area can be used as a source of learning various species of biota base of waters or various species of another aquatic biota. Species from the bottom biota of waters contained in the mangroves Reuleung Leupung this can be used as a source of learning to study Invertebrate Zoology in universities, especially at Syiah Kuala University and at the State Islamic University Ar-Raniry Darussalam Banda Aceh.

The objectives of the research are to develop learning resources through the study of the bottom biota of marine ecosystem Mangrove Reuleung Leupung in Invertebrate Zoology study as well as to analyze the composition of the bottom biota of water as a learning resource in Invertebrate Zoology study in Biology Education Study Program. The benefits of this study can provide information about the species of aquatic biota that can be used as a learning resource in Invertebrate Zoology learning in Higher Education.
2. Research methods

2.1. Place and time research
Research conducted in the area of Mangrove Ecosystems Reuleng Leupung River, Aceh Besar District, Aceh Province, to lecturers and lab assistants of Invertebrate Zoology in Biology Education Program of Syiah Kuala University and Biology Education Program of Ar-Raniry Islamic State University, Indonesia. Baseline biota use using Ekman Grap and quadrant using survey method, and analysis of species and species composition of marine biota is conducted in Biology Education Laboratory, Syiah Kuala University, in July 2017. Data collection using Biota Bottom waters used in the concept of learning is done on the students of these two courses are traced through a book of practicum activity assistance, and a search through a practicum book used by the student at each practicum.

2.2. Determination of observation station, sampling plot and source of
2.2.1 Animals sampling and data source learning concept of
Mangrove Ecosystem Reuleung Leupung of Aceh Besar Regency as a research area, divided into 3 stations: Station 1 mangrove ecosystem of the river estuary, Station 2 mangrove ecosystem in flow and station 3 mangrove area in the early area of the brackish waters of the Reuleung Leupung River of Aceh Besar District (Figure 1). Each station is set 5 sampling plots measuring 1 m x 1 m, conducted by purposive sampling that takes into account the presence of species of biota base waters in the mangrove ecosystem of Reuleung Leupung River, Aceh Besar District. The aquatic biota species was taken by damaging the sampling plots and then cleaning, after which each sampling plot was identified at each station. The species is recorded in number and the number of individuals tabulated in the observation table will be used as a learning resource in the learning process.

Each species and individual aquatic biota that has been obtained in the field as a source of learning, then tabulated according to concepts, phyla, and classes are taught in the Invertebrate Zoology Course. Each concept that uses aquatic biota is derived from a practicum guide used by students at the time of practicum and from an assistant who handles students doing the practicum. Meanwhile, the use of aquatic biota in learning in the lecture hall, obtained through a lecturer who teaches Invertebrate Zoology Courses. All of these data are recorded in the observation table, which has been prepared in advance.

2.2.2. Learning concept
The concept of learning using the bottom biota species of mangrove ecosystem waters of the Reuleung Leupung River of Aceh Besar District as a learning resource was obtained through the study of the Invertebrate Zoology practice manual of each Study Program [4]. To complete the data about the concept of learning that uses basal biota as a source of learning, we also conducted interviews with Lecturers and three laboratory assistants of Invertebrate Zoology Courses in each study program.
3. Data analysis

3.1. Percentage of each phylum and class as a source of learning
Percentage of each species of phyla and class which is used as a learning resource is done through a descriptive approach, after being studied through simple statistics in the form of modified percentages [5]. The formula used in this calculation is shown as follows.

\[
\text{Percentage of Use} = \left( \frac{\text{Number of species each phylum} / \text{class}}{\text{Total species of each phylum/grade}} \right) \times 100\%
\]

If a percentage of 0-20% means very low usage, 21-40% means the low use, if 41-60% means Medium usage, if 61-80% means high usage, and if the percentage of 81-100% means very high usage.

3.2. Composition
Analysis of the composition of the use of marine aquatic species in the development of learning resources conducted descriptively after the study through simple modified composition formula. The calculation formulation of the composition of the use of marine aquatic species as a source of learning with the formulation as follows.
Number of species used
Composition = ---------------------------------- x 100
Total species

Composition (K) use ranges from 0 -1, if K = 0,00-0,50 means low use composition, if K = 0,50-0,75 medium use composition, and if C = 0,75-1,00 high usage composition [6].

4. Results and discussion

4.1. Percentage of species each phylum and class as a learning source
Percentage of each species of phylum used as a learning resource in the Invertebrate Zoology Course ranges from 3.13% to 87.50%. Meanwhile, the percentage used by basin biota based on class as the source of learning ranging from 3.13% to 62.50%. The percentage of species of aquatic biota used as a learning resource in the Invertebrate Zoology study based on phyla and class is presented in Table 1.

Table 1. Percentage of species used learning resources learning zoology invertebrate

| No | Phylum     | Number of species | Percentage species phylum | Species used | Classes       | Number of species | Percentage species class | Species used |
|----|------------|-------------------|---------------------------|--------------|---------------|-------------------|------------------------|--------------|
| 1  | Porifera   | 0                 | 0                         | -            | Calcarea      | 0                 | 0                      | -            |
| 2  | Coelenterata| 0                 | 0                         | -            | Hydrozoa      | 0                 | 0                      | -            |
| 3  | Platyhelminthes | 0             | 0                         | -            | Trematoda     | 0                 | 0                      | -            |
| 4  | Nemathelminthes | 0             | 0                         | -            | Nematodes     | 0                 | 0                      | -            |
| 5  | Annelida   | 1                 | 3.13                      | Low          | Polychaeta    | 1                 | 3.13                   | Low          |
|    |            |                   |                           |              | Oligochaeta   | 0                 | 0                      |              |
| 6  | Mollusk    | 28                | 87.50                     | Gastropod    |              | 20                | 62.50                  | Medium       |
|    |            |                   |                           | Bivalves     |              | 8                 | 24.24                  | Low          |
|    |            |                   |                           | Polyclacopora|              | 0                 |                        |              |
| 7  | Crustaceans| 3                 | 9.38                      | Malacostraca |              | 3                 | 9.09                   | Low          |
| 8  | Echinodermata| 0              | 0                         | Holothuroidea|              | 0                 |                        |              |
| 9  | Small Phylum| 0                | 0                         | Acanthocephala|              | 0                 | 0                      | -            |
|    | Total      | 32                | 100                       | -            |              | 32                | 100                    | -            |

The results of the analysis listed in Table 1 show that there are three phyla from the bottom biota of Mangrove Ecosystem Reuleung Leupung ecosystem, which is used as a learning resource in the process of Invertebrate Zoology in Syiah Kuala University and at Ar-Raniry State Islamic University Banda Aceh. Species from Phylum Mollusca had the highest percentage of use as a learning resource of 87.50%, while the species of Phylum Annelida and Phylum Crustacea had the lowest usage rate of 3.13% and 9.38%, respectively.

The phylum molluscs learning process that uses various species as a learning resource in learning Invertebrate Zoology is necessary [11], because in addition to using the body as an animal study also uses the shell as a protective animal body. Students as learners can study more closely about the body of the molluscs concerning the body structure of each species such as the structure of the gonads and the structure of the body system it possesses, in addition to using the shells of each species to study morphology, and the anatomy of each shell [12]. Sarong et al. [13] stated that the female gonadal structure of Geloina erosa (Bivalve) as one of the members of the class of Phylum Mollusc is different from the female gonadal structure. This can be observed from the morphology and anatomy of each
gonad studied in accordance with the objectives of learning, using the bottom biota of the water directly as a source of learning so as to obtain maximum results.

When examined for the presence of species in these three phyla, it shows that Mollusca Phylum has the largest species, used as a learning resource in the study of Invertebrate Zoology. This indicates that the species of the Mollusca Phylum are found in the waters of the Reuleung Leupung municipal ecosystem of Aceh Besar Regency. The existence of species from this phylum in the bottom waters of mangrove ecosystem Reuleung Leupung, because this mangrove ecosystem has salinity with various litter that has been able to be exploited by basin biota including Mollusca Phylum. This is in accordance with the opinion of Sarong [14], [15] which states that the basal area of mangrove ecosystem of Aceh Besar Regency, many have mud with various leaf litter detritus of mangrove. The mangrove litter is utilized by a variety of aquatic fauna [16], especially the aquatic biota consisting of infauna and epifauna, as a source of food in life at the bottom of the waters. Nasution [17] stated that the Moluska Phylum that lives in the waters bottom of the waters of Bintan Riau, utilizing algae, plankton and detritus as the food source.

At the grade level, the species of the Gastropoda Class are widely used in the Invertebrate Zoology study process, to examine the taxonomic hierarchy ranging from the phyla, class, order, family, and at the genus level. The use of species in each of this taxonomic hierarchy, as the main specimens, assess and know more fully the existence of these aquatic biotas in each hierarchy. The class of Gastropods as the bottom biota of waters living in the waters of the mangrove ecosystem of Reuleung Leupung, has the most widely used species in the study of Invertebrate Zoology. Many species of this class that live at the bottom of the waters of this mangrove ecosystem, Konsep an existence of food components available in the bottom waters of this mangrove ecosystem. Many mangrove leaves become litter decomposed by various microbial base waters to become detritus and become a source of energy for aquatic biota including Gastropoda [18]. [13] Meanwhile, Bivalvia, Polychaeta and Malacostraca Classes are not so many species found in this region, so there is not much that can be used in Invertebrate Zoology.

4.2. The composition of species biota bottom waters as a source of learning invertebrate zoology

A composition of species Biota Bottom Waters of Mangrove Ecosystem Reuleung Leupung Aceh Besar District used as a learning resource in Invertebrate Zoology, ranging from 0.03 to 0.87. This suggests that the composition of the use of aquatic biota species as a learning resource in the Invertebrate Zoology Initiative is low to high, and can be considered in Table 2.

The concept of learning Invertebrate Zoology that has the composition of the use of Biota bottom waters Mangrove Reuleung Leupung high is the concept of animal classification with the composition 0.94 and the concept of Phylum Mollusc with a composition of 0.87. Both of these concepts comprise the use of species as a source of learning is high because the availability of species required in both these concepts is very much found in the bottom waters of mangrove ecosystem Reuleung Leupung Aceh Besar District. [5] which acquired 15 bottom biota species of waters of the Reuleung Leupung mangrove ecosystem, as aquatic biota belonging to the Gastropoda Class, Bivalves, and Malacostraca Classes. Many of the results of the research resulting from the benthos group found in the waters of the mangrove ecosystem of Reuleung Leupung of Aceh Besar Regency can be used as learning resources in Invertebrate Zoology.

Studying the concept of learning in Invertebrate Zoology more closely and producing maximum learning outcomes, can be done by using various components required in the concept [19]. The concept of classification of animals and the concept of Phylum Mollusks requires the object of direct study derived from the environment such as various species of biota base waters scattered in various bottom biota waters including the mangrove waters of Reuleung Leupung Aceh Besar [20].
Table 2. The concept of learning using species biota bottom waters as a source of learning

| No | Concept                          | Condition species | Used | Index composition | Composition |
|----|----------------------------------|-------------------|------|-------------------|-------------|
| 1  | Classification of animals        | 30                | 0.94 | Height            |             |
| 2  | Nomenclature and naming rules    | 20                | 0.62 | Medium            |             |
| 3  | Phylum Porifera                  | 0                 | 0    | -                 |             |
| 4  | Filum Coelenterata               | 0                 | 0    | -                 |             |
| 5  | Phylum Platyhelminthes           | 0                 | 0    | -                 |             |
| 6  | Phylum Nemathelminthes           | 0                 | 0    | -                 |             |
| 7  | Filum Annelida                   | 1                 | 0.03 | Low               |             |
| 8  | Phylum Mollusca                  | 28                | 0.87 | Height            |             |
| 9  | Phylum Crustacea                 | 3                 | 0.09 | Low               |             |
| 10 | Phylum Mandibulata               | 0                 | 0    | -                 |             |
| 11 | Phylum Echinodermata             | 0                 | 0    | -                 |             |
| 12 | Small Phylum                     | 0                 | 0    | -                 |             |

5. Conclusions
Conclusions obtained from the results of data analysis in this paper, among others, can be described as follows. The bottom water biota that has the highest percentage as a learning resource is the Moluska Phylum from Gastropoda Class, while the Phylum Crustacea from the Malacostraca Class is the least utilized in Invertebrate Zoology study used in Invertebrate Zoology study at Syiah Kuala University and UIN Ar-Raniry. Moreover, the composition of bottom water biota of mangrove ecosystems of Reuleung Leupung municipality of Aceh Besar Regency as a learning resource in low to high Zoology Invertebrate learning.

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