Empowerment of Animalia Classification Material: A Review of Literature

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	ABSTRACT
  	This article is a literature review that discusses the characteristics of animal classification as biology learning material. Animalia classification material is one of the materials that are difficult for students to understand. So the purpose of this literature review is to analyze the characteristics of Animalia classification material to determine and find the right way of empowerment so that students can receive the material well. The method used is a systematic literature review (SLR) with PRISMA guideline, reviewed from 2013-2023 with certain criteria. The literature obtained based on these criteria obtained as many as 150 articles from Google Schoolar, Scopus, and Web of Science, but after analysis based on abstracts, keywords, research methods, and discussion, 21 articles were finally selected. The results of the literature review show that Animalia classification material can be empowered with a learning model that is collaborative learning combined with online visual media. One of the learning innovations that can be used is project-based learning in online media.

1. INTRODUCTION

Biological material that is quite difficult to understand, one of which is taxonomic (Arifin et al. 2019). The material requires a specific description so that students can understand the classification clearly (Istiani and Retnoningsih 2015). Students consider taxonomy material to have a wide scope so it requires clear examples or depictions so that it can be understood well and easily (Aziz et al. 2021).

Taxonomy is a branch of learning in biology that is systematic (Mayr 2015). Systematics in classification is concerned with learning about the identification, naming (nomenclature), and classification of a living thing. The classification of an organism can be grouped based on physical or nonphysical characteristics. The classification system of living things was first introduced by Linnaeus in 1735, which divided the grouping of living things into two groups called the two-kingdom classification system (Verma and Prakash 2020). The classification system of the two

kingdoms distinguishes living things into kingdoms Plantae (plants) and Animalia (animals). From 2015 to date, the classification system has developed into seven kingdoms consisting of Bacteria, Archaebacteria, Protozoa, Chromista, Fungi, Plantae, and Animalia (Rudyshyn and Samilyk 2015).

The purpose of classifying living things is to simplify the grouping of abundant biodiversity (Swift et al. 2004). To date, more than 1.6 million species have been identified. One of the kingdoms with the most varied members is the animal kingdom. Kingdom Animalia is grouped into two major groups, namely invertebrates and vertebrates (Verma and Prakash 2020). Furthermore, the two groups are further divided into several taxon orders after kingdom, namely phylum, class, order, family, genus, and species (Mohammed et al. 2011). Each taxon sequence has specific features that characterize the group of a species (Segata et al. 2012). The concept of animalia classification should not be rote but needs to be understood so that when students are confronted with real circumstances they will easily group the individual into the taxa sought (Hamidah et al. 2019).

The concepts of Animalia classification are often not easily accepted, not only because of their characteristics but can occur for other reasons, affecting students' understanding of animal classification. One of the causes that often complicates the acceptance of concepts is the lack of explanation from sources (Simpson 1961). In addition, learning media can affect the acceptance of the concept of animal classification (Widodo and Utomo 2021). The need for learning media that can accommodate the characteristics of Animalia classification material can be sought or further developed (Putri, 2016).

This article examine more deeply the characteristics of Animalia classification material and determine the right learning to deliver Animalia classification material so that students can understand the classification system, not just memorize it. So the purpose of this literature review is to analyze the characteristics of animalia classification material to determine and find the right way of empowerment so that students are able to receive the material well.

2. MATERIALS AND METHODS

The method used is Systematic Literature Review (SLR). The guideline used in this research literature review is PRISMA. PRISMA provides a methodological standard for selecting usable literature (Rethlefsen et al. 2021). SLR is performed to identify, analyze, and interpret all available information. The SLR stage begins with determining the formulation of the research problem. The formulation of the research problem is 1) What are the characteristics of Animalia classification material in biology learning?; 2) How to empower Animalia classification material in biology learning?; and 3) How to choose the right learning to meet the characteristics of Animalia classification material in biology learning?

The literature search is carried out by determining criteria related to Animalia classification material. The initial literature obtained was selected based on predetermined criteria, namely: 1) reputable Indonesian and English articles; 2) Articles are collected from electronic databases (Google Scholar, Scopus, and Web of Science) using the following keywords: animal kingdom material in biology, animal taxonomy in biology, animal kingdom material, Animalia classification, and animal taxonomy learning; 3) The search is limited to articles published from 2013 to 2023; and 4) The article contains a clear identity such as title, author, and year.
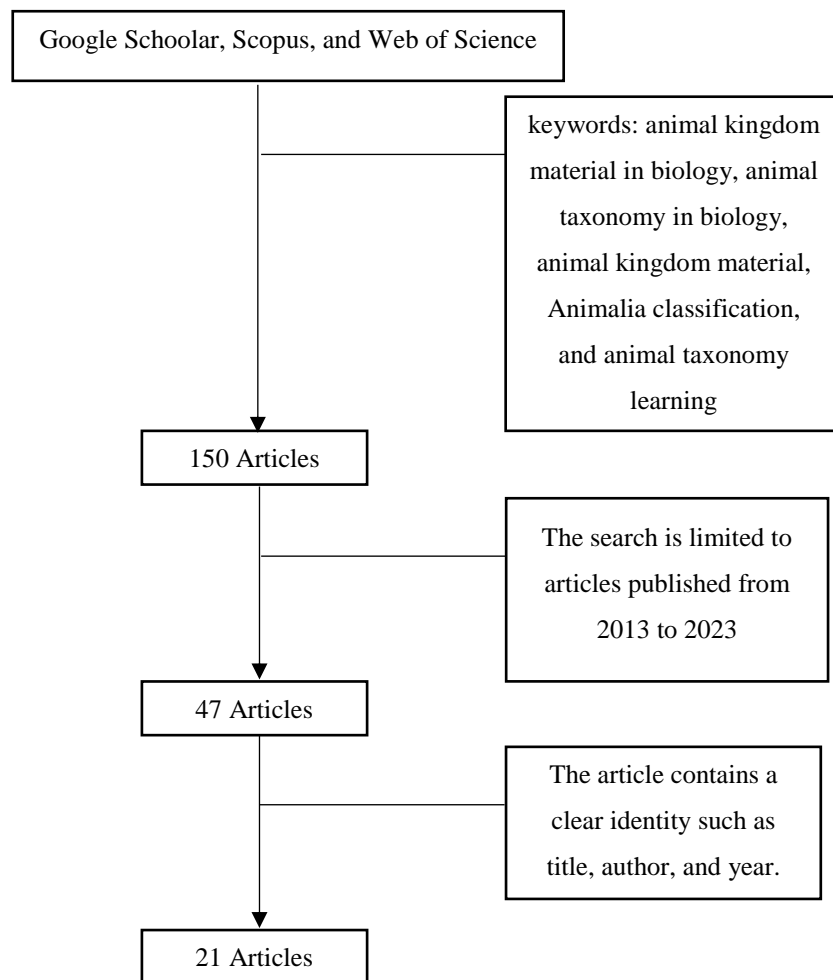
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Figure 1. Flow Chart of Literature Search

The selection of articles that match the criteria is done by filtering titles, abstracts, and keywords. The results of the literature based on the requirements amounted to 150 articles from Google Schoolar, Scopus, and Web of Science. However, after being analyzed based on the discussion, finally 21 articles were selected that could be used as study material for the research objectives (see Fig. 1). This article discusses the characteristics of Animalia classification material, how to empower learning animal classification material, and how to learn about Animalia classification material.

3. RESULTS AND DISCUSSION

3.1. Literature Review Result

This study discusses the characteristics of animal classification material, how to empower learning animal classification material, and how to learn about animal classification material. The list of review articles used as a study can be seen in the table below (**Table 1**).

Table 1. Article Reviews

No	Author	Title	Year	Review
1	Emilia Fägerstam and Jonas Blom	Learning biology and mathematics outdoors: effects and attitudes in a Swedish high school context	2014	It is better to give questions regarding the taxonomy of animal classification in essay form to practice analytical skills.
2	Michael Allen	Preschool children's taxonomic knowledge of animal species	2015	How to learn the classification of Animalia by describing and comparing the structure of animals
3	Noah Wafula Wekesa and RaphaelOdhiambo Ongunya	Project Based Learning on Students' Performance in the Concept of Classification of Organisms among Secondary Schools in Kenya	2016	Project based learning is a model that can be used for Animalia classification material.
4	Didem Kılıç	Pre-service Teachers " Conceptual Structures and Reasoning Patterns on Animal Classification. Universal Journal of Educational	2016	Discussion activities or peer learning can occur and the use of animal classification materials and models allowing concrete experiences can be suggested to facilitate the creation of connections about animal characteristics.
5	Alex R. Hardisty, et al.	BioVeL: a virtual laboratory for data analysis and modeling in biodiversity science and ecology	2016	The concept of taxonomy is a branch of biology related to the naming, identification, and classification of organisms to facilitate scientific communication towards biological objects.

No	Author	Title	Year	Review
6	Putri Agustina	Senior High School Biology Teacher Perception about Learning Media for the Subject of Animals Kingdom	2017	Learning about kingdom classification requires simple animal identification and determination activities.
7	Ben G. Weinstein	A computer vision for animal ecology	2017	Animalia classification material can be presented with computer-based media
8	Valleta, Torney, Kings, Thornton, and Madden	Applications of machine learning in animal behaviour studies	2017	Classification of animals can be grouped with the help of videos
9	Alexander Weiss	Personality Traits: A View From the Animal Kingdom	2018	Kingdom Animalia has many theories in its classification
10	Willi, Pitman, Cardoso, Locke, Swanson, Boyer, Veldthuis, and Fortson	Identifying animal species in camera trap images using deep learning and citizen science	2018	Animalia classification material needs to be visualized to be able to identify animal characteristics
11	Jana Wäldchen and Patrick Mäder	Machine learning for image based species identification	2018	One simple way to identify species to determine their classification is through pictures.
12	Zofia Anna Chyleńska and Eliza Rybska	Understanding Students Ideas about Animal Classification	2018	In learning animal classification students must understand the basic concepts to achieve the classification of species that are rarely found
13	Fahad Alharbi, Abrar Alharbi, and Eiji Kamioka	Animal species classification using machine learning techniques	2018	Unique characteristics of animals such as ears and eyes can observe by image
14	Zayyana Fatati Azizah, Puguh Karyanto, and Yudi Rinanto	Challenges and opportunities of using virtual laboratory in teaching biodiversity and classification	2019	Project-based learning is one of the constructive strategies for enhancing the meaningfulness in

No	Author	Title	Year	Review
15	Andro Satria, Afreni Hamidah, and Upik Yelianti	Development of Magic Disc on Animal Taxonomy Material for Student of Senior High School	2019	Animal classification material is not memorized but needs to be understood.
16	Intan Delia Tivania Putri, et al.	Learning Kingdom Animalia Material Using AnimalPedia	2020	Material about the kingdom Animalia is better conveyed in visual form.
17	Kombe Musonda and David Chituta	Impact of Problem Based Learning on Learner Achievement and attitude in Animal Taxonomy: A case at Kasama College of Education	2020	Classification of animals can be grouped by looking at traits such as morphology, physiology, behavior, and distribution.
18	Yulyani Arifin, Hendra, Rosyid Prasetio Wibowo, and Ozsa Praditiya	Taxondroid: Design Interactive Application for Animal Taxonomy Learning Using Teen-Computer Interaction Approach	2020	Classification of animals can be understood by looking at the anatomy and structure of the body, so it requires learning media that can visualize it
19	Diamanto Filippatou and Stavroula Kaldi	The Effectiveness of Project-Based Learning on Pupils with Mild Learning Difficulties: A Preliminary Study	2020	Project based learning is effectively used as a learning model in marine animal classification material.
20	Yigal Rosen, Iris Wolf, and Kristin Stoeffler	Fostering collaborative problem solving skills in science: The Animalia project	2020	Collaborative learning is the best approach for identifying and classifying Animalia.
21	Astried Pascafitri Harenda, Puguh Karyanto, and Muzzazinah	Online Learning Design for Animalia Classification Materials With Discovery Learning-Based Learning Videos and Vee. Diagrams	2021	Video can be used as a semi-contextual learning medium for classifying animals when it is unable to present real animals

The table show 43% of literature reviews stated that empowerment of learning methods is needed in order to improve students' ability to describe, analyze, and group animals into an appropriate classification. This method of empowerment based on the results of the literature of

43% stated that it can be done by developing the right learning media, the learning media studied in the literature of 10% stated that project-based learning in online media.

3.2. Characteristics of Animalia Classification Material in Biology Learning

Animalia classification material has characteristics that biology teachers must know to conduct appropriate learning. The characteristics of Animalia classification materials include::

a. Taxonomy is the study of theoretical, basic, principles, procedures, and classification rules (Simpson 1961).

b. Selection and use of words that are difficult for ordinary people to understand (Simpson 1961).

c. The material is difficult to present in a systematic and interesting form (Mallik and Ramani 2015).

d. Requires the definition of terms so that the material can be conveyed properly (Simpson 1945).

e. Experience the novelty of science continuously (Elshahed et al. 2008).

f. Has many theoretical approaches (Weiss 2018).

g. Wide material coverage due to the potential for interbreeding (Simpson 1961).

h. Many animals do not yet have a clear classification (Simpson 1961).

i. Homology is the basis of classification and phylogeny (Hall 2012).

j. Need references to study taxonomic material (Simpson 1961).

k. Many subspecies of species are distinguished by geographical location (Simpson 1961).

l. In modern taxonomy, it has more to do with populations rather than individuals (Simpson 1961).

The classification material of Animalia is described as broad because of the many variations within each species. So it requires the right approach in the learning process. The learning process in animal classification material requires the unity of appropriate models, media, and learning techniques to be conveyed properly. Thus, the concept of learning Animalia classification must find an ideal foundation to organize various tools and practices in the best way.

3.3. How to Empower Animalia Classification Material in Biology Learning

How to empower Animalia classification material can be done by applying learning that is constructivism and collaborative learning. Constructivism is carried out to achieve meaningfulness in learning Animalia classification, strengthening students' ability to recognize animal traits to be classified in taxon (Azizah et al. 2019). Collaborative learning is used as a means of student discussion in groups because in animal classification material a lot of information needs to be explored so that collaboration between students in sorting and determining information can be done more quickly and precisely if done together (Rosen et al. 2020).

Project based learning (PjBL) is one of the learning models in which there are constructivism and collaborative learning strategies. PjBL has proven effective as a learning model in Animalia classification material (Azizah et al. 2019; Filippatou and Kaldi 2016; Wafula and Ongunya Raphael Odhiambo 2016). PjBL is a project-based learning model that has five stages, the five stages in PjBL can empower students' ability to analyze and group animals into their classification system.

The first stage is planning an investigation process according to driving questions: students can identify various types of animals, determine specific markers on these animals, and formulate problems to be solved (Turgut 2008). This stage will accommodate a person to raise initial questions as the initial process of achieving higher-order thinking skills and analytical thinking.

The second stage is searching for the theoretical background of the driving questions: students collect and analyze theories that can answer problem formulations (Turgut 2008). At this stage, a thesis or statement can be raised as an answer to the problem formulation.

The third stage is presenting that theoretical background to class and discussion about issue: students present the results of exploring the information that has been obtained and discuss it in groups (Turgut 2008). Discussion in groups is intended so that students obtain more evidence that can be used to answer problem formulations.

The fourth stage is deciding the study group the way of collecting data and data analysis: students and group mates make a decision to start the project (Turgut 2008). At this stage, students must be able to collaborate to connect answers to problem formulations and information that has been obtained to be able to compile projects well.

The last stage is evaluating data, arriving a conclusion, presenting the project in class as preferred and discussion (Turgut 2008). At this stage, students can evaluate information data to compile a logically reasoned conclusion based on the project that has been produced. The final stage is to present the results in class discussion.

3.4. Proper Learning for Animalia Classification Material

Based on the characteristics of the material, Animalia classification can be given to students in several ways that utilize learning innovations. Learning activities that can meet the characteristics of Animalia classification material are by multiplying activities or activities describing and comparing the characteristics of various animal species because Animalia classification material is a grouping of animals by looking at traits such as morphology, physiology, behavior, distribution, and genetic inheritance (Agustina 2017; Wäldchen and Mäder 2018; Willi et al. 2019). Activities that are trained students will provide an experience so that students can constructivistically build their knowledge (Azizah et al. 2019). So that Animalia classification material is accepted by students as understanding, not rote memorization (Weiss 2018). An

understanding of classification material can make it easier for students to analyze and determine the taxon of a species.

The selection of teaching materials and the way of delivering the material affect students' understanding of Animalia classification material. The teaching materials used must be able to meet the characteristics of Animalia classification materials. The characteristic of Animalia classification material that needs to be considered in the preparation of teaching materials is the existence of animal visualizations that can be accessed at any time by students to be able to describe and analyze the characteristics of these animals without time limits (Arifin et al. 2019; Putri et al. 2020; Willi et al. 2019). The teaching materials needed can be embedded in online learning media. Online learning media can be accessed by students anywhere and anytime. In addition, this learning media has other advantages, namely being able to display video and sound (Valletta et al. 2017). The pictures presented through online learning media can make it easier for students to practice grouping activities in animal classification (Alharbi et al. 2019). Online learning media also makes it easier for students to access other learning resources, in animal classification materials, other internet-based sources are needed to assist students in analyzing animal characteristics so that students can group these animals (Pascafitri and Karyanto 2021).

Learning media can be arranged in such a way that it can meet learning objectives (Williamson et al. 2020), That is, students can analyze animal characteristics to group them to find the right classification. The learning media developed must be able to increase students' understanding of animal classification material. Based on a learning model that can empower students' ability to classify animals, it is necessary to develop project-based learning in online media.

4. CONCLUSIONS

Based on a review of literature related to the classification of animals as learning materials with various characteristics, 43% of literature reviews stated that empowerment of learning methods is needed in order to improve students' ability to describe, analyze, and group animals into an appropriate classification. This method of empowerment based on the results of the literature of 43% stated that it can be done by developing the right learning media, the learning media studied in the literature of 10% stated that project-based learning in online media.

5. ACKNOWLEDGEMENT

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