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Innovative Contextual Learning Using West Kalimantan Biodiversity as a Resource for Organism Classification in Junior High Schools

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Abstract

The biodiversity of West Kalimantan offers a rich and relevant context for Natural Sciences learning. However, no study has examined its potential for teaching organism classification in junior high schools using clearly defined learning resource requirements. Therefore, this study aims to explore the potential of West Kalimantan's biodiversity in creating a conceptual foundation for integrating and utilizing it as a learning resource for teaching organism classification in junior high schools. Qualitative study was utilized, beginning with a literature review to identify peer-reviewed publications related to West Kalimantan's biodiversity across the Monera, Protista, Fungi, Plantae, and Animalia kingdoms. The identified biodiversity data were then analyzed using a biology learning resource analysis framework that covers six requirements, employing qualitative evaluation to evaluate whether West Kalimantan's biodiversity could support the conceptual and procedural demands of organism classification in junior high schools. The results indicated that West Kalimantan hosts an outstanding level of biodiversity, such as *Durio tanjungpurensis* Navia and *Macaca fascicularis* (Raffles, 1821), which provides concrete and contextual examples for teaching organism classification. The biology learning resource analysis framework revealed that West Kalimantan's biodiversity meets all six requirements, demonstrating its exceptional potential for use in learning activities, particularly problem-based learning that can incorporate authentic issues related to the biodiversity. Therefore, this study contributes to the development of a conceptual foundation by structured evaluation of West Kalimantan's biodiversity, providing a basis for creating localized and contextualized learning resources on organism classification in junior high schools that have the potential to support students' academic performance.

Keywords: advance meaningful learning, progressive education, challenging learning, contextual learning, problem-based learning, future learning.

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1. Introduction

Learning resources are a fundamental component of the learning process and play a crucial role in supporting students' academic performance. Effective learning cannot be separated from learning resources, as it depends largely on the availability and quality of learning resources that facilitate interactions between students and the subject matter. Omusula (2025) emphasizes that interactions

between students and learning resources are a critical factor in achieving high-quality learning. Learning resources come in various forms that contribute to students' learning environments by offering different ways for them to access and process information (Joshi et al., 2025; Lebeničnik et al., 2015), including textbooks, digital media, visuals, physical specimens, and interactive materials. Learning resources serve to provide essential information and learning experiences to support students in building competencies in the subjects they study (Aguma et al., 2026; Yani & Sapriati, 2026). Without adequate and relevant learning resources, the learning process becomes less engaging and more difficult, especially in topics that are content-heavy or abstract.

One of the key subjects in the junior high school curriculum, particularly in the context of the Indonesian education system, that is heavily reliant on effective learning resources is Natural Sciences. This subject provides students with the foundational knowledge necessary to understand the world around them through a scientific lens, using a variety of theoretical and experimental approaches (Hogan & O'Flaherty, 2022). The Natural Sciences subject encompasses four fields of science: physics, chemistry, biology, and earth and space sciences (Dawson et al., 2022; Islami et al., 2022; Winarno et al., 2020). Within this subject, students are introduced to various natural phenomena and learn to understand them as processes, products, and attitudes. The Natural Sciences subject aims to foster students' critical thinking about their natural surroundings and environment, thereby enhancing their ability to acquire, retain, and apply the relevant concepts (Widiyatmoko & Shimizu, 2018). Among the disciplines covered by Natural Sciences, biology plays an essential role in introducing students to the diversity of life and the principles underlying living systems (Aleknavičiūtė et al., 2023; Nehm, 2019).

A core topic in biology is organismal classification, which involves the systematic grouping of organisms based on their characteristics (Löbl et al., 2023; Petrović, 2022; Sandall et al., 2023). Through this topic, students gain an understanding of how scientists organize life on Earth based on its characteristics and how this system can be used to support the interpretation of biodiversity. However, organism classification is generally perceived by students as formidable because of its complexity and abstraction, leading to difficulties in comprehending it primarily due to a lack of motivation to study the topic and the existing curriculum's failure to sufficiently highlight its practical values (Mooney et al., 2021). Organism classification covers extensive concepts, such as taxonomic ranks and intricate terminology, all of which can be overwhelming for students, especially if not supported by adequate learning resources (Ningsih et al., 2025). Furthermore, many students struggle with using identification keys, which are crucial tools for classifying organisms (Torkar, 2021). These foundational concepts are also important in supporting students' future learning of more advanced biological concepts, such as the construction and interpretation of phylogenetic trees, while establishing a progression from basic classification knowledge toward higher-order biological reasoning (Blacquiere et al., 2020; Bokor et al., 2014; Flinn, 2015; Punyasettro & Yasri, 2021).

Difficulties in learning organism classification have been widely reported across studies, indicating that students frequently struggle to meet predetermined learning objectives due to several interconnected factors. First, the scope of the organism classification topic is very broad (e.g., Maskour et al., 2019; Ningsih et al., 2025; Wai & Khine, 2020), ranging from

microscopic organisms to complex multicellular organisms. Second, many of the concepts covered are difficult to visualize and internalize due to the lack of supportive and contextual aids (Widyasari et al., 2025). For example, students may have difficulty understanding hierarchical classification systems when presented solely as textual descriptions, without adequate visualization. Another critical issue is the lack of engaging learning resources tailored to students' local environments. Existing textbooks tend to focus on general, non-native organisms, frequently omitting native organisms that could enhance students' interest and motivation in studying organism classification (Chyleńska & Rybska, 2018). Therefore, inadequate learning resources that lack the richness and interactivity grounded in contextual learning can negatively impact students' academic performance.

To address the aforementioned challenges, it is important to develop new, contextually relevant learning resources that can improve students' academic performance and learning motivation. One efficacious approach is to integrate local potential into the learning resources being developed. Local potential is a term used to describe specific resources found in a particular location that encompass the environmental, cultural, and socioeconomic aspects that reflect the uniqueness and richness of the location as well as the communities inhabiting it (Ramdiah et al., 2020; Syahmani et al., 2026; Wilujeng et al., 2020). By integrating local potential into Natural Sciences learning, students can engage more actively with authentic phenomena, connect new scientific concepts with their prior knowledge and lived experiences, and progressively construct meaningful understanding through contextual and learner-centered experiences. Furthermore, the use of local potential provides real-world examples that help students understand abstract concepts in practical contexts, thereby fostering an appreciation for their regional identity. Learning resources integrated with local potential have been shown to improve various aspects of students' academic performance, such as conceptual mastery and science process skills (Wilujeng et al., 2020), critical thinking (Fajeriadi et al., 2024), scientific literacy (Zuslia & Subiantoro, 2024), and problem-solving (Wahyuni et al., 2025). Among the local potentials in Indonesia, biodiversity offers a rich and relevant context for learning about organism classification.

Biodiversity refers to the variety of organisms across multiple levels of biological organization, ranging from molecular and genetic diversity to species, populations, communities, ecosystems, and landscapes (Cochrane et al., 2016; Lausch et al., 2016). West Kalimantan, a province in Indonesia, has been recognized globally as one of the country's regions with very high biodiversity (Leo et al., 2022; Marlina et al., 2022; Yeni, Faturrahman, Saputra, et al., 2025), spanning across the five kingdoms of organisms. The biodiversity present in West Kalimantan provides a highly valuable, authentic context for teaching organism classification, especially for students living in the province. By studying organism classification based on local biodiversity, students are more likely to meaningfully engage with the learning content and participate in the learning process, while deepening their understanding of the environment around them (Oliveira et al., 2025). Furthermore, West Kalimantan is home to a variety of endemic species, which further enriches its value as a learning resource for the classification of organisms. It is emphasized that the application and utilization of organism classification requires biodiversity as its foundation (Costello, 2020; Thiele et al., 2021).

Prior studies on literature reviews that discuss the utilization of Indonesian biodiversity as a learning resource have focused primarily on other areas and in specific contexts, such as particular taxonomic ranks. Prabaningrum et al. (2021) summarized the level of Gastropod diversity across various islands in Indonesia, which can be used as a learning resource in senior high schools for the biodiversity topic. Muflihaini & Suhartini (2019) reviewed various plant species that serve as components in the *Tarub* ceremony a procession that is part of the wedding ceremony tradition in the Javanese tribe and have the potential to be used as learning resources, particularly for the topics of biodiversity and bioconservation. However, no study has examined the potential of West Kalimantan's biodiversity to teach organism classification in junior high schools using clearly defined learning resource requirements, considering that it offers a rich and relevant context for Natural Sciences learning. This represents a significant gap in the literature. Therefore, this study aims to explore the potential of West Kalimantan's biodiversity in creating a conceptual foundation for integrating and utilizing it as a learning resource for teaching organism classification in junior high schools. Specifically, this study seeks to identify and synthesize information regarding the biodiversity of West Kalimantan across the five kingdoms of organisms, as well as to evaluate its suitability as a learning resource for organism classification—particularly for junior high schools within the *Merdeka* Curriculum context—and to discuss its practical implications and further development. This study is expected to contribute immensely in improving the quality of Natural Sciences learning, especially in the context of the *Merdeka* Curriculum, the current nationwide curriculum framework in Indonesia that encourages a learning process tailored to students' needs and supports enjoyable, meaningful activities. We expect this literature-based investigation to provide valuable insights for curriculum development and to support localized Natural Sciences learning, thereby positively contributing to various aspects of students' academic performance.

2. Method

This study is qualitative in nature. Qualitative methods provide a comprehensive overview by using non-numerical data to gain in-depth insights into complex phenomena (W. M. Lim, 2024). This study was conducted through two primary stages: a literature review and a learning resource requirements analysis (Figure 1).

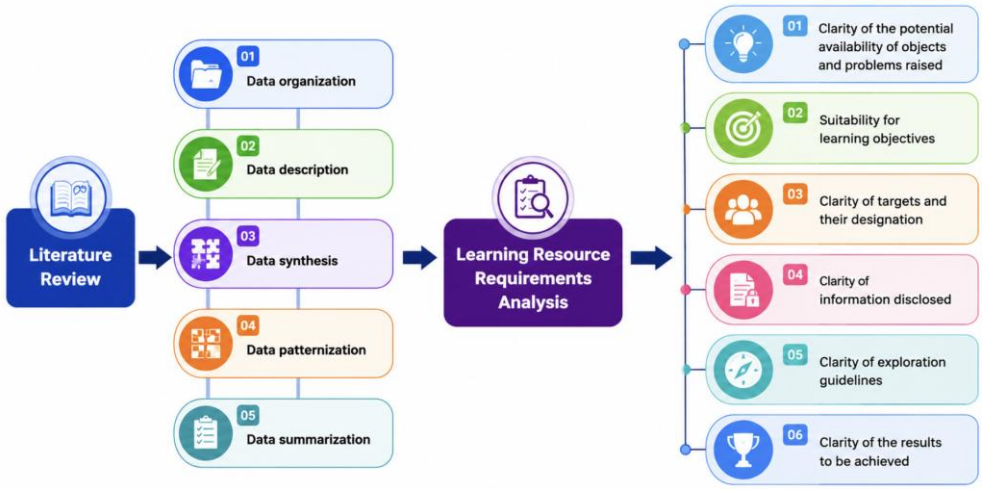

Figure 1. Study Stages

a. Literature Review

The literature review was conducted by gathering information and data from various sources related to the study topic. The type of literature review used in this study is narrative narrative literature reviews focus on producing a critical, comprehensive qualitative analysis of existing literature while presenting theoretical perspectives as an agenda for further studies (Chigbu et al., 2023; Snyder, 2019). Using secondary data as the basis for this stage, Google Scholar was used to search for relevant literature on the biodiversity of West Kalimantan. The search was conducted using several relevant keywords, such as "Biodiversity," "Monera," "Protista," "Fungi," "Plantae," "Animalia," and "West Kalimantan." Boolean operators were also used to refine the literature results displayed on Google Scholar (e.g., "Animalia *AND* West Kalimantan"). Focusing on peer-reviewed and reputable scientific journals, proceedings, and books to ensure data quality, this study utilized several inclusion criteria: literature on the biodiversity of West Kalimantan, written in Indonesian or English, containing identifiable organism records, and published between 2015 and 2025. Limiting the publication timeframe to the past decade was intended to ensure the relevance and recency of data on the study topic, thereby avoiding outdated information.

The search for relevant literature began with an initial screening of each piece of literature obtained using the keywords and inclusion criteria, based on titles and abstracts. Literature that met the initial relevance criteria were then subjected to a full-text review to verify its eligibility for inclusion in the narrative literature review. Following the standpoint of Greenhalgh et al. (2018), this study acknowledges that narrative literature reviews are intrinsically interpretive rather than entirely free of researcher perspectives; therefore, methodological rigor was enhanced through a transparent, structured process that included predefined search strategies, explicit inclusion criteria, and systematic screening procedures. After determining the literature to be used as references, analysis was conducted following Sidiq & Choiri (2019), which includes data organization, description, synthesis, patternization, and summarization.

The biodiversity data obtained from the referenced literature were crosschecked with several taxonomy databases, such as the Catalogue of Life (catalogueoflife.org), Index Fungorum (indexfungorum.org), Plants of the World Online (powo.science.kew.org), and National Center for Biotechnology Information Taxonomy

Database (ncbi.nlm.nih.gov/taxonomy) to ensure the use of currently valid scientific and author names. The crosschecking was conducted after the preliminary identification of each organism from the relevant taxonomic literature. For each recorded taxon, the scientific name was entered into the databases' search interface and checked against the currently recognized taxonomic classification. When a recorded taxon was listed as a synonym, the currently accepted scientific name and author name were adopted for the final dataset. Recorded taxa for which the scientific and author names were consistent with the databases were considered taxonomically verified. Records that could not be matched confidently to a recognized taxon were not treated as fully verified until their identity could be resolved through additional taxonomic references.

Given the extensive biodiversity records identified through this stage, this study presents illustrative examples, particularly for non-endemic organisms, rather than an exhaustive inventory. The examples were purposely selected based on the completeness of taxonomic information, relevance to the local context of West Kalimantan, and their potential to support learning in organism classification in junior high schools.

b. Learning Resource Requirements Analysis

The primary unit of analysis in this stage was the synthesized information regarding the biodiversity of West Kalimantan obtained from the referenced literature. The secondary unit of analysis involves relevant documents regarding the *Merdeka* Curriculum and the implementation of Natural Sciences learning within the curriculum framework, such as the predetermined learning outcomes included in the decree issued by the Education Standards, Curriculum and Assessment Agency of the Republic of Indonesia (*Badan Standar, Kurikulum, dan Asesmen Pendidikan Republik Indonesia* [BSKAP RI], 2025), specifically Decree Number 046/H/KR/2025 concerning Learning Outcomes in Early Childhood Education, Elementary Education, and Secondary Education under the *Merdeka* Curriculum; and the Natural Sciences learning objectives flow directly collected from several junior high schools in West Kalimantan that have implemented the *Merdeka* Curriculum. In the particular context of the *Merdeka* Curriculum, the predetermined learning outcomes specify the competencies that students are expected to achieve at the end of each developmental phase, comprising the Foundation Phase for early childhood education (Robingatin et al., 2025), Phases A–C for primary education (Wardani et al., 2023), and Phases D–F for secondary education (Sofiani et al., 2025). To facilitate direct classroom practices, the learning outcomes are then translated into the learning objectives flow, which organizes the expected competencies into a logical sequence of learning objectives to guide teachers in designing and implementing learning activities within a certain phase. Therefore, the relevant curriculum documents act as a guide to match the primary unit of analysis with appropriate learning objectives previously determined by the respective teachers in the schools.

The learning resource requirements analysis is based on the framework proposed by Suhardi (2012). The framework includes six requirements: clarity of the potential availability of objects and problems raised, suitability for learning objectives, clarity of targets and their designation, clarity of information disclosed, clarity of exploration guidelines, and clarity of the results to be achieved. Within this framework, this study qualitatively evaluated the suitability of information on West Kalimantan's biodiversity for the topic of organism classification in the

Natural Sciences subject in junior high schools using the six requirements of the framework. The operationalization of each learning resource requirement in this study, based on Suhardi's (2012) framework, is presented in Table 1.

Table 1. Operationalization of learning resource requirements analysis

No.	Learning Resource Requirement	Indicator	Data Source
1	Clarity of the potential availability of objects and problems raised	Availability of biodiversity data and local issues related to the biodiversity of West Kalimantan	Literature review results
2	Suitability for learning objectives	Alignment with Phase D learning outcomes on organism classification within the *Merdeka* Curriculum	Literature review results and curriculum documents
3	Clarity of targets and their designation	Relevance to seventh-grade students in junior high schools	Curriculum documents
4	Clarity of information disclosed	Availability of information regarding the characteristics and classification of organisms in West Kalimantan	Literature review results
5	Clarity of exploration guidelines	Potential use in local contexts-based learning activities	Literature review results
6	Clarity of the results to be achieved	Potential contribution to cognitive, affective, and psychomotor learning outcomes	Literature review results and curriculum documents

The referenced literature on the biodiversity of West Kalimantan was examined for each requirement to determine whether it fulfilled the corresponding indicators. As previously mentioned, the analysis focused on determining whether and how the information on West Kalimantan's biodiversity met each requirement, rather than employing a numerical scoring system. For example, the suitability for learning objectives requirement was evaluated by examining the alignment between the biodiversity information and the *Merdeka* Curriculum learning outcomes predetermined by BSKAP RI (2025), as well as the Natural Sciences learning objectives flow collected directly from several junior high schools in West Kalimantan. The evaluation results were interpreted descriptively to determine the overall potential of West Kalimantan's biodiversity as a contextual learning resource, specifically for the organism classification topic in the seventh-grade Natural Sciences subject in junior high schools. To ensure the rigor and trustworthiness of the analysis, the evaluation was conducted collaboratively by the first, second, and third authors, the primary personnel of the study team. The results were then discussed and reviewed with the remaining authors. Differences in interpretation were resolved through discussion and reevaluation until consensus was reached.

3. Results and Discussion

The results and discussion of this study are organized into four sections. The first section presents a brief overview of the geographical profile of West Kalimantan, highlighting how this province is home to a high level of biodiversity. The second section synthesizes findings related to West Kalimantan's biodiversity derived from a curated body of literature, illustrating the abundance of biodiversity present. The third section presents the results of the learning resource requirements analysis based on the framework proposed by Suhardi (2012) to evaluate the suitability of biodiversity data as a learning resource for the topic of organism classification. The fourth section suggests several practical implications and examples

for further development of learning resources on the topic of organism classification based on the biodiversity of West Kalimantan. Together, these sections provide a comprehensive basis for understanding the educational potential of West Kalimantan's biodiversity in supporting the contextuality of Natural Sciences learning.

a. Geographical Profile of West Kalimantan

West Kalimantan is one of Indonesia's provinces, with Pontianak as its capital (see Figure 2 for the province map). West Kalimantan's geographical location is highly strategic, as it is situated on the island of Borneo, shares a border with Malaysia, and faces the South China Sea to the west (Sada et al., 2019). According to data from the West Kalimantan Provincial Statistics Agency (*Badan Pusat Statistik Kalimantan Barat*, 2024), West Kalimantan is located between 2°08' North latitude, 3°02' South latitude, and 108°30' and 114°10' East longitude on the Earth's map. West Kalimantan has an area of 147,037 km^2 (7.68% of Indonesia's total area). West Kalimantan borders Sarawak (East Malaysia) to the north, Central Kalimantan and the Java Sea to the east, East Kalimantan and the Java Sea to the south, and the Natuna Sea and Karimata Strait to the west. Most of West Kalimantan's area is still forested, including scrub forests, dense forests, swamp forests, and other types. The province also has several lakes and rivers. The extensive lowlands of West Kalimantan contribute to the relatively low elevation and the presence of non-volcanic mountains. West Kalimantan's geographical profile supports rich ecological niches and the biodiversity found across its various regions (Leo et al., 2022).

Figure 2. West Kalimantan map (reproduced from Susiati et al., 2022; *Heliyon*, Cell Press, licensed under CC BY 4.0 [https://creativecommons.org/licenses/by/4.0/])

b. Biodiversity of West Kalimantan

The biodiversity data presented in this section are based on a synthesis of the referenced literature. The referenced literature reveals that West Kalimantan possesses a very high level of biodiversity across various taxonomic ranks, including species classified as endemic and species of sociocultural significance. To facilitate the presentation of this section, the findings are organized into two main categories: endemic species and non-endemic species, with the second category further classified according to the five kingdoms of organisms.

(1) Endemic Species

Endemic species can be defined as species with a restricted distribution to a specific geographic region (Behroozian et al., 2020). Therefore, endemic species are considered unique to their respective areas because they are not naturally found elsewhere. The presence of endemic species plays an essential role in maintaining the balance of biodiversity and ecology within an ecosystem, indicating that there are unique adaptations to the ecosystems inhabited by endemic species (Zhensikbayeva, 2024). As a province with high biodiversity, West Kalimantan is home to several endemic species. Although studies on the endemic biodiversity of West Kalimantan have been conducted, the available literature primarily focuses on species within the Plantae and Animalia kingdoms. This aligns with the findings of Amelia & Rahmaida (2017), who concluded that most scientific publications regarding biodiversity in Indonesia are concentrated on the two aforementioned kingdoms, implying that exploration of the other three kingdoms remains limited.

Several endemic plant species in West Kalimantan have been identified through previous studies, such as durian tengkurak (*Durio tanjungpurensis* Navia; as identified by Navia & Chikmawati, 2015) and several species of water trumpets (*Cryptocoryne* Fisch. ex Wydler), such as *Cryptocoryne aura* Wongso & Ipor (as discovered by Wongso et al., 2016), as well as *Cryptocoryne verrucosa* Wongso & Asih and *Cryptocoryne* × *nakamotoi* Bastm. (as investigated by Asih et al., 2022). Sidiyasa (2015) reported several tree species with no assigned vernacular name with distributions limited exclusively to West Kalimantan, such as *Diospyros campanulata* Bakh., *Durio lissocarpus* Mast., and *Ficus kalimantana* C.C.Berg. Robiansyah et al. (2021) emphasized the presence of the critically endangered tree *Vatica cauliflora* P.S.Ashton, which is found only in Kapuas Hulu Regency, as a species of the genus *Vatica* L. more commonly known as resak.

Unlike the abundant endemic plant species reported in studies, endemic animal species are unfortunately represented in very few studies. One of the most notable species is the red-striped halfbeak (*Hemirhamphodon kapuasensis* Collette, 1991; as stated by H.-C. Lim et al., 2016), whose distribution is limited to the Kapuas River basin. Meanwhile, primate species such as the tricolored langur (*Presbytis chrysomelas cruciger* [Thomas, 1892]), long considered endemic to West Kalimantan (as implied by Samsul et al., 2023), have actually been recorded in several parts of Malaysia (as demonstrated by the study of Ampeng et al., 2024). However, it must be noted that in Indonesia, their occupancy is still restricted to West Kalimantan, thereby maintaining their value as a primate species that can still be introduced as locally endemic in the province. A picture of *P. c. cruciger* as one of the notable local species in West Kalimantan is presented in Figure 3.

Figure 3. An individual of *P. c. cruciger* (adapted from Ampeng et al., 2024; *Check List*, Pensoft, licensed under CC BY 4.0 [https://creativecommons.org/licenses/by/4.0/]; the image was cropped to highlight relevant details)

(2) Non-endemic Species

Non-endemic species are organisms not limited to specific geographic areas (Caesar et al., 2017). It should be noted that this study focuses on the use of the five-kingdom system proposed by Whittaker (1969), with a brief description of each kingdom of organisms presented in Table 2. The five-kingdom system is widely used in Indonesian junior high school learning resources for introducing the classification of organisms. Although more recent classification systems have been developed, the five-kingdom system remains relevant as an accessible foundation for junior high school students in Indonesia to understand major groups of organisms and their distinguishing characteristics. Therefore, the following presents brief data on the non-endemic biodiversity of West Kalimantan for five kingdoms of organisms. The examples presented in this subsection are intended to illustrate the biodiversity documented in the reviewed literature and do not represent an exhaustive inventory of West Kalimantan's biodiversity.

Table 2. Brief description of each kingdom of organisms

No.	Kingdom	Brief Description
1	Monera	Prokaryotic organisms lacking membrane-bound nuclei, such as bacteria and cyanobacteria
2	Protista	Mostly unicellular eukaryotes with diverse nutritional modes, including protozoa and algae
3	Fungi	Eukaryotic heterotrophs that obtain nutrients by absorption and play crucial ecological roles as decomposers
4	Plantae	Multicellular photosynthetic organisms characterized by cell walls containing cellulose
5	Animalia	Multicellular heterotrophic organisms that ingest food and generally possess specialized tissues, with the majority of the members having active locomotion

(a) Monera Kingdom

Studies on the diversity of the Monera kingdom in West Kalimantan have been conducted. Khotimah et al. (2020) isolated and identified a total of 19 cellulolytic bacteria inhabiting fibric, hemic, and sapric peat in Teluk Bakung Village peatlands located in Kubu Raya Regency, with the isolates of *Bacillus cereus* Frankland & Frankland, 1887 and *Bacillus stratosphericus* Shivaji et al., 2006 being shown to have the highest cellulose enzyme activities. Nainggolan et al. (2015) investigated the diversity of ammonia-degrading bacteria in rubber liquid waste around Pontianak, with the results concluding in several species, such as *Nitrosomonas* Winogradsky, 1892; *Nitrosospira* Winogradsky & Winogradsky, 1933; and *Nitrosococcus* Winogradsky, 1892. The study conducted by Islamiah et al. (2017) revealed five genera of rhizosphere bacteria in the *Avicennia* L. a plant genus that consists of several species of mangrove tree species soil area in Terusan Village located in Mempawah Regency: *Acinetobacter* Brisou & Prévot, 1954; *Bacillus* Cohn, 1872; *Pseudomonas* Migula, 1894; *Serratia* Bizio, 1823; and *Vibrio* Pacini, 1854. An image of *Vibrio* isolate is presented

in Figure 4. The organisms classified in this kingdom play critical roles in biogeochemical cycles (such as nutrient cycling and nitrogen fixation), biotechnology (including food production and bioremediation), and human health (microbiome functions).

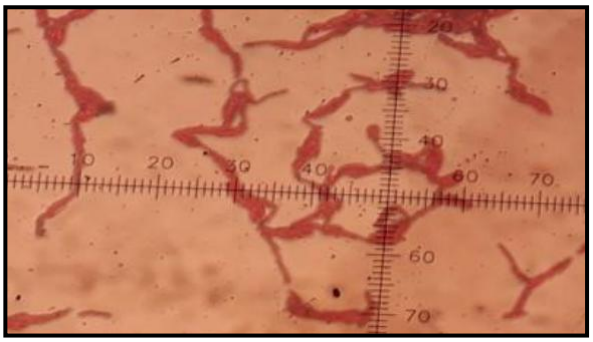

Figure 4. *Vibrio* isolate (adapted from Islamiah et al., 2017; *Protobiont*, Universitas Tanjungpura, licensed under CC BY-NC 4.0 [https://creativecommons.org/licenses/by-nc/4.0/]; the image was cropped to highlight relevant details)

(b) Protista Kingdom

Members of the Protista kingdom in West Kalimantan have been studied extensively. As the kingdom that represents dominant eukaryotic diversity (Singer et al., 2021), Protista exhibits tremendous diversity in West Kalimantan, as demonstrated by existing studies. The investigation conducted by Ramadhani et al. (2024) identified 52 phytoplankton species inhabiting the Bun-bun River in Kubu Raya Regency. The study by Dita et al. (2023) shows that 59 phytoplankton species were present in the downstream of Segedong River, Kubu Raya Regency, including *Peridinium quinquecorne* Abé, 1927; *Chaetoceros diversus* Cleve, 1873; *Tripos lineatus* (Ehrenberg) F.Gómez, 2013; and *Skeletonema costatum* (Grev.) Cleve, 1873. Based on a phytoplankton inventory in the Teluk Nibung River, Kubu Raya Regency, conducted by Qairunisa et al. (2024), a total of 56 phytoplankton species were encountered, such as *Tolypothrix distorta* Kützing ex Bornet & Flahault, 1886; *Protoperidinium obtusum* (Karsten) Parke & J.D.Dodge, 1976; and *Euglena gracilis* Klebs, 1883. An image of *E. gracilis* is presented in Figure 5. The kingdom Protista plays key roles in maintaining the ecosystems it inhabits by facilitating nutrient cycling (Singer et al., 2021).

Figure 5. Microscopic view of *E. gracilis* (adapted from Häder & Hemmersbach, 2022; *Life*, Multidisciplinary Digital Publishing Institute, licensed under CC BY 4.0 [https://creativecommons.org/licenses/by/4.0/]; the image was cropped to highlight relevant details)

(c) Fungi Kingdom

The diversity of the Fungi kingdom in West Kalimantan has been widely studied, particularly mushrooms, the taxonomic group that dominates most studies. Yeni, Faturrahman, Saputra, et al. (2025) mapped a total of 94 mushroom species from 30 families across Ascomycota and Basidiomycota found in three protected forests in Sambas Regency. Notable species include bristly tropical cup (*Cookeina tricholoma* [Mont.] Kuntze), common puffball (*Lycoperdon perlatum* Pers.), artist's bracket (*Ganoderma applanatum* [Pers.] Pat.), and turkeytail (*Trametes versicolor* [L.] Lloyd). Ekyastuti et al. (2023) investigated mushroom diversity in smallholder oil palm plantations on tropical peatlands in Kampung Baru Village, Kubu Raya district, and reported a total of 34 species across 16 families (e.g., splitgill [*Schizophyllum commune* Fr.] from the Schizophyllaceae family). Khotimah et al. (2021) studied the potential of cellulose-

degrading microfungi at various peat maturities in the peatlands of Teluk Bakung Village in Kubu Raya Regency, and the isolate with the highest cellulase activity was identified as *Penicillium citrinum* Thom.

Aside from the fact that members of the kingdom Fungi play crucial roles in maintaining ecosystem balance (e.g., as decomposers, pathogens, and nutrient recyclers, as noted by Gafforov et al., 2020), many members of this kingdom are widely used in human life. Fungi, especially mushrooms, are widely used as a source of food and medicine (Mayirnao et al., 2025; Sileshi et al., 2023). The use of the Fungi kingdom is often rooted in traditional knowledge and examined through the field of ethnomycology. However, only a small number of ethnomycological studies have been conducted in West Kalimantan. For example, Faturrahman & Yeni (2024) reported eight mushroom species used by the Malay tribe in Lorong Village, Sambas Regency, as food and medicine, including *Auricularia* sp., *Schizophyllum* sp., *Cookeina* sp., and *Daldinia* sp. (Figure 6). A higher number of species is documented by Yeni, Faturrahman, Widyastuti, et al. (2025), with a total of 16 species used by the Dayak Kubin tribe in Nanga Raku Village, Melawi Regency, as food and medicine, such as wood ear (*Auricularia auricula-judae* [Bull.] Quél.), funnel woodcap (*Lentinus sajor-caju* [Fr.] Fr.), and yellow-stemmed micropore (*Microporus xanthopus* [Fr.] Kuntze).

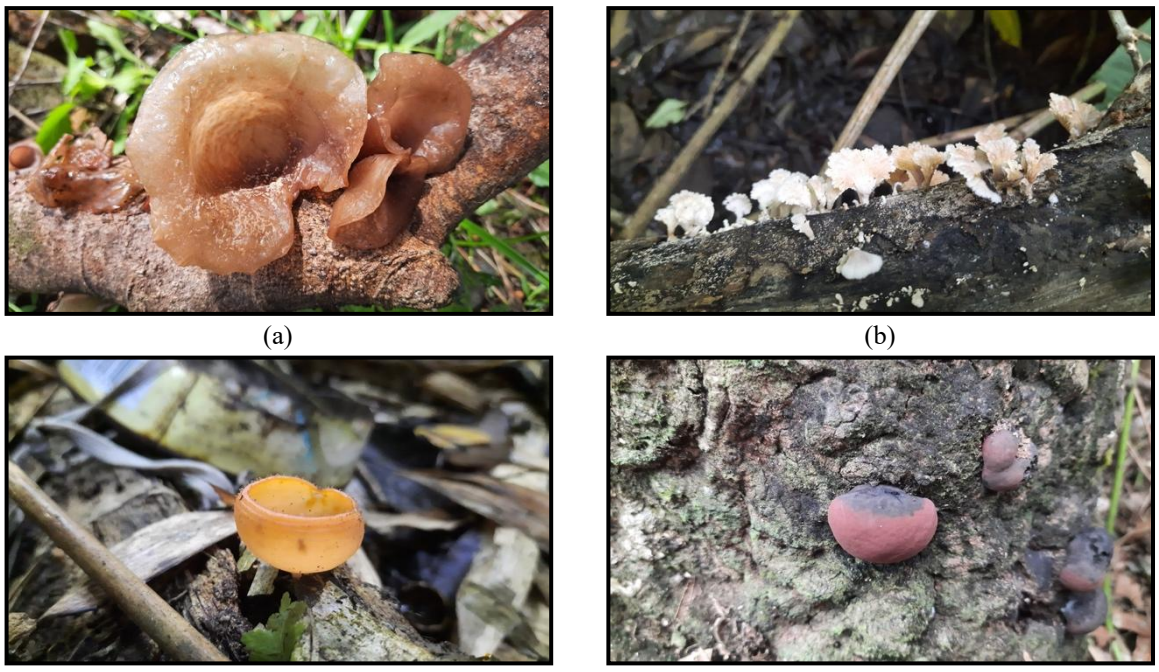

Figure 6. (a) *Auricularia* sp., (b) *Schizophyllum* sp., (c) *Cookeina* sp., and (d) *Daldinia* sp. (adapted from Faturrahman & Yeni, 2024; *Jurnal Pijar MIPA*, Universitas Mataram, licensed under CC BY 4.0 [https://creativecommons.org/licenses/by/4.0/]; the images was combined to highlight relevant details)

(d) Plantae Kingdom

Among the two most studied kingdoms of organisms in Indonesia, as stated by Amelia & Rahmaida (2017), studies on the diversity of the Plantae kingdom in West Kalimantan are tremendously extensive. Syamswisna & Karmadi (2023) examined the diversity of tropical pitcher plants (*Nepenthes* L.) in the Bukit Perasak area, Sambas Regency, and discovered three species: *Nepenthes gracilis* Korth., *Nepenthes* × *neglecta* Macfarl., and *Nepenthes mirabilis* (Lour.) Druce.

The exploration conducted by Natasya et al. (2024) unveiled a total of 14 species of ferns inhabiting the Gunung Raya Protected Forests in Sambas Regency, such as swamp vine fern (*Stenochlaena palustris* [Burm.f.] Bedd.), false staghorn fern (*Dicranopteris linearis* [Burm.f.] Underw.), nest fern (*Asplenium nidus* L.), and silver fern (*Pityrogramma calomelanos* [L.] Link). Astiani et al. (2018) evaluated the species composition in a degraded peatland forest in Kubu Raya Regency, revealing more than 70 species inhabiting the area, including chempedak (*Artocarpus integer* [Thunb.] Merr.), kundong (*Garcinia parvifolia* [Miq.] Miq.), and matoa (*Pometia pinnata* J.R.Forst. & G.Forst.).

Plants play an important role in the survival of organisms on Earth by producing oxygen as a byproduct of photosynthesis (Yan et al., 2025). Aside from the fact that many plant species are consumed daily for their edibility, Bolouri et al. (2022) state that most plants can be used in pharmaceuticals and other industries. As with the Fungi kingdom, the uses of plants today are rooted in traditional knowledge from many indigenous communities, often studied in the field of ethnobotany. A high number of ethnobotany studies in West Kalimantan have been conducted, evaluating the utilization of plants in many aspects of human life. Panjaitan et al. (2024) concluded that a total of 26 plant species are used for reproductive health by the communities in Balai Harapan Village, Sintang Regency, including painted nettle (*Coleus scutellarioides* [L.] Benth.), elephant apple (*Dillenia indica* L.), mountain ebony (*Bauhinia variegata* L.), and wild mussaenda (*Mussaenda frondosa* L.) (Figure 7). A study on the ethnobotany of postpartum medicinal plants in Nanga Danau Village, Kapuas Hulu Regency, conducted by Panjaitan et al. (2025), identified 10 plant species, including turmeric (*Curcuma longa* L.) and ginger (*Zingiber officinale* Roscoe). Many plant species are also used in traditional rituals Hasanah et al. (2025) investigated the ethnobotany for agricultural rituals in Ambawang Village, Kubu Raya Regency, identifying 24 plant species, such as coco-grass (*Cyperus rotundus* L.) and common bamboo (*Bambusa vulgaris* Schrad. ex J.C.Wendl.).

(a) (b) (c) (d)

Figure 7. (a) *C. scutellarioides*, (b) *D. indica*, (c) *B. variegata*, and (d) *M. frondosa* (adapted from Panjaitan et al., 2024; *Pharmacognosy Journal*, EManuscript Technologies, licensed under CC BY 4.0 [https://creativecommons.org/licenses/by/4.0/]; the images was combined to highlight relevant details)

(e) Animalia Kingdom

The kingdom Animalia encompasses a highly diverse range of taxa and complex classification systems. However, the study of the Animalia kingdom in junior high schools in Indonesia is generally introduced through two major groups, particularly invertebrates and vertebrates, to help students recognize

fundamental differences among animal groups before progressing to more detailed taxonomic classification in higher levels of education. Therefore, the biodiversity findings presented in this subsection are based solely on these two major groups to align with the organism classification topic at the junior high school level in Indonesia. It should be noted that, as with the presentations of other kingdoms in this study, the examples are intended to illustrate the two major animal groups rather than to provide an exhaustive taxonomic inventory of the animals of West Kalimantan.

Various studies have been conducted on the diversity of invertebrate animals in West Kalimantan. Indrayani et al. (2022) discovered seven genera of termites in the secondary forest of Kapuas Hulu Regency: *Odontotermes* Holmgren, 1910; *Pericapritermes* Silvestri, 1914; *Coptotermes* Wasmann, 1896; *Schedorhinotermes* Silvestri & Silvestri, 1909; *Nasutitermes* Dudley, 1890; *Microcerotermes* Silvestri, 1901; and *Macrotermes* Holmgren, 1909 (four genera are presented in Figure 8 as examples). Ginoga et al. (2019) encountered 49 butterfly species in an oil palm plantation located in Ketapang Regency, some of which were striped blue crow (*Euploea mulciber* [Cramer, 1777]), chocolate grass yellow (*Eurema sari* [Horsfield, 1829]), and tawny bushbrown (*Mycalesis anapita* Moore, 1857). The study conducted by Nuraya & Agamawan (2025) revealed that a total of two mud crab species inhabit the mangrove ecosystem of Batu Ampar District, Kubu Raya Regency: serrated mangrove swimming crab (*Scylla serrata* [Forskål, 1775]) and green mud crab (*Scylla paramamosain* Estampador, 1950).

(a) (b) (c) (d)

Figure 8. (a) *Odontotermes* sp., (b) *Pericapritermes* sp., (c) *Coptotermes* sp., and (d) *Macrotermes* sp. (adapted from Indrayani et al., 2022; *IOP Conference Series: Earth and Environmental Science*, Institute of Physics Publishing, licensed under CC BY 3.0 [https://creativecommons.org/licenses/by/3.0/]; the images was cropped and combined to highlight relevant details)

Similar to studies on invertebrate animals, studies on the diversity of vertebrate animals in West Kalimantan have also been widely conducted. Haryono (2020) conducted a study on the fish community structure and distribution at Lake Siawan in Kapuas Hulu Regency, revealing a total of 57 fish species, with several notable species including temopong (*Leptobarbus hosii* [Regan, 1906]), adungan (*Hampala bimaculata* [Popta, 1905]), and berbaju (*Puntigrus anchisporus* [Vaillant, 1902]) (Figure 9). Kennedi et al. (2024) studied the herpetofauna diversity in Bukit Baka Bukit Raya National Park they discovered 50 amphibian species, such as the dwarf slender toad (*Ansonia minuta* Inger, 1960) and the Bornean flat-headed frog (*Barbourula kalimantanensis* Iskandar, 1978); and 25 reptile species, including the Bornean short-

tailed python (*Python breitensteini* Steindachner, 1881) and the Sumatran flying dragon (*Draco sumatranus* Schlegel, 1844). Hernowo (2016) investigated the composition of bird communities in the mangrove area of Batu Ampar District, Kubu Raya Regency, resulting in the discovery of 57 species, including blue-tailed bee-eater (*Merops philippinus* Linnaeus, 1767) and lesser adjutant (*Leptoptilos javanicus* [Horsfield, 1821]). Comanesi et al. (2017) discovered three diurnal primate species in a lumber company area located in Batu Ampar District, Kubu Raya Regency: crab-eating macaque (*Macaca fascicularis* [Raffles, 1821]), silvery lutung (*Trachypithecus cristatus* [Raffles, 1821]), and proboscis monkey (*Nasalis larvatus* [van Wurmb, 1787]).

(a) (b) (c)

Figure 9. (a) *L. hosii*, (b) *H. bimaculata*, and (c) *P. anchisporus* (reproduced from Haryono, 2020; *IOP Conference Series: Earth and Environmental Science*, Institute of Physics Publishing, licensed under CC BY 3.0 [https://creativecommons.org/licenses/by/3.0/])

Animals are an essential part of Earth and play various important roles in ecosystems worldwide (Narayan & Liu, 2024). In addition to maintaining the balance of ecosystems in their natural habitats, animals also support human survival in today's ever-evolving society. Kandel et al. (2025) summarize that, across the globe, animals now play organizational roles in human life, such as serving as livestock, providing entertainment (e.g., zoos), assisting police and the military, and serving as office companions. Animals are now commonly used in biomedical studies due to the similarity of their body structures to those of humans (Mukherjee et al., 2022) for example, Panjaitan & Liridah (2021) used mice (*Mus musculus* Linnaeus, 1758) to evaluate the effects of various doses of kratom (*Mitragyna speciosa* Korth.) leaves on liver function. In the context of traditional beliefs, several studies have examined the ethnozoology in West Kalimantan. For example, Rahmawati et al. (2024) discovered that the communities in Kubu Raya Regency utilized mammals as food, trade, medicine, and cultural expression. Similarly, Kurniawan et al. (2024) reported that local communities in Kapuas Hulu Regency perceive hornbills (Bucerotidae Rafinesque, 1815) as targets for hunting, as ornaments, and as having cultural and spiritual significance.

c. Learning Resource Requirements Analysis

The *Merdeka* Curriculum is the current curriculum in effect in Indonesia. The existence of the *Merdeka* Curriculum in Indonesia, replacing the 2013 Curriculum, represents a systemic change in the Indonesian education system, which has been severely impacted by learning loss a condition associated with the decline of students' academic knowledge and skills, leaving many Indonesian children unable to comprehend simple reading and basic math exacerbated by the Coronavirus 2019 pandemic (Ningsih et al., 2026; Susanti et al., 2025). In its implementation, the *Merdeka* Curriculum

emphasizes flexible learning tailored to students' needs (Utari et al., 2025), focusing on essential learning topics, skills, and character development, supported by modern technologies (Saa, 2024). Furthermore, the *Merdeka* Curriculum emphasizes contextualized aspects of learning through the integration of local potential (Marlina et al., 2026). Therefore, this curriculum encourages students to actively construct their understanding by connecting scientific concepts to their surrounding environment, rather than focusing primarily on memorizing content. Within the *Merdeka* Curriculum, organism classification is introduced in Phase D (junior high schools), particularly in seventh grade, as a foundational biology topic that requires students to learn to identify similarities and differences among organisms, classify them based on observable characteristics, and develop an appreciation for biodiversity.

The curricular expectations arising from the implementation of the *Merdeka* Curriculum highlight the importance of using locally relevant learning resources to support students' conceptual understanding and engagement. In this regard, the results of the literature review on the rich biodiversity of West Kalimantan in the five kingdoms of organisms have the potential to be used as a learning resource for organism classification. However, a learning resource requirements analysis must be conducted beforehand. Learning resource requirements analysis is the process of examining the local availability and suitability of resources for the learning outcomes predetermined in the curriculum (Ardiyanto et al., 2024). In this study, the learning resource requirements analysis refers to Suhardi's (2012) framework, with the results presented in Table 3.

Table 3. Learning resource requirements analysis results

No.	Learning Resource Requirement	Analysis Results
1	Clarity of the potential availability of objects and problems raised	The potential assessed is West Kalimantan's high level of biodiversity in the five kingdoms of organisms, with the problem raised being the limited learning resources on the topic of organism classification, providing the opportunity to develop learning resources that leverage West Kalimantan's biodiversity to support localized learning and enhance students' understanding and motivation in Natural Sciences
2	Suitability for learning objectives	The topic of organism classification in the Natural Sciences subject is included in the predetermined learning outcome of the *Merdeka* Curriculum: "At the end of phase D, students can examine the results of the identification of organisms based on their characteristics," while the corresponding teacher-developed learning objectives for implementing the literature review as a learning resource are "Analyze the distinctive characteristics of each kingdom of organisms" and "Explain the role of organisms in human life"
3	Clarity of targets and their designation	The target object is the literature review on West Kalimantan's biodiversity across the five kingdoms of organisms for the topic of organism classification, whereas the target subject is seventh-grade students in junior high schools
4	Clarity of information disclosed	The information reveals the biodiversity of West Kalimantan, which students can use to learn the classification of local organisms as part of West Kalimantan's biodiversity and their roles in human life
5	Clarity of exploration guidelines	Students can identify the classification of various organisms in West Kalimantan by examining biodiversity-related problems that often occur in reports in peer-reviewed scientific journals
6	Clarity of the results to be achieved	The existence of learning resources can help students achieve cognitive, affective, and psychomotor learning outcomes

The first requirement is the clarity of the potential availability of objects and problems raised. This requirement involves clearly identifying local potential and the specific problems to be addressed. In this study, the identified local potential is the rich biodiversity in West Kalimantan across the five kingdoms of organisms: Monera, Protista, Fungi, Plantae, and Animalia. This biological richness is a highly valuable educational asset. Yet, it remains underutilized and not fully integrated into a holistic approach, particularly in the topic of organism classification in junior high schools. The problem being addressed is the limited availability of contextual and localized learning resources, which has contributed to students' difficulties in understanding the classification of organisms. This is supported by Chyleńska & Rybska (2018), who state that existing textbooks generally focus on commonly found organisms, often omitting native organisms that could enhance students' interest and motivation in studying organism classification. Therefore, using the local biodiversity of West Kalimantan as a learning context for organism classification makes the topic more relatable and meaningful to students. The results of a study by Santana et al. (2024) show that students' knowledge is strongly tied to non-native biodiversity and tends to be detached from local biodiversity, suggesting the need to develop contextualized learning resources to increase their awareness of local biodiversity. This step will certainly help students master key concepts and promote environmental awareness and a sense of regional identity, which have become essential in 21st-century education.

The second requirement is the suitability for learning objectives. This requirement concerns the alignment between the local potential studied and the learning objectives relevant to the topic. The findings from the literature review confirm that West Kalimantan is rich in biodiversity across the five kingdoms of life, making it a relevant and authentic context for supporting the Natural Sciences subject. Based on the analysis of this requirement, it is evident that information regarding the biodiversity of West Kalimantan can be used to support the teaching of organism classification in the Natural Sciences subject in junior high schools, as outlined in Phase D of the *Merdeka* Curriculum, included in the learning outcomes governed by BSKAP RI (2025). Moreover, information on the biodiversity of West Kalimantan can support specific learning objectives related to organismal classification, including analyzing the distinctive characteristics of each kingdom of organisms and explaining the role of organisms in human life. Therefore, it is concluded that West Kalimantan's biodiversity aligns with the learning outcomes and objectives in the *Merdeka* Curriculum for the organism classification topic in junior high schools. By studying locally prevalent species, students are exposed to relevant examples that make organism classification easier to understand. As supported by Costello (2020) and Thiele et al. (2021), insights into organism classification are foundational to comprehending biodiversity as a whole. The integration of local potential in Natural Sciences learning enhances students' ability to connect scientific concepts to their environment, increasing the likelihood of more lasting learning outcomes.

The third requirement is the clarity of targets and their designation. This requirement emphasizes the need for clarity about who the learning resources are intended for and what they are intended for. In this study, the target object is the biodiversity of West Kalimantan across the five kingdoms, synthesized through a literature review. This biodiversity is proposed to be used as material to develop a

learning resource that can support the contextual teaching and learning of the organism classification topic (Negara et al., 2025). Meanwhile, the target audience for these learning resources is seventh-grade junior high school students, as this is the level where organism classification is introduced in the Natural Sciences subject within the *Merdeka* Curriculum framework for junior high schools. The clear identification of the learning object and subject ensures that the learning resource can be developed with the appropriate depth and complexity, resulting in suitable pedagogical strategies in teaching local biodiversity-based organismal classification. Febriyanda et al. (2022) emphasize that effective learning resources require both object clarity (content) and subject clarity (student profile) to be impactful and developmentally appropriate. Furthermore, Doctora (2022) underscores the need for localized and contextual learning resources that are suitable for students' level of development, contributing to the attainment of the intended specific learning objectives.

The fourth requirement is the clarity of information disclosed. This requirement concerns the transparency and usefulness of the information provided by the local potential in this study, the biodiversity of West Kalimantan, collected from various peer-reviewed sources. Engaging students in the learning process by using learning resources that present concrete information rather than abstract ideas without relevant examples can enhance the effectiveness of the teaching and learning process (Akbaşlı & Yeşilce, 2018; Micallef & Newton, 2024). The literature review stage presents clear and structured information on the types and characteristics of organisms found in West Kalimantan. Furthermore, there is extensive literature presenting information on the roles of organisms from the five kingdoms in human life, increasing the value of biodiversity in West Kalimantan as a learning resource. It is worth noting that accurate and well-presented information on local biodiversity may inspire students to actively explore and interact with the natural resources in their surroundings (Niemiller et al., 2021). Therefore, the information disclosed about West Kalimantan's biodiversity is sufficiently clear for students to learn to classify local organisms based on observable characteristics, as outlined in the *Merdeka* Curriculum. In addition, the results serve as a springboard for students' further inquiry, such as exploring the ecological roles, conservation status, and cultural significance of specific organisms (as demonstrated by existing ethnobiological studies in West Kalimantan, including Panjaitan et al., 2024, 2025). This knowledge can help expand students' understanding of the potential of local biodiversity in West Kalimantan (Faturrahman et al., 2025; Faturrahman, Asyrofi, et al., 2024; Faturrahman, Ningsih, et al., 2024; Faturrahman & Ningsih, 2024).

The fifth requirement is the clarity of exploration guidelines. This requirement focuses on whether information on West Kalimantan's biodiversity, as learning resources, can provide students with a clear pathway to actively and meaningfully explore the topic of organism classification. In this study, exploration is guided by the framing of real-world, authentic problems related to biodiversity, especially those occurring in the local context of West Kalimantan. Many studies have reported problems and urgent issues related to the biodiversity of West Kalimantan in peer-reviewed sources, providing essential information that can be utilized by Natural Sciences teachers to enhance learning quality by presenting these sources to students as part of specific learning activities. This provides a baseline for many innovative learning models, particularly problem-based learning

(PBL). The PBL model is appropriate for use within the *Merdeka* Curriculum settings. This is further supported by the findings of Ningsih et al. (2026), which conclude that PBL is the learning model most used by teachers in implementing the *Merdeka* Curriculum, followed by project-based learning, discovery learning, inquiry learning, cooperative learning, and contextual teaching and learning. Biodiversity-related issues, such as deforestation, species endangerment, and habitat degradation, are pressing concerns in many regions of Indonesia (Faturrahman, 2023), including West Kalimantan. Therefore, presenting authentic and challenging problems related to West Kalimantan's biodiversity invites students to engage with organism classification not merely as a theoretical topic, but as a cognitive and analytical tool for investigating complex environmental issues, evaluating possible explanations, and developing evidence-informed solutions. Such challenging learning experiences require students to deal with uncertainty, analyze multiple sources of information, justify their reasoning, collaborate in solving problems, and transfer biological knowledge to unfamiliar and authentic situations. According to Lagoudakis et al. (2022), explorative learning activities in biology are essential to aid the development of students' intrinsic curiosity.

The sixth requirement is the clarity of the results to be achieved. This requirement involves identifying the expected learning outcomes of using the developed learning resources based on the biodiversity of West Kalimantan. By engaging with biodiversity-based content from West Kalimantan, students can achieve learning outcomes across three domains: cognitive, affective, and psychomotor. Cognitively, students are expected to develop a deeper understanding of the classification system and the diversity of organisms in West Kalimantan, their local environment. This is supported by several studies that show that the use of local biodiversity-based learning is effective in enhancing students' academic performance, such as Ramdiah et al. (2020) and Na'imah et al. (2022). Affectively, the learning resources have the potential to foster a sense of appreciation and care for local biodiversity, ultimately leading to students' character development focused on encouraging local resource heritage and environmental responsibility. Psychomotor learning outcomes are addressed through the involvement of students in active learning tasks, such as compiling biodiversity reports, creating classification charts based on local organisms, and proposing solutions to issues related to West Kalimantan's biodiversity. The clarity of the expected results is in line with Ojating & Ojating (2022), which implies that learning resources should lead to both tangible products and meaningful learning processes. Moreover, Cleaver et al. (2025) emphasize the presence of biology learning activities that support the interrelated achievement of cognitive, affective, and psychomotor learning outcomes. Therefore, the learning resources developed from information on West Kalimantan's biodiversity have the potential to contribute to academic achievement, as well as to the development of scientifically literate and environmentally conscious students.

In summary, the analysis of learning resource requirements conducted within this study clearly demonstrates that the biodiversity of West Kalimantan across the five kingdoms of organisms meets the essential requirements defined by the framework proposed by Suhardi (2012), pointing to the potential for further development as contextual and relevant learning resources for junior high school students, particularly those residing in West Kalimantan. Integrating West Kalimantan's local biodiversity as a pathway for developing new learning resources can address the

scarcity of such resources in schools. Furthermore, this integration aligns with curriculum goals focused on meaningful student engagement and the achievement of learning outcomes in the cognitive, affective, and psychomotor domains. The integration of West Kalimantan's local biodiversity also helps strengthen regional identity, as students who understand and appreciate the region's natural wealth tend to develop a sense of pride in their cultural and environmental heritage (Sembiring et al., 2024). By incorporating local potential into learning, particularly in the Natural Sciences subject, students are empowered to connect scientific concepts with their immediate environment, thereby enhancing their understanding and awareness of organism classification and local biodiversity.

d. Practical Implications and Further Development

Based on the results of the learning resource requirements analysis, which indicate that the biodiversity of West Kalimantan meets all six requirements for learning resources as outlined by Suhardi (2012), several practical implications arise for implementing learning in organism classification within the Natural Sciences subject for junior high schools. The first implication is the facilitation of contextualized learning. Contextualized learning promotes progressive and learner-centered education by engaging students in exploring their surrounding environment, connecting new scientific concepts with prior knowledge and lived experiences, and gradually constructing understanding through meaningful interaction with authentic local contexts (Murtini et al., 2022). Such an approach shifts the learning process from teacher-directed transmission of biological knowledge toward active student participation, exploration, collaboration, reflection, and application of knowledge to locally relevant situations. Conversely, a learning process that relies solely on conventional methods without integrating authentic, real-world examples relevant to students' circumstances is indicative of low-quality teaching (Bustami et al., 2018). Therefore, the analysis conducted in this study provides a foundation for Natural Sciences teachers, particularly those in West Kalimantan, to incorporate local biodiversity data into their lessons as an innovative learning design. As a result, students are expected to understand and recall taxonomic ranks and organismal characteristics, and to recognize similarities and differences among organisms they encounter daily. Such experiences have the potential to advance meaningful learning by bridging scientific concepts with students' prior knowledge and lived experiences, while progressively developing students' higher-order cognitive abilities to identify, compare, analyze, and interpret biological characteristics in authentic contexts.

The second implication is the provision of opportunities to support the development of biodiversity literacy within Natural Sciences learning. Biodiversity literacy refers to students' capabilities in reading about, thinking about, writing about, comprehending, analyzing, and discussing concepts relevant to biodiversity, spanning levels from genes to ecosystems (Katili et al., 2021). When students possess strong biodiversity literacy, they are expected to develop a solid understanding of biodiversity, enabling them to contribute positively to its long-term sustainability (Argiyanti et al., 2024; Hiola et al., 2023; Nursalima et al., 2025). In addition to identifying the various species living in their surroundings, students can cultivate a sense of care and responsibility toward biodiversity, which encourages them to learn about the threats facing it (such as deforestation and the illegal wildlife trade) and to formulate relevant solutions. As a

result, students become more aware of the importance of bioconservation efforts in maintaining ecological balance in nature. Exposure to local biodiversity enables students to learn to identify organisms, interpret their distinguishing characteristics, recognize patterns of similarity and difference, and appreciate the roles different organisms play within various ecosystems. Natural Sciences learning that strengthens biodiversity literacy can encourage students to move beyond rote memorization toward a deeper understanding of the interconnection between organisms and their habitats. Several studies suggest that biodiversity literacy, despite being increasingly important, is often underemphasized in formal and non-formal education contexts (e.g., Aminullah et al., 2025; Fajri et al., 2025). By understanding how local biodiversity contributes to ecological stability and human well-being, students may develop a more informed perspective regarding the consequences of biodiversity loss and the urgency of bioconservation actions. This is in line with the biodiversity literacy framework proposed by Aminullah et al. (2025), which states that biodiversity literacy requires students to understand biodiversity, develop awareness, and take action.

The third implication is the provision of evidence-based references for educational policymakers to strengthen the integration of local biodiversity into Natural Sciences learning guidelines. This integration is valuable and has the potential to raise students' awareness of the biodiversity and local potential in West Kalimantan (Faturrahman et al., 2025), particularly given the important role of policymakers in developing regulatory and curriculum-related documents that guide teaching practices at various levels of implementation (Nguyen, 2018). The foundation synthesized in this study, based on the existence of West Kalimantan's biodiversity, may serve as a base for educational institutions and curriculum developers to design learning resources and teaching practices guidelines that reflect the unique biological characteristics of each region in Indonesia while remaining aligned with the *Merdeka* Curriculum learning outcomes established by BSKAP RI (2025). Therefore, the findings of this study reflect the ability to support junior high schools in Indonesia, particularly in West Kalimantan, in contextualizing the implementation of the *Merdeka* Curriculum by incorporating local examples relevant to students, rather than adopting uniform learning resources across diverse geographical settings. Moreover, this study implies opportunities to serve as a resource for formal teacher professional development initiatives, such as the Subject Teacher Forum (*Musyawarah Guru Mata Pelajaran*, hereinafter referred to as MGMP). The MGMP facilitates specific subject teachers in a region to discuss and communicate about the planning and implementation of learning, as well as to brainstorm problem-solving strategies during the learning process (Daryanto et al., 2020; Winingsih et al., 2019). Through MGMP, Natural Sciences teachers can exchange ideas and discuss the educational value of local biodiversity, potentially resulting in the design of learning resources that reflect the richness of West Kalimantan's biodiversity.

The fourth implication is the enhanced capacity of Natural Sciences teachers, particularly in West Kalimantan, to develop new learning resources that explicitly integrate local biodiversity information to support localized, contextualized Natural Sciences learning. This follow-up initiative is built upon the findings of this study, transforming local biodiversity data into structured learning activities that provide opportunities to enhance students' competencies as a pathway to support 21st-century education. In line with this

implication, a PBL module integrating West Kalimantan's biodiversity was developed, from the learning objectives to the assessment.

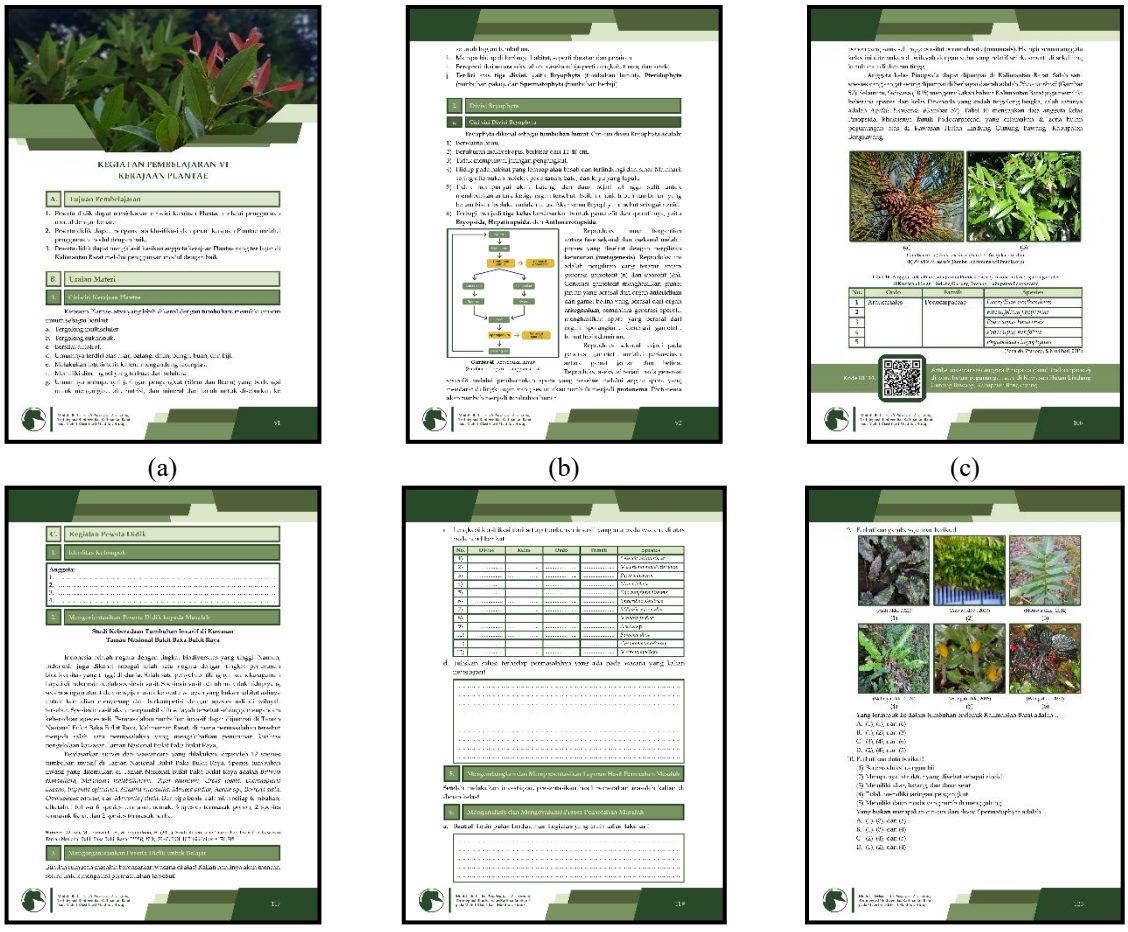

Figure 10. Excerpt of the Plantae kingdom learning activity: (a) learning objectives, (b) explanation regarding Bryophyta division, (c) examples of West Kalimantan's biodiversity in Pinopsida class, (d–e) student worksheet with an authentic West Kalimantan's biodiversity problem presented, and (f) formative test questions with an emphasis on West Kalimantan's endemic plants (in Indonesian)

Figure 10 presents an excerpt from a learning activity from the module developed as an extension of this study, focusing specifically on the kingdom Plantae. The module integrates biodiversity data from West Kalimantan throughout every learning component. The learning objectives align with the *Merdeka* Curriculum learning outcomes established by BSKAP RI (2025), and emphasize familiarizing students with plant species found in West Kalimantan, both endemic and non-endemic. The content presented in the learning activity is comprehensive, covering key concepts of the kingdom Plantae, including distinguishing characteristics across divisions and classes. The learning activity also provides examples of local plant species drawn from peer-reviewed sources, such as Sidiyasa (2015) and Natasya et al. (2024). Another component featured is a student worksheet developed using the PBL framework. The structure of the student worksheet follows the typical PBL syntax written by Arends (2015) and integrates an authentic problem related to the Plantae kingdom; specifically, an issue concerning invasive plant species, as identified in a peer-reviewed scientific article (Table 4).

The developed module aligns with the view of Babou et al. (2023), who state that teaching biodiversity concepts should involve analyzing real-world phenomena related to local biodiversity around students to support sustainable development. The formative assessment items in the learning activity are designed to evaluate students' understanding not only of general botanical concepts but also of plant species found in West Kalimantan. These items aim to measure both conceptual knowledge and students' ability to apply what they have learned to their local biodiversity context. Therefore, the developed module functions as a concrete example of how data-based learning resources can bridge the gap between scientific studies and classroom application. The developed module reinforces the idea that the teaching and learning process rooted in local potential can be meaningful while remaining aligned with the national predetermined learning outcomes of the *Merdeka* Curriculum.

The PBL activity is intentionally designed as a challenging learning experience because students are required to integrate classification knowledge with ecological reasoning, evidence analysis, collaborative investigation, and solution development rather than simply recall taxonomic information.

Table 4. Details of the PBL model in the "Plantae Kingdom" learning activity

No.	Syntax of PBL Model	Description
1	Orient students to problem	Students are oriented to a problem through a scientific article by Abduh et al. (2021), which reports on the presence of invasive plants in Bukit Baka Bukit Raya National Park, identifying 12 invasive species such as Indian rhododendron (*Melastoma malabathricum* L.), false staghorn fern (*D. linearis*), and shameplant (*Mimosa pudica* L.)
2	Organize students for learning	Students are guided to formulate problems derived from the given scenario
3	Assist independent and group investigation	Students are tasked with analyzing the given scenario and consulting references to address the accompanying questions and instructions they are asked to explain how invasive species threaten native species, describe the four growth forms of invasive plants found in the national park, classify each invasive plant from the division level to its species, and propose solutions to the problem
4	Develop and present problem-solving report	Students are directed to present and discuss their problem-solving results before the class
5	Analyze and evaluate the problem-solving process	Students are guided to formulate conclusions from the activities they have carried out and to record any obstacles experienced during the problem-solving process

The developed module serves as a tangible example of how local biodiversity specifically that of West Kalimantan can be used as the primary material for creating structured, engaging learning resources and activities grounded in a context-rich approach. By presenting learning components based on the biodiversity of West Kalimantan, the developed module exemplifies how scientific studies can be localized and adapted to connect with students' learning experiences. This embodies the principle of contextual learning in Natural Sciences learning, where local potential is positioned as a central element of the teaching and learning process (Lestari et al., 2026). Throughout the module, students are encouraged to explore and analyze biological phenomena in their province, particularly those related to West Kalimantan's biodiversity, which in turn supports the development of various aspects of students' academic performance (such as

critical thinking, problem-solving, and inquiry skills). Furthermore, the use of local biodiversity in education promotes environmental awareness and fosters a sense of responsibility among students toward their region's biological richness. It also strengthens regional identity, as students may begin to value and take pride in the unique biodiversity of their local area.

The developed module also supports advanced learning by integrating West Kalimantan's biodiversity with problem-based learning (PBL), enabling students to move beyond conventional knowledge acquisition toward higher-order processes of analyzing biological characteristics, evaluating authentic biodiversity problems, constructing explanations, and proposing evidence-informed solutions. The relevant, up-to-date information regarding the biodiversity of West Kalimantan in the module connects biology learning with the continuing development of scientific knowledge, reflecting by the study conducted by Amelia & Rahmaida (2017) regarding the increased productivity of Indonesian scientific publications on biodiversity. Meanwhile, the PBL framework integrates real-world and authentic problems that require students to go beyond rote memorization by engaging in analysis, evaluation, problem-solving, inquiry, and evidence-informed decision-making (Arends, 2015; Ningsih et al., 2025; Ningsih et al., 2026). This orientation is further supported by Hiola et al. (2023), who emphasized that the PBL model supported the acquisition of adequate biodiversity literacy. Thus, the integration of locally relevant biodiversity content and the PBL framework positions the module as a learning resource that reflects contemporary biology learning while maintaining direct relevance to organism classification.

This study offers several contributions to biology education, particularly to the discourses on local biodiversity-based learning. First, this study provides empirical evidence that the biodiversity of West Kalimantan has the potential to be used as contextual learning resources for organism classification in Indonesian junior high schools, particularly within the context of the *Merdeka* Curriculum. By synthesizing biodiversity findings from peer-reviewed studies, this study highlights locally relevant examples that may enrich the teaching of organism classification beyond what is found in common textbooks. Second, this study successfully demonstrates how local potential can be systematically evaluated using specific learning resource requirements. The findings extend the discussion of contextual learning resources from merely identifying local potential to critically examining their educational suitability for specific learning objectives. Third, this study provides a reference for the development of contextual learning resources and for professional discussions among teachers on organism classification. The synthesized biodiversity information has the potential to support the adaptation of Natural Sciences learning to locally relevant contexts while maintaining alignment with the nationally predetermined learning outcomes of the *Merdeka* Curriculum (Andyani et al., 2025). Overall, this study contributes to the advancement of contemporary education and learning by providing a conceptual foundation for using locally relevant biodiversity as a contextual learning resource that supports advanced, progressive, and challenging learning experiences. Through the integration of authentic local content and problem-based learning, students can move beyond memorizing taxonomic information toward analyzing biological evidence, investigating authentic environmental problems, collaborating with peers, constructing explanations, and proposing evidence-informed solutions. The alignment between

local potential specifically, West Kalimantan's biodiversity and learning about organism classification enables students to connect various scientific concepts to their surrounding environments, enhancing the relevance and quality of Natural Sciences learning while promoting students' understanding of biodiversity.

4. Conclusion

This study successfully explored the potential of West Kalimantan's biodiversity as a contextual learning resource for organism classification in junior high schools and presented a conceptual foundation for developing innovative learning resources based on this local potential. The study findings indicate that West Kalimantan possesses rich biodiversity across all five kingdoms of organisms, providing exceptional and relevant examples to support the learning outcomes and objectives of organism classification in junior high schools under the *Merdeka* Curriculum. Furthermore, the learning resource requirements analysis indicated that West Kalimantan's biodiversity has the potential to serve as a learning resource by meeting the established requirements. Therefore, the findings of this study highlight that local biodiversity can serve as a meaningful learning resource that connects scientific concepts with students' immediate environments while supporting advanced, progressive, and challenging learning experiences. When integrated with PBL, this contextual resource can progressively engage students in higher-order thinking, authentic inquiry, collaborative problem-solving, and the application of biological knowledge to complex local environmental issues. Practical implications, such as contextualized learning and biodiversity literacy, are formulated to further underscore how West Kalimantan's biodiversity can contribute to enhancing the quality of organism classification teaching and learning. Nevertheless, this study relied primarily on literature-based evidence and did not empirically investigate the implementation of biodiversity-based learning resources in classroom settings. This particular limitation creates opportunities for future studies to develop, implement, and evaluate innovative learning resources based on information about West Kalimantan's biodiversity to determine their effectiveness in improving students' academic performance. In this regard, the study demonstrates that localized biodiversity-based learning can move organism classification beyond conventional content transmission toward a more advanced, learner-centered, and challenging educational experience.

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