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Utilization of the Local Potential Campus Area as a Learning Resource Related to Morphology-Based Poaceae Diversity

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ABSTRACT

The utilization of local potential in the campus area has not been done optimally. The need for contextualized learning resources requires lecturers to provide appropriate learning resources for students, including biology education students in plant morphology. This study aims to utilize the local potential of the campus area as a learning resource regarding the diversity of Poaceae based on morphological reviews. The type of research used is descriptive quantitative. The data collection method in this study was observation. Sampling technique by making plots with the quadrat method with a size of 1x1 meter at several points in the campus area. The results of this study indicate that the Poaceae family identified in the PGRI Ronggolawe University campus area consists of 12 species, including *Stenotaphrum secundatum*, *Elymus repens*, *Poa annua*, *Paspalum dilatatum*, *Chloris barbata*, *Zoysia japonica*, *Muhlenbergia schreberi*, *Thyrsotachys oliveri*, *Bambusa vulgaris*, *Cymbopogon citratus*, *Digitaria sanguinalis*, *Panicum repens* with four subfamilies namely Bambusoideae, Pooideae, Panicoideae, Chloridoideae with a total of 259 individuals found. Overall, the level of Poaceae diversity in the campus area is H' = 2.19, which is a moderate category. The level of Poaceae diversity in the campus area from the highest to the lowest value is the subfamily Panicoideae (1.09), Chloridoideae (1.05), Pooideae (0.69), and Bambusoideae (0.66). Analysis of the potential of the research results shows that the diversity of Poaceae in the campus area can be used as learning material for plant morphology for biology education students.

Keywords: Poaceae, Local potential, Morphology, Diversity, Learning resources

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Introduction

Poaceae is a taxon of flowering plants or a family of large plants with a height of 50-100 cm that dominates tropical land for about 40% with 12 subfamilies and more than 11,000 species, and is divided into around 600-770 genera (Carballo et al., 2019; Hodkinson, 2018; Lee et al., 2020; Maftuna, 2022; McSteen & Kellogg, 2022; Soreng et al., 2022). Poaceae originates from the Cretaceous period (100 million years ago) and was identified at the beginning of the Miocene era (23-16 million years ago) (Wei et al., 2023). The Poaceae family belongs to the Angiosperms with anemogamous pollination, known as true grasses or shallow-rooted annual plants with solid and fast vegetative growth, and can survive as halophytes (Ghirardello et al., 2022; Gupta & Ranjan, 2020; Huang et al., 2022; Jaber & Al-Abide, 2023; Keshavarzi, 2020; Majeed et al., 2020; Ullah et al., 2021). Poaceae was first classified by Brown (1814), then revised most recently by molecular phylogenetics (Hodkinson, 2018; Saarela et al., 2018). The Poaceae family has been well-researched, especially as an economically advantageous (Baiakhmetov et al., 2020). For example, Yang et al. (2021) examined the hemicellulose part of Poaceae, which contains oligosaccharides. Poaceae is experiencing habitat changes with many species that are easily adaptable and known to be tolerant in most ecosystems, such as Arctic regions and deserts (Gallaher et al., 2022; Goma Al-Sghair, 2019; Malaviya et al., 2020; Trytsman et al., 2020). Apart from that, the Poaceae family is a plant with abundant species, so it is essential to study its diversity.

Diversity is the total number of species in a particular geographic area, including species variations between species and environments (Khan et al., 2020, 2022). Diversity shows the relationship between individual distributions and each other (Salami et al., 2021). The diversity of Poaceae dominates the ecological region and has crossed space, time, and lineages of more than 11,500 species and is related to wild plants (Donnelly, 2022; Favaretto et al., 2018; Jardine et al., 2020; Rocha et al., 2021). Poaceae has diverse species, habitats, and communities in all climate settings and plays a role in ecological resources (Majeed et al., 2022; Muller et al., 2021). Poaceae diversity is influenced by water availability, temperature, rainfall, and large-scale climate change (Abbas et al., 2021; Fatima et al., 2021; Pellegrini et al., 2021). The diversity of Poaceae provides a role for world vegetation, namely as environmental restoration and as a local potential for the area (Gori et al., 2022; Patra et al., 2021; Tenikecier & Ates, 2018).

The local potential is the potential of a region's specific natural resources or uniqueness (Jumriani & Prasetyo, 2022; Wulandari & Djukri, 2021). The local potential is currently being researched from different points of view, such as Pires-Lira et al. (2020) exploiting the local potential of Poaceae *Panicum aquaticum* Poir as a phytoresource for lead-contaminated environments. The diversity of the Poaceae family was studied by Arisandi et al. (2019) in the Rawa area of Sungai Lumbah Village, Barito Kuala and Majeed et al. (2022) in the Punjab area, Pakistan, based on distribution patterns. The local potential of medicinal plants was also identified by Hapid et al. (2023) in the Central Sulawesi Forest area, Kudadiri et al. (2022) in Sitinjo village, Dairi Regency, North Sumatra, Supiandi et al. (2023) in Tamambaloh, West Kalimantan and Agustina et al. (2022) on the coast of Prigi Bay, Trenggalek. Muryani et al. (2023) exploited the potential of herbaceous plant diversity at the Pancurendang gold mine site, Banyumas, as a mercury (Hg) hyperaccumulator. Local potential is found in various areas, such as mining, forest, and campus areas. The local potential in this place can be used as a learning resource. So far, utilizing local potential, such as campus areas, has yet to be carried out optimally and is rarely realized well. Most of the local potential of the campus area is not utilized as a learning resource, so it is neglected because it is considered ordinary things that are regional, have no value, and need to be more innovative. If developed well, the potential of the local campus area as a source of learning has its superior value. This value is based on a region's social, cultural, and environmental aspects (Jumriani et al., 2021).

Utilizing local potential as a learning resource is generally easy to find in an area so that students can understand the material contextually, easily apply it in real life, maximize learning outcomes and improve biology learning skills (Agusty et al., 2021; Hafizha et al., 2022; Handayani et al., 2022; Hasanah et al., 2022; Imtihana & Djukri, 2020; Saadah et al., 2022; Sam et al., 2023). Utilizing local potential, in this case, is the hope of the curriculum so that learning becomes more innovative, contextual, applicable, and meaningful to prepare students with local wisdom and be able to preserve the local potential of their region (Budiarti et al., 2022; Budiarto et al., 2020; Na'imah et al., 2022; Sobiatin et al., 2020; Wulandari & Djukri, 2021). Several previous studies have been conducted that utilize local potential for learning. Utilization of the local potential of Poaceae diversity was carried out by Najwa & Irianti (2023) in the Beringin Kencana Tabunganen rice fields as a high school electronic pocketbook, Hikmah & Winarti (2021) in the Tabanio Coastal Forest as a scientific book and Pohan et al. (2022) developed a 3D *page flip* based pocketbook. Handayani et al. (2022) utilized the local potential of the diversity of herbaceous-strata vegetation on Yogyakarta's Purba Mujib Volcano as a source for high school biology learning. Lestari & Cintamulya (2023) utilize local potential in Bektiharjo Baths, Tuban, as a source of Biology learning. Hasanah et al. (2022) develop local potential in Bantimurung Busaraung National Park as a botanical learning material. Sofyan et al. (2019) developed an E-Module based on the potential of local wisdom in Jambi City. Sunarsih et al. (2020) exploit Wonosobo's local potential as a biodiversity module. Wilujeng et al. (2020) exploit the local potential for blended learning videos.

Based on several previous studies, this is the first time anyone has utilized the local potential of the campus area as a source of learning about plant morphology. Environment-based learning resources are one of the crucial elements that can maximize the current learning process (Badria et al., 2021; Ediyani et al., 2020; Sari et al., 2022). Education and the environment must be integrated because the environment provides the contextual nature and specificity of teaching materials (Hastuti et al., 2020). However, these two things cannot be separated as needs (Ramadhan, 2021). The need for contextual learning resources requires lecturers as facilitators to provide appropriate, innovative, and exciting learning resources and evaluation tools so that learning is more meaningful and improves students' critical thinking (Alifteria et al., 2023; Mertha & Mahfud, 2022; Nurmalisa et al., 2023; Rahmatika et al., 2021). Many current educational developments utilize the environment's potential as a source of learning (Ilham et al., 2022). Lecturers chose the utilization of the local potential of the environment as a learning resource to support contextual learning efforts for students (Kustyarini et al., 2020; Rezi & Mudinilllah, 2022; Sulistyo & Kurniawan, 2020). With this use, it is hoped that it will create a learning atmosphere that is contextual, innovative, and interesting and that can be applied in today's learning. Therefore, we are new to previous research by utilizing the local potential of the campus area as a contextual learning resource.

Based on the description of Poaceae diversity in the campus area and the need for contextual plant morphology learning resources, the problem formulation in this research is how to utilize the local potential of the campus area as a learning resource related to Poaceae diversity based on a morphological review. The research objective is to utilize the local potential of the campus area as a learning resource related to Poaceae diversity based on morphological reviews.

Methods

This type of quantitative descriptive research describes the morphological diversity of the Poaceae family in the Universitas PGRI Ronggolawe campus area. In descriptive research, the researcher only explains the variables and describes the study findings and data from a subjective angle (Doyle et al., 2020; Siedlecki, 2020). The data collection method in this research is observation. Observation methods can help identify the type needed and observe changes that occur (Pope & Allen, 2020). Direct observations were made by making several plots using the square method with a size of 1x1 meter placed at each point in the campus area. A 1x1 plot size is used as it can provide a representative population sampling and facilitate the calculation of the diversity index. The total area of the Universitas PGRI Ronggolawe campus is 4 hectares, and the open area without buildings is 2 hectares. Samples were taken from 50% of the open area and divided into 12 sample spots.

Sampling was conducted on Sunday, 22 October 2023, in the Universitas PGRI Ronggolawe campus area (Figure 1). The tools and materials used in the research were stationery, a ruler, raffia rope, scissors, wooden stakes, a tape measure, a hammer, and a cell phone camera. The sampling technique involves making plots measuring 1x1 m in several spots on the campus area. The Poaceae found in the plot were then identified morphologically (roots, stems, leaves, flowers, fruit, and seeds), and the results of the observations were recorded in a table. This research variable is a single variable, namely the diversity of Poaceae in the Universitas PGRI Ronggolawe campus area. The single variable method only requires one type of data (Ding et al., 2022).

Figure 1. Location of research sampling (Author documentation)

The research data analysis technique used is quantitative, using the diversity index value to calculate it. Quantitative methods first use mathematical concepts and calculations (Moraga et al., 2020). Once known, the diversity index values and morphological observation data are analyzed descriptively using learning resources.

Poaceae diversity observation data was identified through the diversity index equation of Shannon & Wienner (1963). In *Shannon's* diversity, the greater the diversity in the number of species and the even distribution between species, the greater the uncertainty in selection (Augousti et al., 2021). The Shannon & Wienner index equation (1963) in Yudhistian & Wulandari (2024) is as follows:

$$H' = -\sum_{i=1}^{s} \text{pi}.\, ln\, \text{pi}$$

Description: H′ = Shannon-Wienner diversity index
pi = the number of individuals found in genus *i* in a population
pi = $\frac{ni}{N}$ with; ni = the number of individuals in one species;
N = is the total number of individuals of the species found
ln = Natural logarithm

The known diversity index (H') is grouped with the definition criteria of the Shannon-Wienner diversity value (1963) in Yudhistian & Wulandari (2024), as presented in Table 1 below.

Table 1: Diversity index value criteria

H′ value	Diversity Category
H′ <1	Low Level
1 ≤ H′ ≤3	Medium Level
H′ >3	High level

Results and Discussion

Morphological Identification of Poaceae

The results of research related to Poaceae diversity from morphological studies in the Universitas PGRI Ronggolawe campus area showed that there were 12 types of Poaceae, each found in a different spot. Morphological observations were carried out directly by observing the roots, stems, leaves, flowers, fruit, and seeds. The results of observations on the morphology of Poaceae diversity found in the Universitas PGRI Ronggolawe Tuban campus area are presented in Figure 2.

Figure 1: Result of morphological observations of Poaceae diversity. (a) *Stenotaphrum secundatum*; (b) *Elymus repens*; (c) *Poa annua*; (d) *Paspalum dilatatum*; (e) *Chloris barbata*; (f) *Zoysia japonica*; (g) *Muhlenbergia schreberi*; (h) *Thyrsotachys oliveri*; (i) *Bambusa vulgaris*; (j) *Cymbopogon citratus*; (k) *Digitaria sanguinalis*; (l) *Panicum repens* (Author documentation).

The Poaceae species identified chiefly live in groups and creep on the ground; only some grow tall. It can be seen from the picture that the Poaceae species have parallel, ribbon-shaped leaves with pointed tips, are upright, most of them have flower spikes, and are brownish black. The seeds are ovoid, small, arranged in compounds, and elongated. The identification of observation results related to the morphology of Poaceae diversity can be seen in Table 2.

Table 2: Identify morphological observations of Poaceae in the campus area

Species	Morphological Characteristics				
	Root	Stem	Leaf	Flower	Fruit/Seeds
Stenotaphrum secundatum	Fibre	Thin, unsegmented, flat branches above the base	Parallel, broad, furrowed, fine-haired	Grains, anthers brown, upper lemma thin, veined	Grain, elongated oval, green
Elymus repens	Fibre	Straight, short segments	Aligned, stacked, small	Small oval grains, hairy	Grain, smooth, small, round, green
Poa annua	Fibre	Segments short, slender, erect	Parallel, green, short, flat	Grains, yellow, oval anthers	Grain, tight, big
Paspalum dilatatum	Fibre	Segments short, erect	Aligned, flat, neat	Black, small, hairy, spiked, pointed shoots	Egg-shaped grains, pointed tip, veined, brownish, numerous
Chloris Barbata	Fibre	Green, erect, hairy, stems clump, creeping	The shape of the leaves is striped, the tip is pointed, the base is notched, and the edges are rough and flat.	White grains, black husks, complete flowers	Grain, brownish black, numerous
Zoysia japonica	Fibre	Short segments, straight uphill	Small, stiff, rigid, straight, pointed tip	Grain, black, small	Grain, ovate, awn, black
Digitaria sanguinalis	Fibre	Segments short, bent	Fingering, green, wavy	Grain, flat, winged, yellow-grey	Grains are unequal, green, elongated
Panicum repens	Fibre	Segments short, erect, stiff	Straight, green, scaly, pointed, parallel	Grain, long oval, green	Grain, pale green, shiny, smooth
Cymbopogon citratus	Fibre	Unsegmented, reddish-white, short, rigid, flexible	Hard, scaly, leathery, parallel, ribbon, pointed tip, flat	Grain, compound, bowed, narrow-winged	Grain, separate
Thyrsostachys oliveri	Fibers, supporting roots	Segmented, cylindrical, complex, dark green, smooth	Compound, oval, parallel, dark green, rough	Compound, green	Brownish green
Bambusa vulgaris	Fibers, supporting roots	Segmented, cylindrical, hard, yellow striped, erect, clumped, smooth	Parallel, oval, compound, smooth, pointed tip	Infinite compound	Brownish-yellow
Muhlenbergia schreberi	Fibre	Segments smooth, shiny, small	Aligned, smooth, small	Pointed shoot, few hairs	Grain, veinless, round, green, small

Overall, the roots of the identified Poaceae species have fibrous roots *(radix adventicata)* that grow at the base of the lower stem segments. These fibrous roots show that Poaceae is classified as a monocot plant. The fibrous roots of Poaceae look fine, clustered, and spread underground. Fine roots can increase the area for absorption of water and nutrients by roots in the soil (Fort & Freschet, 2020; Zhou et al., 2020). These fibrous roots also make Poaceae plants strong and easily absorb water and nutrients from the soil into the plant parts. Poaceae has thin fibrous roots and can quickly absorb water in shallow soil; it can also provide oxygen for root respiration to the rhizosphere (Granse et al., 2022; Jiang et al., 2022). Water and nutrients are absorbed by the xylem vessels in the central cylinder of the root (Yamauchi et al., 2021). The species *Thyrsostachys oliveri* and *Bambusa vulgaris* have brace roots that grow at the base of the stem above ground level. Support roots are called node roots because they develop from stem nodes (Sparks, 2023). These supporting roots function as supports for the stem and absorb more water (Hostetler et al., 2021). These supporting roots are only found in high-level Poaceae species but not at lower levels, such as in grass species. The fibrous roots of this grass have fibrous fibers, which can strengthen the soil structure and prevent soil erosion (Ekeoma et al., 2021).

The stems of the identified Poaceae species have an upright, flat morphology and are segmented or *noded*. The size of Poaceae stem segments varies depending on each species. Short stem segments such as *Poa annua, Elymus repens, Paspalum dilatatum, Zoysia japonica*, and *Digitaria sanguinalis.* Long stem segments, as in *Thyrsostachys oliveri* and *Bambusa vulgaris.* These stem segments are related to the plant's growth so that the plant grows tall and the leaf branches develop (Fu et al., 2020). The stems of Poaceae species are also unsegmented, such as *Stenotaphrum secundatum* and *Cymbopogon citratus*. Cymbopogon *citratus* has axillary buds capable of producing new offspring (Susilowati & Syukur, 2022). Different from the others, *Cymbopogon citratus* has reddish-white stems. The stems of the identified Poaceae species have a soft structure but are not watery, do not branch, and do not have vascular cambium like woody plants, so they are classified as monocot stems. Vascular cambium is not found in monocot stems but in dicot stems (Jura-Morawiec et al., 2021). Several species of Poaceae have cylindrical, stiff, and rigid stems, such as *Thyrsostachys oliveri* and *Bambusa vulgaris.* These two species also have cavities in their stems, following Mousa et al. (2021), who said that hollow stems are often found in monocot plants belonging to the Poaceae family. Generally, this bamboo species has two types of stems, namely rhizomes (underground) and stems located above the ground (Damayanto et al., 2020).

Observations on the leaf morphology of all Poaceae species found to show that Poaceae have parallel leaf veins, are bright green, compound, and have pointed tips. This primary characteristic of leaf shape influences plant growth, survival, and ecosystem habitat (Huang et al., 2020). The observation that the Poaceae leaves are neatly arranged, small in size, and alternate follows the statement of Rzanny et al. (2022), which states that the Poaceae leaves are alternate and attached to the stem node. The small size of Poaceae leaves can efficiently use water in the photosynthesis process in the dry season (Baird et al., 2021). Poaceae leaves also have fine or scaly hairs. *Thyrsostachys oliveri* and *Bambusa vulgaris* leaves have parallel veins with an oval shape because the leaves are composed of long, tubular cells (Leandro et al., 2020). Differences are also found in *Digitaria sanguinalis,* which has finger veins. The *Cymbopogon citratus* species has long, ribbon-like parallel leaves that are flat and have a hard and stiff texture. The species *Stenotaphrum secundatum* has a wrinkled leaf structure; this is different from the leaf structure of other Poaceae. According to Chen et al. (2020), fan cells *(bulliform cells) were found* in the leaves of the Poaceae family. This is what causes several Poaceae species to be found curled, such as *Cymbopogon citratus, Thyrsostachys oliveri,* and *Bambusa vulgaris*. This leaf-rolling process can reduce water evaporation in the dry season.

The Poaceae species' flower morphology shows that Poaceae have spike flower compounds with an oval shape, hair, and small size. *Spikelet* flowers are compound flowers composed of short lateral branches and a pair of small compound husks (Ren et al., 2020; Y. Wang et al., 2022). These *spikelets* are produced along the husk axis in a right and left pattern (Wang et al., 2022). Flowers in Poaceae contain several grain heads, also called compound grains (Yuan et al., 2020). Observations often found that the grains on Poaceae pungas were still young, so they were covered by protective leaves *(bracts),* such as those on *Chloris barbata, Stenotaphrum secundatum,* and *Elymus repens.* Almost all Poaceae species' flowers are covered in protective leaves (AuBuchon-Elder et al., 2020). The flower spikes of the Poaceae found are generally black, brown, and yellow. Flowers in the species *Elymus repens* and *Chloris barbata* have hairs on the spikes. The *Chloris barbata* species also has black husks growing on the flower spikes. The *Poa annua* species has oval pollen heads, differentiating it from other Poaceae species. In general, pollen grains in Poaceae are round grains with a single pore *(mono part)* surrounded by an annulus (Ngernsaengsaruay et al., 2023). Flowering in the species *Thyrsostachys oliveri* and *Bambusa vulgaris* is annual or seasonal and monocarpic, and after flowering, most species will die (Lima et al., 2020; Yang et al., 2021). This is also the same as annual plants in *Cymbopogon citratus* and *Digitaria sanguinalis* (Mirzaie et al., 2020; Oreja et al., 2023). Meanwhile, *Stenotaphrum secundatum* is classified as a perennial plant (Luo et al., 2020).

Based on observations regarding the morphology of fruit and seeds in Poaceae species, it was found that there were no fruits in Poaceae species. Therefore, these observations focus only on seeds of Poaceae species. Most of the Poaceae species found have elongated oval and egg-shaped grains with a tiny size. The seeds found are green, such as those of *Stenotaphrum secundatum, Elymus repens*, and *Muhlenbergia schreberi.* There are also brownish-black seeds, such as *Elymus repens, Chloris barbata,* and *Zoysia japonica*. The color of these seeds indicates the age of the seeds; when they are young, the seeds are bright green, and when they mature, they turn brownish black. The seeds in Poaceae species mostly grow together with the fruit wall, known as *the caryopsis*. *Caryopsis* from Poaceae is very small but has essential morphological characters in the division of the Poaceae subfamily (Abid et al., 2022). Seed morphology is strongly influenced by environmental factors, such as soil salinity and vegetation composition (Ma et al., 2021). The role of seeds in Poaceae is huge, namely as a means of generative reproduction, which will later develop into sprouts and the next generation (Dai et al., 2020). Apart from their role in the species, seeds also preserve diversity in the forest through their distribution (Bona et al., 2020). Germination in Poaceae depends on factors such as seed size, soil type, species, and hydrocarbon concentration. Large seeds can capture more nutrients and food than tiny seeds (Yousaf et al., 2022).

Poaceae Diversity Levels

The identification results found 12 Poaceae species with a total of 259 individuals. Of the 12 types found, four subfamilies are Bambusoideae, Pooideae, Panicoideae, and Chloridoideae. The Bambusoideae identified were *Thyrsostachys oliveri* and *Bambusa vulgaris*. The Pooideae identified were *Poa annua* and *Elymus repens*. The Panicoideae identified were *Stenotaphrum secundatum, Elymus repens, Paspalum dilatatum, Digitaria sanguinalis* and *Cymbopogon citratus.* The identified Chloridoideae were *Chloris Barbata, Zoysia japonica* and *Muhlenbergia schreberi*. Overall, the Poaceae family is classified into seven subfamilies, namely Bambusoideae, Oryzoideae, Pooiddeae, Panicoideae, Arundinoideae, Chloridoideae and Centothecoideae (Usma et al., 2019). The Poaceae species diversity index based on subfamily in the campus area is presented in Table 3.

Table 3: Poaceae diversity index value based on subfamily in the campus area

Subfamily	Species	ni	pi $\left(\frac{ni}{N}\right)$	$\ln pi$	H′	Category
Bambusoideae	*Thyrsostachys oliveri*	10	0.63	-0.47	0.29	Low
	Bambusa vulgaris	6	0.38	-0.98	0.37	Low
	Total	16	1.00	-1.45	0.66	Low
Pooideae	*Poa annua*	32	0.53	-0.63	0.34	Low
	Elymus repens	28	0.47	-0.76	0.36	Low
	Total	60	1.00	-1.39	0.69	Low
Panicoideae	*Paspalum dilatatum*	11	0.10	-2.32	0.23	Low
	Stenotaphrum secundatum	72	0.64	-0.44	0.28	Low
	Digitaria sanguinalis	14	0.13	-2.08	0.26	Low
	Panicum repens	13	0.12	-2.15	0.25	Low
	Cymbopogon citratus	2	0.02	-4.03	0.07	Low
	Total	112	1.00	-11.02	1.09	Medium
Chloridoideae	*Chloris Barbata*	14	0.20	-1.62	0.32	Low
	Zoysia japonica	30	0.42	-0.86	0.36	Low
	Muhlenbergia schreberi	27	0.38	-0.97	0.37	Low
	Total	71	1.00	-3.45	1.05	Medium

The diversity index (H') describes the condition of individual populations mathematically to make it easier to analyze information on the number of individuals of each type in a community. The overall level of Poaceae diversity in the campus area from the highest to the lowest value is the subfamilies Panicoideae (1.09), Chloridoideae (1.05), Pooideae (0.69) and Bambusoideae (0.66). The Bambusoideae and Pooideae subfamilies are classified in the low diversity category with index results of 0.66 and 0.69 based on the $H' < 1$ diversity index criterion. The Bambusoideae subfamily is only divided into three tribes, namely Arundinariae (temperate woody bamboos), Bambuseae (tropical woody bamboos) and Olyreae (herbaceous bamboos) (Zhang et al., 2020). Meanwhile, the Pooideae subfamily is often found in the highlands with cold climates and is rarely found in the lowlands (Tkach et al., 2020). The Panicoideae and Chloridoideae subfamilies are classified in the medium diversity category with index results of 1.09 and 1.05 based on the $1 \leq H' \leq 3$ diversity index criteria. This is relatively high considering that the location used for research is a campus area. The Panicoideae subfamily dominates many tropical grasslands worldwide (Welker et al., 2020). Meanwhile, the Chloridoideae subfamily is the largest Poaceae subfamily, with more than 1,400 species throughout the world (Wang et al., 2022).

Based on Table 3, there are 12 types of Poaceae, with a total of 259 individual species identified in the field. The *Stenotaphrum secundatum* species has the largest number of individuals compared to other species, with 72 individuals. *Stenotaphrum secundatum* is often found in warm and subtropical climates in the world (Tran et al., 2021). Meanwhile, the *Cymbopogon citratus species* has the smallest number of species compared to the other species, with only two individuals. The *Cymbopogon* genus consists of around 55 species and is found in tropical climates (Hartatie et al., 2020). The Panicoideae subfamily has the most significant number of individuals compared to the other three subfamilies, based on observations with 112 individuals. The Panicoideae subfamily is known as lower grass plants (Ge et al., 2020). Meanwhile, the Bambusoideae subfamily has the smallest number of individuals compared to the other three subfamilies based on observations, with only 16 individuals. The growth of Bambusoideae is strongly influenced by air temperature and rainfall, especially soil temperature, which plays a role in the development of bamboo rhizomes (Chan et al., 2022). Table 4 presents the analysis results related to the overall Poaceae diversity index in the campus area.

Table 4: Poaceae diversity index value overall in the campus area

Species Name	ni	pi $\left(\frac{ni}{N}\right)$	$\ln pi$	H′
Thyrsostachys oliveri	10	0.04	-3.25	0.13
Bambusa vulgaris	6	0.02	-3.77	0.09
Poa annua	32	0.12	-2.09	0.26
Elymus repens	28	0.11	-2.22	0.24
Paspalum dilatatum	11	0.04	-3.16	0.13
Stenotaphrum secundatum	72	0.28	-1.28	0.36
Digitaria sanguinalis	14	0.05	-2.92	0.16
Panicum repens	13	0.05	-2.99	0.15
Cymbopogon citratus	2	0.01	-4.86	0.04
Chloris Barbata	14	0.05	-2.92	0.16
Zoysia japonica	30	0.12	-2.16	0.25
Muhlenbergia schreberi	27	0.10	-2.26	0.24
Total	259	1.00	-33.88	2.19

Based on the data analysis in Table 4, it is known that the Poaceae diversity in the campus area obtained a result of H′ = 2.19, which is classified as in the medium category with the criteria 1≤H′≤3. The results obtained are quite high considering that the location taken for diversity observations is a campus area with dry and hot conditions. Plant diversity often changes at any time because each vegetation requires a different amount of time to complete its life span. Changes in plant communities coincide with changes in growing places and are also influenced by ecological factors. Climate is the main factor that significantly influences plant diversity; warm and wet climate regions support more species than cold or arid climate regions (Harrison et al., 2020). The diversity of Poaceae is strongly influenced by various morphological characteristics, pollination, and distribution, as well as the ability to adapt to habitat and successful growth. Tall grass plants have a longer dispersal distance and a lower level of competition, thus supporting the potential for successful spread and growth. Low-grass plants have a lower survival and growth rate but a higher invasive potential for dispersal (Touafchia et al., 2023). This is proven by identifying diversity in the Panicoideae subfamily, where the plants are small and have the most significant number of individuals. The Bambusoideae subfamily and *the Cymbopogon citratus species* have tall plant sizes and a small number of individuals.

Analysis of the Potential of Research Results as a Learning Source

The research results show that Poaceae's diversity level in the campus area is medium, with 12 identified species. The identification also includes morphological characteristics of each species, such as roots, stems, leaves, flowers, fruit, and seeds. The twelve species that have been identified can be used as a learning resource for biology education students who are taking plant morphology courses on plant diversity material. The utilization of learning resources from research results can be in the form of developing teaching materials and learning media designed using the Contextual Teaching Learning (CTL) model that presents Poaceae species in the context found in the campus area. This development is expected so students can understand the material in context and easily correlate it with the surrounding environment. According to Handayani et al. (2022), biological research results can be used as a learning resource if they meet the requirements as a learning resource. The following is an analysis of the research results on the diversity of the Poaceae family in the campus area based on morphology and its use as a learning resource for plant morphology.

1. Clarity of potential, availability of objects, and problems taken

   The object used in this research is morphology-based Poaceae diversity in the Universitas PGRI Ronggolawe campus area. This family is easy to find, recognize, and identify based on its morphology and is very easy to find in the local environment. The relevance of the problem taken to its potential as a source for learning plant morphology is that there has yet to be research that utilizes the campus area as a source for learning plant morphology contextually.

2. Suitability to learning objectives
   The learning objective of the Merdeka curriculum is to provide critical, quality, expressive, applicable, varied, and progressive learning (Vhalery et al., 2022). Referring to the Biology Learning CP, especially plant morphology, the Merdeka curriculum in the Ministry of Education and Culture, BSKAP (2022). The nature of science as a process and product, there are two elements in this subject, which include (1) understanding biology and (2) process skills. The Merdeka curriculum learning objectives stated in the Biology Learning CP, especially plant morphology, are elements of understanding biology, which include biodiversity material, following the statement by Manalu et al. (2022) The Merdeka learning curriculum changes learning methods that were initially carried out in the classroom and has changed to learning outside the classroom. This follows the research results, which utilize the local potential of the campus area as a source of learning about plant morphology so that students can learn by directly observing the diversity of Poaceae in the campus area.
3. Target material, subject matter, and purpose
   The clarity of the target material in this research is material on the diversity of the Poaceae family based on morphology, especially the level of diversity of the Poaceae family and Poaceae morphology, such as roots, stems, leaves, flowers, fruit, and seeds. Meanwhile, the target subjects of this research are biology education students.
4. Information to be explained
   Based on the research that has been carried out, the clarity of the information that can be explained is in the form of facts and concepts. The facts obtained were the discovery of 12 Poaceae species in 4 subfamilies with 259 individuals in the Ronggolawe PGRI University campus area. The species found include *Stenotaphrum secundatum, Elymus repens, Poa annua, Paspalum dilatatum, Chloris barbata, Zoysia japonica, Muhlenbergia schreberi, Thyrsotachys oliveri, Bambusa vulgaris, Cymbopogon citratus, Digitaria sanguinalis, Panicum repens.* The subfamilies found are Bambusoideae, Pooideae, Panicoideae, and Chloridoideae. The diversity level of the Bambusoideae (0.66) and Pooideae (0.69) subfamilies is classified as low, while the diversity level of the Panicoideae (1.09) and Chloridoideae (1.05) subfamilies is moderate. The concept obtained from this research is the level of Poaceae diversity based on morphology. According to Priantin et al. (2022), the Merdeka learning curriculum is implemented using media and teaching resources that have been prepared. This follows the research results, which are used as a learning resource for implementing the Merdeka curriculum.
5. Clarity of exploration guidelines
   Based on the results of this research, it is necessary to have clear and coherent exploratory research guidelines, starting with selecting research areas, research objects, work procedures, tools and materials, data collection, data analysis, and conclusion. Referring to Biology Learning CP, especially plant morphology, the process skills elements in the Ministry of Education and Culture BSKAP (2022) include (1) observing, (2) questioning and predicting, (3) planning and conducting investigations, (4) processing and analyzing data and information, (5) evaluating and reflecting, and (6) communicating results. The results of this research can be used to support CP biology learning, especially plant morphology, namely biodiversity material or, more precisely, the level of Poaceae diversity based on morphology.
6. Gains to be achieved
   The clarity of the results obtained in research on learning resources must be based on the objectives to be achieved in the learning process. Good learning resources can ideally provide meaningful experiences to improve students in the cognitive, affective, and

psychomotor fields (Handayani et al., 2022). This can be realized through contextual learning, one of which is by presenting contextual, authentic, and concrete learning resources that are close to students through using environmentally based learning resources around them. According to Rahmat et al. (2023), the classification of learning resources according to type or origin consists of two types, namely (a) learning resources based on learning design (by design), namely teaching resources that are specifically and deliberately designed or developed to achieve learning objectives. , such as textbooks, worksheets, modules, teaching materials, and practical instructions; (b) learning resources based on their use, namely teaching resources that are not designed or developed specifically for learning purposes but can be selected and used for learning purposes, such as newspapers, community figures, museums, television broadcasts, and historical places. The Universitas PGRI Ronggolawe campus area is one of the local potentials that can be utilized to learn about plant morphology.

Conclusion

Based on research results, the Poaceae family identified in the Universitas PGRI Ronggolawe campus area consists of 12 species, including *Stenotaphrum secundatum, Elymus repens, Poa annua, Paspalum dilatatum, Chloris barbata, Zoysia japonica, Muhlenbergia schreberi, Thyrsotachys oliveri, Bambusa vulgaris, Cymbopogon citratus, Digitaria sanguinalis*, *Panicum repens,* with four subfamilies, namely Bambusoideae, Pooideae, Panicoideae, Chloridoideae, and a total of 259 individuals found. Overall, the level of Poaceae diversity in the campus area was H' = 2.19, which is classified as in the medium category. The highest level of diversity is the Panicoideae subfamily at 1.09 in the medium diversity category. The lowest level of diversity is the Bambusoideae subfamily at 0.66 in the low diversity category. Analysis of the potential research results shows that the diversity of Poaceae in the campus area can be used as a source of learning about plant morphology for biology education students, and that further research needs to be carried out to utilize the results of this research as a learning resource. The contribution of the results of this research is to develop biology learning, especially plant morphology, for biology education students.

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