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Preface

Assalamu'alaikum warahmatullahi wabarakatuh,

Praise and Gratitude go to the presence of Allah SWT for His blessings and gifts so that we can complete and publish the BIOEDUSCIENCE, Prof. Muhammadiyah University. DR. HAMKA. BIOEDUSCIENCE is published twice a year in June and December. The articles published are the scientific work of lecturers and researchers in biology and biology education. We hope that the BIOEDUSCIENCE can be used optimally by all lecturers, researchers and academics throughout Indonesia.

We want to thank the Chancellor and Deputy Chancellors, Faculty Leaders, Postgraduate School Directors, Heads of Institutions, Heads of Bureau Prof. DR. Hamka. We also thank the editors and reviewers for their assistance in completing the scientific publication of the BIOEDUSCIENCE Volume 05 Number 02 of 2021. We are aware that in the making of this electronic journal, there are still shortcomings. Therefore we expect criticism and suggestions from various parties for the good of this journal.

Hopefully, this journal will provide the best possible benefit and contribute to the development of science in Indonesia. Thank you.

Wassalamu'alaikum warahmatullahi wabarakatuh.

Jakarta, August 2021
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Biological Aspects of Waanders's Hard-lipped Barbs (*Osteochilus waandersii*) in Tambatan River, North Sumatera, Indonesia

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A B S T R A C T

Background: Waanders's hard-lipped barbs or scientifically known as *Osteochilus waandersii* belong to the family Cyprinidae with the potamodromous category. This fish can be found in the Tambatan river, and it has the potential for commercial consumption or ornamental fish. **Methods:** This study was conducted in the Tambatan river from November to January 2021. The determination of three research stations was carried out using a purposive sampling method. Sampling was undertaken using cast nets. Furthermore, data analyzed were growth patterns, condition factors, and gonad maturity levels. **Results:** The growth patterns of male (1.944) and female (2.379) *Osteochilus waandersii* were in a harmful allometric category. Besides, The Fulton's condition factor for male fish ranged from 0.42 - 3.43 with an average of 1.05, while that for female fish ranged from 0.59 - 3.67 with an average of 1.47. The result of the observation on the gonad maturity level for male and female *O. waandersii* in the Tambatan river indicated that they were dominated by fish with gonad maturity stage I (immature). **Conclusions:** Waanders's hard-lipped barbs *O. waandersii* found were in the stage towards the mature level**.**

Aspek Biologi Waanders's hard-lipped barb (*Osteochilus waandersii*) di Sungai Tambatan, Sumatera Utara, Indonesia

Kata kunci:
Osteochilus waandersii;
Pola pertumbuhan;
Sungai Tambatan;
Tingkat Kematangan Gonad;

A B S T R A K

Background: *Waanders's hard-lipped barbs* atau secara ilmiah dikenal sebagai *Osteochilus waandersii* termasuk dalam famili Cyprinidae dengan kategori potamodromous. Ikan ini dapat ditemukan di sungai Tambatan dan memiliki potensi untuk konsumsi komersial atau ikan hias. **Metode:** Penelitian ini dilakukan di sungai Tambatan pada bulan November hingga Januari 2021. Penentuan tiga stasiun penelitian dilakukan dengan menggunakan metode purposive sampling. Pengambilan sampel dilakukan dengan menggunakan jaring cor. Selanjutnya data yang dianalisis adalah pola pertumbuhan, faktor kondisi, dan tingkat kematangan gonad. **Hasil:** Pola pertumbuhan *Osteochilus waandersii* jantan (1,944) dan betina (2,379) termasuk dalam kategori alometrik negatif. Sedangkan faktor kondisi Fulton untuk ikan jantan berkisar antara 0,42 - 3,43 dengan rata-rata 1,05, sedangkan untuk ikan betina berkisar antara 0,59 - 3,67 dengan rata-rata 1,47. Hasil pengamatan tingkat kematangan gonad *O. waandersii* jantan dan betina di sungai Tambatan menunjukkan bahwa mereka didominasi oleh ikan dengan kematangan gonad tahap I (belum matang). **Kesimpulan:** Waanders's hard-lipped barbs yang ditemukan *O. waandersii* berada dalam tahap menuju tingkat dewasa.

Introduction

The Waanders's hard-lipped barb (*Osteochilus waandersii*) is a freshwater fish belonging to the family Cyprinidae. Its morphometric and meristic characteristics are included in the order Cypriniformes, family Cyprinidae, genus *Osteochilus*, and species *Osteochilus wandersii*. Based on its morphology, this fish has a blackish back (Kottelat *et al*., 1993). All fins are yellow. The base of the dorsal and tail fins is black (Sukmono & Margaretha, 2017). Furthermore, this fish has a clear black stripe from the gill to the tip of the tail. It also has 12 - 13 forked dorsal. In addition, its tail fin, back fin, pectoral fin, and pelvic fins have light orange or red color (Fishbase, 2021). *O. waandersii* belongs to the potamodromous category, meaning that this fish can live in freshwater only (Riede, 2004).

In Indonesia, this fish has several names, including *kujam garis* in Jambi and its surrounding (Sukmono & Margaretha, 2017). In Czechia, this fish is known as *tvrdoretka waandersova* (Hanel, L. & Novák, 2002). In Estonia, it is called *waandersi luumokk* (Biodiversity, 2015). Besides *kujam garis* in Jambi, it is also known as *bantak surik*/*bantak batu* in several region in Indonesia (Kottelat, & M. Widjanarti, 2005). Cambodian people call this fish *trey kros* (Rainboth, 1996). In Laos, it is called *pa khang lai gnai*/*pba kang lai* (Baird, 1998). In China, this fish is known as *wa shi shi wen chun yu* (Wu et al., 1999).

Distribution *O. wandersii* spread across several countries, including Thailand (the Mekong river, Chao Phraya), to the Malay peninsula, Sumatra, and Borneo (Kottelat, 1998). In addition, this fish can also be found in Vietnam (Kottelat *et al*., 1993), Cambodia, and Laos (Kottelat, 1998). The habitat of this fish is large freshwater rivers with fast currents and rocky & gravel substrates (Kottelat, 1998). It is a species of omnivore fish that eats algae, mosses, and small animals. In other words, this fish can be called detritus – decomposers of organic waste from plants and animals (Rainboth, 1996).

Several studies have been conducted on this topic. Septian *et al.* (2020) studied the distribution of *Osteochilus* sp. in Kapuas Hulu District. Soetignya *et al.* (2020) investigated the reproductive aspects of *O. waandersii*. Samuel & Suryati (2014) and Atminarso *et al.* (2015) measured the growth parameters of *O. waandersii*. Adiansyah & Samuel (2017) observed the mortality and growth patterns of *Osteochilus Sp.* William & Beamish (2006) studied the habitat of *O. waandersi* from the family Cyprinidae.

In this study, the chosen research location is the Tambatan river. It is one of the tributaries, administratively located at Bandar Durian village, North Labuhanbatu. This river is widely used by the community for many activities. The flow of this river disembogues into the Kualuh river. In addition, the community activities around this river are fishing for filling their daily necessities and mining sand & stone traditionally. These various activities are presumed to be the cause of the decline in the distribution of the population of *O. waandersii*.

To date, not much information has been known about the bioecological aspects of the Waanders's hard-lipped barbs (*O. waandersii*) in the Tambatan river because a study related to this topic is rarely conducted. Therefore, this study aims to present information on biological aspects, such as growth patterns, condition factors, and the level of gonad maturity, of Waanders's hard-lipped barbs (*O. Waandersii*). Data presented in this study are expected to be able the initial information to manage the potential of freshwater fisheries resources in the future.

Methods

Research Setting

This study was conducted from November 2020 to January 2021 in the Tambatan river, Bandar Durian Village, North Labuhanbatu, North Sumatra. The determination of sampling stations was carried out using a purposive sampling method, in which this method allows the sampling points to be determined based on specific considerations to make the obtained data more representative.

Samples

Sampling was conducted once a month from 10:00 a.m. to 3:00 p.m. There were three research stations in this study. They were determined using the Global Positioning System (GPS). The description of information of sampling station (Table 1.), Station 1 was located at 2°21'28.37" N, 99°41'20.38" E, this station is in Dusun II Jarinjing near community settlements. At this station, the substrate of the river channel primarily consists of sand with a calm current and is surrounded by community-owned oil palm plantations. Station 2 was located at 2°21'42.58" N, 99.40'40.88" E. This station is still in Dusun II Jarinjing but far from community settlements. At this station, the substrate of the river channel mostly consists of rock with a moderate current and is surrounded by woods. Station 3 was located at 2°21'38.26" N, 99°40'52.18" E. This station is also in Dusun II Jarinjing, far from community settlements. At this station, the substrate of the river channel mostly consists of sand and rock with a moderate current. Data analysis was carried out in the Ecology Laboratory, Faculty of Teacher Training and Education, Labuhanbatu University. The object of this study was Waanders's hard-lipped barbs (*O. waandersii*) from the Tambatan river. Sampling was conducted for three months, from November 2020 to January 2021.

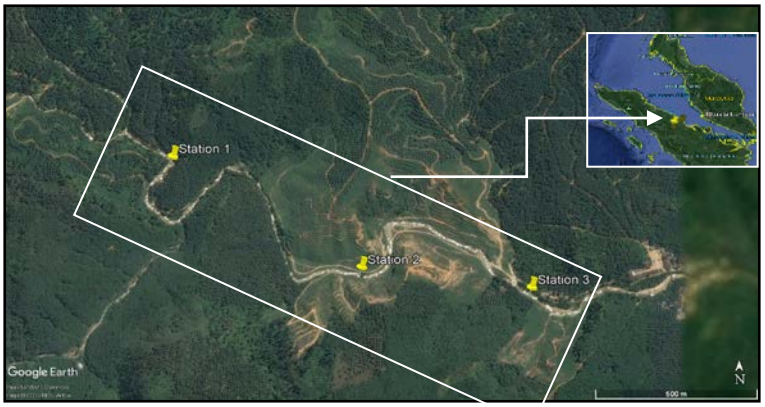

Figure 1. Study site of sampling in the Tambatan river, Labuhanbat

Table 1. Description of Sampling Location

Location	Ordinate Point	Description
Station 1	2°21'28.37" N, 99°41'20.38" E	this station in Dusun Jarinjing II is near community settlements. This station has a substrate of river mostly consisting of sand with a calm current and surrounded by oil palm plantations
Station 2	2°21'42.58" N, 99.40'40.88" E	This station is far from community settlements. At this station, the substrate of the river mostly consists of rock with a moderate current and is surrounded by woods
Station 3	2°21'38.26" N, 99°40'52.18" E	This station, the substrate of the river channel mainly consists of sand and rock with a moderate current

Instruments

The samples were caught using cast nets with a diameter of 2 m & a mesh size of ½ inch. In addition, other tools used in this study were millimetre paper, aquarium, camera, ruler, and callipers. Samples of fish caught were weighted (gram) using a digital scale with an accuracy of 0.01 grams and measured their length (cm) using callipers with an accuracy of 0.01 mm.

Research Procedure

Sampling was carried out during the day with cast nets. The nets were thrown 20 times at each station. The captured samples were put into an aquarium to obtain a clear description of the fish. They were then put into a styrofoam box and sent to the Ecology Laboratory of Labuhanbatu University for further identification process, including morphometric measurements, body weight measurements, and gonad maturity level observations (Kottelat et al., 1993).

Data Collection and Data Analysis

1. Growth Pattern

The growth pattern was calculated using the formula proposed by (King, 1995).

$$W = aL^b$$

Where: W is the total weight (g) of the fish; L is the total length (cm) of the fish; the coefficients a and b are the constants of the growth pattern formula.

The applied growth pattern categories are as follows. (A) If b is equal (=) to 3, then the growth is balanced between length and weight (isometric). (B) If b is lower (<) than 3, then the growth in length is more dominant than the growth in weight (negative allometric). (C) If b is higher (>) than 3, then the growth in weight is more dominant than the growth in length (positive allometric).

2. Observation of the Gonad Maturity Level (GML)

This observation referred to Table of the Gonad Maturity Level for Male and Female *O. waandersii* in Rivers.

Table 2. Categories of Gonad Maturity Level (Hayati, 2018)

GML	Males	Females
I	The gonads are not yet developed.	The gonads are not yet developed.
II	The surface of the testicles is slightly serrated and milky white.	Ovaries are reddish yellow, and the eye cannot see eggs.
III	The surface of the testicles is serrated and white. Furthermore, the blood vessels are still visible.	Morphologically, the eggs in the ovary are yellow, and the grains begin to appear.
IV	The testicles look like those in GML III, but clearer, and blood vessels are not visible.	The ovaries are getting bigger. The eggs are yellow and easy to separate. However, the oil grains are not visible.
V	The testicles on the back deflated and near	The ovaries are wrinkled, the walls are

	the outlet were still filled.	thick, and the side eggs are located near the release.

3. Condition Factor Analysis

In this study, the relative weight (Wr) and the condition factor coefficient were used to calculate the condition factor for each sample. To calculate the relative weight (Wr), the researchers applied an equation proposed by Rypel & Richter (2008).

$$Wr = W / Ws \times 100$$

Where: Wr is relative weight; W is the weight of each sample; Ws is the prediction of the standard weight of the same sample as it is calculated from the combined length-weight regression over the range between species.

$$K = WL^{-3} \times 100$$

Where: K is the condition factor; W is the weight (g); L is the length (cm); 3 is the length coefficient to test whether the K value tends to be close to 1. According to Morton & Routledge (2006), the fish population is in good condition if the K value is more than 1.

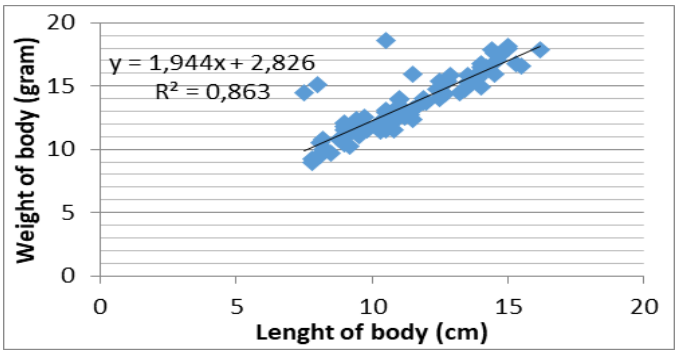

Figure 2a. The growth pattern of male *O. waandersii*

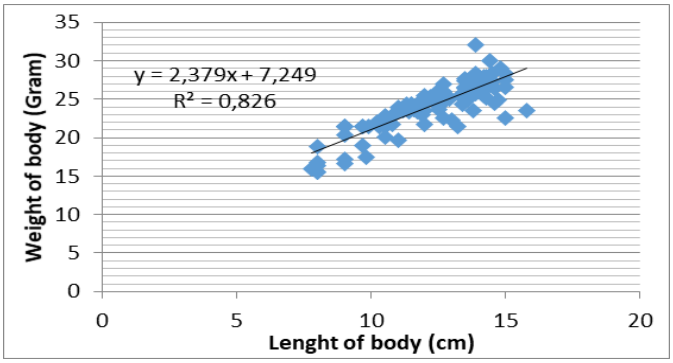

Figure 2b. The growth patterns of female *O.waandersii*

Table 3. Biological parameters observed on *O. wandersii*

Parameters	Males	Average	Females	Average
Total length (cm)	7.5 – 16.2	11.52	7.80 – 15.80	5.61
Measured weight of fish, W (grams)	9.0 – 18.6	13.72	15.50 – 32.00	4.82
Predicted weight, Ws (grams)	9.09 – 18.76	13.61	7.17 – 20.59	14.17
Relative weight, Wr	62.74 – 111.45	99.40	39.61 – 87.65	58.29
Fulton condition factor, K	0.42 – 3.43	1.05	0.59– 3.67	1.47
The coefficient of determination (r^2)	0.863	-	0.826	-
b-Value (Growth Pattern)	1.944	-	2.379	-

**GML=Gonad Maturity Level*

Results

The Condition Factor

Based on the analysis results, the length (TL) of *O. waandersii* ranged from 7.5 - 16.2 cm for males and 7.80 - 15.80 cm for females. The weight (W) ranged from 9.0 - 18.6 grams for males and 15.50 - 32.00 grams for females. Weight prediction (Ws) ranged from 9.09 - 18.76 for males and 7.17 - 20.59 for females. The relative weight (Wr) ranged from 62.74 - 111.45 for males and 39.61 - 87.65 for females. The Fulton's K condition factor ranged from 0.42 - 3.43 for males and 0.59 - 3.67 for females. The coefficient of determination (r^2) was 0.863 for males and 0.826 for females. For the last, the b value was 1.944 for males and 2.379 for females.

Growth Pattern

The results of data analysis on the growth pattern of Waanders's hard-lipped barbs (*O. waandersii*) indicated that the obtained b value was 1.944 for males and 2.379 for females. For more detailed data, it can be seen in the figures 2ab. The data concerning the growth patterns of male and female *O. waandersii* in the Tambatan river indicated a negative allometric relationship because the value of b is < 3, meaning that the growth in length is faster than the growth in weight.

Gonad Maturity Level (GML)

This study analysed the gonad maturity level of male and female O. waandersii, starting from the immature level (stage I) to maturity stage V, as shown in Figures 3a and 3b. The total of male *O. waandersii* caught throughout this study were maturity stage I (immature) 47 individuals/m^2, gonad maturity stage II (19 ind/m^2), with a maturity stage III (12 ind/m^2), maturity stage IV (6 ind/m^2), and maturity stage V (2 in/m^2). Meanwhile, the total of female *O.*

waandersii caught was 54 individuals/m^2 with a maturity stage I (immature), maturity stage II (29 ind/m^2), maturity stage III (23 ind/m^2), maturity stage IV (8 ind/m^2), and maturity stage V (3 ind/m^2).

Male *O. waandersii* were found mostly in maturity stage I (immature) with the length ranging from 7.5 - 13.74 cm. Furthermore, the length of fish found ranged from 11.25 - 14.99 cm for those in maturity stage II, 12.5 - 16.24 cm for those in maturity stage III, 13.75 - 16.24 cm for those in maturity stage IV, and 15 - 16.24 for those in maturity stage V. Meanwhile, the length of female fish found ranged from 7.8 - 14.79 cm for those in maturity stage I (immature), 11.8 - 14.79 cm for those in maturity stage II, 11.8 - 14.8 cm for those in maturity stage III, 13.8 - 15.8 cm for those in maturity stage IV, and 14.8 - 15.8 cm for those in maturity stage V.

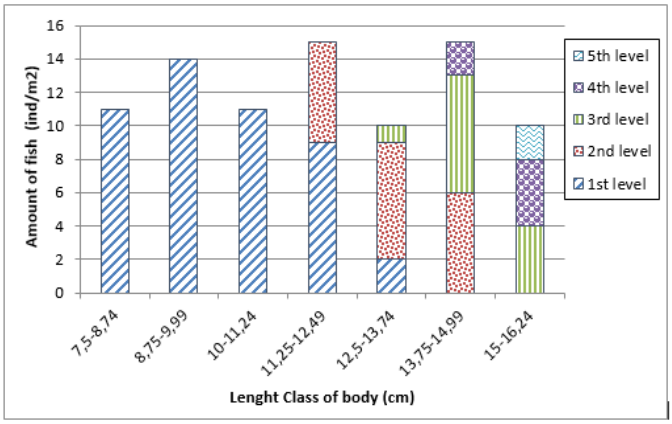

Figure 3a. The gonad maturity level of male *O. waandersii*

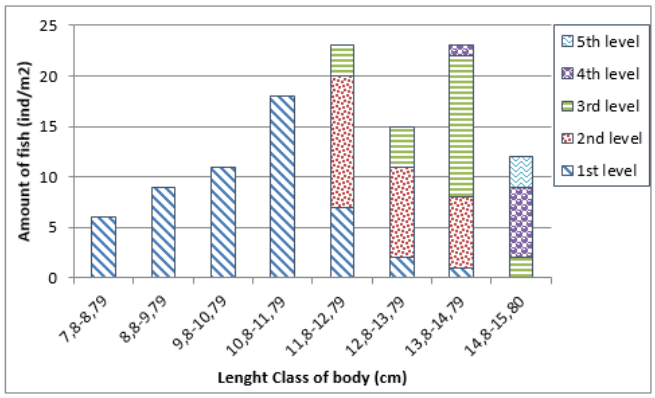

Figure 3b. The gonad maturity level of female *O. waandersii*

Discussion

Condition Factor

The average value of the relative weight (Wr) condition factor was 99.40 for male *O. waandersii* and 58.29 for female *O. waandersii*. These values 10 to be close to 100, indicating that the environment is in a balanced state. The condition factor is the physiological condition of the fish, showing the fish obesity rate (Susanto & Novitasari, 2017; Rahardjo & Simanjuntak, 2008). The value of the condition factor can be calculated based on the equation of the relationship between length and weight of fish. Fish condition factor values can differ, which are influenced by the kind of species, availability of food sources, sex, age, and gonad maturity levels (Anibeze, 2000).

The condition factor is usually indicated as a "condition coefficient", denoted by 'K'. It is useful as a tool for diagnosing the physiological condition of fish in interacting with biotic and abiotic factors, as well as being used to monitor feed intensity, age, and fish growth rate (Ujjania et al., (2012); Kachari, (2017). The results of the Fulton's K condition factor calculation showed that the K value for male fish ranged from 0.42 - 3.43 with an average of 1.05, while that for female fish ranged from 0.59 - 3.67 with an average of 1.47. Based on those values, it can be concluded that the average condition factor value of the female fish is greater than that of the male fish of the same size, meaning that the female fish tends to be bigger than the male. The gonad maturity condition supports this state. According to Jusmaldi et al., (2020), the condition factor is closely related to the number of fish with a mature gonad condition. Concerning this study, Jusmaldi et al., (2020) found different results from what the researchers found in this study. He discovered that male *Osteochilus vittatus* in the Benanga reservoir, East Kalimantan, is more significant than female *Osteochilus vittatus*, with an average of 1.18 > 0.949.

Growth Pattern

The obtained value regarding the growth pattern from male and female *Osteochilus waandersii* is classified in the harmful allometric category, meaning that the growth in length is faster than the growth in weight. Muchlisin *et al.* (2010) explained that the growth pattern of fish is influenced by several factors, including food availability and water conditions. They added that the behaviour of the fish influences the b coefficient. Active swimming fish will show a lower b value compared to passive swimming fish. It is perhaps related to the allocation of energy expended for movement and growth. In general, fish will have a b value ranging from 2 - 4 (Samat *et al*., 2008; Jamabo *et al*., 2009). Effendie (1979), stated that the high b value in fish is influenced by age, sex, gonad maturity level, and food. Food availability generally affects the length-weight relationship in fish (Ubamnata *et al*., 2017; Khairul, 2020).

A similar condition was also found by Rochmatin et al. (2014) in the Pening swamp, Semarang, with the b value of 2.8392. A study conducted by Putri et al. (2015) in Lake Telaga, Central Sulawesi, resulted in a b value of 2.838 and a negative allometric growth pattern. Meanwhile, Rochmatin et al. (2014), conducted a study on the Rawa swamp, Semarang, resulting in a b value of 2.839 and a negative allometric growth pattern. Furthermore, a different condition was found by Jusmaldi et al., (2020), in

which they discovered that the b value for *Osteochilus vittatus* in the Benanga reservoir, East Kalimantan was 4.425.

Gonad Maturity Levels

Table 3a showed that male *O. waandersii* caught was dominated by fish with an immature gonad level, totalling 54.65%. Meanwhile, male fish with a mature gonad level ranged from 2.32 - 22.09%. As shown in Table 3b, female *O. waandersii* caught was also dominated by fish with an immature gonad level, totalling 46.15%. Meanwhile, female fish with a mature gonad level ranged from 2.56 - 24.8%. From tables 3a and 3b, it can be concluded that the male *O. waandersii* caught with a mature gonad level are less than the female *O. waandersii* caught in the same gonad maturity level. A similar condition was also found in *Osteochilus vittatus* by Omar, (2010) in Lake Sidenreng, South Sulawesi.

The condition of *O. waandersii* which was in the maturity stage I (immature) during the study was carried out (November to January 2021) illustrates that the population of *O. waandersii* is on average at the stage towards the mature level. A similar situation was found by Sartika et al., (2015) on *O. waandersii* in the Rokan Kiri river, Riau, in which it was dominated by fish with a maturity stage I, totaling 42%. Dewantoro et al., (2019) studied *Osteochilus schlegelii* in the Kapuas and Sekayam rivers, West Kalimantan, from March to August 2018. The result showed that fish with maturity stage I also dominated the catches with 81.08 - 100%. (Nasution et al., 2006), studied *Osteochilus kelabau* in the Kampar river, Pelalawan, Riau, from February to October. They found that fish with the genus *Osteochilus* had gonad maturity peaks in October with synchronous reproduction patterns.

Conclusion

The growth patterns of male (1.944) and female (2.379) Osteochilus waandersii were in negative allometric category, meaning that the growth in length is faster than the growth in weight. This growth pattern indicates that there is an allegation of pressure or disturbance from environmental factors in the Tambatan river. Biological parameters show that the value of Fulton's condition factor was 0.42 - 3.43 for male fish with an average of 1.05 and 0.59 - 3.67 for female fish with an average of 1.47. The result of the observation on the gonad maturity level for male and female *O. waandersii* in the Tambatan river indicated that they were dominated by fish with a gonad maturity stage I (immature gonad level). This condition illustrates that the Waanders's hard-lipped barb (*Osteochilus waandersii*) was in the stage towards the mature level.

Declaration statement

The authors reported no potential conflict of interest.

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DNA Isolation of Chicken Feathers from the Base of the Young Feathers, the Base of the Old Feathers, and the Tip of the Feathers

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Background: The goal was to provide information on DNA templates in chicken samples so that the molecular research sampling process may employ feathers instead of hurting the test animals. The sample used consisted of 10 Bangkok chickens which were sampled for young feathers and old feathers and the tips of the feathers. **Method:** Quantitative techniques by comparing the results of DNA isolation which were analyzed using a nano photometer and then confirmed using real-time PCR with the SYBR green method. **Result:** The analysis of purity and concentration showed that at the base of young chicken feathers, the average value of purity was at 1,790, with an average value of the concentration of 4,210. At the base of the old feather, the average purity value was 0.638, with an average concentration value that was not detected. Likewise, at the tip of the feather, the average purity value is 0.894, and the concentration value is not detected. Confirmation tests performed on all samples using the real-time PCR melt curve method showed that all samples were detected with a Tm value of 78.5 for young feathers, 78.5 for old feathers, 79.0 for positive controls and 78.7 for positive controls, while negative controls were not detected. **Conclusion:** DNA isolation can be carried out at the base of the young feathers, the base of the old feathers, and the feathers' tips.

Analisis Hasil Isolasi DNA dari Bulu Ayam yang Dicuplik dari Pangkal Bulu Muda, Pangkal Bulu Tua dan Ujung Bulu

Kata kunci:
Bulu ayam;
Pangkal Bulu;
Ujung Bulu;

A B S T R A K

Backgrond: Dengan tujuan memberi informasi tentang penggunanan DNA template pada sampel ayam sehingga proses sampling untuk penelitian molekuler bisa menggunakan bulu sehingga tidak menyakiti hewan uji. Sampel yang digunakan terdiri dari 10 ekor ayam bangkok yang disampling bulu muda dan bulu tua serta ujung bulu. **Metode:** Menggunakan metode kuantitaif dengan membandingkan hasil isolasi DNA yang dianalisis menggunakan nano photometer kenudian dikonfirmasi menggunakan real time PCR dengan metode SYBR green. **Hasil:** Analisis kemurnian dan konsentrasi menunjukan bahwa pada pangkal bulu ayam muda, rata-rata nilai kemurnian berada pada 1.790 dengan nilai rata-rata konsentrasi 4.210. Pada pangkal bulu tua rata-rata nilai kemurnian berada pada 0.638 dengan nilai rata-rata konsentrasi yang tidak terdeteksi. Begitupun pada ujung bulu nilai kemurnian rata-rata 0.894 dan nilai konsentrasi tidak terdeteksi. Uji konfirmasi yang dilakukan terhadap seluruh sampel menggunakan metosde melt curve real-time PCR menunjukan semua sampel terdetksi dengan nilai Tm pangkal bulu muda 78.5, pangkal bulu tua 78.5, ujung bulu 79.0 dan kontrol positif 78.7, sedangkan untuk kontrol negatif tidak terdeteksi. **Kesimpulan:** isolasi DNA dapat dilakukan pada pangkal bulu muda, pangkal bulu tua dan ujung bulu.

Introduction

In principle, DNA isolation through a red chloroform extraction process, the sample will go through three main processes, namely lysis (destruction of cell walls), separation of DNA from protein/cellulose and purification. Each of these stages plays an essential role in the success of the DNA isolation process to get good results, namely

results whose purity is in the range (1.7-2) and concentrations above 20 ng / µl (Qiagen, 2014). In a DNA analysis using animal samples, the most important thing to note is the ethical issue of the object of research.

This problem is fundamental to pay attention to because it concerns how the test animals used as the object of research do not experience pain or pain when the sample is taken. Therefore, other references are needed in taking DNA samples. Generally, in chicken samples, samples were taken from the blood (Abinawanto et al., 2019) and lower abdominal incisions (Kamagi, 2017). These two types of samples certainly have different ways and risks when compared to the sampling method in the form of chicken feathers. The selection of chicken samples is due to the large number of studies using chickens with limited reference information regarding sampling as the object of research. Besides that, this research is also expected to be another solution.

Because the kit used does not have specifications for use on chicken feathers, the preliminary test stage through optimization is essential. The data obtained can be used as a source of information for similar research in using similar extraction kits so that knowledge of information about the characteristics of the kit and its functions can be enriched from the results of this study. This study aims to become a source of information in taking samples for research purposes on poultry in general or chickens in particular. The novelty aspect of this research lies in the initial idea of selecting a sample that will be the reference source for similar research.

Methods

The materials in this study were chicken feathers, RNA free water, Dneasy mericon Food Kit (50) paint extraction kit. 69514 (Qiagen). QuantiNova SYBR Green RT-PCR Kit Real-Time PCR Kit (100) paint. 208152 (Qiagen).

Sample Preparation

The sample was weighed as much as 1 g, added 1 mL of Food Lysis Buffer, and 25 µl of proteinase K then vortex for 15 seconds until homogeneous. Incubate (temperature 65°; 60 minutes; 1100 rpm), let the sample stand at room temperature for 30 seconds, and then put it in an ice block/freezer for 10 minutes. Then, centrifugation at 2500xg for 10 minutes. Pipette 500 µL of Chloroform into a new 2 mL tube Carefully remove the 700 µL transparent layer in step 6, without touching the precipitation at the bottom of the tube. Put it in a 500 µl tube containing Chloroform (step 1-6). Vortex for 15 seconds, then centrifuges at 14000xg for 15 minutes. Take 350 µL of the transparent layer. Please put it in Qiacube, use the standard method with 60 ul of E.B. buffer elution. The eluted DNA can be used directly for real-time PCR processing or stored at -20o or -80o for long storage.

Data analysis

Data analysis was carried out by looking at the average values of purity and concentration by a nanodrop microphotometer at a wavelength of A260-A280 and comparing them. Good results are shown with a purity value of 1.7 - 2.1 and a concentration of > 20 ng / µl.

Data analysis confirmation test with real-time PCR was carried out based on two main criteria: (i) Ct (Cycle threshold) analysis which looked at the value of sample Ct and compared it with controls. (ii) Analysis of melting temperature (Tm), which is the melting point at the temperature at which melting occurs and comparing the melting point to the positive control (Sophian et al., 2020).

Results

DNA Isolation

Data analysis of template DNA using the Mericon Food kit can be seen below (Table 1). The data below shows DNA isolation results for samples from the base of young hair, the base of old hair, and the tip of the hair.

Table 1. DNA Isolation Results Data

Sample	A260-A280 purity	Concentration
Young Feather Base	1.630	4.400
Young Feather Base	1.577	4.100
Young Feather Base	1.950	3.900
Young Feather Base	1.804	4.150
Young Feather Base	1.473	4.050
Young Feather Base	1.886	4.150
Young Feather Base	1.483	4.300
Young Feather Base	2.150	4.300
Young Feather Base	2.073	4.250
Young Feather Base	1.875	4.500
The base of Old Fur	0.071	Not detected
The base of Old Fur	0.433	Not detected
The base of Old Fur	0.324	Not detected
The base of Old Fur	0.237	Not detected
The base of Old Fur	0.364	Not detected
The base of Old Fur	0.119	Not detected
The base of Old Fur	0.297	Not detected
The base of Old Fur	0.361	Not detected
The base of Old Fur	0.333	Not detected
The base of Old Fur	0.289	Not detected
Feather Tip	0.869	Not detected
Feather Tip	0.906	Not detected
Feather Tip	0.927	Not detected
Feather Tip	0.979	Not detected
Feather Tip	0.935	Not detected
Feather Tip	0.935	Not detected
Feather Tip	0.717	Not detected
Feather Tip	0.872	Not detected
Feather Tip	0.833	Not detected
Feather Tip	0.974	Not detected

From the data above, if an average meal will be presented as (Table 2). The analysis of purity, meanwhile the concentration analysis, showed that the concentration value was not detected at the base of the old hair and the tip of the bladder. At the base of young hair, the purity values are 1,473 - 2,150 with a concentration of 3,900 -

4,500. This result can be said to be better when compared to the purity and concentration like at the base of the old hair and the tips of the hair. According to O'Neill et al., (2011), a purity value above 2 indicates that the extracted sample is contaminated with RNA, while a purity value below 1.8 indicates the sample is contaminated with a protein.

Table 2. Data Mean Value of DNA Isolation

Sample	Purity	Concentration
Young Feather Base	1.790	4.210
The base of Old Fur	0.638	Not detected
Feather Tip	0.894	Not detected

The method that is often used to analyze isolated DNA is the reading method using a nano photometer. According to Held. P.G., (2001), the analysis of concentration and purity was carried out using a nano photometer, which reads DNA absorption at wavelength A260 / A280. Matlock B., (2015) expressed another opinion. Which states that the results of the purity analysis and good concentration on the sample do not guarantee a successful sample is amplified. Another equally important factor is the sample itself. However, the purity and concentration analysis method to see the quality and quality of isolated nucleic acids using a nano photometer is a reasonably effective method to determine the quality of the extraction results in a shorter time when compared to the horizontal electrophoresis method, which requires agarose gel (Sambrook et al., 1989; Kirby, 1990; Artama, 1991; Eppendorf, 2016).

Confirmation of Isolation Results Using Real-Time PCR

The PCR analysis carried out was the melt temperature (Tm) analysis using a qualitative method with the SYBR green quantinova kit. In this kit, DNA polymerase is inhibited by an enzyme which will only be active if the inhibiting enzyme is denatured by PCR at a temperature of 95o. When viewed in (Figure 1), the peak points of the observed curve vary slightly, this is due to the composition and size of the nucleotides. In the SYBR green analysis, the annealing stage plays an important role here at this stage the fluorescent signal will pick up when the DNA bands begin to separate (Dwight et al., 2011). The melting process in molecular analysis and can be used to see the specificity level of the analysis, where the single peak can be used as a reference for specificity, while the peaks that appear other than the target peak can be used as initial information to predict mutation processes (Bruzzone et al., 2013).

In (Figure 1), all samples experience amplification, even though the concentration data in (Tables 1 and 2) for old feather traps and feather tips are not detected. For the purity data, the two samples have numbers that detect the presence of nucleic acid.

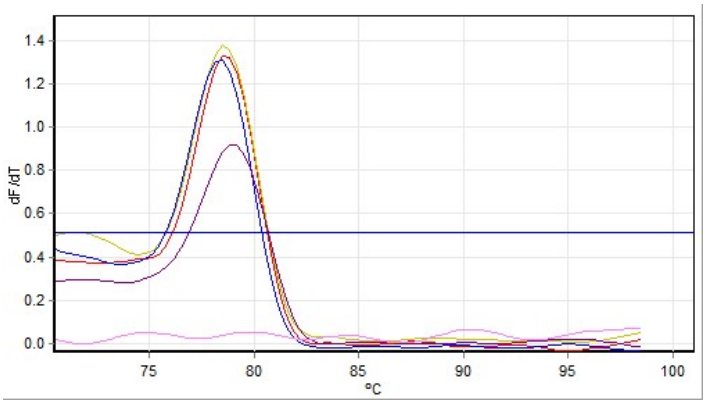

Figure 1: Results of melt cure (Tm) analysis using real-time PCR (red = positive control; yellow = light hair tips; blue = dark hair tips; purple = feather tips; light purple = negative control).

Table 3. Real-Time PCR Analysis Results

Sample	Tm value
Young Feather Base	78.5
The base of Old Fur	78.5
Feather Tip	79.0
Positive control	78.7
Negative control	Not detected

Discussion

Tissue sampling for molecular/genetic analysis in chickens is an integral part of carrying out molecular analysis. The body part used as the object for sampling must also be considered to avoid harming the test animal. Therefore, selecting the fur section as a sampling site for DNA research to avoid the sampling process that hurts the test animals.

Somebody parts that have been used as sampling sites for chickens include blood Abinawanto et al., (2019) and chest muscle tissue incisions (Kamagi, 2017).

According to Sophian, (2021), the purpose of carrying out the DNA lysis process is to remove the genetic material contained in cells so that it can be used to carry out molecular analysis. This solution can be done with the help of chemical and enzymatic processes. The chemicals and the remaining enzyme residues that are produced from the lysis process will be purified in the extraction process to produce inhibitor-free DNA. The low purity of extracted DNA could be caused by residual phenol or other reagents used in the extraction process (Matlock B., 2015).

Of the five nucleotide acid constituents that make up DNA or RNA, if you read the absorbance at wavelength A260 / A280, it will show different values for each nucleotide component, namely: guanine (1.15), adenine (4.50), cytosine (1.51), uracil (4.00) and thymine (1.47). The results of the purity analysis resulting from the absorbance readings are then averaged and will be the absorbance value. This is the basis for determining the

purity values generally for DNA analysis in the range (1.8-2.0) (Leninger, 1975).

Each type of real-time PCR has a different level of detection capability. To measure the sensitivity of the tool can use LOD analysis. The tool's smallest value that can be detected ranges from 0.01-2 p / µL (Perandin et al., 2004; L et al., 2011; Kamau et al., 2013; Xu et al., 2015; Srisutham et al., 2017).

After adding proteinase K, the samples were incubated at 70 oCwhile shaking in the DNA extraction process. This heating aims to activate the proteinase K enzyme to actively work to carry out lysis (Renshaw et al., 2015). In the centrifugation stage, macromolecules such as proteins and polysaccharides will settle at the bottom of the tube, while DNA and water are in the top layer (Sophian, 2021).

In the discussion, use references with a consistent format as in the introduction paragraph, namely the system "*name and year*". The discussion must lead to the results of research, and the language used is standard and not convoluted. Discussions should not repeat or display research results. Use references to support or compare the results of the research.

Conclusion

This study concludes that samples derived from the base of young feathers have better purity and concentration values than samples from the base of the old hair and the tips of the hairs.

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Declaration statement

The authors reported no potential conflict of interest.

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LOTS and HOTS Capabilities as Assessment Instruments Made by Elementary School Teachers in Jakarta

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Background: Assessment is a crucial step for determining whether or not a learning process has been successful. High-order thinking skills are a requirement for learning achievement in the twenty-first century. This project aims to put quantitative evaluation instruments created by Jakarta elementary school teachers to the test. **Methods:** A mixed-method is used, which combines descriptive qualitative research with document analysis and quantitative research with instrument testing on reproductive system material, which is then examined using Anates. The participants in this study were eight Jakarta-based grade VI primary school teachers. **Results:** It demonstrates that teachers' capacity to construct evaluation instruments varies widely. Testing using Anates shows 15% of the questions compiled are valid and 85% invalid, one school with strong reliability and seven other schools are less reliable. The difference shows that 42.5% are accepted, and 57.5% are rejected. The difficulty level showed that as many as 8.75% of the questions were in the very easy category, 18.75% easy, 51.25% moderate, 7.5% difficult and 13.75 very difficult. These results form the basis of the importance of the hierarchy of teacher understanding in-depth, especially in relation to the preparation of HOTS-based assessment instruments because the quality of learning success is largely determined by the assessment instrument used. **Conclusions:** The LOTS and HOTS-based capability instruments made by the teacher at 8 East Jakarta Elementary Schools have not been maximized and need development by these teachers.

Kapabilitas LOTS dan HOTS Instrumen Penilaian Buatan Guru Sekolah Dasar di Jakarta

Kata kunci:
Guru SD;
HOTS;
LOTS;
Instrumen Penilaian;

A B S T R A K

Background: Penilaian merupakan proses penting yang menjadi tolok ukur keberhasilan proses pembelajaran. Kemampuan berpikir tingkat tinggi merupakan bagian urgensi dalam pembelajaran abad 21 yang menjadi tuntutan ketercapaian pembelajaran. Penelitian ini bertujuan untuk menguji secara kuantitatif dan mendeskripsikan instrumen penilaian yang dibuat oleh guru SD di Jakarta. **Metode:** Menggunakan mix method dengan menggabungkan penelitian kualitatif deskriptif melalui teknik pengumpulan data menggunakan analisis dokumen dan penelitian kuantitatif dengan pengujian instrumen pada materi sistem reproduksi yang kemudian dianalisis dengan menggunakan Anates. Subjek dalam penelitian ini adalah 8 guru SD kelas VI di Jakarta. **Hasil:** Menunjukkan adanya variasi kemampuan guru dalam mengembangkan instrumen penilaian. Pengujian menggunakan Anates menunjukkan 15% soal yang disusun sudah valid dan 85% tidak valid, 1 sekolah dengan reliabilitas kuat dan 7 sekolah lainnya kurang reliabel. Daya bedanya menunjukkan 42,5 % diterima dan 57,5 % ditolak. Tingkat kesukaran menunjukkan sebanyak 8,75 % soal dalam kategori sangat mudah, 18,75% mudah, 51,25 % sedang, 7,5% sukar dan 13,75 sangat sukar. Hasil tersebut menjadi dasar pentingnya hierarki pemahaman guru secara mendalam, terutama terkait dengan penyusunan instrumen assesmen berbasis HOTS karena kualitas keberhasilan pembelajaran sangat ditentukan oleh instrumen assesmen yang digunakan. **Kesimpulan**: Kapabilitas instrumen penilaian berbasis LOTS dan HOTS buatan guru pada 8 Sekolah Dasar Dijakarta Timur belum maksimal dan perlu adanya pengembangan oleh guru.

Introduction

The standard of competence that learners must possess at the basic level is listed in the Regulation of the Minister of Education and Culture number 21 of 2016 on the standard of primary and secondary education content, while the skills that must be possessed are thinking and acting skills including creative, productive, critical, independent, collaborative, and communicative in a clear, systematic, logical and critical language, in aesthetically pleasing work, movements that reflect a healthy child, and actions that reflect the child's behaviour according to his stage of development.

The world of education continues to get the spotlight especially related to success, even effective processes in learning. In the process, an educator is highly required to be able to prepare various and innovative learning facilities so that it is expected that education can motivate learners to learn and achieve so as to improve personal, school and education qualities globally. This can be seen from the results of the effective assessment by educators of the learning process implemented.

Marzano & Pickering, (1994) in the HOTS assessment playbook (2019) explained that in the dimensions of the way students think and act students are guided to have the ability to think critically, creatively and self-regulate in thinking. These learning processes are oriented towards the quality of education. Improving the quality of learners is done by improving the quality of learning oriented to high-level thinking skills. The quality of learning also needs to be measured by assessing higher order thinking skills (HOTS). It is oriented to the demands and adaptation of 21st century learning and must be a characteristic in the learning process that starts from the learning plan, learning process and assessment based on high-level thinking skills.

Based on the results of the UN in 2019 PUSPENDIK KEMENDIKBUD explained that students are still weak in higher order thinking skills such as reasoning, analyzing, and evaluating so that teachers must be able to carry out HOTS-based assessments so that students are familiar with problems and learning oriented to higher order thinking skills in order to be encouraged by their critical thinking skills. It can be applied in everyday assessments in learning.

The development of tests that are used as a measurement of the harpability of a learning process is very important because with the development of the test tool, more and more valid information can be extracted. In accordance with the opinion of Aminoro & Daryanto, (2016) explained that a test is said to be valid if the test can precisely measure what it should measure. In the opinion of Arikunto, (2013) validity is the ability of a measuring instrument to measure its measuring goals. Maolani & Cahyana, (2016) support that alidity is a quality that shows the conformity between the measuring device and the goal to be measured/what should be measured. The intended validity is the validity of the assessment used by the teacher in the learning process that has been designed to be implemented so that the learning capability can be known. Based on the opinion of these experts, it can be concluded that the validity of the assessment is the quality of the measuring instrument on the assessment to be measured in accordance with the purpose of learning.

Aminoro & Daryanto, (2016) suggest that the validity of the contents indicates an instrument condition arranged based on the content of the evaluated subject matter arranged to measure the specific purpose of the given subject matter. In accordance Yusup, (2018) about the validity of content that focuses on providing evidence on the elements in the measuring instrument and processed with rational analysis to make the assessment easier.

Bloom, (1956); Situmorang, (2018) describes that the cognitive domain or cognitive realm emphasizes intellectual aspects, such as knowledge, understanding, and thinking skills. Bloom, (1956); Situmorang, (2018) also argues that the domain of cognition is divided into six levels of hierarchy, divided into two parts, namely low-level thinking skills consisting of knowledge and understanding, while high-level thinking skills consist of application, analysis, synthesis, and evaluation. Anderson in Situmorang (2018) adds the ability to think creates as the highest level, after the ability to evaluate into the hots category.

The material studied at the elementary school level includes materials that are factual or based on facts found in everyday life so it is necessary for a teacher to direct the hots learning process, this is found by learners in everyday life can be understood and learned quickly and pleasantly in the hope that learners are able to explore and apply high-level thinking from an early age, And can be used as a provision at the next level of education. Low-level thinking proposed by Situmorang (2018)consists of the ability to know and understand which is the most basic level of thinking of the cognitive aspect or realm. Sudjana, (2010); Prasetya, (2012) posits that the cognitive realm is a realm related to intellectual learning outcomes that includes six aspects namely knowledge or memory, understanding, application, analysis, synthesis, and evaluation. The first two aspects are called low-level cognitive knowledge and understanding. Anderson & Krathwohl, (2010) explains lots is a low level of thinking that includes the dimensions of the process of thinking knowing (C1) and understanding (C2) that measure factual, conceptual and procedural knowledge.

Brookhart (2010) in his book explained that higher order thinking skills are divided into three categories, namely HOTS as a transfer process, HOTS as a critical thinking and problem-solving ability. Good assessment instruments must meet the appropriate criteria, while Aminoro & Daryanto, (2016) explained that a good

measuring instrument must have validity, reliability, objectivity, practicality, and economy. Wijayanto et al., (2016) that in an assessment instrument, there needs to be curricular validity based on content or content related to the material to be measured in accordance with the curriculum, syllabus, and Learning Process Plan (RPP) then the use of language in the assessment instrument will affect the level of difficulty of the problem item that is prepared so that it must pay attention to grammar in accordance with EYD. Wijayanto et al., (2016) also explained that the use of appropriate language would facilitate students in understanding the intent of the problem well so that the assessment instruments that are prepared can measure what to be measured must be logical and empirical. Based on the description of the expert opinion, it can be concluded that qualitatively, the assessment instrument must have validity, reliability, objectivity, practicality, economics and pay attention to the logical and empirical arrangement of language so that it can be said to be a qualitatively qualified instrument.

In fact, there are still many teachers who have not implemented HOTS-based assessments, so that between the learning process and HOTS-based learning outcomes is still low. Wachyudi et al., (2015) said that the government has been trying to change the assessment of cognitive, affective and psychomotor specs but has not shown maximum results. In accordance with Nurani et al., (2019) mentioned that cognitive assessment in the 2013 curriculum is the most complicated and confusing assessment, so that the assessment carried out by the teacher is only based on the understanding and knowledge of the teacher. To overcome this, the government has pursued various strategies to implement hots-based learning processes and assessments in accordance with the demands of the progress of the times. Another factor that causes low achievement of HOTS in Indonesia, namely Indonesian students who are not used to doing HOTS problems. Many teachers find it difficult to structure HOTS problems so that they use existing and previously made problems that are still in the LOTS (Lower Order Thinking Skills) category. This factor is one of the factors for children not trained in solving HOTS-based problems.

The difficulty of teachers in understanding the differences in students' abilities is also an obstacle for teachers in preparing a learning plan that contains the assessment to be done. This difficulty affects the preparation of hots. However, the difficulties experienced by this teacher can also be caused by the difficulty of teachers in understanding how to prepare HOTS-based assessment instruments used in learning.

At the international level, there are several tests used to measure the ability of learners in the form of HOTS, such as those organized by PISA (Programme for International Student Assessment) and PIRLS (Progress in International Reading Literacy Study), the achievements obtained by Indonesian learners are not satisfactory and only reach level two of the six levels contained in PISA. This low achievement is possible because of several factors, including the learning process or even assessment used by teachers so that learners are not familiar with the form of HOTS problems. In addition, many found teachers did not test the instrument before it was used for assessment. In addition, many found teachers did not test the instrument before it was used for assessment. Mendikbud, (2019)also explained the results of PISA findings on Indonesia's literacy ability to decrease reading scores.

Based on the description above, it is important for an educator to master the preparation of assessment instruments so that the research "LOTS Capabilities and HOTS Assessment Instruments Made by Elementary School Teachers in Jakarta" is very necessary because with the right assessment instruments it will show appropriate learning results especially related to low-level thinking skills (LOTS) and high-level thinking skills (HOTS).

Methods

Scope of Research

The research method used in this study is a mixed-method by combining quantitative research to find out the validity, reliability, different power and difficulty level of problem items and qualitative research to find out cognitive levels (LOTS and HOTS) through validation by experts. The subjects of this study were eight teachers in the 6th grade of public elementary schools in Jakarta. Data collection is carried out in January - March 2020 in the even semester of the 2019/2020 school year. Material is used as material for preparing problem items by teachers, and there is material on the theme of 7th grade 6, namely material about the reproductive system.

Research Procedure

This research begins by reviewing the library as a source of research reference. Then the researchers analyzed the problems that often arise in learning carried out by elementary school teachers in Jakarta. Then the researchers made observations to dig up information about assessments conducted by elementary school teachers in Jakarta.

The observation results are used to continue the preparation of research instruments in the form of interview guidelines related to the teacher's understanding of LOTS and HOTS-based assessment instruments and assessment applications used in learning. In-depth interviews were also conducted to support document data using assessment instruments made by elementary school teachers in Jakarta. Assessment instruments made by teachers are then validated by two experts who are competent in the assessment of IPA subjects at the

elementary level. The problem points compiled by the teacher are also tested on learners to find out the validity, reliability, different power, and difficulty level of each problem item. The material that is used as material for the preparation of problem items is the material on theme seven about the reproductive system.

Data Collection and Data Analysis

Data collection is done by collecting documents in the form of assessment instruments made by teachers and testing problem points on learners. Quantitative data analysis is done using the Anates application, and qualitative data analysis is analyzed with comparative analysis, namely by comparing expert validation results, bloom taxonomic theory concepts and interview results with 6th-grade elementary school teachers.

Results

The first research results in the form of documents in the form of assessment instruments made by teachers are validated by two experts, the results of which can be seen in the following table.

Table 1. Expert Validation 1

School	LOTS	HOTS	Other
School A	6	4	0
School B	8	2	0
School C	8	2	0
School D	7	3	0
School E	10	0	0
School F	8	2	0
School G	5	5	0
School H	10	0	0
Sum	62	18	0

Two experts also validate the assessment instrument compiled by the teacher. The results of expert validation two can be seen in Table 2 below:

Table 2. Expert Validation 2

School	LOTS	HOTS	Other
School A	9	1	0
School B	6	4	0
School C	9	1	0
School D	6	4	0
School E	4	4	2
School F	8	1	1
School G	7	3	0
School H	10	0	0
Sum	59	18	3

Data on instrument test results provided to learners is quantitatively analyzed with anas software whose results can be seen in the following table:

Table 3. Results of Analysis with Anates Software

School	Validity		Reliability	Difficulty level		Different power	
	V	IV		TM	TL		
A	2	8	0,38	6	4	8,75	SM
B	1	9	0,36	4	6	18,75	M
C	0	10	-0,04	0	10	5125	SD
D	4	6	0,75	9	1	7,5	S
E	0	10	0	2	8	13,75	SS
F	0	10	-1,18	3	7		
G	3	7	0,56	4	6		
H	2	8	-0,06	6	4		
Sum	**12**	**68**		**34**	**46**		
%	**15**	**85**		**42,5**	**57,5**		

Discussions

Overall in school A there are 6 points of questions that fall into the category LOTS and 4 points of questions included in the HOTS category, There is a difference in rationalization between constituents and experts is possible because of different levels of understanding, Based on interviews with teacher A shows that LOTS-based assessment instruments are easy problems while HOTS-based assessment instruments are difficult problems, so that the constituent is not right in using KKO for indicators about it.

As supporting data from the results of the analysis of the problem compiled by teacher A in school A was tested using Anates software while the result was only two valid questions, namely at numbers 4 and 10 while eight other problems were invalid, the quality of instruments in school A showed weak reliability with a reliability of 0.38. While the other power there are 6 points of questions accepted and 4 points of the problem rejected, to the difficulty there are 2 points of very difficult questions, 2 points of simple questions, 1 point of very simple questions and 5 points of moderate problems. Proportionally from the level of difficulty of the instrument made by teacher A shows the right proportion because each category has a problem item that represents the level of difficulty. Proportionally in school, A is proportional because there are already HOTS problem points in the assessment device. But there needs to be an improvement in content so that more quality instruments such as research conducted by Rudhito and Prasetyo need trials and revise the practical aspects of the problem developed for assessment.

In school B, the results of the analysis showed that there were 8 points of questions that fall into the LOTS category and 2 points of questions fall into the HOTS category, which is then coupled with the data of the results of the analysis with Anates, which shows that the valid problem is only one point of the problem and nine other questions are invalid with the reliability of 0.36 with weak categories. But in terms of content, the problem item created is in accordance with the validity of the content because the

material to be measured in the problem item is in accordance with the achievements on the indicator. Then there are 4 points of questions received and 6 points of questions rejected based on the different power. Furthermore, the level of difficulty in the instrument arranged there are 2 points of very difficult questions and 6 points of moderate problems and 2 points of simple problems. The number of more dominant invalid problem items is something that needs to be considered by teachers in school B. In contrast to the obstacles that arise in the research conducted by Ratnawati that teachers have difficulty understanding the speaker's material delivered during training because of differences in perception from the speaker to cause confusion when applying HOTS-based assessments.

In school C, the number of questions based on the cognitive domain includes two questions in the HOTS category, and eight other problem items fall into the LOTS category. Then the results of the analysis with Anates 10 points of invalid problems with reliability is very weak even worth -0.04, which indicates that the problem must be revised in total even though the content has fulfilled the full validity of the content. Then the difficulty level of the problem there is 2 very difficult questions, 3 points of medium questions, three simple questions and 1 point of very simple questions. They are judging from the different power all about being rejected. This means that the instruments that are compiled must be reviewed and repaired so that they can be used as good assessment instruments. The ability of learners is also the cause of the lack of functioning of the problem points compiled. This is similar to the results of research conducted by Wulandari et al which states that different student learning achievement causes teachers to make different assessments with the planning that has been made.

In school D, expert validation results showed that 7 points of questions belonged to the LOTS category and 3 points of the problem belonged to the HOTS category. In school D, the results of the analysis using Anates showed that the 10 points of questions compiled had a strong reliability level with a number of 0.75 with the number of 4 questions already valid, namely number 2,6,8,9 and 6 other problems were invalid. Based on the difference, there are 9 points of questions accepted, and 1 point of the question rejected, while based on the difficulty level 1 point of a difficult question, 7 points of the medium problem and 2 points of a simple problem. The assessment process needs to be not continued to the maximum so that the results will be in accordance with what is expected as described by Alimuddin that the assessment can be used as a mapping of learners' learning difficulties and improvement of the learning process.

Analysis of problem items in school E as a whole the details of the problem that have been analyzed and validated by experts turned out that all the points of the problem compiled by teacher E fall into the LOTS category. Supporting data used from Anates analysis shows that 10 problems compiled are not valid with a reliability of 0 and can be said to be very weak, with 8 points of questions rejected and 2 points of questions accepted based on different forces. Then based on the level of difficulty, there are 2 points of very difficult questions, 1 point of difficult questions, 5 points of moderate problems, 1 point of simple questions and 1 point of very simple questions. The content of teachers don't pay attention to the suitability of the problem points with the indicators compiled, so it needs a self-evaluation from the teacher. This is in accordance with Hadiana's statement stating that there needs to be an internal assessment that must be done by the classroom teacher as material for ongoing self-evaluation that can be done by stating that hots-based problems must be seen from several issues that are not valid can be used as improvements on various instrument building factors, this is in accordance with Hartini and Sukarjo who state that HOTS-based problems must be seen from several issues. What are aspects such as material, construction and language.

Ten points of questions compiled in school G turned out to be 7 points of questions that fall into the lots category and 3 points of questions included in the HOTS category. Teachers at G school have also participated in preparation training on HOTS. Then the results of the analysis showed 2 points of the same problem according to the teacher and both experts, namely items number 2 and 4 or 20% of this difference is possible because the understanding gained by the teacher during training is not applied optimally in daily assessments. In school G, there is 1 point of inappropriate questions about the reproductive system, namely at number 7 based on the validation of the second expert. What is conveyed by the teacher during the interview is that it is necessary to procure further training to establish self-understanding related to HOTS-based assessments. This obstacle can be answered from the exposure delivered by Gusmarni that workshop activities can improve the competence of teachers in compiling problem points in elementary school.

Analysis of the subject points in school H showed that all the problems analyzed by experts fall into the LOTS category with a very weak reliability of -0.06 based on analysis with Anates. Then the validity yes there are 2 valid questions and eight invalid questions, 6 points of questions accepted and 4 points of questions rejected based on the different power. Next is the difficulty level, 1 point of a difficult question, 4 points of the medium question, 3 points of a simple question.

Overall, the problem items created by teachers who fall into the LOTS category amount to 81.25% of the total and 18.75% of the problem items are included in the HOTS

category. This is similar to the research conducted by Samosir et al., (2019) with the results of the number of HOTS quality questions amounting to 51% and LOTS amounting to 49%, the difference in the number of HOTS in this study is less than the research of Aldenan et al. In contrast to the research conducted by Himmah, (2019) where in his research also analyzed about mots levels with the questions analyzed in his research is about PAS in MTK subjects. But the method used in his research is the same as this study, namely with descriptive analysis. Other similar research on the analysis of the point of the question was also conducted by Cahyono & Adilah, (2016) and Muklis & Oktora (2015), who used the categories of cognitive level knowing, applying and reasoning.

Data analysis using Anates software to determine the validity, reliability, different power and difficulty. The results of 30 questions there are 14 questions already valid 16 other problems are invalid. After an interview with elementary school teachers in East Jakarta, the problem of educators neglecting their duties and functions such as not doing an analysis of the problems given to students.

Proportionally the hots problem is arranged with fewer numbers because each assessment device must be adjusted to the work time so that there are no significant obstacles for learners who work. In addition, the teacher still has difficulty in compiling hots problems. It is possible that the teacher has not participated in the preparation of HOTS.

Based on interviews with 6th-grade teachers, all pay attention to the validity of the content when compiling problem items because the suitability of the material becomes the main benchmark. Then associated with the results of validation by experts, the validity of the content contained in each point of the problem has also been but what needs to be improved on the assessment instrument is KKO (Operational Verb) on indicators that do not match the form of questions that arise in the problem.

Related to the quality of the points about all teachers who were the subject of the study said that never tested the validity of reliability, difficulty level, different power on the grounds of class administration demands that took longer, so in this study tested on every instrument made by the teacher to find out the quality of the teacher's problem. Testing is done with the help of Anates software to find out the validity, reliability, different power, difficulty level. As for the results that have been listed in the recapitulation table of the analysis results. This study obtained the interesting fact that the questions provided by the government in the books published by the ministry, banks of problems that are easily accessible online and bank problems in printed books turned out to be the main source of teachers in testing their students in daily repeats, midterms, end-of-semester exams and even end-of-year assessments, so that the ability of teachers who have been owned from training is less developed in daily life.

Furthermore, the problems that teachers usually use are the problems that are already available in the package book that has been provided to students. Especially daily repeats. But there are also points of questions that teachers modify in accordance with the conditions and materials delivered in the classroom. Testing of assessment instruments before being used as a measuring tool for the success of the learning process must indeed be done so that learning goals can be achieved properly, testing on this study is done as research support data to find out the quality of the problem items compiled, which in previous research conducted by Hartuti & Handayani, (2019) by not testing so that they only know the results of the analysis only. In his research, it was produced that the implementation of the 2013 curriculum assessment, in general, was in accordance with the 2013 curriculum assessment standards with the creation of HOTS problems from UH PTS, PAS was in accordance with syllabus, RPP, teacher's book, and curriculum standards 2013.

Conclusion

Based on the results of the discussion above, it can be concluded that the instruments made by elementary school teachers exist that have met the requirements of LOTS and HOTS-based assessments proportionally. Still, there are assessment instruments that only measure lots, and there are errors in determining the cognitive level used in compiling problem points in their assessment devices. The results of the analysis data using Anates showed low validity, reliability, different power and difficulty levels of problem items compiled by elementary teachers.

Based on this study, the advice that can be given is that teachers should understand the difference in cognitive levels (C1-C6) so that they will be more regular in compiling lots and HOTS-based assessment instruments that are proportional. The applicable implication is the preparation and use of LOTS and HOTS-based assessment instruments.

Declaration statement

The authors reported no potential conflict of interest.

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Diversity of Entomophatogenic Fungi from Gunung Tukung Gede Nature Reserve

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Background: Entomopathogenic fungi are one of the potential biodiversity assets to be used as biological control agents. However, information about the diversity of entomopathogenic fungi, especially in the Gunung Tukung Gede (GTG) nature reserve, is very limited. This study aimed to provide information on the biodiversity of entomopathogenic fungi in the GTG nature reserve. **Methods:** The entomopathogenic fungi were explored from 3 different stations: primary forest, secondary forest, and disturbed forest. Entomopathogenic fungi were isolated identified both macroscopically and microscopically. **Results:** A total of 15 specimens of entomopathogenic fungi consisting of 5 families and 8 types of fungi were successfully isolated. The entomopathogen fungi were *Basidiobolus haptosporus, Beauveria bassiana., Metarhizium aniesophalie, Paecilomyces sp., Aschersonia sp., Aspergillus sp. 1, Aspergillus sp.2, and Septobasidium sp*. These fungi infect insect hosts from the orders Lepidoptera, Hemiptera and Homoptera. The index of the diversity of entomopathogenic fungi at 3 consecutive stations is 1.5495; 1.3322; and 0.6365 (medium category). **Conclusions:** The GTG Nature Reserve has a diversity of entomopathogenic fungi. Therefore, further research is needed to determine the diversity and potential utilization of the existing entomopathogenic fungi.

Keanekaragaman Fungi Entomopatogen Lokal Asal Cagar Alam Gunung Tukung Gede

Kata kunci:
Cagar Alam;
Gunung Tukung Gede;
Cendawan Entomopatogen;
Keanekaragaman;

A B S T R A K

Background: Fungi entomopatogen merupakan salah satu aset keanekaragaman hayati yang potensial untuk dimanfaatkan sebagai agen pengendali hayati. Akan tetapi, informasi mengenai keragaman fungi entomopatogen terutama di cagar alam Gunung Tukung Gede (GTG) sangat terbatas. Tujuan dari penelitian ini adalah untuk menyediakan informasi mengenai keanekaragaman hayati fungi entomopatogen di cagar alam GTG**. Metode:** Cendawan entomopatogen dieksplorasi dari 3 stasiun berbeda yaitu hutan primer, hutan sekunder dan hutan perambahan. Fungi entomopatogen ditumbuhkan dalam medium buatan dan diidentifikasi secara makroskopis dan mikroskopis. **Hasil:** Berdasarkan hasil eksplorasi diperoleh 15 spesimen fungi entomopatogen yang terdiri dari 5 famili, dan 8 jenis fungi yaitu *Basidiobolus haptosporus, Beauveria bassiana., Metarhizium aniesophalie, Paecilomyces sp., Aschersonia sp., Aspergillus sp.1, Aspergillus sp.2, dan Septobasidium sp*. Fungi entomopatogen ini menginfeksi inang serangga yang berasal dari ordo Lepidoptera, Hemiptera dan Homoptera Indeks keanekaragaman jenis cendawan entomopatogen pada 3 stasiun berturut-turut adalah 1.5495; 1.3322; dan 0.6365 (kategori sedang). **Kesimpulan:** Cagar alam GTG memiliki kekayaan fungi entomopatogen. Oleh karena itu, penelitian lebih lanjut diperlukan pada berbagai wilayah GTG lainnya yang belum tereksplorasi guna mengetahui keragaman dan potensi pemanfaaatan fungi entomopatogen yang ada.

Introduction

The nature reserve is a natural protected area that has distinctive flora and fauna. Gunung Tukung Gede Nature Reserve (GTG) is a conservation area located in the Serang Regency of Banten Province. Gunung Tukung Gede (GTG) nature reserve covering an area of 1,700 ha was designated as a nature reserve based on the Decree of the Minister of Agriculture No.395/Kpts/Um/6/1979 dated June 23, 1979 and updated through the Decree of the Minister of Forestry No. SK.3622/Menhut-VII/KUH/2014 dated May 6, 2014 Nature Reserve covering an area of 1,519.50 Ha m (BKSDA, 2016).

GTG nature reserve has two types of vegetation, namely mountain rainforest vegetation types and plant forests that strongly support animals, plants, and microorganisms to grow and develop, so it can be ascertained that this region has a high level of biodiversity. Biodiversity can be a very useful asset. However, there are still various obstacles such as lack of information data related to microorganism biodiversity, especially entomopathogen mushrooms. This causes exploration, identification and inventory of biodiversity activities carried out to be still limited (Purwati, 2013). Therefore biodiversity loss is the most common environmental challenge faced in developing countries such as Indonesia (Adenle et al., 2015). Information related to the diversity of microorganisms, one of which is the group of entomopathogen fungi in gtg nature reserves, is still minimal and has not been widely studied. Meanwhile, entomopathogen fungi have a lot of potentials to be utilized in human life, ranging from antibacterial in the world of medicine (Lee et al., 2005) to as a biological controlling agent in the agricultural world (Evans et al., 2018).

As a bio-controlling agent, entomopathogen fungi become the primary regulator of insect populations in integrated pest management strategies and become effective in their application compared to chemical insecticides because they do not cause resistance in controlling pests (Jiang et al., 2020). Entomopathogen fungi have mycelium that overgrows colonizing insects as their host. The fungi can also produce toxins (Davari et al., 2015) specific to certain target insects, and the side effects for non-target organisms are so low that they do not kill useful insects. In the infection process, entomopathogen fungi can also produce secondary metabolites or production of extracellular enzymes. The production of secondary metabolite compounds and extracellular enzymes by entomopathogen fungi (Ismail et al., 2020) can suppress the population of plant-damaging pest insects (Chandrasekaran, R. et al., 2012).

Based on the results of several studies, there are more than 700 types of entomopathogen fungi represented by 90 genera (Goettel et al., 2010) that have been widely studied in the Asia Pacific region. The types of entomopathogens mostly found in insects are Beauveria and Metarhizium. Two kinds of mushrooms infect insects from the groups, often Lepidoptera, Homoptera, Coleoptera and Diptera (Khastini et al., 2019).

The purpose of this study is to provide information on the biodiversity of entomopathogen fungi in gtg nature reserves that are the basis for further studies of the potential use of these fungi in the future.

Methods

This entomopatogen mushroom diversity research was conducted from March 2019 to October 2020. The sampling

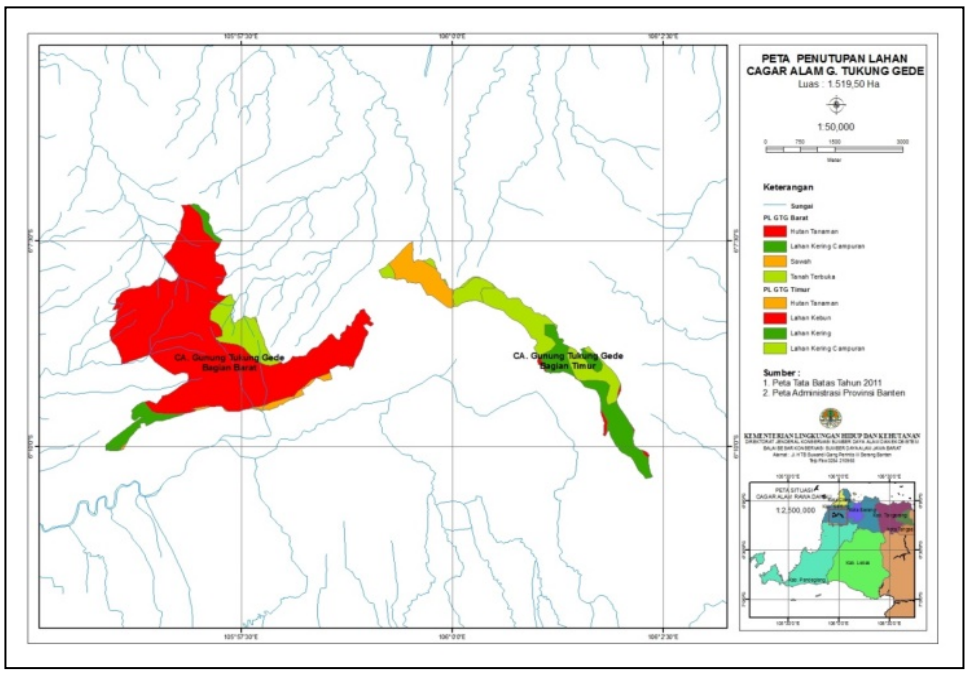

Figure 1. location of the GTG nature reserve

was conducted at GTG Nature Reserve, Serang Regency, Banten Province, which is geographically located at 6°14' - 6°20' LS and 105°52' - 105°57' BT (Figure 1).

The method for selecting observation areas is to use the cruising method at three different stations, namely primary and secondary forests and encroachment areas in gtg nature reserves. These three stations were selected as sampling locations considering that environmental conditions influence the diversity of entomopathogen mushrooms. Environmental parameters in the form of temperature, relative humidity and light intensity at the sampling site are measured and documented (Table 1).

Table 1. Conditions of the location of the sampling plot in the Tukung Gede Mountain nature reserve

Station	GPS	Temp (°C)	Relative humidity (%)	Light intensity	Vegetation character
HP	6°07'58.1"LS-106°00'23.1"BT	28	92	1323	The dominating plant at the site is the mahogany tree (*Swietenia macrophylla*), *Pulus (Laporta stimulant),* and *Burahol (Stelechocarpus burahol)*
HT	6°08'13.6"LS-106°00'15.0"BT	31	69	1441	The dominant plant in the location is the Bayur Tree *(Pterpspernum javanicum)* and durian (*Durio zibethinus*)
P	6°08'48.9"LS-106°01'45.8" BT	32	52	1570	The dominant plant in the location is plantation crops, namely Cocoa *(Theobroma cacao),* Melinjo *(Gnetum gnemon)* and Coffee *(Coffea canephora)*

Ket: HP: Primary forest, HS: Secondary forest, P: Encroachment forest

Sampling is carried out on entomopathogen fungi that live parasites on insects as hosts, found in parts of plant organs such as leaves, twigs and stems, and litter on the forest floor. Specimens that have been successfully found in research locations, then documented with their natural habitat, then stored in paper bags are then taken to a laboratory for identification.

Isolation and identification of entomopathogen fungi is carried out in the Laboratory of Biological Education, FKIP, UNTIRTA through direct isolation techniques that scratch the fungal spores that grow on the surface of the host's body in the growth medium Pottato Dextrose Agar (PDA) (Luangsa-ard et al., 2006). The cup containing the isolate is then stored in a closed box with a temperature of 25o C. Spores that have grown are then transferred to a new PDA medium to get pure breeding.

Identification is made through macroscopic observation and microscopy. Macroscopy is observation in plain sight, including the color, shape and size of the stroma, the color and size of the cinema and its host. Microscopic observations are made by making thin slices of specimens, then made preparations with methylene blue colouring to be observed using a microscope (Pratiwi, 2012). Microscopic observations include the shape and size of peritesium, ascetics and ascetics, the colour and shape of picnidium and dium. Identification refers to Luangsa-ard et al., (2008) based on the reproductive structure of fungi found in the bodies of insect animals.

Diversity Index

The identified sample then calculated the value of diversity. Species diversity can be said to be the homogeneity of species and is a hallmark of community structure. The formula used to calculate species diversity is the formula of the Shannon-Wiener Diversity index (Batten, 1976).

$$H' = -\Sigma pi \ln pi; pi = ni/N$$

Note:
H' = Shannon-Wienner diversity index
Pi = Relative abundance of a species
ni = number of individuals of a species
Nt = total number of individuals of all species

Then the H' value obtained is matched with the criteria for the Shannon-Wienner diversity index

H'> 3: High diversity, uniform number of individuals, no dominant species.

1≤ H'≤ 3: Moderate diversity, the number of individuals is almost uniform, there are several dominant species.

H'< 1: Diversity is low, the number of individuals is not uniform, there is a dominant species.

Results

Entomopathogenic fungi are microorganisms that live parasitic on insects that are commonly found in the tropics. Figure 2 shows the morphological variations of fungi that colonize insect hosts, which can be seen from the shape of the mycelium of the fungus on the surface of the host.

Based on the calculation results, it is known that the index numbers for the first and second plots are H´= 1.5495 and H´= 1.3322. Diversity Index of Entomopathogenic Fungi in Mount Tukung Gede Nature Reserve. Note: Station 1=primary forest, Station 2=secondary forest and Station 3=encroached forest.

Figure 2. Morphology of entomopathogenic fungi in insects a. cicadas; b. Centipede; c. aphids; d. caterpillar; e. moth; f. spider scale bar = 1 cm.

Discussion

The entomopathogen fungi were found in three different host orders of insects. According to Ortiz-Urquiza & Keyhani, (2013), entomopathogen fungi can infect an extensive range of host insects. The mechanism of infection is carried out by entomopathogen fungi in the susceptible host through direct penetration in the cuticle as an initial interaction. Entomopathogen fungi have developed tools for adhesion and recognition of host surface cues that help immediate adaptive responses that include the production of: (a) hydrolytic enzymes, assimilation, and/or detoxification including lipase/esterase, catalase, cytochrome P450, protease, and chiinase; (b) special infection structures, e. g. appressoria or penetrant tubes; and (c) secondary metabolites and other metabolites that facilitate infection.

The conditions that support the growth of life's entomopathogen fungi are influenced by the abiotic factors that exist in the environment in which entomopathogen fungi grow. These abiotic factors include physical and chemical factors in the form of temperature, humidity, light intensity, and degree of acidity (pH). Environmental conditions at the 3 sampling stations can be seen in Table 1. Related to this, Purwowidodo, (2015), states that fungi have different conditions to grow especially against sun exposure. This leads to differences in the diversity of the types of fungi that grow at these locations. This varied canopy cover is also supported by a forest area that looks larger than the area at the third station. Koneril & Suroyo, (2012) state that habitat structures and diverse vegetation forms have a positive relationship with the diversity of a species including entomopathogen fungi.

The percentage of diversity of an organism in an ecosystem can be known from the value of H'. The value of species diversity can also be used to measure the stability of existing communities in the environment (Thibaut & Connolly, 2013). Based on the diversity index analysis (H') at the three stations where sampling fungi entomopatogen is medium, two of the three stations, namely station one and station two, have a higher index than the third station. The value of this index indicates the diversity of "moderate" levels. This moderate level of diversity shows that the environmental conditions at both stations are still quite good and support the life of microorganisms in it, especially entomopatogen mushrooms, but there need to be efforts to maintain the sustainability of the entomopatogen mushrooms. Good environmental conditions can support

Table 2. Identification of entomopathogenic fungi in Mount Tukung Gede Nature Reserve

Family	Spesies	Colony color		Hifa	Conidia	Host
		Upper	Button			
Basidiobolaceae	*Basidiobolus haptosporus*	ash-gray	white	Hialin, septum	sphere	Lepidoptera
Clavicipitaceae	*Beauveria bassiana*	white	white	Hialin, no septum	Oval	Lepidoptera
	Aschersonia sp.	white	white	Hialin, septum	sphere	Homoptera
Moniliaceae	*Metarhizium aniesophalie*	gray	gray	Hialin, septum	sphere	Hemiptera
	Paecilomyces sp.	brown	brown	Hialin, septum	sphere	Homoptera
Trichocomaceae	*Aspergillus* sp.1	gray	green	Hialin, no septum	Oval	Hemiptera
	Aspergillus sp.2	purple	purple	Hialin, septum	sphere	
Septobasidiaceae	*Septobasidium* sp.	black	black	Hialin, septum	Oval	Lepidoptera

entomopathogen mushroom spores to germinate, mycelia can grow and develop and the mushroom cansporulate (Lopez & Sword, 2015).

Based on the results of the analysis, it can be known that the difference in numbers is relatively very small, which is 0.2173. This relatively small difference is due to the similarity of the constituent vegetation structures found in primary forests and secondary forests. Both stations have habitat types that are dominated by tall tree types. However, the type of canopy is different, which impacts the intensity of incoming sunlight becomes different.

In contrast to the index values seen on the first and second stations, the diversity index value on the third station is classified as low-level diversity, with an index value of 0.6365. This is because the type of habitat at this third station is an encroachment forest whose constituent vegetation structure is different from primary and secondary forests. This area is dominated by the encroachment of residents around the nature reserve in the form of durian trees (*Durio zibethinus*) and melinjo (*Gnetum gnemon*). The area of this encroachment forest also appears smaller than the primary and secondary forests. This condition causes the types of plants and insects that live in it to be less, so that the host insects of entomopathogen mushrooms become fewer as well.

The difference in the diversity of entomopathogen mushrooms in these three types of habitats is closely related to abiotic factors. According to Wang et al., (2017), organisms and their abiotic environment are closely related and affect each other. In this case, the growth of entomopathogen mushrooms depends on the temperature of the environment, so entomopathogen mushrooms must be in the appropriate environment.

Research station 1 has the highest diversity index value among other research stations, which is 1.5495. According to Morris et al., (2014), the value of the diversity index is influenced by two components, namely the number and merity of species. The study's diversity index tends to be high because no species dominates at each station. It is also supported by adequate abiotic factors. Temperature and humidity in this area is also enough to support the growth of entomopathogen mushrooms. The second research station had a diversity index value that tended to be low, although it was still at a moderate criterion. The diversity index at this station is only 1.3322. The low diversity index at this station is due to the area of the station which is a secondary forest. Secondary forests in the tukung gede mountain nature reserve have canopy cover that tends to be less dense, so the temperature in the area is quite high.
This high temperature also produces low humidity, so the growth of entomopathogen mushrooms in the area is less than optimal. This is evidenced by only found as many as 4 types of entomopathogen mushrooms. Barlow, J. et al., (2007), stated that naturally regenerating secondary forests can provide conservation services like primary forests but cannot match their biodiversity value.

Station 3 has the lowest diversity index among other stations. This is because the area of station 3 is an encroachment area that residents around the GTG Nature Reserve often visit. This area is adjacent to the settlement of residents so often the surrounding residents who live near the nature reserve area pass around the area to disrupt the growth of entomopatogen mushrooms. In the forest, encroachment is also often given by motor vehicles from the surrounding residents, causing air conditions that are bad enough for the survival of entomopatogen mushrooms.

Conclusion

This research has provided essential data on the diversity of entomopathogen fungi whose diversity and distribution of mosses are strongly influenced by environmental conditions. The results of exploring the diversity of entomopatogen mushrooms in gtg nature reserve obtained 15 samples consisting of 8 types of mushrooms. These entomopathogen fungi infect insect hostes of the orders Lepidoptera, Hemiptera and Homoptera. The index of entomopathogen mushroom diversity at three stations in a row is 1.5295; 1.3322; and 0.6365 (medium category). The results of research on the diversity of entomopathogen mushrooms in GTG Nature Reserve can be used as a basis for information for research and development of potential entomopathogen mushrooms that are useful for human life.

Declaration statement

The authors reported no potential conflict of interest.

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Variations in Morphology and Anatomy of Breadfruit (*Artocarpus altilis*) Based on Differences in Altitude

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Morphology;

A B S T R A C T

Background: Breadfruit (*Artocarpus altilis* (Parkinson ex F.A. Zorn) Fosberg) is a versatile plant that humans can use. Breadfruit has morphological variations that are thought to be related to anatomical variations that are formed as an adaptation mechanism to survive in a different area. This plant has the ability to live in different altitude ranges, from coastal regions to upland sites. This research was conducted for eight months in areas with altitude ranges of <350 masl, 350-700 masl, and >700 masl in Banyumas, Purbalingga, and Cilacap Regencies. A sampling of plants was carried out randomly selected (purposive random sampling), then described their morphological characteristics. Furthermore, the leaves are made for anatomical preservation to determine the anatomical character. Breadfruit plants that grow at an altitude of fewer than 350 m above sea level have the characteristics of a higher, larger diameter stem, have a tighter branching, more sap production, a higher number of fruit and have a larger fruit size. The anatomical characteristics of breadfruit plants that grow at an altitude of less than 350 masl have stomata characters that are wider and longer than those of 350-700 masl and > 700 masl. The highest stomata and trichomata density at an altitude > 700 masl. The highest mean cuticle thickness, epidermis, palisade ratio and mesophyll thickness were highest in breadfruit leaves at altitudes <350 masl.

Variasi Morfologi Dan Anatomi Sukun (*Artocarpus altilis*) Berdasarkan Perbedaan Ketinggian Tempat

Kata kunci:
Anatomi;
Ketinggian Tempat;
Morfologi;
Sukun;

A B S T R A K

Sukun (Artocarpus altilis (Parkinson ex F.A. Zorn) Fosberg) merupakan tanaman serbaguna yang dapat dimanfaatkan oleh manusia. Sukun memiliki variasi morfologi yang diduga berkaitan dengan adanya variasi anatomi yang terbentuk sebagai mekanisme adaptasi untuk bertahan hidup pada suatu wilayah yang berbeda. Tanaman ini memiliki kemampuan hidup dalam rentang ketinggian yang berbeda-berbeda, dari wilayah tepi pantai hingga daerah dataran tinggi. Penelitian ini dilakukan selama delapan bulan pada daerah dengan range ketinggian < 350 mdpl, 350-700 mdpl, dan >700 mdpl di Kabupaten Banyumas, Purbalingga, dan Cilacap. Pengambilan sampel tanaman dilakukan secara acak terpilih (purposive random sampling), kemudian dideskripsi ciri-ciri morfologinya. Selanjutnya bagian daun dibuat preparat awetan anatomi untuk mengetahui karakter anatominya. Tanaman sukun yang tumbuh pada ketinggian kurang dari 350 m dpl memiliki karakteristik lebih tinggi, batang berdiameter lebih besar, memiliki percabangan yang lebih rapat, produksi getah yang lebih banyak, jumlah buah yang lebih banyak dan memiliki ukutran buah yang lebih besar. Karakteristik anatomi tanaman sukun yang tumbuh pada ketinggian kurang dari 350 mdpl memiliki karakter stomata yang lebih lebar dan panjang dibandingkan ketinggian 350-700 mdpl dan > 700 mdpl. Kerapatan stomata dan trikomata tertinggi pada ketinggian > 700 mdpl. Rata-rata tebal kutikula, epidermis, rasio palisade dan tebal mesofil tertinggi pada daun sukun pada ketinggian tempat < 350 mdpl.

Introduction

There are many tropical areas such as Malaysia and Indonesia. The height of this plant can reach 20 meters. Breadfruit is a versatile plant that can be used by humans, and on the island of Java, this plant is used as a cultivated plant by the community. Breadfruit plants produce fruit with carbohydrates and high nutritional content, potentially as an alternative staple food ingredient instead of rice (Purwantoyo, 2007). Breadfruit has many morphological variations. The diversity is influenced by cross-pollination and seed, the diversity of breadfruit populations derived from breeding systems and natural selection associated with differences in local environment, evolution, and human intervention related to the anatomical variation of the plant formed as an adaptation mechanism for survival in a different region (Nayeem & Sushmita, 2013).

Breadfruit has a variety that gives rise to different characters to live in several types of habitats according to environmental conditions. The morphology of a plant is determined by environmental factors and genetic factors that interact with each other during the plant life cycle, giving rise to different phenotypes in individuals in one species. Plant development ranging from seeds to adults undergoes biochemical, physiological, anatomical, and morphological changes, for example, plants undergo plasticity, namely morphological changes influenced by environmental factors (Estalansa et al., 2018). The earth's surface consists of various reliefs, such as mountains, lowlands, hills and coastal areas, the difference in altitude is one of the factors that affect the distribution and development of plants. This is possible because the difference in the height of a region also causes differences in life-supporting factors such as plant breeding) that cause genetic and morphological variations. Morphological variations are thought to be temperature, humidity, rainfall, light intensity and nutrients available in the soil (Akanbi et al., 2009). The height factor of the place affects the plant's growth, the higher the planting place, the height of the plant and the size of the leaves decreases. The part of the plant that is influenced by environmental factors such as the height of the place one them is the anatomy of the stomata and trichomes. Stomata anatomy includes the type, size, density and index of stomata (Rehatta & Kesaulya, 2010).

The increase in altitude from above sea level in the mountains is directly proportional to the abiotic environmental checks received by plants, with increasing altitude it will cause REDUCED CO2, increased intensity of sunlight, UV-B radiation and drought. Differences in height and environment will be an important factor for fruit plants because it will determine the results of existing fruits, both quality and quantity. In response to the abiotic environment, plants need to adapt to various aspects such as physiological changes, anatomy and morphological changes (Streb et al., 1998).

Breadfruit research that has been conducted in Indonesia is about the diversity of breadfruit plants based on a morphological character in Yogyakarta (Estalansa et al., 2018). Morphological variations and nutritional content of breadfruit fruit (Adinugraha & Kartikawati, 2012). Research conducted by Akinloye et al., (2015); Palupi et al., (2021) on anatomical characters in breadfruit (Artocarpus altilis) and kluwih (A. communis) can be used to identify and describe both species, anatomical characters can be used to obtain special characters that can be used to limit 2 taka. Anatomical characters are specific to distinguish in Artocarpus altilis and A. Communis is the vascular tissue at the root, the tissue on leaf correction, the density of the trichromata, as well as the abaxial and adaxial epidermal cells.

Banyumas, Cilacap, and Banjarnegara districts have a diverse topography ranging from highlands to lowlands. This topographic difference can certainly cause morphological and anatomical variations in plants that grow in the region. Morphological and anatomical variations as a form of adaptation strategy are thought to also occur in breadfruit. Research on morphological and anatomical variations of breadfruit attributed to differences in altitude has not been done.

Information about morphological and anatomical variations of breadfruit that grows at different altitudes is expected to add information about the richness of germplasm and become a foundation in efforts to manage and develop its potential and benefits, especially for science and society in general. Based on the above information, formulated the problem of whether there are variations in the morphological and anatomical characteristics of breadfruit at different heights as a form of adaptation of different environments to get the information needed for the breadfruit development program so that its potential can continue to be improved. The specific purpose of the study was (1) to know the morphological variation of breadfruit based on the height of the place, and (2) to know the anatomical variation of breadfruit based on the height of the place.

Methods

A sampling of breadfruit plants will be conducted at locations with gradient ranges of different places (< 350 m dpl, 350-700 mdpl, and >700 m above sea level.) in Banyumas, Cilacap, and Purbalingga districts. Observation of morphological character was carried out at the Herbarium Faculty of Biology Unsoed (PUNS) and the preparation and observation of anatomical character was carried out in the Laboratory of Plant Structure and

Development of the Faculty of Biology, Universitas Jenderal Soedirman.

The ingredients used in this study are: breadfruit plants (Artocarpus altilis) taken from several locations of different heights. The petroleum materials used include: FAA fixative solution (Formalin, Acetic Acid, Alcohol), ETHANOL PA, xylol, 96% alcohol, paraffin, glacial acetic acid, formalin, glycerin, safranin, akuades, entelan, and transparent kutext. The tools used in the study include field tools including thermohygrometer, GPS, pH meter and altimeter. Laboratory tools include object glass, cover glass, flacon bottle, holder, staining jar, drip pipette, Bunsen, stirrer rod, tray, scalpel, razor, tweezers, thermostat, binocular microscope, stove, rotary microtom, beaker glass, erlenmeyer glass, objective micrometer, ocular micrometer, square micrometer, plastic bag, ice box, ruler, digital camera, stationery and label paper.

Method of sampling breadfruit plants with survey methods, with purposive random sampling patterns. The study used five trees in each location with five repeats. The sample is then described morphologically. Making Fresh Preparat leaves are samples of breadfruit leaves made preparing slices stretched. Observation of the anatomical character of the leaves is done by making preparations using the paraffin method, staining with 1% safranin in 70% alcohol. The manufacture of cross-leaf slices by the paraffin method is first cut for 1 cm long with a razor, then annexed with an FAA fixative solution for 24 hours. Dehydration with double-grade alcohol ranging from 70% alcohol to absolute alcohol for 30 minutes each. Dealcoholization with alcohol-xilol solution with a ratio of 3: 1, 1 : 1, and 1 : 3 each for 30 minutes. Infiltration with an xylol-paraffin mixture with a ratio of 1: 9 for 24 hours, then replaced with pure paraffin is done in the oven at a temperature of 57 oC. Making blocks of paraffin, made small boxes of cardboard paper, then liquid paraffin is poured on small boxes that have been smeared with glycerin. Pieces of breadfruit leaves are put in a box and placed in such a way.

The colded paraffin block is removed from the mold then cut and affixed to the holder in the rotary microtom. Slices of paraffin tape containing the preparation are placed on the glass of objects that have previously been dripped with glycerin and albumin and dried over the heating box until the paraffin tapes stretch. Staining by a dipping glass of objects that have contained preparations into pure xylol is repeated 2 times, then xilol-alcohol with a ratio of 3 : 1, 1 : 1, and 1 : 3, then treated with alcohol decreased from alcohol 100% to alcohol 70%. It is then incorporated into the 1% colour substance safranin in 70% alcohol for 1 - 2 hours. Washing with 70% alcohol and dehydration with 70% alcohol to 100% alcohol, alcohol-xilol with a ratio of 3: 1, 1: 1, and 1 : 3, then pure xylol repeated 2 times each 5 minutes. Closing or mounting is done using a entelan dripped on the preparation and covered with a glass cover.

The observed parameter is the morphological character of the breadfruit plant by observing its morphological features, including roots, stems, leaves, flowers and fruit. The 5th leaf located on the branch in the middle of the stem is taken and made anatomical preparations to find out the anatomical character. The observed anatomical characteristics include the thickness of the cuticle, the thickness of the epidermis, the thickness of the mesophile leaves, the size and density of the stomata, and the trichomes' density per 1 mm2 area. The data from morphological and anatomical observations obtained, then analyzed descriptively to obtain morphological and anatomical variations of breadfruit plants found at different altitudes.

Results

The results of observations on morphology and anatomy in the form of fresh preparation of leaves have been obtained, which amounted to 73 morphological characters of stems, leaves, flowers and fruit. Based on research conducted in the area of Banyumas Regency, Purbalingga Regency and Cilacap Regency. The results of characteristic morphological observations show that breadfruit plants grow at the height of less than 350 mL have Habitus breadfruit is a tree with a round stem shape. Plant height 17.5-24 m. The circumference of the stem is 120-145cm. The texture of the rods is rough or very rough. Brown stem skin colour with white patches. The direction of growing stems is perpendicular. The shape of the canopy is funneling or the pyramid widens. Vertical bar branching pattern. The density of branching is very tight. The colour of the white sap is thick. Production of sap is medium to many.

Roots appear slightly on the surface of the ground, Single leaf type with a reflection of the leaves. The shape of the egg-round leaves is egg-round. The width and length of the leaves are 23-58 x 18-48 cm. Shape the ends of the leaves blunt or tapered. The base of the leaves is blunt. The edges of the strands of the leaves are snuffed. The upper surface color of the leaves is dark green and the colour of the lower surface of the leaves is light green. The texture of the top surface of the shiny leaves. The texture of the surface under the leaves is coarsely hairy. The texture of the stalks of the leaves is smooth. The colour of the stalks of light green leaves. The length of the fruit is 16-23 cm. The shape of the fruit is round or round.

Breadfruit plants that grow at heights between 350-700 mdpl have a breadfruit habitus is a tree with a round trunk shape. The height of the plant is 15-20 m. The circumference of the stem is 125-130cm. The texture of the rods is rough or very rough. Brown stem skin color with white patches. The direction of growing stems is perpendicular. The shape of the pyramid canopy widens.

Vertical bar branching pattern. Density of branching tightly until very tight. The color of the white sap is thick. Medium sap production. Roots appear slightly at the surface of the soil. Single leaf type with a rectuating of the leaves. The shape of the egg-round leaves is egg-round. The width and length of the leaves are 20-43 x 16-38 cm. Shape the ends of the leaves blunt or tapered. The base of the leaves is blunt. The edges of the strands of the leaves are snuffed. The leaves' upper surface colour is dark green, and the leaves' lower surface colour is light green. The texture of the top surface of the shiny leaves. The texture of the surface under the leaves is coarsely hairy. The texture of the stalks of the leaves is smooth. The colour of the stalks of light green leaves. The length of the fruit is 17-20 cm. The shape of the fruit is round or round.

Breadfruit plants that grow at an altitude of more than 700 mdpl have a breadfruit habitus is a tree with a round trunk shape. The height of the plant is 15-19 m. The circumference of the stem is 120-128 cm. The texture of the rods is rough or very rough. Brown stem skin colour with white patches. The direction of growing stems is perpendicular. The shape of the pyramid canopy widens. Vertical bar branching pattern. The branching density is stretched until tight. The color of the white sap is thick. Production of sap slightly to moderately. Roots appear slightly at the surface of the soil. Single leaf type with a rectuating of the leaves. The shape of the egg-round leaves is egg-round. The width and length of the leaves is 21-430 x 15-35 cm. Shape the ends of the leaves blunt or tapered. The base of the leaves is blunt.

Figure 1. Plants, leaves and breadfruit that grow in areas that have a height of < 350 m above sea level

Figure 2. Plants, leaves and breadfruit that grow in areas that have a height of 350-700 m above sea level

Figure 3. Plants, leaves and breadfruit that grow in areas that have a height of > 700 m above sea level

The edges of the strands of the leaves are snuffed. The upper surface colour of the leaves is dark green and the color of the lower surface of the leaves is light green. The texture of the top surface of the shiny leaves. The texture of the surface under the leaves is coarsely hairy. The texture of the stalks of the leaves is smooth. The colour of the stalks of light green leaves. The length of the fruit is 16-18 cm. The shape of the fruit is round or round. The observed anatomical characteristics are the size and density of stomata and the density of trichomes per 1 mm2 area. Parameters are thick cuticle, epidermis thickness, palisade ratio, and mesophile thickness.

Stomata

Measurements of the length and width of the stomata of different heights were obtained at the height of the < 350

mdpl has the largest average stomata length of 18.90 µm, while the smallest stomata length is found at a place height of > 700 mdpl which is 14.55 µm. Measurements of the width of breadfruit leaf stomata at different heights showed results at altitudes where < 350 mdpl had the largest average stomata width of 7.4 µm, while the average width of the smallest stomata was found at the height where the > 700 mdpl was 6.65 µm. The results of measuring the density of stomata of breadfruit leaves at different heights were obtained at the height of places where > 700 mdpl had the largest average stomata density of 44.04, while the smallest stomata density is found at a place height of < 350 mdpl which is 37. The density of stomata on leaves affected by the height of the place will show higher results in areas with a height of > 700 mdpl.

Stomata are one of the epidermal derivates, fissures (holes) that form between the epidermal layers. Stomata play a role in the exchange of CO_2 and O_2 gases that play a role in the process of photosynthesis of leaves. In addition to being a place of gas inflow, another function of stomata is as a way for transpiration process used in regulating excess water that occurs in plant tissues due to excess water absorption and as temperature regulation on leaves due to the rise in environmental temperature by direct sunlight. Stomata breadfruit at each height have the same structure and are found only on the bottom of the leaves, these stomata are not found on the top of the leaves. Stomata are arranged in groups on the leaves, according to Croxdale, (2000) reports that the different distribution patterns of stomata on the surface of the leaves are the result of interactive processes that occur during leaf growth and may be caused by cellular interactions.

Trichomes

Based on paradermal incisions there are two types of trichomes found in breadfruit leaves: non-glandular, unicellular, tapered ends, rounded bases, and surrounded by several radial epidermal cells and glandular trichomes, multicellular head cells consisting of 4-8 cells, and surrounded by several epidermal cells radially. The base of the trichochroma is characterized by a hexagon shape with an oval shape in it. The base of the trichochroma on the paradermal incision is thought to be part of the stalk cells of the glandular trichomes when viewed transversely. Trichomes in plants show great variation in terms of shape and structure, among them unicellular or multicellular trichomes, glandular or non-glandular trichomes.

The results of measurements of the density of upper and lower trichomes on breadfruit leaves obtained results that have the largest average density of non-glandular trichomes at the height of < 700 mdpl which is 18.78 / mm2 and the smallest at a place height of 350-700 mdpl which is 18.30 / mm2. The average density of non-< > lower glands is 14.78 / mm2. The average density of the largest upper gland trichomes on breadfruit leaves at a height of > 700 mdpl is 12.75 /mm2 and the smallest at the height of the < 350 mdpl is 12.05 / mm2. The average density of the lower gland trichomes is the largest in breadfruit leaves at the height of the > 700 mdpl which is 14.78 / mm2 and the smallest at the height of the place < 350 mdpl which is 14.62 / mm2. The density of trichomes in leaves affected by the height of the place will show higher yields in areas with high elevations. According to Molina-Montenegro et al., (2006) the low density character of trichomes and thin leaves make the leaves preferred by herbivorous insects.

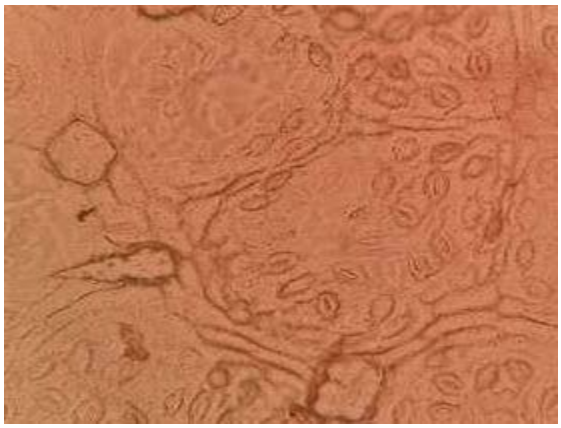

Figure 4. Lower epidermis of breadfruit plant leaves at a height of < 350 mdpl

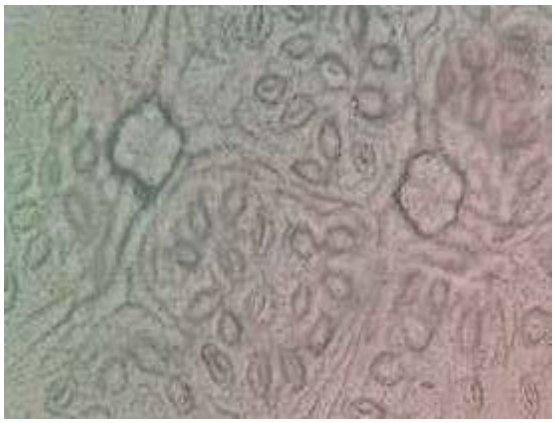

Figure 5. Lower epidermis of breadfruit plant leaves at an altitude of 350-700 mdpl

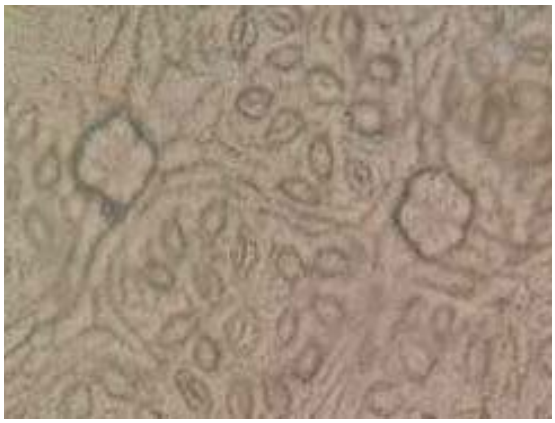

Figure 6. Lower epidermis of breadfruit plant leaves at an altitude of >700 mdpl

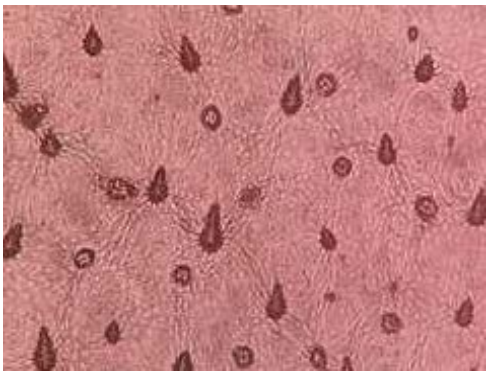

Figure 7. Upper epidermis of breadfruit plant leaves at high altitude < 350 mdpl

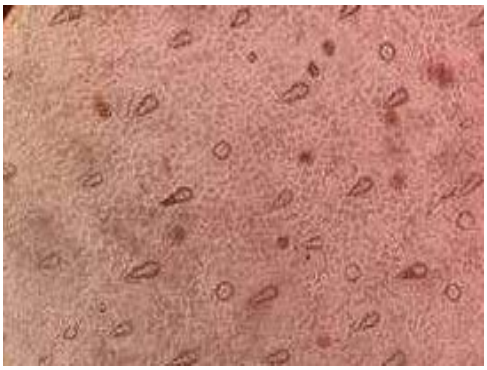

Figure 8. Upper epidermis of breadfruit plant leaves at high altitude 350-700 mdpl

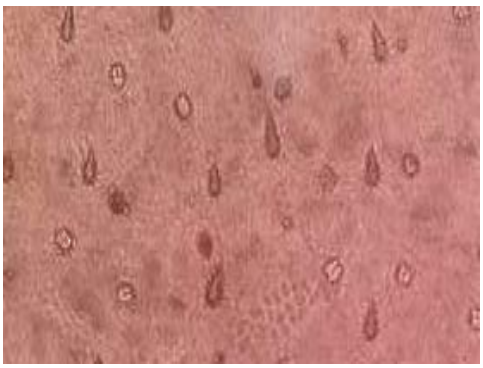

Figure 9. Upper epidermis of breadfruit plant leaves at high altitude >700 mdpl

Table 1. Average character length, width, and stomata density of breadfruit at different heights

Altitude (mdpl)	Length of stomata (µm)	Width of stomata (µm)	Stomata density (mm²)
< 350	18,90	7,4	37
350-700	16.70	6,7	40,8
> 700	14,55	6,65	44,4

Table 2. Average density of glandular and non-glandular trichromata on breadfruit leaves

Altitude (mdpl)	Non-Upper Glands (mm-²)	Non-Lower Glands (mm-²)	Upper Glands (mm-²)	Lower Glands (mm-²)
< 350	18.54	14.78	12.05	14.62
350-700	18.30	15.20	12.56	14.68
> 700	18.78	15.78	12.75	14.78

Observation of Microscopic Preparations of Transverse Incisions

The results of the cross-the-road incision of breadfruit leaves at different heights show a similar structure. Breadfruit leaves have the structure of epidermis, mesophiles and vessels. In accordance with the function of leaves in plants that play a role in the process of photosynthesis, which turns solar energy into carbohydrates as an ingredient in growth and development. Leaves in plants are the organs most affected by environmental changes that are less beneficial because the leaves directly regulate water, photosynthesis, and respiration in plants. So that the leaves require adaptation mechanisms in the tissues to defend themselves against unfavorable environmental conditions. Cuticles on leaves are formed by changes in environmental factors that are less favorable to plants, the thickness of the cuticle in plants is formed as a form of adaptation in reducing the rate of transipiration in the leaves. The cuticle on the breadfruit leaves is found at the top of the leaf while there is no clear structure of the cuticle layer at the bottom of the leaf. The epidermis has different shapes and structures, all epidermises will always be tightly arranged with each other and form solid buildings with no space between cells. Cutler et al., (2007) added, in dicot plants generally mesophilic tissue will be differentiated into 2 different forms, namely the network of poles (palisade) and coral tissue (sponges) that have the same function as the place of photosynthesis. Palisades in dicot plants have different amounts in each plant because the number of palisade cells depends on the intensity of light obtained by plants during photosynthesis.

Cuticle

The results of measurements of the thickness of breadfruit leaves at different heights were obtained results at the height where < 350 mdpl has the largest average thickness of the cuticle which is 6.8 µm, while the smallest cuticle thickness is found at a height where the > 700 mdpl is 5.3 µm. Cuticles have a major role in reducing the occurrence of water evaporation on the surface of the leaves due to direct sun exposure and rising air temperature in the environment. In addition to reducing evaporation on the surface of the leaves, cuticles also play a role in reducing exposure to UV-B rays that are too high that can damage the leaves. The thickness of the cuticle will adjust to the temperature and humidity conditions around the plant. The thicker the cuticle, the reduction in transpiration rate in plants in water stress conditions can be prevented, so that plants can still hoard water as a backup for photosynthesis.

Menururt Ali et al., (2009) because in low areas the air temperature will increase and the humidity decreases and

the pH of the soil is alkaline. The high temperature and low humidity of the air will cause water loss through transpiration in the leaves is getting bigger, so the plant will adapt by thickening the cuticle layer in protecting the leaves from direct sunlight exposure and minimizing the evaporation of water through the leaf surface.

Epidermis

Measurements of the thickness of upper and lower epidermis of breadfruit leaves at different heights were obtained at altitudes where < 350 mdpl had the largest average thickness of upper and lower epidermis at 12.00 µm and 7.50 µm, while the smallest upper and lower epidermis thicknesses were found at altitudes of 350-700 mdpl at 11.74 µm and 7.00 µm.

The epidermis of the leaves is found on the upper surface and the leaf, which has an important role in protecting the organ and protecting the tissues under it from both biotic and abiotic disorders from the environment. As the tissues locatedmost outside the epidermis form derivates such as stomata and trichomes that function in protection and aid in the process of photosynthesis and metabolism. The thickness of the epidermal layer becomes a determining factor of adaptation by the leaves in response to the environment, the thicker the epidermis that the leaves have can mean the high environmental checks received by the leaves directly.
The increase in the thickness of the epidermis over some plants dicots at different heights, according to Jian Jing et al., (2012) is caused by the intensity of light in the environment as protection from UV-B radiation, especially high areas and low areas that have high light intensity. A thick epidermal layer is thought to be associated with water storage functions in low-humidity environments. This is one indication that a plant has a wide and diverse habitat distribution in a variety of different environmental conditions. The thickness of the epidermis is usually supported also by the thickness of the cuticle layer due to its interrelated function in preventing the evaporation of water from tissues (Ali et al., 2009). The higher the air temperature and low humidity in the environment of a growing plant, the epidermis will experience thickening in preventing water loss in tissues.

Palisade Ratio

The results of measuring the palisade ratio of breadfruit leaves at different heights were obtained at the height where < 350 mdpl had the largest average palisade ratio of 8.87, while the smallest palisade ratio was found at a > altitude of 700 mdpl which is 7.45. The palisade ratio in breadfruit leaves that are influenced by the height of the place will show the lower the result of a place, the greater the palisade ratio. Palisade on breadfruit leaves is one of the mesophilic derivates that function in photosynthesis. Palisade cells are located under the upper epidermis to get full sunlight and contain many plastids (chloroplasts) that function in capturing light and the site of photosynthesis. Istiqomah et al., (2010) states that the interaction of plants with the availability of water and the intensity of light has a significant influence on the palisade ratio in plants. When the condition of an environment has less groundwater and water content in the air (moisture), the number of palisade cells in the leaves will increase to speed up and maximize the transport of water to the epidermis. In accordance with the conditions at the altitude of the < 350 mdpl which has a high temperature and low humidity so that it will increase the number of palisade cells in sufficient availability of water for photosíntesis and maintain turgor pressure on the tissues. This is because the water in the leaves is transported through the network of vessels and transported through the space between cells in the mesophile. Plants in an environment with full light intensity will also form additional palisade cells or increase the length of palisade cells to maximize the process of photosynthesis.

Mesophile

The results of measurements of the thickness of breadfruit leaf mesophiles at different heights were obtained at altitudes where < 350 mdpl had the largest average mesophile thickness of 280.20 µm, while the smallest mesophile thickness was found at a height where > 700 mdpl was 207.20 µm. Thick mesophiles on breadfruit leaves that are influenced by the height of the place will show results at low altitudes will get thicker. Mesophile or leaf meat is a basic tissue that fills the middle on the leaves. Mesophiles play a role in photosynthesis in which each mesophile cell contains plastids (chloroplasts). In addition to playing a role in photosynthesis, in the mesophile network there is a network of vessels that function in the transport of water and minerals from the soil to the leaves, so that the mesophil has an air cavity between its cells that allows water transport through gaps between cells to maximize water needs in photosynthesis.

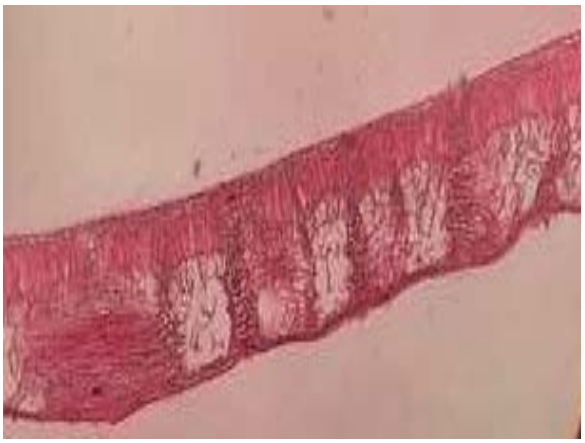

Figure 10. Anatomy of Breadfruit Plant Leaves at the height of < 350 mdpl

Figure 11. Anatomy of Breadfruit Plant Leaves at an altitude of 350-700 mdpl

Figure 12. Anatomy of Breadfruit Plant Leaves at an altitude of > 700 mdpl

Table 3. Average anatomical character of breadfruit thick of leaves at different heights

Latitude (mdpl)	cuticle (µm)	Upper Epidermis (µm)	Lower Epidermis (µm)	Palisade Ratio	Mesophyll (µm)
< 350	6,8	12,00	7,5	8,87	280,20
350-700	5,9	11,74	7,0	7,75	225,50
> 700	5,3	11,80	7,2	7,45	207,20

Conclusion

Morphological characteristics of breadfruit plants that grow at altitudes of less than 350 m above sea level (low) have the most superior character compared to heights of 350-700 mdpl (medium) and > 700 mdpl (high). Breadfruit plants can grow at various altitudes but are rarely found at altitudes of more than 1000 mdpl. Breadfruit plants that grow at heights of less than 350 m above sea level have higher characteristics, larger diameter stems, tighter branching, more sap production, more fruit numbers, and a larger fruit count. Anatomical characteristics of breadfruit plants that grow at altitudes of less than 350 m above sea level (low) have a wider and longer stomata character than heights of 350-700 mdpl (medium) and > 700 mdpl (high). The highest density of stomata and trichomes at an altitude of > 700 mdpl. The average thickness of cuticles, epidermis, palisade ratio and mesophile thickness highest in breadfruit leaves at the height of < 350 mdpl .

Declaration statement

The authors reported no potential conflict of interest.

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Development of Electronic Magazine Teaching Materials for Key Determination and Cladograms in Ethnobotany and Phytochemical Studies

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A B S T R A C T

Background: The use of teaching materials in learning can improve learning results. It requires exciting teaching materials whose material is by the essential competencies to be achieved. One of the teaching materials that can be used is an electronic magazine. This study aimed to determine the validity, practicality, and potential effects of the use of teaching materials on study results. In the critical material of determination and cladogram. **Methods:** Development research was carried out using the 4D model, with the research subjects of class X students at SMAN 2 Palembang. **Result:** (1) the validity was 100% from material experts, 89% from linguists, 75% from media experts; (2) practically is known that the NRS is 91% of students and 98% of biology teachers; (3) the N-gain test obtained a score of 0,64 with the medium potential category to improve learning outcomes in the realm of knowledge, while for the skills of students, they were able to make and present cladogram. **Conclusion:** Teaching materials in electronic magazines are declared valid, practical, and have sufficient potential to improve study results.

Pengembangan Bahan Ajar Majalah Elektronik untuk Penentuan Kunci dan Kladogram dalam Studi Etnobotani dan Fitokimia

Kata kunci:
Etnobotani;
Kladogram;
Kunci determinasi;
Majalah Elektronik;

A B S T R A K

Background: Penggunaan bahan ajar dalam pembelajaran dapat meningkatkan hasil belajar. Bahan ajar yang digunakan harus menarik dan memiliki materi yang sesuai dengan kompetensi dasar yang hendak dicapai. Salah satu bahan ajar yang dapat digunakan adalah majalah elektronik. Tujuan penelitian untuk mengetahui kevalidan, kepraktisan, dan efek potensial bahan ajar terhadap hasil belajar pada ranah pengetahuan dan ketetampilan. **Metode**: penelitian pengembangan dilakukan menggunakan model 4D, dengan subjek penelitian, yakni peserta didik kelas X di SMAN 2 Palembang. **Hasil:** (1) kevalidan bahan ajar mendapat skor 100% dari ahli mater, 89% dari ahli bahasa, dan 75% dari ahli media; (2) kepraktisan bahan ajar memperoleh nilai respon 91% dari peserta didik dan 98% dari guru biologi; (3) uji N-*gain* didapatkan skor 0,64 dengan kategori berpotensi sedang untuk meningkatkan hasil belajar pada ranah pengetahuan, sedangkan untuk keterampilan peserta didik mampu membuat dan menyajikan kladogram. **Kesimpulan:** bahan ajar berbentuk majalah elektronik dinyatakan valid, praktis, dan cukup berpotensi dalam meningkatkan hasil belajar.

Introduction

Industrial revolution 4.0 is familiar to our ears, where there is a development in digital systems, artificial and virtual intelligence in this era. This development is influential in almost all fields, including the field of education. Education itself is a means to produce quality human resources. Therefore, the government is currently working to overhaul the curriculum by emphasizing Science and Technology as we know that the application of technology to the learning process has only been made about one year ago due to the pandemic situation that the government was forced to change the learning pattern that was initially implemented face-to-face to online. This means that inevitably, technology must be integrated into the learning process, including influential components in it. One component that can affect the quality of learning and its use can improve learning outcomes is teaching materials. Teaching materials used in schools during face-to-face learning are printed teaching materials, such as LKS, package books, modules, and others. While currently,

learners are required to learn through online learning media. To support the online learning process requires electronic teaching materials. This is because teaching materials have several advantages, namely (1) the material can combine several types of teaching materials into one, such as audio, audiovisual, and multimedia; (2) practical and easy to carry everywhere because it is stored in a device; (3) may present movements to clarify material of an abstract nature; (4) can be presented with a colourful display (Sriwahyuni, Risdianto, & Johan, 2019). Therefore, to find out the need for electronic teaching materials, researchers conducted questionnaires in one of the State High Schools in Palembang City.

Through the spread of questionnaires conducted in one of the high schools, namely SMA NEGERI 2 Palembang, it is known that teachers use teaching materials in the form of package books provided from schools and LKPD downloaded from the internet and edited as needed, in addition, the teacher explained that the most elusive material by learners is the key to determination and cladogram. In line with the questionnaire results distributed to participants in several high schools in Palembang city, it is known that 35% of learners have difficulty remembering scientific names, making the determination key and cladogram. If teachers use teaching materials during online learning, a video that does not follow the content is incomplete. Material that becomes difficult for learners is one of the competencies that must be mastered. This can be seen in Permendikbud No. 37 of 2018. Therefore, the right solution must be found to overcome this difficulty.

A teacher who is a facilitator can help learners to understand the material. This is in line with the opinion of Mu'minah (2017), who stated that teachers as facilitators can be learning advocates that help learners in solving problems and helping them in understanding the material. One solution that can be done is to develop teaching materials. The teaching materials developed can be a source of learning for learners. The use of teaching materials is one of the factors that play a role in the learning process, and can affect the quality of learning and improve learning outcomes (Arsanti, 2018; Alperi, 2019; Sagita, 2019; and Pramana, et al., 2020). Rahayu, Harjono, & Gunawan (2019), added that using teaching materials can make the learning process more effective and affect the quality of learning. Therefore, the use of teaching materials is essential in the learning process.

The teaching materials developed should be interesting, colorful, contain short, clear, and solid material to facilitate learners in learning and understanding the material. One of the teaching materials that match these characteristics is a magazine. Nur (2014) explained that magazines can have been covered as an attraction, contain more images/ photos, and have longer actualization value. Astuti et al. (2019), explained that images loaded with teaching materials can make it easier for teachers to convey material and make it easier for learners to understand the material during the learning process, especially during online learning that takes place today. Based on data obtained from the Statistik Central Agency in 2019, it is known that smartphone users continue to increase from year to year until reaching 63.53%. This means that we can utilize the sophistication of technology for the benefit of learning, one of which is to distribute teaching materials in the electronic form to learners.

As a driver of teaching materials, teaching materials require a learning model. According to Fitriah (2015), teaching materials should be combined with appropriate strategies, methods, or learning models. Based on the results of RPP analysis, it is known that biology teachers at the high school use a discovery learning model. Discovery learning is a model where the learning step makes learners discover concepts and principles through their mental processes (Mansur & Bare, 2019). While based on the results of the questionnaire, it is known that learners have difficulty remembering scientific names, making determines keys and classes. Learners will be more accessible if given direction during the learning process.

In Permendikbud Number 22 of 2016, four models are recommended in the learning process: inquiry. According to Sari et al. (2019), the guided inquiry model has a syntax that directs learners ranging from inductive to deductive steps. This means that the guided inquiry model will help learners from the beginning to the end of the activity. Learners can determine the key to determine and create a cladogram. Research conducted by Putri et al. (2016), Iswatun et al. (2017), Bera (2019) showed that guided inquiry models could improve learning outcomes and science process skills. In addition, the key to determination and cladogram related to plants should contain examples of plants that are generally used by the community in everyday life, one of the studies that discuss plants used by the community in everyday life is ethnobotany.

Research conducted by Handini, Kasrina, & Irawati (2018) shows that teaching materials containing ethnobotany studies deserve to be used in teaching materials. In addition, to increase knowledge in teaching materials also need to contain additional information. The material that will be contained in teaching materials focuses on plants, then provide researchers with information related to phytochemical content in plants. Jambak, Hadiarti, & Fadhillah (2019) research shows that phytochemicals should be used as material in teaching ingredients because they can be supplements. Based on the description, the researcher will develop teaching material in an electronic magazine for essential determination and class X cladogram.

Methods

This research will be conducted at SMA Negeri 2 Palembang class X, with the type of research and development (R&D) using the 4D development model (define, design, development, and decimate) from Thiagarajan (1974). The development that will be done is the development of teaching materials.

Participant

The sample in this study were class XI IPA 1 and 2 learners, class X IPA 4 and 6 learners, and class X biology teachers.

Instrument

The instruments used are questionnaire sheets used for needs analysis, assessment of validity from experts, the practicality of users, namely learners and teachers. At the same time, potential effects for the realm of knowledge are measured using tests in the form of electives, while skills use product assessment sheets.

Research procedure

In the initial stage (define), researchers disseminate questionnaires and literature studies and analyze teaching materials used by teachers. After that the researcher goes into the stage (design) where the researcher makes a problem, chooses teaching materials, and designs teaching materials. Phase three (development) researchers ask experts to measure the validity of the teaching materials developed. The last stage (disseminate) of researchers at this stage will be tested to find out the potential effects of teaching materials. After a trial and the results are known, the product will be disseminated through the www.flipsnack.com http://www.flipsnack.com site. If you have enough time, the researcher will do the diffusion stage.

Data Collection and Data Analysis

The data in this study is 2, namely the initial and final data. The initial data is collected using the questionnaire sheet while the final data is data obtained from the results of research and development, namely using the questionnaire of validity and practicality, as well as potential effects using test techniques and products. Here are the criteria for validity, which can be seen in Table 1, the practicality of Table 2, and the potential effects in Table 3. Skills assessment uses product assessment that refers to the assessment guidelines of Permendikbud No. 104 of 2014.

Table 1. Wisdom Based on Tegeh et al. (2014)

Percentage (%)	Category	Information
90 – 100	Very Good	No revision needed
75 – 89	Good	Revised as necessary
65 – 74	Good enough	Enough revisions
55 – 64	Less	Many revisions
0 – 54	Bad	Totally revised

Table 2. Practicality Based on Teacher and Student Response Value Criteria Using Wicaksono, (2014)

Value Range	Information
0% ≤ NRS < 20%	Very weak
20% ≤ NRS < 40%	Weak
40% ≤ NRS < 60%	Enough
60% ≤ NRS < 80%	Strong
80% ≤ NRS < 100%	Very strong

Table 3. Potential Effects for the Realm of Knowledge Using Hake, (1999)

Value Range	Information
N-*gain* ≥ 0,7	High
0,3 ≤ N-*gain* < 0,7	Enough
N-*gain* < 0,3	Low

Results

The products developed in the study are ethnobotany plant electronic magazine teaching materials used to determine cladograms and phytochemicals in class X. The results obtained from this study are valid, practical, and potential effects of teaching materials on learning outcomes in the realm of knowledge and skills. Here are the results of the study.

Validity Test of Magazine-Shaped Teaching Materials

The validity of magazine-shaped teaching materials is obtained through expert assessment. Assessment is done to get advice and criticism as a guideline for the improvement of teaching materials. Expert opinion is essential during the progress because before testing the potential effects, the product must be valid based on expert assessment. Three experts are used to assess teaching materials, namely material experts, languages, and media. Here are the results of expert assessments of materials and media presented in Table 4.

The above assessment results show that the expert assessment of the material is 100% with an outstanding category, so it does not need to be revised. The language obtained a total achievement of 89% with a suitable category, which means several parts in the sentence and words in the teaching material need to be improved, while the media gets a total achievement of 75%.

Table 4. Results of Expert Assessment of Materials, Languages, and Media

Expert	Total	Category	Information

of	Achievement (%)		
Material	100	Very Good	No need for revision
Language	89	Good	Revised as necessary
Media	75	Good	Revised as necessary

Fatmawati (2016) explained that products rated in the category are sufficient to be good to be used. When viewed from the assessment above, the media is the minor aspect of the three. Therefore, researchers do quite a lot of revisions, especially in the appearance of magazines to magazine contents. After improving the language and media sections, researchers again asked for advice and criticism to improve teaching materials. Once it is felt, teaching material in electronic magazines can be used for practical tests and potential effects, as for the newness of the electronic magazine developed. The magazine uses plant data from ethnobotany studies as examples and phytochemicals as supporting information and electronic magazines based on guided inquiry models.

Practicality of Magazine-Shaped Teaching Materials

The practicality test of teaching materials is carried out to find out the practicality of teaching materials in the form of magazines according to users, namely learners and teachers and make improvements based on advice from users. Here are the practicality test results presented in Table 5.

Table 5. Practicality Test Results

User	%NRS	Information
Students	91%	Very strong
Teacher	98%	Very strong

Based on the results of the practicality test above it is known that learners provide response scores of 91% and teachers 98% with powerful categories. This means that learners and teachers positively respond to teaching materials in electronic magazines as teaching materials for teachers and learning resources for learners.

There are several improvement suggestions given by learners including, the appearance of the cover and background, size and typeface, and material. Some improvements are made based on the advice given, but some are not improved because it is felt to have been following basic competence and the format of teaching materials.

Potential Effects of Magazine-Shaped Teaching Materials on Learning Outcomes

Potential effect tests are conducted after the product is declared valid by the validator and tested through several trials to learners, ranging from preliminary, quantitative, and final testing. The purpose of testing the potential effects of teaching materials is to determine the difference in learning outcomes before and after using teaching materials developed against learning outcomes. Potential impacts are calculated using the N-gain formula. The value of potential effects is obtained from the pretest and posttest for the realm of knowledge and create a cladogram to find out the influence of teaching materials on learning outcomes in the realm of skills.

The potential effect test conducted to class X learners is known that the acquisition of N-gain score is 0.64 with enough categories, which mean that teaching materials in the form of electronic magazines are quite potential in improving learning outcomes in the realm of knowledge, while in the realm of skills learners are asked to create a cladogram. The results showed that as many as 17 students could create a cladogram with details of 3 learners getting A grades, seven people getting B+ grades, and seven more people getting B grades.

Many obstacles were encountered during this test, including signal difficulties and constrained learning facilities such as the availability of gadgets and quotas, causing learners who only follow the first or second meeting. There are even learners who do not follow the first and second meetings at all. In addition, a less conducive learning environment becomes one of the obstacles during the learning process. As family members speak to learners, noise coming from outside the house, poor learning positions, such as studying in the living room and above the bed, are disturbances in the learning environment.

According to Jannah & Sontani (2018), learning facilities significantly affect the success of the learning process and learners' academic achievement. Rustiana & Chalifah (2012) also added that the learning environment affects learners' process and learning outcomes, where learners who have a less conducive learning environment will affect the learning concentration of learners. Setyani & Ismah (2018) explained that learning concentration is vital in the learning process because attention can make it easier for learners to understand the material and concepts and answer the given questions appropriately to achieve learning goals. Otherwise, this will affect learning outcomes.

During online learning, it is crucial to ensure the availability of adequate facilities for learners. If facilities are inadequate, then schools can help facilitate the needs of learners. In addition, teachers must also have the ability to teach learners during online learning because doing online learning is more complicated than doing face-to-face learning.

Conclusion

Based on the validity test, the product is declared valid through expert assessment, practical according to users, namely teachers and learners, and quite potent in improving learning outcomes in the realm of knowledge

and the realm of skills learners can create present a program.

Suggestion

1. This teaching material is suitable for use in schools where the majority of learners who have the availability of facilities, such as gadgets, quotas, and a conducive learning environment
2. It is expected that other researchers can use this teaching material to see the consistency of the potential effects of teaching materials on learning outcomes.

Declaration statement

The authors reported no potential conflict of interest.

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Knowledge Analysis of High School Students on Work Safety in Laboratory

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A B S T R A K

Background: A laboratory is a learning tool for conducting experiments or observations. Knowledge of workplace safety procedures and laboratory tools and materials can simplify and streamline the learning process. This study aims to analyze the understanding of high school students on laboratory work safety material. **Methods:** This study is a quantitative study that describes students' knowledge of laboratory work safety. The research subjects were class X MIA 1 and MIA 2 SMAN 7 Jambi City students, class X students of SMAS Insan Madani Jambi. Primary data on students' abilities about work safety in the laboratory were measured by a multiple-choice test consisting of 4 choices, namely A, B, C, and D. Secondary data were taken using an interview sheet for class X biology. Data were analyzed according to Miles and Huberman, namely data reduction, display data, and conclusions. **Results:** High school students' knowledge of work safety materials in the laboratory is still low, namely 61.86%. Students' understanding of using the tools and their functions showed the lowest percentage, 55.36% (poor category). In contrast, the safety aspect of laboratory work showed the highest rate, namely 73.71% (the suitable type). **Conclusion:** High school students have common knowledge in understanding work safety material in the laboratory. It is necessary to deepen the material so that students' knowledge of laboratory work safety increases.

Analisis Pengetahuan Siswa SMA terhadap Keselamatan Kerja di Laboratorium

Kata kunci:
Keselamatan kerja;
Laboratorium;
Pengetahuan;
Siswa SMA;

A B S T R A C T

Background: Laboratorium merupakan sarana pembelajaran untuk melakukan percobaan atau pengamatan. Pengetahuan tentang prosedur keselamatan kerja serta alat dan bahan laboratorium dapat mempermudah dan memperlancar proses pembelajaran. Penelitian ini bertujuan menganalisis pengetahuan siswa SMA pada materi keselamatan kerja laboratorium. **Metode:** Penelitian kuantitatif yang menggambarkan pengetahuan siswa tentang keselamatan kerja laboratorium. Subjek penelitian ialah siswa kelas X MIA 1 dan MIA 2 SMAN 7 Kota Jambi dan siswa kelas X SMAS Insan Madani Jambi. Data primer kemampuan siswa tentang keselamatan kerja di laboratorium diukur menggunakan soal bentuk pilihan ganda terdiri dari 4 alternatif pilihan yaitu A, B, C, dan D. Data sekunder diambil dengan lembar wawancara pada guru biologi kelas X. Data dianalisis menurut Miles dan Huberman yaitu reduksi data, menampilkan data, dan kesimpulan. **Hasil:** Pengetahuan siswa SMA pada materi keselamatan kerja di laboratorium masih rendah yaitu 61,86%. Pengetahuan siswa tentang cara penggunaan alat dan fungsinya menunjukkan persentase paling rendah yaitu 55,36% (kategori kurang), sedangkan aspek keselamatan kerja laboratorium menunjukkan persentase tertinggi yaitu 73,71% (kategori cukup). **Kesimpulan:** Siswa SMA memiliki pengetahuan yang rendah dalam memahami materi keselamatan kerja di laboratorium. Perlu adanya pendalaman materi sehingga pengetahuan siswa tentang keselamatan kerja laboratorium meningkat.

Introduction

A good education can facilitate students to the maximum. Facilities and infrastructure become components that must exist in creating a good education. Based on the Regulation of the Minister of National Education No. 40 of 2008 on Standards of Facilities and Infrastructure, bringing the laboratory is a means that supports learners' success in experimental activities. It is also supported by the Regulation of the Minister of Education and Culture No. 32 of 2013 on National Standards of Education that the laboratory is one of the standards of facilities needed to support the learning process in meeting learning achievements.

The condition of laboratory facilities and infrastructure of some schools has differences. Some schools have

complete laboratories, but there are some schools with minimal laboratory conditions. This will affect the quality of the practice learning process in the laboratory. Learning with a laboratory involves interactions between students, equipment and materials (Gobaw, 2016). Tools and materials in the laboratory must be utilized optimally in practicum activities. Laboratory accidents generally occur in students because they do not know how much risk if they do not understand the safety of workers in the laboratory. (Yuliani et al., 2020). Some chemicals that come into direct contact with the skin, eyes or interactions between chemicals can cause injury (Cimera et al., 2020).

Interviews with biology teachers at N 7 Kota Jambi High School and SMAS Insan Madani Jambi obtained data that students have been taught safety in the laboratory in classroom learning. However, there are still accidents due to student negligence. Some accidents that occur due to student carelessness include (1) the rupture of glass instruments such as test tubes, measuring cups, glass objects and Petri dishes, (2) mouldy microscopes due to improper storage methods, (3) improper practicum ways such as heating substances that are too close to the heating source so that the test tube breaks, (4) the abundance of substances, and (5) irritation of the skin of students' hands due to alcohol exposure 96%. Often students are negligent and do not use work safety equipment in conducting experiments resulting in school and self-harm.

The role of teachers and learning resources used to make students understand occupational safety in the laboratory will be well-formed. The interview results mentioned that students were given biology handbooks and LKPD for use in the classroom. LKPD teaching materials are considered less attractive to students because they only contain descriptions of subject matter so that students are less interactive in the teaching and learning process (Li et al., 2015).

Knowing how to use laboratory equipment is an essential factor in supporting practice training. Misuse of laboratory tools by students can result in errors or errors in the use of tools and errors in obtaining practicum results. Knowledge of operating laboratory equipment is essential to be passed on to avoid laboratory accidents to students from the start as a critical skill for performing exercises and improving process skills. Moreover, the practice of biology in the laboratory is a form of laboratory utilization following its function.

Awareness of work safety can be grown one of them with knowledge of work safety (Tarawi et al., 2020). Students with good work safety knowledge will know the risks that can occur if ignored. Students' compliance with safety regulations on using available equipment, materials, and substances in the laboratory may reduce the risk of accidents (Salazar-Escoboza et al., 2020). With sufficient knowledge of workplace safety procedures in the laboratory, students can anticipate and handle cases of accidents and care for laboratory facilities. Given the critical role of the laboratory as a means of learning, this study aims to analyze students' knowledge of occupational safety in the laboratory.

Methods

The study used quantitative descriptive methods to describe high school student's knowledge of laboratory work safety materials.

Population and sample

The subjects in this study were students of class X SMAN 7 Kota Jambi and SMAS Insan Madani, which amounted to three classes with a total of 87 students who were included in saturated sampling (Table 1).

Table 1. Number of student samples

No.	Class	Σ
1.	X MIA 1 SMAN 7 Kota Jambi	30
2.	X MIA 2 SMAN 7 Kota Jambi	29
3.	X MIA SMAS Insan Madani Jambi	28
	Total	87

Instrument

The instruments used in this study are test sheets developed from learning indicators (3.1.1) students' understanding of aspects of laboratory safety, (3.1.2) how tools are used and their functions, and (3.1.3) symbols of the dangers of chemicals in the laboratory. The number of question items on the test sheet is 20 items of multiple-choice questions with four alternative options, namely A, B, C, and D. If the correct answer gets a score of 1 and 0 if the answer is wrong. Secondary data is obtained by way of interviews with biology teachers.

Data Analysis

Data analyzed with the Miles & Huberman (1994) model is data reduction, presentation, and conclusion withdrawal. Reducing data means summarizing and selecting essential things. Once the information is reduced, the next step presents the data in the form of a table. Continued withdrawal of conclusions and verification. According to Arikunto (2007) the criteria for knowledge assessment are divided into three.

Results

The results showed that high school students' knowledge of work safety materials in the laboratory was relatively low (Table 2).

Table 2. Student knowledge of laboratory work safety materials

Indicator	Knowledge	Information
3.1.1	73,71%	Enough
3.1.2	55,36%	Less

3.1.3	56,51%	Less
Average	61.86%	Low

Table 2 shows that high school students' knowledge of work safety materials in the laboratory is relatively low. The average student knowledge is 61.86%. Each school presents different knowledge results (Table 3).

Table 3. The number of correct answers in each school

Class	Indicator	Correct answer frequency	Percentage
X MIA 1 SMAN 7	3.1.1	191	79,58
	3.1.2	101	56,11
	3.1.3	106	58,89
X MIA 2 SMAN 7	3.1.1	155	66,81
	3.1.2	106	60,92
	3.1.3	95	54,60
X SMAS INSAN MADANI	3.1.1	167	74,55
	3.1.2	82	48,81
	3.1.3	94	55,95

Discussion

Knowledge of workplace safety procedures and laboratory tools and materials can facilitate and facilitate the learning process. Knowledge of the operation of laboratory equipment is essentially passed on to students from the beginning before starting the practicum. This is to ensure the practice and safety of work is carried out appropriately in the laboratory.

Indicators of laboratory work safety aspects

Based on the results in Table. 1, the learning indicator with the highest value is the aspect of work safety in the laboratory, while the lowest indicator is how the tool is used and its function. The average student's knowledge of occupational safety in the laboratory is 73.71% (good category). Based on the results of the interview, this happens because every learning in the teacher's practicum method reminds students of the crucial things that students need to do so that the practicum runs smoothly such as (1) using laboratory uniforms, (2) not eating and drinking during the learning process, (3) working carefully and (4) not joking while in the laboratory.

To introduce occupational safety materials in the laboratory, students are given materials in presentations using PowerPoint and learning videos. Students are introduced to all potential hazards, such as (1) unsafe actions performed in the laboratory, (2) work procedures in the laboratory, (3) personal protective equipment and, (4) emergency response procedures in the event of an accident. Learning videos teach students to use personal protective equipment, wash their hands before and after activities, laboratory standard procedures and follow instructions from practicum instructors, namely teachers.

Laboratory use of biological learning processes is required in some materials, including (1) observation of cell shape, (2) photosynthesis experiments, and (3) experiments to determine blood type. Research shows that students who are taught using laboratory methods achieve better average results than those taught using conventional methods in school (Emda, 2017)

Based on biology teacher interviews, due to lack of understanding of safety aspects, a student experiencing irritation of the skin of the hands due to alcohol exposure 96%. As a result of neglect, the student experienced hand irritation for not using gloves (hand stones). This is an example of students' lack of understanding of self-harming safety rules. The safety and security of the laboratory aim to ensure that the staff, community and environment of laboratory users can always work in a healthy, comfortable, safe, productive and prosperous condition (Rahmantiyoko et al., 2019).

Indicators of the use of tools and their functions

Based on the results in Table.1, indicators of students' knowledge of how the tool is used and its function show a low percentage of 55.36% (less category). Factors that affect the standard ability of students about how to use the tool is the lack of practicum experience due to the habit of working groups so that only a few students focus on observing. The teacher confirmed this is a deficiency due to the limitations of equipment in the laboratory, so that it cannot be sufficient for every student. Incomplete equipment and the presence of tools available but not used according to their function lead to a common understanding of the use and function of laboratory equipment (Khaerunnisa et al., 2019).

As for some mistakes made by students in explaining the function of laboratory tools such as (1) students know the name of laboratory tools but do not know their function, (2) cannot classify laboratory tools based on basic materials of production, (3) students do not understand how to use tools properly. In general, the lack of knowledge of students in the use of tools includes (1) how to hold a test tube in the heating process, (2) how to use bunsen, (3) handling microscopes.

Good student knowledge in using tools and materials in the laboratory can facilitate students in the learning process. The absence of laboratory assistants makes students know every part of the tool and how to handle it to maintain and maintain laboratory facilities. Some laboratory tools such as chemical glasses, microscopes, thermometers, Petri cups, wash bottles, skeletons, and materials such as agar, benedict, iodine, alcohol need special handling (Umar, 2017)

Knowledge of tools is an essential factor in supporting laboratory learning. Students have practical skills when knowledge of laboratory tools, including tool names, tool functions and how to use them is good (Juvitasari et al., 2018). Knowledge of the usefulness of laboratory tools

aims so that students can minimize the occurrence of errors and accidents during practicum. Errors in operating the device are one reason for the inaccurate data generated in practice (Sari, 2016).

Based on the research results on the use of laboratory equipment and its functions, high school students lack understanding or are unable to classify exactly the type of laboratory equipment and its functions. The results of this study are in line with the research (Lase, 2020), that knowledge of laboratory equipment and its functions is relatively adequate and requires improvement, as well as several factors that contribute to it (a) the amount of equipment and materials that are still lacking and some tools are damaged; (b) limited time; c) less actively involved in the preparation of tools and materials; (d) the evaluation system and practice report are rudimentary.

Indicator of hazard symbols in the laboratory

Based on the results in Table. 1, student knowledge indicators identifying symbols of safety hazards show a low percentage of 56.51% (less category). No laboratory assistant helps students know the harmful materials used so as not to negatively affect students and the environment, such as how to dispose of substances that have been used so as not to harm the environment. Keeping the environment from polluting hazardous substances is critical to laboratory safety, while toxic and dangerous gas concentrations significantly impact laboratory accidents (Zhang et al., 2020).

Chemicals are the largest source of laboratory work accidents. Students in the laboratory need an understanding of the types, properties, and handling of chemicals. Lack of knowledge about chemicals can harm students' health and the laboratory environment. Chemical accidents can occur when substances enter the body through the mouth, skin, and respiratory tract. First aid skills in accidents due to chemical contamination in the laboratory are needed in the event of chemical contamination (Lasia et al., 2017).

In general, the lack of knowledge of students in understanding hazardous materials, among others (1) classifying the type of hazardous materials, (2) how to handle hazardous materials, and (3) understanding the meaning of safety symbols. According to an interview with biology teachers, material about workplace safety in the laboratory has been explained during the classroom learning process, which is a sub-chapter of the Biology Scope material. Still, the lack of learning time in the classroom resulted in discussions about workplace safety in the laboratory not being delivered to the maximum. In addition, the absence of practicum guides is a factor in low student knowledge. Some teaching materials that can be used as guidelines in the safety of learners in the laboratory include (1) modules, (2) practicum guides, (3) magazines and, (4) e-books. Laboratory guideline magazines have a higher percentage of basic process science skills than integrated process science skills (Wei *et al*., 2020). In the magazine inserted material describing chemical warning signs including (1) symbols of health hazards, (2) irritants, (3) toxic, (4) explosive, (5) corrosive, (6) flammable, (7) oxidizing, (8) compressed gases, and (9) hazards to the environment (Al-Zyoud *et al*., 2019).

Conclusion

The results showed that respondents had low knowledge of laboratory work safety materials, especially in indicators (3.1.2) of tools used and their functions. In general, the lack of understanding of respondents about the safety of laboratory work includes (1) how to hold a test tube in the heating process, (2) how to use bunsen, (3) handling microscopes (4) classifying the types of hazardous materials, (5) how to handle hazardous materials, and (6) understanding the meaning of safety symbols. While the safety aspect of laboratory work is the indicator that respondents most easily understand.

Declaration statement

The authors reported no potential conflict of interest.

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Potential of Bioactive Compounds of Arenga Vinegar as Traditional Medicine Through Reverse Docking Technique

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Keywords:
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Background: Arenga vinegar (*Arenga pinnata*) has been trusted by the indigenous people of Kampung Kuta as traditional medicine, one of which is used as a diabetes medicine. For this reason, this study aims to examine the bioactive compounds contained in Arenga vinegar, namely acetic acid, which is predicted to be scientifically proven using reverse docking techniques. **Methods:** This research is descriptive qualitative research, by interpreting the data obtained from Pubchem and PDB database & Discovery Studio, AutoDock Tools, AutoDock Vina, and USCF Chimera software. **Results:** There is a binding pose between acetic acid and the sucrase-isomaltase enzyme (3LPO), the lowest binding affinity value is -3.2 kcal/mol, and the binding site occurs hydrophobic interactions with the amino acids Trp327(A), Asp355(A), Ile392(A), Trp470(A), Phe604(A), His629(A), Trp586(A) as well as hydrogen bonding to the amino acid asp472(A). **Conclusions:** The acetic acid-binding pose binds well to the sucrase-isomaltase enzyme so that the binding affinity value appears even though the value is not too low and the binding site occurs. This can be used as proof of the indigenous people's belief of Kampung Kuta, namely the treatment of Arenga vinegar as a diabetes drug, especially as a level control blood sugar.

Potensi Senyawa Bioaktif Cuka Aren Sebagai Obat Tradisional Melalui Teknik *Reverse Docking*

Kata kunci:
Arenga Vinegar;
Bioactive Compound;
Reverse Docking;

A B S T R A K

Background: Cuka aren (*Arenga pinnata*) selama ini dipercaya oleh masyarakat adat Kampung Kuta sebagai pengobatan tradisional, salah satunya digunakan sebagai obat diabetes. Untuk itu tujuan dari penelitian ini menguji senyawa bioaktif yang terdapat pada cuka aren yaitu asam asetat yang diprediksi sebagai pembuktian secara ilmiah dengan menggunakan teknik *reverse docking*. **Metode:** Penelitian ini merupakan penelitian kualitatif deskriptif, dengan menginterpretasikan data yang diperoleh dari *database* dan *software*. **Hasil:** Terjadi *pose* pengikatan antara asam asetat dengan enzim *sucrase-isomaltase,* nilai afinitas pengikatan paling rendah yakni sebesar -3,2 kcal/mol, dan *site* pengikatan terjadi interaksi hidrofobik pada asam amino Trp327(A), Asp355(A), Ile392(A), Trp470(A), Phe604(A), His629(A), Trp586(A) serta terjadi ikatan hidrogen pada asam amino Asp472(A). **Kesimpulan:** *Pose* pengikatan asam asetat mengikat dengan baik terhadap enzim *sucrase-isomaltase,* sehingga muncul nilai afinitas pengikatannya meskipun nilainya tidak terlalu rendah dan terjadi *site* pengikatan. Hal tersebut dapat dijadikan sebagai pembuktian kepercayaan masyarakat adat Kampung Kuta yakni pengobatan cuka aren sebagai obat diabetes khususnya sebagai pengontrol kadar gula darah.

Introduction

Arecaceae family plants are widely used by the people of Kampung Adat Kuta, Tambak Sari Subdistrict, Karangpaninggal Village, Ciamis Regency as traditional medicine. The people of Kampung Adat Kuta use palm vinegar fermented nira water (*Arenga pinnata*) to treat fever, aches, liver, diabetes, stomach acid and external wounds. Scientific proof is needed by testing the bioactive compounds contained in the palm vinegar.

Current technological advances led to the initial procedure of testing bioactive compounds contained in palm vinegar, and it is necessary to predict in advance to see the compound's performance by modelling chemical structures through an in silico approach. (Hairunnisa, 2019). This aims that wet experiment testing (pre-clinical) in the next stage, namely with in vitro and in vivo approaches in practice, will be more targeted and avoid trial and error. It will shorten the clinical testing time in the next stage. The technique used in this in silico approach is reverse docking which is a technique to analyse the potential of a compound against the target protein in the human body. (Zheng et al., 2011).

The docking program will predict the binding between small molecules and target complex proteins to find the best binding by ranking by specific assessments. (Park & Cho, 2017). This assessment can be reviewed from the binding pose, binding site, and binding affinity (Pangastuti et al., 2016). Most drug receptors are proteins. Receptors are a special class of proteins that bind to specific ligand molecules; when ligands bind to their receptors, they can change conformation, transmitting signals into the cell. (Casem, 2016).

Related to this, researchers conducted a library study on the content of bioactive compounds in palm vinegar (Arenga pinatta). However, unfortunately, there have been no studies that identify the content of palm vinegar, but there is research on determining the quality of palm vinegar that some mineral contaminants can be considered as bioactive compounds such as Cu and Zn, and in palm vinegar there are compounds NaCl, glucose, fructose and its main component is acetic acid resulting from the fermentation stage of simple sugars into alcohol, furthermore, alcohol is fermented into high-grade acetic acid, with a concentration value of 7.20%. (Baharuddin et al., 2009). As a comparison that, acetic acid is also the main compound of apple cider vinegar with a concentration of 3-9%. (Beheshti et al., 2012). Acetic acid, better known as vinegar acid (CH3COOH), is a liquid-shaped compound, colourless, pungent-smelling, has a sharp sour taste, and dissolves in water, alcohol, glycerol, etc ether. (Hardoyo et al., 2017).

Therefore, researchers tried to predict acetic acid compounds to visualise their binding to receptor proteins associated with diseases believed by the indigenous kuta community, through reverse docking techniques, by reviewing binding poses, binding affinities and binding sites. Acetic acid, can inhibit the activity of disaccharide enzymes namely sucrase, maltase, trehalase and lactase (Toonen et al., 2012). Based on the results of searches in PDB with the keyword enzyme, a protein derived from the enzyme disaccharide sucrase-isomaltase was obtained with GDP ID 3LPO.

Methods

Descriptive qualitative research was conducted to prove the bioactive compounds of palm vinegar, acetic acid. The study results will be associated with the belief of Kampung Adat Kuta that palm vinegar can be used to control blood sugar levels by interpreting data obtained from databases and software.

The reverse docking stage is by predicting the target protein. Molecular docking, downloading and preparing ligands in acetic acid using the PubChem database, Discovery Studio software, and AutoDock Tools. Download and preparation of sucrase-isomaltase receptor proteins using GDP databases, Discovery Studio software and AutoDock Tools.

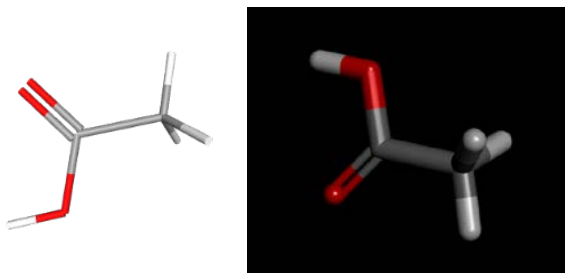
Molecular tethering uses AutoDock Tools software, AutoDock Vina, and visualises interactions between acetic acid compounds with sucrase-isomaltase target proteins using USCF Chimera software and Discovery studio. Using the Miles and Huberman model, data analysis techniques include data reduction, data presentation, and conclusion withdrawal and verification. (Sugiyono, 2016).

Results

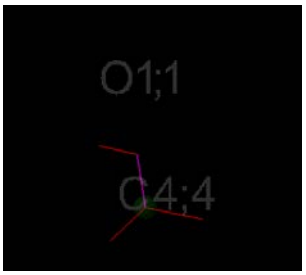
This study determined target proteins with a literature study of previous experimental studies on diseases related to fever, aches, liver, diabetes, stomach acid, and external wounds. Acetic acid compounds cannot be predicted in webserver http://www.pharmaexpert.ru/passonline/ because they have only two carbon atoms. The literature study results obtained acetic acid compounds that can be tethered to disaccharide enzymes in the human small intestine, controlling blood levels for people with diabetes.

Download and Preparation of Acetic Acid Ligand

Downloading ligand files in the form of acetic acid can be done on the PubChem website and can be accessed on the https://pubchem.ncbi.nlm.nih.gov/ page. The search process is done by writing the name acetic acid, then downloaded in 3D conformer with Sybil Data Files format (*.sdf) and then stored in a particular folder for molecular docking purposes. After that, ligand is predicted using Discovery Studio software and AutoDock Tools.



(a) (b)

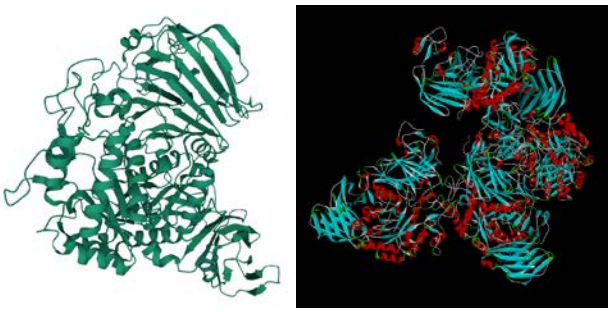


(c)

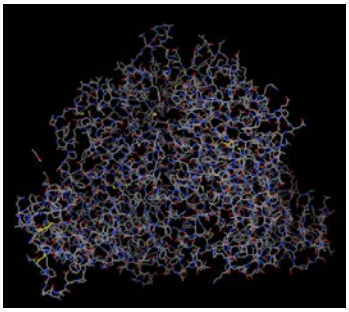
Figure 1. (a) 3D structure of natural compounds acetic acid (PubChem, 2021) (b) Ligand acetic acid preparation using discovery studio software (C) Ligand acetic acid preparation using AutoDock Tools software

Download and Preparation of Sucrace-Isomaltase Receptor Proteins

Downloading of receptor protein files or target macromolecules can be done at the Protein Data Bank site which is a repository of biological structures, and can be accessed on the https://www.rcsb.org/ page by looking for receptor files in the form of disaccharide enzyme derivatives, while the search results found are sucrase-isomaltase with codes named 3LPP and 3LPO.



(a) (b)



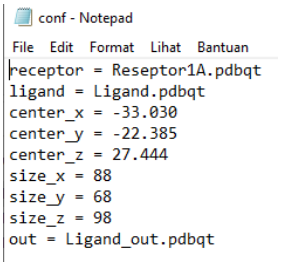
(c)

Figure 2. (a) Sucrase-isomaltase receptor protein (3LPO) (PDB, 2021) (b) 3LPO receptor protein prepared using Discovery studio software (C) Protein receptor 3LPO resulting from separation of preparation chain using AutoDock Tools software

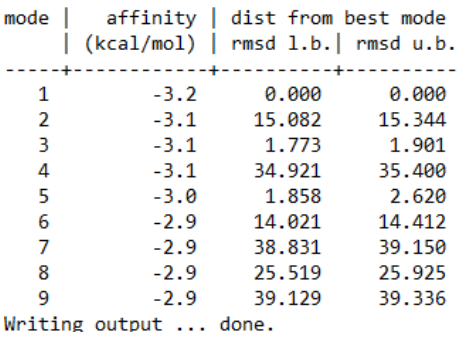
The protein used in the study was a sucrase-isomaltase receptor protein (3LPO) that has a chain of 4, A B C D, and there is only one congenital ligand in the form 2-acetamido-2-deoxy-beta-D-glucopyranose and no other residues. Therefore, protein (3LPO) is cleaner in structure than protein (3LPP), facilitating researchers in preparation. After that, the receptor protein (3LPO) is interpreted using Discovery Studio software and AutoDock Tools.

Molecular Tethering

Before molecular tethering, the grid box is done using AutoDock Tools software. Gridbox creation data is used to call AutoDock Vina applications using Command Prompt so that the tethering process can occur. The results of creating a grid box are written on a notepad file, as in Figure 3.



(a)



mode	affinity (kcal/mol)	dist from best mode rmsd l.b.	rmsd u.b.
1	-3.2	0.000	0.000
2	-3.1	15.082	15.344
3	-3.1	1.773	1.901
4	-3.1	34.921	35.400
5	-3.0	1.858	2.620
6	-2.9	14.021	14.412
7	-2.9	38.831	39.150
8	-2.9	25.519	25.925
9	-2.9	39.129	39.336

Writing output ... done.

(b)

Figure 3. (a) Notepad file resulting from the creation of grid box (b) molecular tethering results in the form of affinity binding values

Visualisation of Interactions Between Acetic Acid Compounds And Target Proteins Sucrase-Isomaltase (3LPO) Chain A

After tethering using Autodock Vina, file Ligand_out.pdbqt image 3(a) will appear, can be opened in the Discovery studio software. Ligands with the lowest binding affinity of -3.2 kcal/mol are copied and stored in the receptor folder. The result stored as a receptor visualises it in 3D and 2D using UCSF Chimera and Discovery Studio software (figure 4).

The results of 2D visualisation using discovery studio software that the results of molecular docking visualisation occurred hydrophobic interactions in amino acids Trp327(A), Asp355(A), Ile392(A), Trp470(A), Phe604(A), His629(A), Trp586(A) and hydrogen bonding in amino acids Asp472(A).

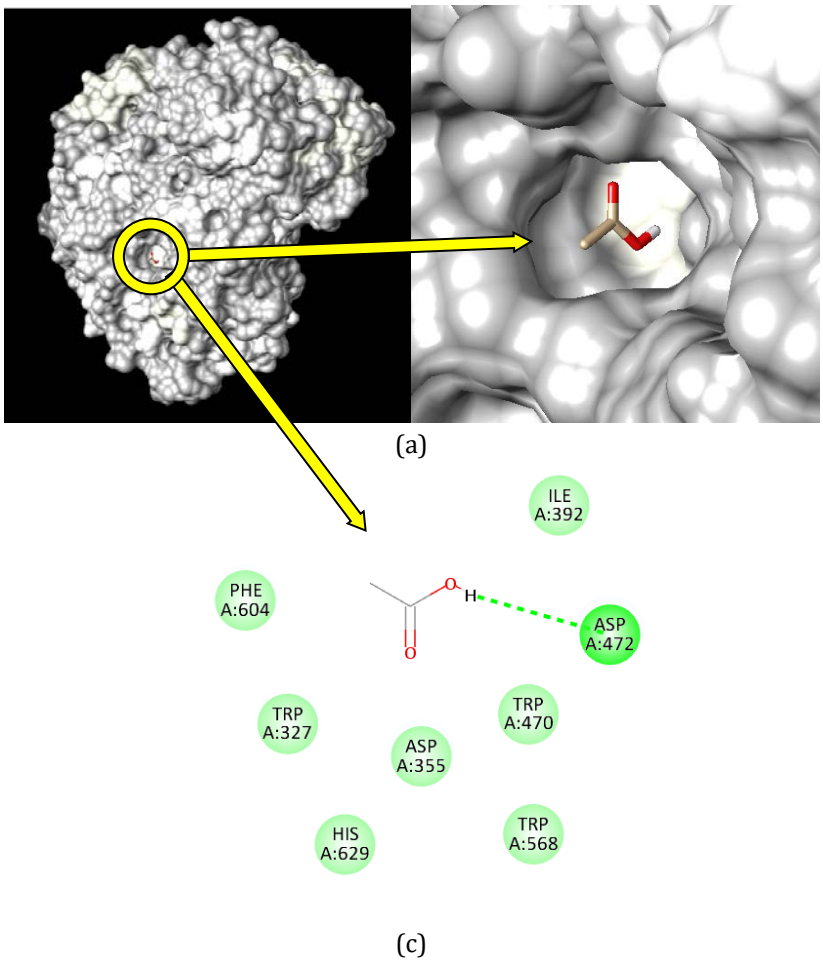


Figure 4. (a) Site binding interaction between acetic acid and chain sucrase-isomaltase enzyme A using UCSF Chimera Software software (b) 2D visualisation of acetic acid with chain sucrase-isomaltase enzyme using Discovery Studio software

Discussion

Reverse docking focuses on the ability of one or more compounds to bind to multiple evaluated proteins in silico, which is done by molecular docking techniques, which are helpful computational methods for identifying potential interactions between molecules and their pharmacological targets. It is helpful to identify molecular targets of bioactive compounds to be predicted, so it will propose new molecular mechanisms, find alternative indications of drugs, or predict drug toxicity. (Domling, & Velasco-Velazquez, 2020). In short reverse docking is a technique that becomes a tool in repositioning or finding drugs by analysing the potential of a compound against target proteins in the human body. (Kharkar et al., 2014; Zheng et al., 2011).

The ligand used in this study is acetic acid which is the main bioactive compound in palm vinegar. Acetic acid or vinegar acid is a saturated fatty acid compound that does not contain a double bond with carbon atoms as much as two pieces with the molecular formula (CH3COOH). Acetic acid is the main product in the fermentation of carbohydrates by the breeding organism, the form of liquid, colourless, pungent smell, has a sharp sour taste and dissolves in water, alcohol, glycerol, and ether (Hardoyo et al., 2017; Murray et al., 2017). Ligands are molecules that bind to the site of a specific complex target protein molecule. (Kemp, 2013).

The target protein or receptor protein is a particular class of proteins that bind to specific ligand molecules. When the ligand binds to the receptor, the receptor can change conformation, transmitting signals into the cell (Casem, 2016). One type of receptor protein molecule is an enzyme that is a nonliving thing produced by living cells and makes up most of the total protein in the cell, its function as a biocatalyst which is an essential component in metabolism and biological processes (Ferdinal, 2005; Susanti & Febriana, 2017).

Disaccharide enzymes (glycosidase enzymes) as receptor proteins were used in this study. This enzyme is located in the mucous cells of the intestine, precisely in the small intestine. (Murray et al., 2017; Wahyuni, 2017). Glycosidase activity is found in four different types of glycoproteins: glucoamylase, complex sucrases, trehalases and lactases-glucosylsamidase (Wahyuni, 2017). Sucrase and maltase are two critical enzymes in the intestinal α-glucosidase group and are considered key enzymes

involved in the final step of carbohydrate digestion and glycoprotein biosynthesis. (Lee et al., 2012).

It is proven that acetic acid compounds slow stomach performance by inhibiting the activity of disaccharide enzymes in the small intestine and suppressing enteral carbohydrate absorption. (Mitrou et al., 2015). This is in line with Zubaidah & Nuril (2015) statement that acetic acid can slow down the metabolic response in the body and increase insulin sensitivity to convert glucose into muscle sugar so that the increase in glucose levels in the blood can be controlled and reinforced. Johnston & Buller (2005) opinion is that acetic acid reduces the glycemic response of foods with high glucose levels by inhibiting disaccharides in the epithelium of the small intestine. Acetic acid can inhibit the activity of disaccharide enzymes, namely sucrose, maltase, trehalase and lactase. (Ogawa et al., 2000).

Blood sugar levels are the amount of glucose in human blood circulation. Glucose is an essential carbohydrate absorbed into the bloodstream as glucose is formed through the hydrolysis of starches and disaccharides in food and is the primary metabolic fuel in humans. However, damage to pancreatic function leads to an increase in fasting blood sugar levels. High fasting blood sugar levels are affected by consuming high sugar foods (Murray et al., 2017; Rudi & Kwureh, 2017). John E. Gerich, M.D. revealed that a healthy person in a fasting state would have a blood glucose level of 70 to 105 mg/dL, and a person in a fasting state is considered diabetic if they have blood glucose levels above 126 mg/dL (Estela, 2019).

Diabetes mellitus is a chronic metabolic disease or disorder with multietiology characterised by high blood sugar levels (hyperglycemia), this disease can not be cured but can be controlled by regulating blood sugar levels (Putri et al., 2013). Poor diet is one of the causes of rising blood sugar levels in people with diabetes mellitus. Consuming carbohydrates that index high glycemic will increase the rate of absorption of blood sugar and trigger the secretion of the pancreatic hormone insulin, resulting in a spike in blood sugar levels in the body (Idris, Jafar, 2014).

Acetic acid can inhibit the performance of sucrase-isomaltase enzymes, so blood sugar levels in the body can be controlled. Based on the results of the molecular docking visualisation, it can be seen that there is a good acetic acid binding pose to the enzyme sucrase-isomaltase even though the binding affinity is not too low, which is only -3.2 kcal / mol and there is a binding site that is the interaction of hydrophobic and hydrogen bonding in the amino acid protein 3LPO tethered. This can be used as a proof of the trust of the indigenous people of Kampung Kuta, namely the treatment of palm vinegar as a control of blood sugar levels.

Conclusion

Ligands in the form of acetic acid compounds have been shown to inhibit the activity of disaccharide enzymes in the small intestine, so the epithelium of the small intestine will more slowly absorb that food juices. This will slow down the metabolic response to increasing the sensitivity of insulin in converting glucose into sugar. Testing the results of reverse docking is -3.2 kcal/mol, while the results of two-dimensional molecular docking visualise the binding site, namely hydrophobic interactions in amino acids Trp327(A), Asp355(A), Ile392(A), Trp470(A), Phe604(A), His629(A), Trp586(A) and hydrogen bonds in amino acids Asp472(A).

Declaration statement

The authors reported no potential conflict of interest.

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The Opportunity of Spent Bleaching Earth (Bentonite) and Silica Solubilizing Bacteria as Silica Source for Induction of Secondary Metabolites Production in Plants

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A B S T R A C T

Background: CPO refining, which produces solid waste in the form of spent bleaching earth (SBE) in large quantities, can pollute the environment. SBE from the type of bentonite contains large amounts of silica to be an alternative source of silica besides silica minerals. Silica plays a vital role in increasing plant resistance and bioactive plant compound products. Applying Si in plants can increase secondary metabolites such as phenolic and antifungal compounds in response to disease pathogens. However, the low solubility of silica makes silica not sufficiently available to plants. **Methods**: The use of microorganisms as silica solubilizing bacteria helps increase the solubility of silica in the soil. Bacteria dissolve silica by removing organic acids and producing indole acetic acid (AAI), which stimulates root hairs. **Results:** This review presents the results of a study on the utilization of silica-rich SBE waste as a source of available silica to plants**. Conclusions**: With the help of silica solubilizing bacteria, plant growth and resistance increase plant secondary metabolite compounds.

Kata kunci:
Bakteri pelarut silika;
Metabolit sekunder;
Mineral silika;
Silika;

Peluang Sampah Bleaching Earth (Bentonite) dan Bakteri Pelarut Silika Sebagai Sumber Silika untuk Induksi Produksi Metabolit Sekunder Pada Tanaman

A B S T R A K

Background: Penyulingan CPO yang menghasilkan limbah padat berupa spent bleacing earth (SBE) dalam jumlah yang banyak dapat mencemari lingkungan. SBE dari jenis bentonit mengandung silika dalam jumlah yang banyak, sehingga dapat menjadi sumber silika alternatif selain mineral silika. Silika berperan cukup penting dalam meningkatkan ketahanan tanaman dan produk senyawa bioaktif tanaman. Aplikasi Si pada tanaman dapat meningkatkan metabolit sekunder seperti senyawa fenolik dan anti jamur sebagai respon terhadap patogen penyakit. Namun, karena kelarutan silika yang rendah membuat silika tidak cukup tersedia bagi tanaman. **Metode:** Penggunaan mikroorganisme sebagai bakteri pelarut silika membantu meningkatkan kelarutan silika di dalam tanah. Bakteri melarutkan silika dengan mengeluarkan asam organik dan memproduksi asam indol asetat (AAI) yang dapat merangsang rambut-rambut akar. **Hasil:** Review ini menyajikan hasil studi tentang pemanfaatan limbah SBE yang kaya silika sebagai sumber silika tersedia bagi tanaman. **Kesimpulan**: dengan bantuan bakteri pelarut silika guna meningkatkan pertumbuhan dan ketahanan tanaman, serta meningkatkan senyawa metabolit sekunder tanaman.
***Kata kunci**: Silika; Bakteri pelarut silika; Metabolit sekunder; Mineral silika*

Introduction

One of the essential nutrients for plants is silica (Si), known as the beneficial element for rice plants (Epstein, 1999). Si's function in plants is to aid cell walls, prevent pests and pathogens, reduce water loss by evapotranspiration, and reduce heavy metals' toxicity and elements essential for normal development in some species (Savant et al., 1999). The availability of silica in the soil is a need for plants to deal with the growth period. Silica administration can also increase phosphorus (P) availability and reduce the activity of Al, Fe, and Mn (Yukamgo & Yawono, 2007).

Lack of nutrients Si can reduce the optimum productivity of plants because silica has an essential role in increasing plant resistance. The beneficial effects of the si are usually clearly indicated when the plant is under stress.

Silica in nature is very abundant sourced from the minerals quartz, feldspar, and bentonite. Empty bunches of palm oil are also a reasonably abundant silica raw material (Santi, 2016). In addition, CPO waste that is spent bleaching Earth (SBE) also contains much silica to be an alternative source of silica for plants. SBE waste is available exceedingly abundantly in Indonesia because it is associated with the increasing production of palm oil. This will trigger a buildup of SBE waste if it is not utilized optimally and can be bad for the environment.

Its availability for plants does not follow the abundance of silica sources in the soil. This is because silica is contained in the soil in elements that plants cannot absorb. The availability of nutrients for plants is influenced by the soil's ability to supply nutrients and the ability of plants to absorb the nutrients available. The addition of silica solvent microorganisms contributes to aiding the solubility of silica in the soil so that plants can absorb silica. Many microorganisms can release silica bonds from silica minerals, including Burkholderia, Bacillus, Pseudomonas, and Penicillium. Bacteria can dissolve silica by producing organic acids that stimulate plant growth and secondary metabolism (Santi, 2016; Vasanthi et al., 2018; Kang et al., 2017).

Based on the description that underlies the need for a literature review of the use of SBE as a potential silica source through the application of silica solvent bacteria to meet the needs of plant silica to increase plant growth and resistance and increase secondary metabolite compounds in plants.

Methods

The method used in this narrative review is reviewing scientific articles published in national and international journals. Used as many as 38 scientific articles for the source of narrative review writing literature with the title Bleaching Earth Waste Opportunity (Bentonite) as a Source of Silica in the Induction of Secondary Metabolites of Plants. Details of the use of scientific articles consist of 3 articles in review manuscripts, 34 scientific articles (research articles), and one book. The theme is raised from proposals that have been considered worthy of research. Citation writing using reference management software such as Mendeley with report following APA rules

Results

Silica and Plant Metabolism

Silica (Si) is a building element for plants that are a beneficial element i.e. increasing plant resistance to pest and disease attacks, repairing abiotic acid, and increasing plant growth (Marschner, 1995). Silica can increase plant resistance to disease and pest attacks, particularly in the graminae family. Specifically, silica can affect epidermal cells, thicken cell walls, and reduce transpiration so pest infestations and disease infections will decrease (Gardner &Barber, 1981). Silica is absorbed by plants in monosilicate acid (H4SiO4) (Jones & Handreck, 1967). In soil, the element Si is primarily present as SiO2, about 50-70% of the mass of the soil, and in various forms of aluminosilicate (Sommer et al., 2006). Although si is abundant in the soil, most of these elements are not available to plants due to the low solubility of the si compounds in the soil (Peera et al., 2016).

Silica plays a role in plant tolerance to abiotic stress by increasing the activity of enzymes and antioxidant compounds and helping to increase the efficiency of osmoregulatory by affecting water content levels, decreasing water loss due to transpiration, regulating nutrient adequacy, and limiting the absorption of toxic ions (Sacała, 2009). Silica also plays a role in lowering the rate of pest and disease attacks through two mechanisms: mechanical and physiological barriers in increasing resistance to pests and diseases (Abed-Ashtiani et al., 2012). Silica layers with a thickness of 2.5 μm under the cuticle produce a double layer of cuticle silica that can inhibit or delay pest penetration (Rodrigues &Datnoff, 2005). Silica fertilization is vital in rice cultivation because the silica content available in the soil continues to decrease. Silica can affect the concentration of plant defence metabolites and increased activity of defence enzymes such as chitinase, β-1,3-glucanase, phenylalanine ammonia-lyase, and polyphenol oxidase) that function in fighting biotrophic and hemibiotrophic pathogens) (Rémus et al., 2005).

Correlation of Silica Availability and Increase in Secondary Metabolite Compounds

Silica is one of the essential nutrients for plants in the tropics that plants in the form of Si absorb (OH)4 (Sahebi et al., 2015). Metabolic changes in plants are triggered by biochemical responses that occur (Bhat et al., 2019).

Silica is polymerized within epidermal cells, strengthening plant cell membranes, maintaining water potential, and preventing electrolyte leakage (Agarie et al. 1998). Si application in some plants may stimulate the accumulation of phenolic and fungi toxic compounds in roses (Shetty R, 2011), fungi toxic compounds in cucumbers (Fawe et al., 1998), and antifungal compounds in potato plants (Li et al., 2009), in response to starchy dew pathogens. The binding of silicate acid to phenolic components and cell wall carbohydrates supports the formation of various phenol-carbohydrate complexes.

Si application can increase si deposits and decrease the content of ferulic acid and p-kumari acid in rice (Goto et al., 2003). Si's application in plants allows plants to produce secondary metabolites optimally. Secondary metabolite compounds in plants and practical inhibiting disease attacks in plants also have other functions such as

antioxidants and anticancer found in certain plants. Alternative silica fertilizers for plants can be used from SBE waste.

Spent Bleaching Earth (SBE) Bentonite as a Source of Natural Silica

Bentonite is a substance that resembles montmorillonite crystals, and its structure has a dioctahedral shape; trivalent cations occupy two-thirds of octahedral. Bentonite is named in Spent Bleaching Earth or is commonly used as a built-in colour absorbent in CPO. It is estimated that more than 60 million tons of SBE are used worldwide (Kheang et al., 2006). Spent Bleaching earth (SBE) consists of several types, including bentonite, lynit, and activated charcoal (Ashari et al., 2017). Bentonite is one type of clay derived from weathering and hydrothermal reactions. Its availability is relatively abundant in Indonesia and spread in several regions, such as Java, Sumatra, Kalimantan, and Sulawesi. Bentonite also contains montmorilonite (Nugrahani & Ismiyati, 2014). Montmorillonite is a group of clay minerals that form microscopic crystals. The water content of montmorillonite varies so that when it purifies, the water will expand to several times the initial volume.

The use of SBE that continues to increase affects the accumulation of SBE waste, so there needs to be sBE waste treatment. One of them is an alternative as a source of silica fertilizer. SBE made from bentonite clay contains many elements SiO2 and Al2O3; this element also affects the process of palm oil.

Silica is the most considerable elemental content in bentonite; the structure of montmorillonite sheets is arranged by two layers of 2-tetrahedral containing silica and one octahedral layer containing alumina (Loveland, 1999). This silica element can later be used in fertilization in the soil, but because of the strong bonding of the element in bentonite, the breakdown of the structure needs to be done. This source of silica in bentonite can be an alternative to silica for plants. One way is to use silica solvent bacteria to release elemental bonds in bentonite, thus allowing the bonding of elements in bentonite regardless of the si element.

Positive Correlation of Silica Solvent Bacteria and Plant Growth Activity

Although silica is the second most nutrient in the earth's crust and soil, it does not make it an essential nutrient for high-level plants (Epstein, 1999). This is because some of the silica in the soil is not available to plants. After all, Si's solubility in the soil is relatively low (Santi & Goenadi, 2017). In addition, the decline of Si in the soil can occur in intensive cultivation practices and continuous sustainable monoculture cultivation. As a result, these lands generally have low available Si (Meena et al., 2014). To increase silica solubility in the soil, silica solvent bacteria play an essential role in dissolving silica into being available. Silica solvent bacteria are also recommended as biological fertilizers to dissolve silica (Vasanthi et al. 2018). Some of the microbes studied were able to dissolve silica from natural minerals, namely *Bacillus cladolytycus*, *B. mucilaginosus, Pseudomonas sp, Penicillium sp* (Santi, 2016), *Bacillus flexus, B. megaterium, Pseudomonas fluorescens* (Vasanthi et al., 2018), and *Burkholderia eburnean* (Kang et al., 2017).

Silica solvent bacteria are used as bio-fertilizers and have been shown to promote growth, suppress pest and disease attacks, and increase crop yields. Research shows that silica can increase the persistence of biological agents to survive in the environment and effectively prevent pest attacks and diseases that occur in peatlands (Simamora et al., 2013). After inoculation in rice plants, Bacillus species isolated from soil containing granite granules can increase biomass and grain yields (Meena et al., 2014). The inoculation of silica solvent bacteria in some natural silicates not only dissolves silica but simultaneously releases phosphorus and potassium (Meena et al., 2014). In addition, silica solvent bacteria are also confirmed to increase the solubility of elements Ca and Mg as secondary nutrients (Santi & Goenadi, 2017).

Burkholderia eburnean isolates combined with unused almond silica significantly promote rice plant growth such as bud length, root length, fresh weight of shoots, fresh weight of roots, and chlorophyll content (Kang et al., 2017). The availability of Si is increased due to the application of B. eburnean increases deposition in the leaves and surface area of the leaves, thus helping the absorption of sunlight that can improve the process of photosynthesis (Gong et al., 2005).

Silica and Silica Solvent Bacterial Formulations Linked to Metabolite Productivity Support

Inoculation of silica solvent bacteria can release silica in the soil and remove Si from silica minerals (Meena et al., 2014). It is seen that the bacteria tested can dissolve silica. Inoculation tests of silica solvent bacteria strains with silica minerals (magnesium tricyclic and feldspar) showed that *Bacillus mucilaginous* and *Pseudomonas* are the best silica solvent bacteria, characterized by the formation of clear zones around bacterial growth (Vasanthi et al., 2018). Bacteria in the soil can dissolve unavailable silica such as quartz by removing organic acids and directly dissolve potassium rocks or silica chelate ions to bring potassium and silica into solution (Santi &Goenadi, 2017).

Rhizobakteri isolates identified by Kang et al. (2017) as Burkholderia eburnean can dissolve silica and be associated with organic acid production, especially gluconic acid. Three selected strains of silica solvent bacteria from Santi and Goenadi's study (2017) produced high citric acid,

acetic acid, and oxalic acid. *Burkholderia cenocepacia* strain has a high ability to produce acetic acid, while *Aeromonas punctata* strain can produce citric acid and oxalic acid (Santi & Goenadi. 2017).

Table 1. Production of Organic Acids by Silica Solvent Bacteria

Types of Bacteria	Organic Acids	References
B. eburnean	Gluconic acid	Kang et al. (2017)
B. cenocepacia	Citric acid, acetate, oxalate	Santi dan Goenadi, (2017)
A. punctata	Citric acid, acetate, oxalate	
B. vietnamiensis	Citric acid, acetate, oxalate	
B. flexus	Malic acid, citrate, tartarate, gluconics and oxalate	Vasanthi et al. (2018)
B. mucilaginosus	Acetic acid, hydroxy propionic, phthalate, gluconic, oleic, tartaric and citric acid	

In addition to organic acid production, silica solvent bacteria also release silica by producing extracellular polysaccharides (EPS) (Liu et al., 2006) and exo-polysaccharides (Santi &Goenadi., 2017). The B. eburnean isolate has been shown to produce acetic indol acid (AAI) that stimulates root hair initiation. It increases the number and size of primary and lateral roots (Kang et al., 2017). The utilization of silica in available form (bio-silica) for crops and plantations has the potential as a mediator to increase resistance to climate change, especially in prolonged dry conditions (Santi, 2016). Plant roots absorb silica as silicate acid. Once absorbed, silica moves quickly to the point of active growth, where silica combines with organic compounds to increase the strength of the cell wall, which contributes to the growth of more substantial plant parts (Kang et al., 2017).

Conclusions

The availability of silica in nature is relatively abundant, but silica's low solubility makes silica unavailable to plants. Low solubility is an essential factor in the unavailability of silica for plants, even though plants need silica as a beneficial element for most plants, especially the Gramineae group and other cultivated plants. One potential source of silica is silica-rich Spent Bleaching Earth (SBE) and accumulates a lot as a palm oil refining waste. The application of silica solvent bacteria has been known to play an essential role in providing silica to plants through enzymatic mechanisms, namely the production of organic acids and extracellular polysaccharides. The strategic application and identification of silica dissolution play an essential role in dissolving silica in the soil, i.e. with the combination of silica solvent bacteria applied to SBE. The potential dissolution of silica from SBE waste with silica solvent bacteria needs to be studied to see specific influences on crops' growth and systemic resistance. SBE waste production is increasing, and the abundant content of Si is potential as a silica-rich fertilizer that is beneficial for plants. The utilization of various groups of silica solvent bacteria is expected to dissolve Si in SBE. SBE, which is classified as waste B3, needs further research related to the content of Si and the harmful content before being used for si production.

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Declaration statement

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Radiotherapy Treatment for Melanoma Skin Cancer Disease

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Background: Melanoma is a skin disorder caused by malignant degeneration of the pigment cells melanocytes. The disease is characterized by widespread discolouration with irregular and protruding edges. In treating cancer itself, radiotherapy technology, has been found. It is a method of treating cancer using high-energy radiation rays focused on cancerous tissue to kill or stop cancer cell division. This study aims to determine the effectiveness of radiotherapy technology as a treatment solution for melanoma skin cancer. The focuses of the study in this paper are the integumentary system and skin structure, melanoma skin cancer, the body's mechanisms for melanoma skin cancer, and radiotherapy as a treatment method. **Methods:** The research method used is a literature study narrative review from various sources, to help understand the problem more deeply and completely. **Conclusions:** Melanoma, which attacks one of the body's integumentary systems, namely the skin, has a close relationship with homeostatic dysregulation and endocrine damage. However, radiotherapy can be used to cure melanoma skin cancer by shooting X-rays, damaging the cancer cells, and reducing their spread to other parts of the organs. This method is effective because melanoma skin cancer is localized or has not spread to other organs. However, the use of radiotherapy can also have a negative impact on the body and can give unwanted side effects, so consideration is needed before using this method.

Radioterapi untuk Penanganan Penyakit Kanker Kulit Melanoma

Kata kunci:
Kanker kulit;
Melanoma;
Penanganan;
Radioterapi;

A B S T R A K

Background: Melanoma adalah kelainan kulit yang disebabkan oleh degenerasi sel pigmen melanosit ke arah keganasan. Penyakit ini ditandai dengan perubahan warna yang meluas dengan tepi yang tidak beraturan dan menonjol. Dalam penanganan kanker sendiri, sudah ditemukan teknologi radioterapi, yaitu metode pengobatan kanker dengan menggunakan sinar radiasi berenergi tinggi yang difokuskan pada jaringan kanker untuk membunuh atau menghentikan pembelahan sel kanker. Penelitian ini bertujuan untuk mengetahui efektivitas teknologi radioterapi sebagai solusi pengobatan penyakit kanker kulit melanoma. Fokus kajian dalam artikel ini adalah sistem integumen dan struktur kulit, kanker kulit melanoma, mekanisme tubuh pada kondisi kanker kulit, dan radioterapi sebagai alat penyembuhan. **Metode:** Metode penelitian yang digunakan adalah kajian literatur *narrative review* dari berbagai sumber, untuk membantu memahami materi lebih dalam dan lengkap. **Kesimpulan:** Kesimpulan yang diperoleh adalah kanker kulit melanoma memiliki hubungan yang erat dengan disregulasi homeostasis, kerusakan endokrin, dan penyebaran saraf. Namun, radioterapi dapat digunakan untuk menyembuhkan kanker kulit melanoma dengan menembakkan sinar X yang merusak sel-sel kanker dan mengurangi penyebarannya ke bagian organ lainnya. Metode ini efektif karena kanker kulit melanoma bersifat terlokalisasi atau belum menyebar ke organ lain. Namun, penggunaan radioterapi juga dapat berdampak negatif pada tubuh dan memberikan efek samping yang tidak diinginkan.

Introduction

Cancer is the disease with the number two most patient deaths in Indonesia. One of the most common types of skin cancer is melanoma. In Indonesia, melanoma skin cancer ranks third after uterine cancer and breast cancer. Melanoma is a skin disorder that stems from the degeneration of melanocyte pigment cells toward malignancy. This disease is characterized by a discolouration that widens with irregular and prominent edges (Muhartono & Handriko, 2017). Melanoma is more common in white people because their melanin defenses are not as good as people whose skin is darker and can also occur in residents in places exposed to a lot of sunlight, one of which is Indonesia (Istighfaricha, n. d.). This is what makes the treatment of melanoma skin cancer need to be removed in the article.

The rapid development of technology greatly affects various areas of human life, one of which is in the field of health. In the treatment of cancer itself, radiotherapy technology has been found to be quite capable of handling various types of cancer, including melanoma skin cancer. Radiotherapy is a cancer treatment using high-energy radiation beams focused on cancerous tissue to kill or stop cancer cell division and is also called radiation therapy (Nurhayanti & Lusiyanti, 2006). According to Fitriatuzzakiyyah, Sinuraya, and Puspitasari (2017), out of the 10.9 million people diagnosed with cancer worldwide each year, at least 50% require radiotherapy and 60% of whom are curatively treated. For melanoma itself, it is said that radiotherapy is very effective for treating this type of cancer with only a 5% chance of reappearance and a 1.4% chance of developing melanoma.

This study aims to find out the effectiveness of radiotherapy technology as a solution to the treatment of cancer, especially melanoma skin cancer.

Method

The research method used is a narrative review literature review, which is a study that aims to identify and conclude what has been published previously, avoid duplication, and look for areas of study that have not been observed (Ferrari, 2015). This article will discuss four focus studies: 1) the integument system and skin structure, 2) melanoma skin cancer, 3) body mechanisms in skin cancer conditions, and 4) radiotherapy technology.

Integument system and skin structure

An integument system is an organ system that distinguishes, separates, protects, and informs animals of their environment. The integumental system in humans consists of skin, nails, hair, sweat glands, oil glands and mammary glands (Andriyani et al., 2015). The integument system protects the internal and external structures of the body from damage (Risnawati, 2019). The skin is one part of the integumental system in humans and is one of the largest organs of the entire body with many functions. The skin is a sensory organ that has receptors against heat, cold, touch pain and pressure (Bolon et al., 2020).

The layer of skin and its complementary parts are divided into 3 layers, namely the dermis, hypodermis, and epidermis. The epidermis is the outermost layer of the skin, in a layered epithelium, with several layers visible. There are eccrine and apocrine sweat glands, hair, sebaceous glands, and nails in the epidermis. The outermost part of the epidermis is formed from horns in the corneum layer formed by old skin cells, while the lower part of the epidermis is called the basal layer, where there are cells that will continue to divide to form new skin cells and will continue to rise to the surface, and melanin is also found in this part (Wibowo, 2015). The big picture of the dermis is the fibres that bind together. Most are made up of collagen and the rest consists of elastin fibres with the main cellular elements in the form of fibroblasts, mast cells, and macrophages also contain many blood vessels, lymph, nerves, and sensory receptors (Brown & Burns, 2005).

The structure of the skin will support the implementation of the function of the skin. The skin has many functions including (1) covering and protecting the organs underneath, (2) protecting the body from the entry of microorganisms, (3) temperature regulation, (4) excretion, (5) synthesis, and (6) fat hoarders (Andriyani et al., 2015).

An example of one of the skin functions, namely excretion, is the expenditure of sweat. Sweat released on some parts of the body has a special odor and each is produced by the apocrine gland or odiferus (Andriyani et al., 2015). The skin also protects the human body from the UV rays emitted by the sun with melanin. In human skin, there are melanocytes which are large dendrite cells derived from krista neuralis that play a role in producing melanin pigment. The main stimulus for melanin formation is ultraviolet (UV) radiation. Melanin protects the cell nucleus in the epidermis against radiation (UV) (Brown &burns, 2005).

Melanoma Skin Cancer

Cancer in general can be defined as a disease caused by abnormal cells of body tissues. Cancer cells divide and develop uncontrollably (Cancerhelps, 2014). In line with this, Prastiwi (2012) quoted in the encyclopedia (1990: 121) that cancer is the cells of body tissues that become malignant because cells divide rapidly and uncontrollably and form similar cells, but in primitive form or form become imperfect. Uripi (2002) explained that from various research results, the onset of cancer is mostly due to unhealthy lifestyles such as unbalanced eating habits, smoking, drinking alcoholic beverages, excessive contact with the sun, and frequent sex partners.

Cancer is a disease that consists of various types, one of which is skin cancer. According to Septian et al. (2016), skin cancer is an abnormal skin cell growth that cannot be controlled. Similarly, Wilvestra et al. (2018) explained that skin cancer is a lump or excessive growth of skin tissue that hits part or all of the skin layer, which has an irregular structure with cell differentiation in various levels in chromatin, nucleus and cytoplasm, is expansive, infiltrative to damage the surrounding tissues, and metastasize through blood vessels and or lymph vessels.

Skin cancer has 3 main types, namely carsinomal basal cells, squamous cell carcinoma and malignant melanoma (Hendaria et al., 2006). While according to Ardhiansia (2019), skin cancer is divided into 2, namely:

1. Malignant melanoma (MM). Malignant melanoma is separated from other skin cancers because it has different behaviors.
2. Non melanoma, which can be divided into 3, namely:
   a) Basall cell carcinoma (BCC), has the greatest incidence of the non-melanoma skin cancer group by 75%.
   b) Squamous cell carcinoma (SCC)/epidermoid carcinoma.
   c) Skin adnexal tumor (SAT).

Tan and Dewi (2015) explained that malignant melanoma (MM) is a skin malignancy that comes from melanocyte cells. These cells are able to form melanin so that in general MM is brown or black. There are 95 cases found on the skin, but there are several cases of malinoma found in the organs of the eyes, ears, mouth, gastrointestinal tract of the genital mucosa and leptomeningen (Hanum & Supriana, 2019).

Mechanisms of the Body in the Condition of Melanoma Skin Cancer

Melanoma is a skin cancer characterized by discoloration or pigmentation of the skin accompanied by bleeding, hardening, and hives (Hanum & Supriana, 2015). The characteristics of melanoma are also characterized by the criteria of asymmetric lesions, iregular edges, then colors such as patterned, brownish, black, gray and white, with a diameter of more than 6 mm, changes in size, shape, and surface, which are getting bigger and hardened.

According to Ramda (2014), melanin in the body actually gives color to the skin or for pigmentation, but the occurrence of skin cancer or melanoma is caused by too much exposure to UV rays from the sun so that it can damage melanocyte cells. Damage to these cells can have an impact spread to other parts of the body. This cancer is also a type of superficial spreading that can attack the outer layer of skin (epidermis) and can enter the deeper layer again in some time (months or years).

Skin cancers, particularly melanoma, occur related to dysfunction of homeostasis and endocrine systems in the body. Homeostasis is a process that occurs continuously to maintain stability within the limits of tolerance of cell physiology, not in static conditions (Irawati, 2020). Physiologically, homeostasis determines a cell's attitude toward a condition, such as time for silence, dividing, differentiation, or apoptosis or cell death. This dysregulation will cause a breakdown of the balance of the melanin unit that triggers continuous cell division of melanocytes that will lead to the development of melanoma.

Melanoma skin cancer occurs vulnerable at an advanced age or old age. When a person has entered old age, there begins to be a hormonal imbalance so that in a long time will make carcinogens work to cause cancer (Sudiono, 2016). According to Campbell et al. (2002), carcinogens are chemicals that can cause cancer. MSH or melanocyte stimulating hormone is a hormone that plays a role in forming pigmentation or color on the skin (Mardiati & Maulina, 2019). This hormone can increase rapidly along with the increase in the hormones progesterone and estrogen during pregnancy in a mother (Pratama et al., 2010). This means that an increase in the hormone MSH in the body can also have a major effect on excessive melasma growth, so it can cause skin cancer cells to appear. This is what includes being an internal trigger of the body in the growth of melanoma skin cancer.

Melanoma skin cancer is certainly a thing that interferes with the function and work of cells, tissues, organs and organ systems in the human body. Liokova et al. (2019) explained that skin cancer cells also have the ability to metastasize, especially those that can spread to other tissues, such as fat, muscle, or bone tissue. Tan and Dewi (2015) explained that at level 5, the severity of the disease and its growing size certainly cause invasion or infection into the subcutaneous tissue.

Cancer usually has a stage or severity level. The "T" category is given from a scale of 1 to 4 based on how deeply melanoma tumors have grown inside the skin. Level 1, i.e. in situ melanoma involves the epidermis and there is no invasion; level 2, i.e. infiltration of the upper range of papillary dermis; level 3, i.e. melanoma cells fill and expand to the border of the papillary dermis; level 4, i.e. infiltration of the reticular epidermis, not into subcutaneous tissue; Level 5 is subcutaneous infiltration. The higher the level, the worse the patient's condition, an example of its thickness with a range of 0.6 - 1.1 mm (Massi & LeBoit, 2004). The development of melanoma in the skin can be seen in Figure 1.

At the time of the in situ level, melanoma cells are confined almost exclusively or divide the papillary dermis in the form of a single cell or small nest of melanocytes that are similar in size and number no more than 5-10 melanose

cells, then the melanocyte deposits exist along the dermal epidermis, replacing the basilar region and the spread of pagetoids (spreading upwards) that occurs at level 3 (Nickoloff et al., 2001).

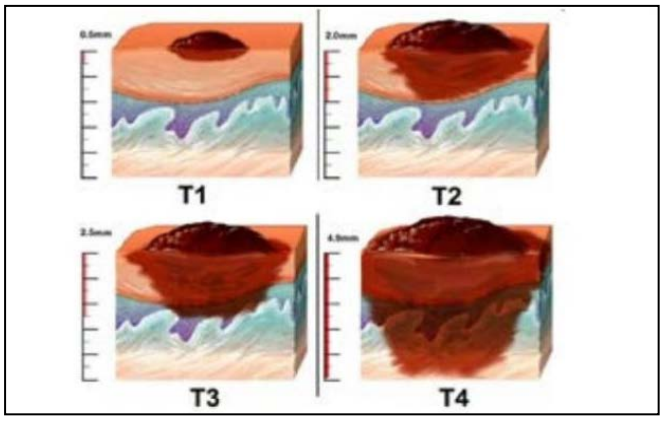

Figure 1. Development of melanoma in the skin (Shead et al., 2018). Description: T1: 0.5-1 mm, T2:2 mm, T3:2.5-4 mm, and T4: more than 4 mm.

Shead et al. (2018) also explained the same thing, namely melanoma skin cancer is divided into 5 stages. At stage 0, melanocytes exist in their natural place, i.e. in the epidermis (outer layer of skin) and have not invaded the dermis (the second layer of skin under the epidermis). In stage 1, the tumor is thinner by about 0.8 - 1.0 mm, the cell divides slowly, no ulceration is visible under the microscope, then at this stage there is no cancer inside the lymph vessels, lymph nodes, or distant organs. In stage 2, the tumour's thickness is greater than 1.0 - 2.0 mm with ulceration or non-ulceration status, but there is no cancer in lymph vessels, lymph nodes, or distant organs. In stage 3, the thickness reaches 2.0 - 4.0 mm, melanocytes have spread to nearby vessels and lymph nodes, or nearby skin. In stage 4, the tumor gets thicker above 4.0 mm, spreads to further places, spreads to the vessels and lymph nodes as well as nearby organs such as the lungs, liver, or brain. Ulceration status means telling whether the upper skin layer of the tumor is present and intact (not ulcerated) or the lining is damaged or lost (ulceration).

Radiotherapy Technology

Treatment of skin cancer can be done through surgery, radiotherapy, chemotherapy, and immunotherapy (Mulyani & Nuryani, 2013). Radiotherapy is the use of high-energy waves, such as X-rays for cancer cell-killing therapy (Rosidah et al., 2017). Radiotherapy is a curative therapy that treats local cancer, so it is difficult to use for cancers that have metastasized to other organs (Soekin et al., 2017). Radiotherapy can be given before and after other treatment methods, or it can also be done in conjunction with chemotherapy (Fitriatuzzakiyyah et al., 2017).

Radiotherapy aims to kill the tumor as close and as much as possible while still protecting and minimizing exposure to normal tissue (Baskar et al., 2012). Radiotherapy uses ionizing radiation that forms ions and stores energy to the tissue cells that pass through it. This energy store will kill cancer cells and alter the genetics that will result in cancer cell death (Fitriatuzzakiyyah et al., 2017).

According to Fitriatuzzakiyyah et al. (2017), there are 5 ways radiotherapy induces cell death, namely by apoptosis, autophagy, necrosis, senescence, and mitosis death. Apoptosis is a form of programmed cell death that occurs when there is cell shrinkage and chromatin fragmentation. Autophagy is when a cell digests its part of the cytoplasm. Necrosis is the uncontrolled death of cells due to environmental conditions, such as extreme pH changes, infection, or loss of energy. Senescence is a state that a cell can't permanently divide anymore. Mitosis death occurs when cells undergo an abnormal process of mitosis because DNA damage occurs after the radiation process. The death of mitosis is often experienced by cancer cells after irradiation. The rate of tumour response depends on the level of proliferation or ability to divide it, the conditions of the surrounding microenvironment, and interaction with extracellular matter so it can be said that cancer cells do not have uniform sensitivity (Setyawan & Djakaria, 2013).

According to Baskar et al. (2012), the biological target of radiotherapy is DNA from cells. Radiotherapy can work directly or indirectly. Radiation can interact directly with a cell's DNA resulting in cell damage. Radiation can also indirectly affect DNA damage by producing free radicals from ionization or obstruction of water components in the cell. The effect is DNA damage in both chain or in one of the pills. DNA that only damages one of its pills is enough to kill a cell and disrupt its genome, but the DNA of the two damaged will be more effective and kill the cell more because it is more difficult to repair (Baskar et al., 2012).

Although radiotherapy can be a safe therapy to cure cancer, like all treatments in general, radiotherapy also has side effects on the body, especially in normal cells or tissues exposed to radiation when directed to cancer cells. According to Setyawan and Djakaria (2013), radiation beams from radiotherapy can affect the performance of several organ systems.

The first organ system affected is the circulatory system, especially in the blood that flows throughout the body. Blood cells exposed to radiation rays decrease in number due to damage to hematopoetic stem cells and progentior cells that are very sensitive to radiation. Radiation rays from radiotherapy can also have an impact on the skin. The skin can experience hyperpigmentation or darkened skin colour after radiotherapy due to the stimulation or destruction of melanocytes. Damage to the skin is

sometimes accompanied by dysfunction of blood vessels and fibroblasts in the dermis layer.

Suppose radiation rays from radiotherapy hit the gastrointestinal or digestive organ system. There can be damage to the villi in the intestinal organs because the villi are very sensitive to radiation causing digestive malfunctions. When it hits the central nervous system, such as the brain and spinal cord, radiation rays can result in endothelial cell apoptosis that alters permeability and causes edema. Radiation rays that hit the respiratory system, especially in the lungs, can cause the release of cells from the basal membrane, the capillaries in the alveolus are severed because they are very sensitive to radiation. In addition to the description above, there are many other risks that radiation rays can pose to the performance of organ systems in the human body.

The general impact for all organ systems is that it is difficult to form mature cells that are functional or can perform their functions well in any organ system (Garau et al., 2011). All the effects of radiation on normal cells and tissues are unwanted side effects, but cannot be avoided, so it becomes a consideration before taking radiotherapy action.

Conclusion

The skin is one part of the human integument system and can not be separated from the possibility of getting diseases, such as melanoma skin cancer. Melanoma skin cancer is characterized by the presence of dark colored lumps with irregular edges. Melanoma skin cancer can occur due to exposure to UV rays that damage melanocyte cells and affect homeostasis and endocrine function. One of the efforts to reduce the propagation of cancer cells is the radiotherapy technique. Radiotherapy is an effective technology to treat melanoma skin cancer, by firing X-rays so that it can damage cancer cells and reduce its spread to other parts of the organ. However, it cannot be denied that the use of radiotherapy also has a negative impact on the body and provides unwanted side effects. Therefore, before patients decide to use this technology, they must consider the effects that will be caused in the future.

Declaration statement

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Diversity of Semar Pockets (*Nepenthes sp.*) at Palangka Raya University

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A B S T R A C T

Background: This study is a pilot project on the effectiveness of flora, especially the type of semar bag (Nepenthes sp) found at the University of Palangka Raya (UPR). The research aims to identify semar bag plants at the University of Palangka Raya. The initial observations found at least more than one type of semar bag that lives in the peat forest of the UPR campus. The study was conducted in August-November 2020. **Methods:** Semar bag diversity data is collected by cruising methods. The data was analyzed using literature studies to be further identified using a sealed bag identification manual. **Results:** The study found three species of semar bags found in the forest campus of Palangka Raya University. The bag is a type of Nepenthes mirabilis (Lour.) Druce, *Nepenthes gracilis* Korth., and *Nepenthes rafflesiana* Jack. Morphological characters that distinguish these three species are the morphology of leaves and pouches. The range of environmental parameter values is air temperature 28-38oC, medium-open coverage, humidity 62-98%, and soil pH 5-7.5. **Conclusions:** This study's results are expected to be a database of flora biodiversity in Central Kalimantan.

Keanekaragaman Kantong Semar *(Nepenthes sp.)* di Universitas Palangka Raya

Kata kunci:
Osteochilus waandersii;
Pola pertumbuhan;
Sungai tambatan;
Tingkat kematangan gonad;

A B S T R A K

Background: Penelitian ini merupakan *pilot project* mengenai keanekragaman flora khususnya jenis kantong semar (*Nepenthes sp*) yang ditemukan di Universitas Palangka Raya (UPR). Penelitian bertujuan untuk mengidentifikasi tumbuhan kantong semar di Universitas Palangka Raya. Dari hasil observasi awal ditemukan setidaknya lebih dari satu jenis kantong semar yang hidup di hutan gambut kampus UPR. Penelitian ini dilakukan pada bulan Agustus-November 2020. **Metode:** Data keanekaragaman kantong semar dikumpulkan dengan metode jelajah. Data dianalisis menggunakan studi literatur untuk selanjutnya diidentifikasi menggunakan buku panduan identifikasi kantong semar. **Hasil:** Hasil penelitian ditemukan ada tiga spesies kantong semar yang terdapat di hutan kampus Universitas Palangka Raya. Kantong semar tersebut adalah jenis Nepenthes mirabilis (Lour.) Druce, Nepenthes gracilis Korth., dan Nepenthes rafflesiana Jack. Karakter morfologis yang menjadi pembeda ketiga spesies ini adalah morfologi daun dan kantong. Kisaran nilai parameter lingkungan yaitu suhu udara 28-38oC, tutupan (coverage) sedang-terbuka, kelembapan 62-98%, dan pH tanah 5-7,5. **Kesimpulan:** Dengan adanya hasil penelitian ini diharapkan menjadi basis data biodiversitas flora yang ada di Kalimantan Tengah.

Introduction

Nepenthaceae is one of the most prominent carnivorous plant families and has ecological and morphological adaptations that exhibit impressive adaptive radiation (Murphy et al., 2020), particularly in the territory of Indonesia. Borneo (Borneo, Sarawak, Sabah and Brunei) is the largest *nepenthes sp* distribution centre globally, where there are ±32 species of semar pouch species. There are 24 species on the island of Sumatra (Arimy et al., 2017) and several species in Sulawesi (9 species), Papua New Guinea (5 species), Maluku and Java (Philipps & Lamb, 1996). From the results of previous research, it is estimated that there are at least 13 types of Nepenthes sp in Central Kalimantan (Mansur, 2008).

In the forests of Kalimantan, semar pockets (Nepenthes sp) can be found in six main habitat types, including tropical rainforest lowlands, Kerangas forests, peat swamp forests, mixed peat swamp forests, mountain forests,

limestone mountains (Clarke, 1997). Most Nepenthes are vines or shrubs with little climbing, attaching themselves to adjacent vegetation using circular tendrils that develop from the ends of leaves. The majority are terrestrial species, but a small number of species grow epiphytically, mainly in mountainous habitats (Clarke, 1997).

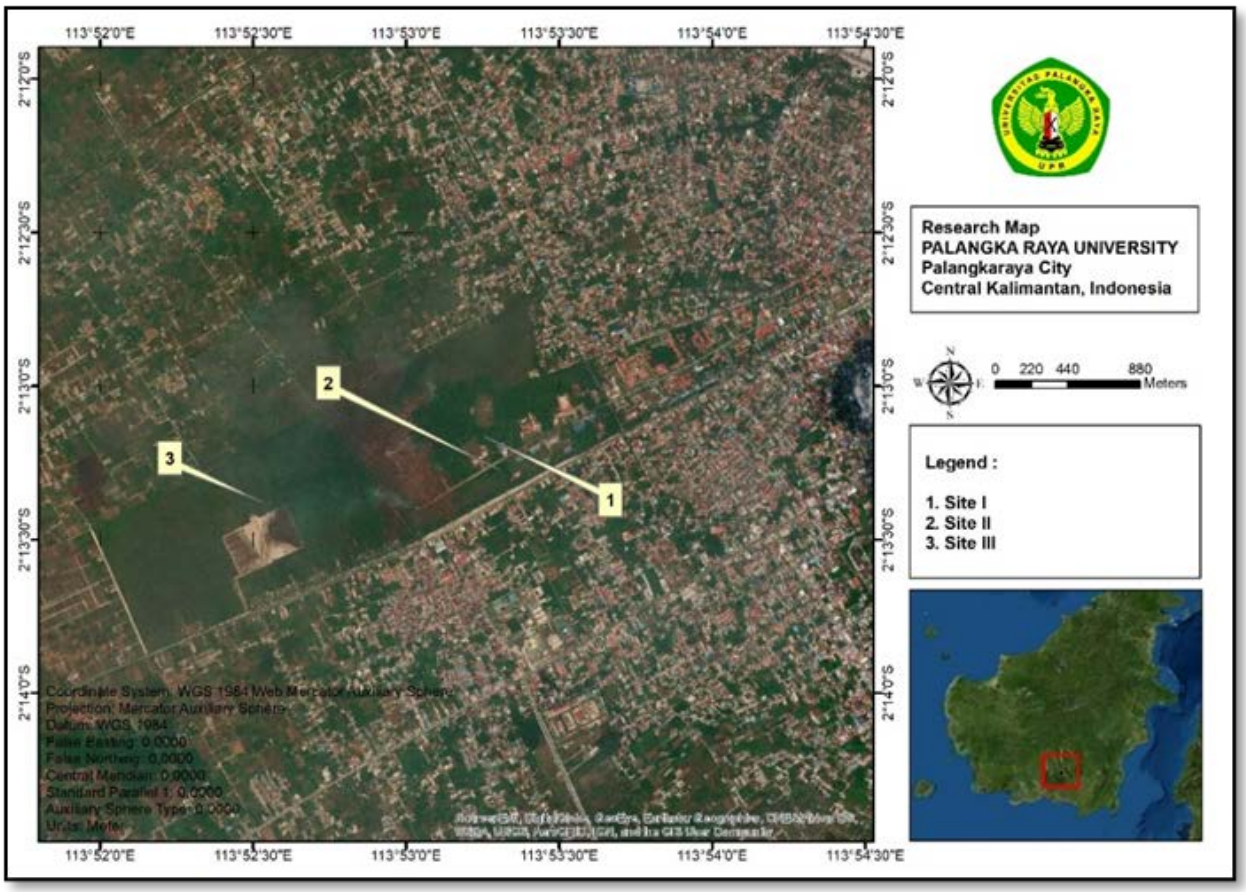

Figure 1. Map of research sites on Palangka Raya University Campus

Palangka Raya University (UPR) has peat forests that store many biological resources: a pocket of semar. However, until now, it is not known the types of pockets in UPR peat forests. The transfer of peat forest land functions into campus facilities and infrastructure development to support lecture activities in UPR and fires that often occur in the dry season will threaten the existence of semar pockets in their habitat. Therefore, studying the semar bag is necessary and then developing its conservation strategy both in-situ and ex-situ. This research aims to find out the type of pockets in the peat forests of Palangka Raya University.

Methods

The tools and materials used in the study are Thermo hygrometer, soil pH meter, camera, tally sheet, Nepenthes of Borneo identification book, Garmin eTrax 10 Global Positioning System (GPS), digital funnel term (Digital Caliper), meter and stationery. While to describe the state of habitat cover (coverage) is described qualitatively with the criteria of close, medium to open the cover. This research activity is carried out using cruising methods through previously existing trails. The location (site) of the discovery of the semar bag can be seen in Figure 1.

Data collection of morphological characteristics and environmental parameters is carried out directly on the ground. Furthermore, the semar pockets found were identified by looking at morphological characteristics possessed based on relevant literature using the nepenthes of Borneo identification book (Clarke, 2001).

Results and Discussion

There are three species of semar bags. The semar pouch is a species of *Nepenthes mirabilis* (Lour.) Druce, *Nepenthes gracilis* Korth., and *Nepenthes rafflesiana* Jack. The following is stated the key to identification based on the distinguishing character or characteristics of the three types of semar bags found in the peat swamp forest of the UPR campus.

1. a. It has a leaf stalk..... 2
   b. It has no leaf stalks, cylindrical sac shape, narrow peristome..... *N. gracillis.*
2. a. The edges of the leaves are jagged..... *N. mirabilis.*

b. The *edges* of the leaves are not jagged, the peristome is wide and the pockets are large ..... *N. rafflesiana.*

The research results conducted in the forest area of the University of Palangka Raya (UPR) campus found there are three species of semar bags. The bag is a type of *Nepenthes mirabilis* (Lour.) Druce,

Description of Nepenthes mirabilis (Lour.) Druce

Nepenthes mirabilis (Lour.) Druce. Trunk: climbing, cylindrical, flat/slippery, thick with clear space. Leaves: stemmed, lanset, <30 cm long and <10 cm wide, taper leaf tip, wavy leaf edge and sometimes hair, tendril length <17 cm, greenish-yellow red.

Figure 2. a) Top pockets and leaves of green N. mirabilis, b) Green N. mirabilis bottom pockets with peristome, lid, and wing maron, c) Lower pockets of N. mirabilis green maron with peristome, lid, and wing maron, d) Top pockets of N. mirabilis green maron with peristome, lid, and wing maron, e) Top pockets and leaves of green N. mirabilis, e) Green N. mirabilis leaves.

Nepenthes gracilis Korth., and *Nepenthes rafflesiana* Jack. As well as the results of research by Rosmaina & Zulfahmi (2004) at UIN Suska Riau Campus for the colour variation of bags from *N. gracillis,* which was found to consist of two types, namely *N. gracillis* with green bags and *N. gracillis* with Maron red bag color with batik motif, while for *N. mirabilis* with the colour of green to light green bag spots maron. At the same time, *N. rafflesiana* with green to light green bag colour and Maron batik motif with Maron red patches/batik motif. Here is the morphological description of the direct observations of the three species of semar bags found.

The lower pocket, cylindrical, narrow and tilted at 1/2 of the bottom, cylindrical or narrowed towards the base of the mouth, is dark yellowish-green, <15 cm high, <35 mm wide. The mouth of the heart-shaped peristome width <5.5 mm is green-brownish-red on the inside of the bag. The bag cap is round in the shape of a reddish-green. The shape of the *N. mirabilis* pouch at first glance looks like the *N. gracilis* pouch, which distinguishes these two types lies in the leaves and the size of the peristome. Where the leaves of *N. mirabilis* have stalks of leaves, wavy with the edges of the leaves are hairy although sometimes found hairless, while the *N. gracilis* leaves have no leaf stalks, sits hugging thicker slipperier stems. Likewise, with the size of the peristome, N.

mirabilis has a thicker peristome size ranging from 3 - 5.5 cm, while *N. gracilis* has the shape of an egg round or oval bag mouth with a peristome that is very narrow, so it is not clearly visible. The shape of the *N. mirabilis* pouch and leaves can be seen in Figure 2.

This species of semar bag is the most widespread in the world. Its habitats range from shellfish, peat forests, and grasslands. It has several natural hybrids including *N. mirabilis x N. ampullaria, N. mirabilis x N. bicalcarata, N. mirabilis x N. gracilis and N. mirabilis x N. raffelsiana, as well as the most extreme varieties of N. mirabilis* found in Sarawak and Brunei are *N. echinostoma* (Trubus, 2006).

Figure 4. a) The shape of the leaves of N. gracilis green, b) The upper pocket of N. gracilis green c) N. gracilis maron, d) The upper pocket of N. gracilis batik motif maron color, e) The bottom pocket of the maron batik motif, e) The bottom pocket of N. gracilis green spotted maron.

Figure 3. (a) Female flower and (b) *N. mirabilis* fruit

Description of Nepenthes gracilis Korth.

Nepenthes gracillis Korth. Trunk: climbing, diameter < 4 mm, triangle. Leaves: thick stiff, sitting without stalks, lanset, length < 20 cm, width < 4 cm, taper end, towards the base narrowed, tendrils length < 18 cm. Bottom pockets and rosettes: the shape of the egg round at the bottom and the top of the tube shape, <16 cm high, <30 mm wide. Peristome narrow, width 1 - 2.25 mm, peristome teeth are not clear. Lid (Bag cap) round and the base of the bag.

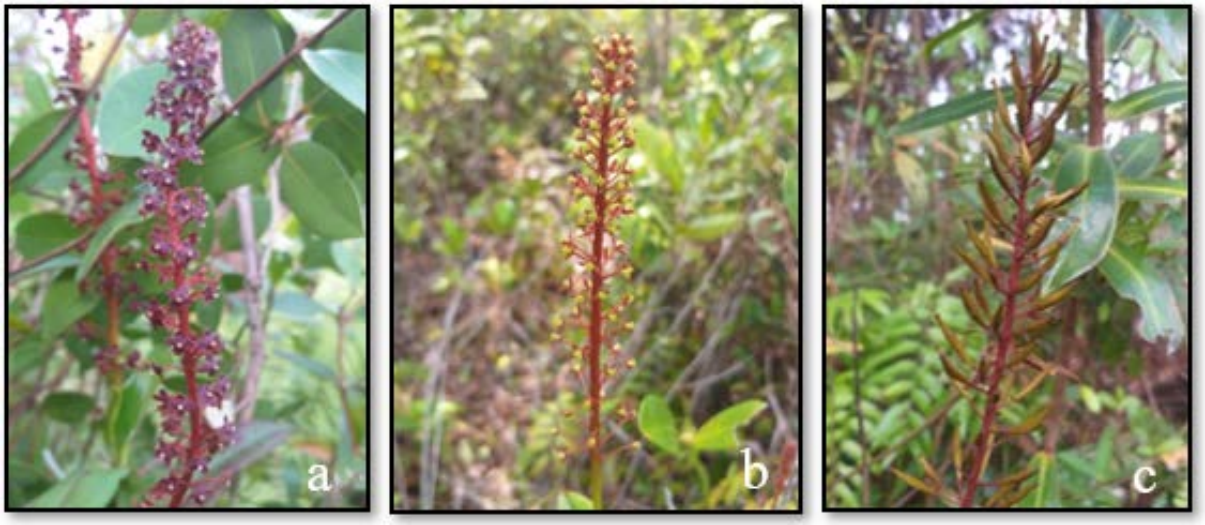

Figure 5. (a) Male flower, (b) female flower, (c) *N. gracilis* fruit

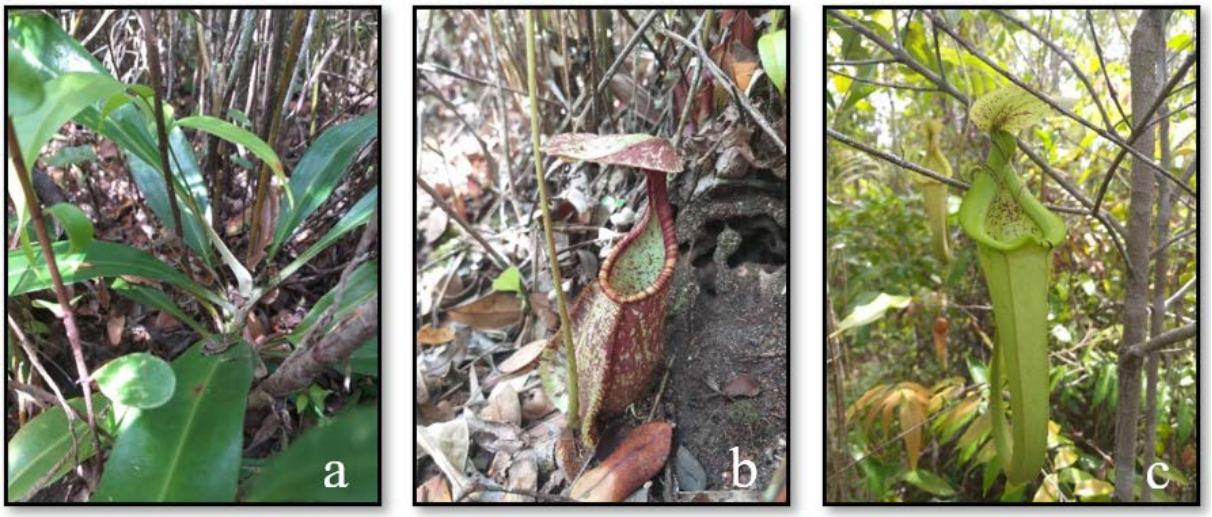

Figure 6. a) The shape of the leaves of *N. rafflesiana*, b) The lower pocket of *N. rafflesiana* motif batik maron, c) The top pocket of green *N. rafflesiana* with maron patches.

Upper pouch: the round shape of the egg at the bottom, then narrows the shape like a tube and widens again towards the mouth, reduced wings, rib-like shape. Mouth circular egg round, narrow peristome, peristome teeth are not clear, round lid and the body's base. The bag colour is green, sometimes Maron red or brownish-red. The shape of the *N. gracilis* pouch and leaves can be seen in Figure 4.

The difference in bag colour in *N. gracilis* is strongly influenced by the pH of the bag fluid (Rosmaina & Zulfahmi, 2004) and soil pH (Dariana, 2009).

This species of semar pouch has a higher tolerance to the environment than any other type (except N. *mirabilis*) (Mansur, 2007). The time of inflorescence of this type of semar bag is different from all other species of semar pouch because this difference in flowering time is rarely found in natural crossings in nature except *N. ampullaria* (Trubus, 2006). The presence of *N. gracilis* can be a natural indicator for critical soils in addition to people in West Sumatra using their stems as binding materials, while water from bags that are still closed is used for eye washing (Trubus, 2006).

Description of Nepenthes rafflesiana Jack.

Nepenthes rafflesiana Jack. The characteristics of this type are; slanted leaves, thick, stemmed, leaf length <30 cm, width <8 cm, tendril length < 38 cm; cylindrical rod, < 4 cm in diameter, can reach 15 m in length; peristome is wide <2 cm with short and clear teeth, the front of the peristome on the lower pocket is relatively high. While the upper pocket is rather high and wide on the front of the peristome; The lower pocket is oval-shaped with the colour of winged Maron batik motif and clean teeth, while the top pocket is green with Maron patches on the lid, peristome and the inside of the bag. The shape of the bag and leaves of *N. rafflesiana* can be seen in Figure 6.

Figure 7. Upper pockets of *N. rafflesiana* in peat habitat of UPR Campus

These three species of pockets are found in habitats that have a range of environmental parameter values, namely at air temperatures of 28-38oC, medium-open coverage, the humidity of 62-98%, and soil pH of 5-7.5—located in a type of habitat dominated by typical plants of secondary peat forests, namely *Combretocarpus rotundatus* (tumih), *Cratoxylum glaucum* (garunggang) and *Melaleuca cajuputi* subs. Cumingia (galam).

The existence of semar pockets at Palangka Raya University is expected to become a database of peatland biodiversity in Central Kalimantan. Forest fires, mining activities, the transfer of land/forests to agricultural or plantation land and overexploitation for commercial purposes continue to threaten the population of the semar pockets in nature, although for species *N. mirabilis* and *N. gracilis,* according to IUCN data, began to increase their populations in nature (Clarke, 2014; 2018a; 2018b).

The habitat of this shrinking semar bag is feared to impact population decline and the diversity of semar pockets. In fact, it can lead to extinction. For this reason, ex-situ conservation efforts need to be done immediately by domestication both through cultivation and breeding mechanisms to remain sustainable, considering that all types of semar bags in Indonesia are protected by Law No. 5 Of 1990, PP No. 7 of 1999 and PP No. 8 of 1999 (Mansur, 2007); (Hernawati et al., 2007; Mansur, 2013). Cultivation, by the way (seeds, stuns and tissue cultures) ex-situ by lovers of semar bags, semar bag cultivators, universities and research institutions is a positive thing and needs to be supported. Thus the preservation of the semar bag can be maintained and prevent it from extinction.

Conclusion

In the peat forest area of Palangka Raya University found three types of semar sacs, namely *Nepenthes mirabilis* (Lour.) Druce, *Nepenthes gracilis* Korth., and *Nepenthes rafflesiana* Jack. N. mirabilis has a variety of bag colours ranging from green to green patches / Maron red lines, *N. gracilis* has a variety of bag colours ranging from green, maron red to patterned red Maron batik and in *N. rafflesiana* has a variety of green colour bags of Maron patches to bags with batik motifs/spots of Maron. Now the existence of the three pockets in the area is threatened, so there needs to be a rescue effort. One of them is the in-situ biodiversity conservation action that must be done immediately considering the transfer of land functions continues. In addition, in-depth research on populations, distributions and molecular studies is expected.

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Declaration statement

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Implementation and Factors that Affect Online Learning in Biology Lessons

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Distance learning;

A B S T R A C T

Background: Online learning changes the learning pattern usually done face-to-face into a distance education system to influence it. This also has an impact on biology lessons at Xaverius High School Lubuklinggau. This study aims to determine the perception of the implementation of online learning in biology lessons and determine the factors that influence it. **Methods:** This research uses descriptive qualitative with data collection techniques using observation, interviews, questionnaires, and documentation which are then analyzed by technical analysis of Miles & Huberman. The research subjects were biology teachers and all grades X, XI, and XII science students at Xaverius High School Lubuklinggau. **Results:** the implementation of learning in biology lessons that have been carried out at Xaverius Lubuklinggau High School there are planning, implementation and evaluation activities as well as face-to-face learning, but in the implementation, there are factors that influence, namely the material cannot be explained, the response of class X students is less active, supervision of the assessment, the ability of teachers to use various educational applications, difficulty in assessing the character of students, some students do not understand the material provided, and the learning environment. **Conclusion:** The implementation of online learning that is applied there are still planning, implementation and evaluation activities, but in the implementation, several factors influence both supporting and inhibiting factors.

Implementasi dan Faktor-faktor yang Mempengaruhi Pembelajaran Daring pada Pelajaran Biologi

Kata kunci:
Pelajaran biologi
Penerapan:
Pembelajaran daring
Pembelajaran jarak jauh;

A B S T R A K

Latar Belakang: Pembelajaran daring mengubah pola belajar yang biasa dilakukan dengan tatap muka menjadi sistem pendidikan jarak jauh, sehingga akan terdapat faktor yang mempengaruhinya. Hal ini juga berdampak pada pelajaran biologi di SMA Xaverius Lubuklinggau. Penelitian ini bertujuan untuk mengetahui persepsi implementasi pembelajaran daring pada pelajaran biologi dan mengetahui faktor-faktor yang mempengaruhinya. **Metode**: penelitian ini menggunakan deskriptif kualitatif dengan teknik pengumpulan data dengan menggunakan observasi, wawancara, kuesioner, dan dokumentasi yang kemudian dianalisis dengan teknis analisis Miles & Huberman. Subjek penelitian yaitu guru biologi dan semua siswa kelas X, XI, dan XII IPA di SMA Xaverius Lubuklinggau. **Hasil**: implementasi pembelajaran pada pelajaran biologi yang telah dilakukan di SMA Xaverius Lubuklinggau terdapat kegiatan perencanaan, pelaksanaan dan evaluasi sama halnya seperti pembelajaran tatap muka, tetapi dalam pelaksanaan terdapat faktor-faktor yang mempengaruhi yaitu materi tidak dapat dijelaskan, respon siswa kelas X kurang aktif, pengawasan penilaian, kemampuan guru dalam menggunakan berbagai aplikasi pendidikan, sulit dalam menilai karakter siswa, beberapa siswa tidak memahami materi yang diberikan, dan lingkungan saat belajar. **Kesimpulan:** Implementasi pembelajaran daring yang diterapkan masih terdapat kegiatan perecanaan, pelaksanaan dan evaluasi, tetapi dalam penerapan terdapat beberapa faktor yang mempengaruhi baik faktor yang mendukung maupun faktor yang menghambat.

Introduction

The spread of the Covid-19 virus in early 2020 led Indonesia to issue Circular Letter number 4 of 2020 concerning the Implementation of Education Policy in the Emergency Period of Corona Virus Disease (COVID-19), a policy to conduct online learning activities from home. This will turn learning activities usually done face-to-face into digital media learning activities (Fitriyani, Fauzi, & Sari, 2020). Online learning is also considered able to accelerate the educational demands of the industrial revolution era

4.0 because the learning system utilizes information technology.

Online learning is an innovation in learning that takes advantage of the development of information technology. According to Mustofa, Chodzirin, & Sayekti (2019), online learning is a distance learning activity that uses various teaching methods and activities carried out separately from those who study. The problem is that online learning is a new thing in high school level learning because learning is usually done directly face-to-face between teachers and students in the classroom. Therefore, online learning will be a new challenge and requires schools, teachers, and students to adapt to new activities or ways of learning. This transition of online learning also occurs suddenly without any preparation in advance, so factors or obstacles will affect the implementation of online learning (Regianti, 2020). Therefore, online learning forces schools to be more creative and innovative in issuing policies in addressing problems and developing learning activities, so that curriculum objectives can be achieved as expected (Mutaqinah & Hidayatullah, 2020).

The problem is that not all teachers and students master the developing technology (Agoestyowati, 2020). Based on the results of Artikawati research (2016), online learning causes a lack of communication between teachers and students during learning and the lack of learning models used during online learning that affect student achievement. Online learning also requires students to adjust to new ways of learning, demands to learn independently at home, and the lack of supervision during learning so that it cannot be denied there will be some problems that students will face during learning (Agoestyowati, 2020). Therefore, a teacher plays a very important role in online learning, because the teacher will arrange the scenario of learning activities that will be carried out to achieve learning goals.

Teachers must innovate in creating a good learning process during online learning activities. The learning process is important in learning activities, whether or not an online learning goal depends on the learning process carried out. If the learning process goes well then the learning results will be achieved following expectations. Teachers can use applications that support in education such as Google Classroom, Zoom and WhatsApp that can support the implementation of online learning (Dhull & Sanksi, 2017). The implementation of online learning must still pay attention to the competencies to be taught. Online learning is not a learning activity that only provides materials or assignments to students through applications but online learning must also be thoroughly designed and implemented, and evaluations such as learning that is usually done in the classroom (Syarifudin, 2020).

The implementation of online learning is also influenced by several supporting factors that inhibit online learning effectiveness. These factors are divided into two, internal and external factors. Internal factors are factors that originate in students and teachers. External factors are factors that come from outside the student and teacher (Sukmawati, 2016). Therefore, it is crucial to analyze the implementation of online learning that has been applied so that it can know about the implementation of online learning that has been applied and know the factors that affect it, which then the results of this study can be a reference for improvement in implementing the following online learning activities. Online learning is also carried out in Lubuklinggau City. In this study, researchers chose Xaverius Lubuklinggau High School because Xaverius Lubuklinggau High School received the highest national examination score (UN) biology in Lubuklinggau City with a score of 65.38. This High School has also been accredited A and, when the research was conducted, has carried out online learning for approximately five months.

This study aims to find out how the implementation of online learning in biology lessons has been applied and know the factors that affect online learning, so it is expected that the results of this study can be helpful to provide information and can be considered in carrying out better online learning.

Method

Scope of Research

The method in this research uses qualitative descriptive methods with case study research strategies because each aspect must be outlined in detail and systematically (Syahmina, Tanjung, & Rohani, 2020). The study was conducted in October 2020 at Xaverius Lubuklinggau High School. The subjects of the study are biology teachers and students of grades X, XI, XII IPA.

Respondents

Respondents in this study were one biology teacher, 35 students of class X IPA, 48 students of class XI IPA, and 33 students of class XII IPA.

Research Instruments

The research instruments used are observation sheets to find out the implementation of online learning on biology lessons and factors that affect online learning, interview sheets used to find out the implementation of online learning and the factors that affect it and questionnaire sheets used to find out the factors that affect online learning.

Research Procedure

The research procedures used in this research are divided into three stages: preparation, implementation, and completion. In the preparation phase, researchers look for information about the implementation of online learning,

then create observation sheets about the implementation of online learning and the factors that affect it, interview sheets for teachers and students about the implementation of online learning, and questionnaire sheets about the factors affecting online learning. In the implementation stage, researchers conduct observations in classes X, XI and XII IPA. Then conduct interviews with biology teachers and students, and distribute questionnaires to students of grades X, XI, and XII IPA using Google Form and take documentation. The documentation taken is a syllabus, RPP, assessment instrument, and photo during the research. The data was analyzed using Miles & Huberman's analysis. In the completion stage, the researcher makes conclusions from the analysis that has been done.

Data Collection and Data Analysis

Data collection techniques are by observing online learning and the factors that affect it conducted in class X, XI and XII IPA, interviews with biology teachers to find out the application of online learning and the factors that affect it, interviews with students to find out the application of online learning that has been done, questionnaires given to students of grades X, XI, XII IPA to find out the factors that affect learning. Online and documentation. The data obtained will be analyzed using Miles & Huberman analysis consisting of 3 stages, namely data reduction (collecting, compiling, classifying the data obtained), display data (understanding, analyzing the data obtained) and verification (drawing conclusions from the data that has been analyzed).

Result

The implementation of online learning that is applied consists of planning, implementing and evaluating learning activities.

Learning Planning

Based on the results of interviews that have been conducted with Mrs. Niken Indra Koestina, S.Si as biology teacher of class X, XI and XII IPA are as follows.

a. Is the syllabus used during online learning a revision syllabus?
   "Yes, the revised syllabus. The syllabus used has a character assessment".
b. During online learning activities, do you still make learning devices?
   "Yes, you still have to make RPP, because it must be used as an archive and facilitate in carrying out learning activities.
c. Do you make rpp one sheet or what?
   "Yes, we have used RPP one sheet".

Based on the interview, the learning tools that teachers have made before carrying out online learning activities are one sheet implementation plan (RPP) and syllabus.

It is also following the results of documentation and observation that the RPP used by teachers is RPP one sheet consisting of core components, namely learning objectives, learning activities and learning assessments. In contrast, complementary components consist of school identity, subject identity, class/semester, basic competence and time allocation. Based on the results of syllabus observations also used, namely, the syllabus that contains character assessment.

Implementation of Learning in Class X

The implementation of learning is any effort made intentionally by the teacher that can cause students to carry out learning activities. There are three activities in the implementation of learning, namely preliminary activities, core activities, and closing activities. Applications used during online learning are Google classroom, Youtube, Google Form, and Whatsapp to facilitate communication between teachers and students.

Based on the results of the study in class X biology lessons, in the preliminary activities, learning activities begin with the teacher saying a greeting "*good morning*", then the teacher conveys a perception such as asking about the student's news, or connecting the previous subject matter with the subject matter to be learned. The teacher also always explains the learning goals that will be achieved in this activity. At core activities, teachers provide material in the form of videos and PPT. The video and PPT have given questions that will be used as assignments for students. Teachers also allow students to ask questions about material that is not yet understood, but the student's response is less active. At the closing activities, the teacher asks students to conclude the material and close the learning by encouraging students such as expressing "happy learning", "keep the spirit". In online learning activities, there are also practicum activities.

Based on the results of interviews conducted with class X students, it is as follows.

1) How are the online learning activities that have been implemented?
   "The teacher explains the learning steps, then provides videos and assignments".
   "*Practicum* activities, recording video material and so on".
2) How are the practicum activities that you have done during online learning activities?
   "Practicum activities are done by writing answers on answer sheets and sending photos as proof we hold a practicum at home".
   "The practical task is that the teacher asks for a video or photo in performing the practical task that has been done".
3) Describe practical applications applied to online learning activities?

"Google Classroom, and Youtube that makes it easy to understand the material".

"Google Classroom is an app that helps us learn online".

4) Explain the effective learning media applied to online learning activities?

"Learning with video keeps me from getting bored".

"Explanations with videos are easier to understand".

Based on the interview, online learning activities on biology lessons conducted are teachers delivering learning instructions, providing material in the form of learning videos, assignments, discussions and independent practicums. The most effective applications used are google classroom and Youtube because it helps students in learning. At the same time, the effective medium in learning is video because it makes it easy to understand the material and not boring.

Implementation of Learning in Class XI

Based on the results of observations of the implementation of online learning in biology lessons in class XI IPA 1 and XI IPA 2, online learning activities begin 5-10 minutes before the specified biology lesson hours. The teacher opened the learning activity by saying the greeting "good morning....." and providing perception by asking about the student's news or conveying what has been learned. After that, the teacher explains the purpose of learning. Then the teacher will give material on the core activities. In the core activities, the teacher does not always provide the subject matter in the form of video, or PPT, because at some meetings, the teacher only asks questions and asks students to answer and discuss those questions during learning activities. The learning video is given in the form of videos that can be directly downloaded and videos connected to Youtube. The video or PPT given contains questions that are used as discussion activities or used as tasks. The teacher also gives students the opportunity to ask questions, and gives other students the opportunity to answer their friends' questions first, then the teacher will answer the student's unanswered questions and confirm the correct answer. The student's response is active in learning. Then, the teacher will have the student conclude the subject matter, and at some meetings the teacher also provides a summary for the student to learn. Teachers also always provide motivation to students during learning, such as commenting on students who answer questions or active students and commenting on the results of student assignments such as "thank you.... Have answered the question, there are others who want to add "thank you for collecting tasks" or "thank you who have responded and answered". In online learning activities, there are also practicum activities.

Based on the results of interviews conducted with class XI students, it is as follows.

1) How are the online learning activities that have been implemented?

"The teacher gives the material in the form of a video or a note to understand. Then we are given the question".

"The teacher uses an explanatory video from Youtube and discusses the questions in the video. How are the practicum activities that you have done during online learning activities?".

2) How are practicum activities that have been carried out during online learning activities?

"Practicum activities in biology are watching practicum videos that teachers have done, and then we make a report. This is quite helpful for us in learning online."

"Observing practicums that have been done through Youtube and making observations".

3) Describe practical applications applied to online learning activities?

"Google Classroom, this application provides benefits that are materials provided by teachers arranged neatly so that it is easier to learn".

"Google Classroom is very effective in online learning activities because it is easy to use."

4) Explain the effective learning media applied to online learning activities?

"I like the medium of learning through video and PowerPoint, and I think it is more interesting and not boring."

"Power points and videos from Youtube make it easy for me to understand the material".

Based on the interview with class XI students, online learning activities are usually done, namely, teachers will provide material in the form of videos or a note for students to understand, and then students are given questions either from video or PPT are observation practicum activities. The most practical application is google classroom because it is easy to use and easy to understand. Materials and tasks are neatly arranged to be easy to learn and can be seen at any time. An effective learning medium is a video because it makes it easy to understand the material and not get bored in learning.

Implementation of Learning in Class XII

Based on the results of observations of the implementation of online learning in biology lessons in class XII IPA, the defence activities opened with the teacher saying hello, and conveyed connecting the lessons learned at the previous meeting with those to be learned. The teacher also conveys the purpose of learning in this preliminary activity. In core activities, the teacher does not always provide the subject matter in the form of video, or PPT, because at some meetings, the teacher only asks questions and asks students to answer and discuss those questions during learning activities. The video provided

can be directly downloaded, and the video is connected to youtube. Teachers always allow students to ask questions about materials that are not yet understood and convey that liveliness will also be assessed in learning. The response of class XII students is very active. At closing activities, teachers ask students to infer material from a given video, sometimes also giving assignments. Teachers are also always motivated by students. In class XII, practicum activities are also still applied.

Based on the results of interviews with students of class XII, the following.

1) How are the online learning activities that have been implemented?
   "The teacher explained video, and then we were given a task related to the material."
   "Interesting because learning is not monotonous, the material is given via video, and there are not always tasks. In learning, there are also discussion activities."
2) How are the practicum activities that you have done during online learning activities?
   "*Practicums are conducted individually, and make practice reports."*
   "The practicum is done that we are asked to search for reports from the internet, then answer the teacher's questions as obtained."
3) Describe practical applications applied to online learning activities?
   "Google Classroom, because there is a notification if there is material or task given and makes it easy to see the value of the task."
4) Explain the effective learning media applied to online learning activities?
   "Video makes it easy for us to understand the lesson."
   "Effective media used during this online learning is in the form of video."

Based on the results of class XII students' interviews, online learning activities that are usually carried out are teachers giving explanations via video. Then there are discussion activities, assignments, and independent practicum activities. Students also state that the most effective application is Google Classroom because it makes it easier for students to know if there are new assignments/materials through notifications, and it is easier to know tasks that have not been done and can also see the value of assignments online. The most effective learning media are video and youtube, but some students also answer PPT more easily understood. The results of interviews with biology teachers at Xavier Lubuklinggau High School are as follows.

a) What is the biological learning procedure that you apply online?
   "Open the lesson by saying hello, then explain the steps students must take, and provide material. Material is provided via video or PPT. Mothers also sometimes only give questions and ask students to answer these questions so that there are discussion activities to be seen active in learning. Some students ask WA (WhatsApp), still, no one asks. Class X is inactive in learning".
b) What apps do you usually use during online learning?
   "Google Classroom, Youtube, Google Form, Mom used Ms. Form as well, actually the same as Google Form, when viewed from the look more interesting in Ms. form is just less interesting in numbering, in this application numbering from the beginning "from the name", if in google form there is part 1, part 2 so it looks more special".
c) What are the most effective applications in online learning?
   "Google Classroom (GC), because networking is easier at GC, the RAM is not too large and facilitates learning activities, and in GC can include videos, PPT, assignments, and discussions.".
d) What kind of media do you use to support online learning?
   "Video and PPT".
e) How do you apply the learning model during online learning?
   "The learning model applied during online learning is the discovery learning model, while the inquiry and other learning models have never been used during online learning activities because they are still confused how to apply other learning models with conditions like this"
f) What strategies do you use in online learning?
   "Using interesting learning videos. Before teaching, must evaluate the video to be given. Usually, the video is given with two video options, namely videos that can be directly downloaded and connected to Youtube, and pay special attention to students who are lazy to learn".
g) Is the practicum still implemented in learning?
   "Still, but not all practicums can be applied. Practicum activities that are applied are related, such as biodiversity materials and species name writing. Practicums that require using laboratory tools and materials are usually done by sending practicum videos that have been done as well as practicum results and asking students to analyze those results and make reports."

Based on the interview results with the biology teacher, online learning activities that are usually carried out are teachers opening learning by saying hello, then explaining the learning goals and steps that students must take and providing subject matter to students. Material is given in the form of PPT and videos containing questions used as discussion materials or as assignments for students. The teacher asks students to ask if the material is not yet understood and allows students to ask questions. The teacher also stated that he paid particular attention to lazy

students learning by sending private messages. Practicum activities can also still be applied in classes X, XI and XII. It is just that not all practicums can be carried out online. Applications used by teachers during online learning are Google Classroom, Youtube, WhatsApp, Google Form, Microsoft From. Learning media used by teachers are power points, videos, and biology package books. The learning model used during online learning is the discovery learning model; teachers have not applied other learning models.

Evaluation

Based on the results of interviews with biology teachers are as follows.

a. During online learning, how do mothers perform effective assessments?

"by conducting student discipline in collecting assignments, student activities in learning."

b. How do you do cognitive assessments?

"with repeats per basic competency, tasks. The curriculum is not required to be achieved all during online learning so only the important cores of the KD must be fulfilled. The replays given are usually multiple-choice, but sometimes also combined with essays and from tasks that answer questions."

c. How do you do psychomotor assessments?

"Reported practicum"

d. Does the mother have difficulty in making judgments?

"Of course there is, the problem is found the same child's answer, difficulty to contact directly outside of KBM hours and supervision".

e. Do you give assignments during online learning?

"Yes, but not every student, because later many want to be corrected, and they will also be saturated, so we have to pay attention to their condition as well."

f. What kind of task does it usually give you?

"The form usually answers questions, later photographed sent at GC, then reports of practice results, as well as notes".

Based on the results of interviews with biology teachers at Xaverius Lubuklinggau High School, attitude assessment is carried out by assessing students' activeness during biology learning and punctuality in task collection. Assessment of knowledge on learning is done by providing questions of repetition of essential competition and student assignments. The task given by the teacher is in the form of answers to questions, notes, and practicum reports. The problems that are usually made are a matter of multiple-choice and essay problems. Skills assessment is done by assessing the student practicum report. Obstacles to assessment are finding the same student answers, difficulty in conducting supervision during the assessment, and difficulty contacting some students outside of biology lesson hours. Some students must be reminded constantly to work on the problem.

Based on the results of interviews with students of grades X, XI and XII, namely "what is the form of tasks given by teachers during online learning?"

a: "The form of tasks is usually a problem, notes and makes a report."

b: "The form of the task is the record, the problem training and the form of the report."

c: "report, summary or answer the question."

Based on the observations in classes X, XI and XII, there are evaluation activities carried out in online learning activities. Affective assessment is carried out by assessing the student's activeness and the timeliness of the assignment collection. Assessment of knowledge in classes X, XI and XII are done by repeating primary competition, assignments, and answers to questions given by teachers. Teachers use Google Form services in repeat implementation and have set the time in their collection so that students who are late to collect assignments will be seen. Teachers will provide student grade results and hold remedial activities for students who get grades under KKM. Teachers also comment on student assignments such as deficiencies or errors in the work of assignments or praise students who get the highest grades, but teachers only give those comments to some students in class XII. Tasks were given in the form of material records, problems, posters and practicum reports. Skills assessment is done by assessing the student practicum report.

Factors affecting online learning

Based on the quetioer results given to classes X, XI, XII IPA to obtain data on factors that affect online learning. Based on the results of the student questionnaire given to 116 students, 113 students answered. Internal factors consist of learning interests, learning motivation, preparation and talent. In the interest factor of student engagement indicators, students state that they are interested and eager to learn biology, but they are embarrassed and afraid to ask teachers, then on motivation only on indicators of a conducive environment, which hinders online learning. Some students state that they are looking for a quiet place during learning while listening to songs or sitting in the study, but there are obstacles such as doing new homework can learn, crowded home conditions, and notifications on mobile phones that interfere with learning concentration. The readiness factor of students in learning has obtained the result that the average student is ready in learning activities, from infrastructure, understanding how to use applications used in online learning, preparing biology books before learning. However, class X students express a lack of confidence, shame, and fear of asking teachers about the mental aspect.

Factors of student talent, only in intellectual piercings that affect students in learning, students state that some materials are difficult to understand because the material is not explained in detail during online learning.

External factors consist of family, school and community environmental factors. Factors that affect online learning activities are family factors. Seventy-three parents do not play a role in helping them during online learning. The next factor is the school factor, the teacher has provided teaching materials and made exciting learning activities, as well as helping students overcome difficulties, but the obstacles are that some teachers provide many tasks so that students do not have time to learn. Some materials are difficult to understand because some of the materials described are not detailed, and sometimes there are no question and answer activities during learning. External factors that do not affect online learning activities are community factors. The average student states that not following activities in the community, but mass media such as the internet is very helpful in learning while friends to get along during online learning activities also do not hinder them from participating in online learning activities.

Based on the results of interviews with biology teachers are as follows.

a) What factors hinder online learning?

"The application and assessment of the character of students, especially in class X because they have never met the student, while for class XI and XII, the mother already knows some students who are lazy to learn and who have difficulty understanding the material, to pay special attention to the student. You will send private messages to these students to remind them to learn and collect assignments. The obstacle is also to awaken the motivation of students, especially class X and class XI students. Students in class X are less active in learning. The next obstacle is the time to study biology is only a little, so you have to really find a way to convey the subject, supervision in assessment, and obstacles to contact students outside of lesson hours, because some students were often late to collect assignments.

b) What factors support online learning?

"Online training or seminars, then pulse assistance from schools and ministries, infrastructure facilities that have been supported, and biology printed books that have been distributed to students".

Based on the results of the interview, the teacher stated that the factors that hinder online learning are the motivation of some students who are still low, students are less active in learning, especially class X, supervision in assessment, little biological study time, some students must get special treatment and difficulty in assessing student character.

Discussion

Learning Planning

The implementation of learning activities must begin with learning planning activities. The teacher makes learning devices such as learning implementation plans (RPP) and syllabuses in this activity. Based on the study results, the syllabus used by teachers following the Circular Letter of the Minister of Education and Culture Regulation No. 14 of 2019 is a character assessment in students. It is also under interviews with biology teachers that there is a character assessment. Character assessment is essential in learning and is also a competency that is expected to be achieved during learning activities, including at Xavier Lubuklinggau High School. This character education aims to build the character of students who have faith, independence, and tenacity able to face problems well to achieve success (Supriyadi, 2015). A biology teacher at Xaverius Lubuklinggau High School stated that online learning could not assess students' character.

Another learning device prepared by the teacher is RPP. RPP made by biology teachers is RPP one sheet. The RPP component compiled by teachers for classes X, XI and XII contains core components, namely learning objectives, learning and assessment activities, and complementary components consisting of school identity, subjects, time allocation, class or semester and essential competencies. In general, biology teachers at Xaverius Lubuklinggau High School have compiled a good RPP, because the RPP has fulfilled most of the components contained in the Circular Letter from Permendikbud No. 14 of 2019 there is only one component that has not been fulfilled, namely in the complementary components, teachers do not write the subject matter on RPP.

Implementation of Learning

Based on the research results, the implementation of biology learning classes X, XI, and XII IPA follows the RPP that has been prepared. Teachers have tried to manage and create excellent and exciting learning activities, using various applications and learning media to deliver subject matter, and there are independent discussions and practicum activities. Teachers also provide rules that students must follow during online learning activities X, XI and XII.

The application used during online learning activities in biology lessons uses the Google Classroom, Youtube, Google Form, and WhatsApp applications. The most effective application during online learning in this school is Google Classroom. This is also revealed from the results of research from Hikmatiar, Sulisworo, & Wahyuni (2020) and Maharani & Kartini (2019) shows that the Google Classroom application has exclusive features that support learning and from the results of research that this

application can increase students' motivation, interest and learning outcomes.

The learning media used by biology teachers in this school is the video learning media and PPT. Based on the study results, students like the medium of learning in the form of video in the delivery of material because it makes it easier for students to understand the material provided and not boring. This is in accordance with the results of research Azis, Taiyeb, & Muis, (2018) states that the use of video makes students more motivated and enthusiastic in learning and improves learning outcomes. It is also revealed in Gazali & Nahdatain (2019) research which states that well-packaged learning videos using easy-to-understand explanations can improve students' learning spirit and make students not bored in learning.

The learning model used by teachers during online learning activities is the discovery learning model. The teacher stated that he had not tried to use other learning models during online learning activities. Learning activities consist of preliminary activities, core activities and closing activities. The preliminary activities conducted in class X, XI and XII IPA at Xavier High School began with the teacher always opening learning activities by saying "good morning". The teacher conveys perceptions such as asking about students and saying "we meet again in biology class, whether you have drank water or breakfast". Teachers always convey the purpose of learning to students, and sometimes teachers also connect the previous subject matter with the material to be taught even though not every learning.

This preliminary activity is important in learning activities because it can focus students before learning activities begin. Perception activities aim to construct students' thinking so that they can understand the lesson in a structured manner (Sudarisman, 2015). This was also expressed by Suryadi (2020) and Pakungwati (2018), who stated that perception is an important stage in learning because it can strengthen students' concepts. Moreover, during online learning, which is a new thing for students, it is necessary to focus students, encourage students to learn, and help students understand the lessons in a structured manner. Based on the results of Octaviani's research, et all (2020) that the perception that can be used during online is able to utilize the environment around the student's home and good perception can make students more active and critical in learning.

The core activities in class X are teachers providing subject matter in videos and PPT. The video and PPT provided contain questions and ask students to write down answers in their notebooks and submit those answers. Teachers always allow asking and responding to their friends' questions, but students' response in class X is less active. This is following the results of an interview with the teacher who stated that class X is less active, although motivation is always given to students in every learning. While based on the results of interviews with students, he stated that he lacked the confidence to be active in learning because he did not know the teacher who taught and felt afraid. This is also revealed from the results of research that states that online learning activities that are only done by providing materials and assignments without discussion cause low student interaction, and lack of communication between students and teachers will also make the online learning process boring (Kurniasari, Pribowo, & Puta, 2020).

The core activity in class XI is that the teacher provides material in video or PPT. Videos are usually provided with two video options: videos that can be directly downloaded and videos connected to Youtube, so students can choose videos that make it easier for them to learn. The video provided also contains questions that must be answered by students or used as discussion materials. The teacher was also asked to summarize the material from the video given. The teacher also said that the activeness and assessment in punctuality in the collection of tasks would also be assessed.

The response of class XI students during learning is to appear active only when there are discussion activities. In this activity, some students ask and answer questions of their friends, then the teacher will confirm the student's answer and answer unanswered questions, but when the teacher only gives material without any questions, students look less active. This is following the results of Mustakim's research (2020: 8) that with the discussion method, teachers and students can increase direct interaction in learning so as to facilitate students during the online learning process.

The core activity in class XII is the provision of material. The material is given in the form of a video with the same two video options, namely videos that can be directly downloaded and videos connected to Youtube. At several meetings, the material is given in the form of 3 different learning videos, such as aerobic respiration material. The teacher gives three videos at once in one meeting, namely glycolysis video, Krebs cycle and electron transport. In the next activity, the teacher asks students to record material from the results of watching the learning video and answer the questions contained in the video. Indirectly, the teacher asks students to conclude the lesson that has been given. Teachers always provide opportunities to ask and respond to questions and convey that there is an assessment of activeness during learning. Discussion activities are also applied during online learning activities in class XII. The response of class XII students seemed very active. This is in line with Pratama & Mulyati (2020) states that online learning activities that can be done are teachers preparing teaching materials that will be given to students, choosing learning media that suit the student's circumstances,

teachers sending the teaching materials to students either videos, problem exercises, modules or others, allowing students to ask and explain the answers to the question, and conduct evaluations and feedback.

Closing activities carried out in classes X, XI and XII IPA are the conclusion of learning. These conclusions are sometimes given by teachers or used as assignments for students. Assignments are also given during online learning activities in classes X, XI and XII IPA at the end of learning. Assignments are given not in every learning activity. This is following the results of the interview that the teacher stated that he does not always give students assignments because of thinking about the health of students and the saturation of students in learning. This is also supported by the results of Prawanti & Sumarni (2020) research stating that tasks given during online learning that are too much can make students feel bored to learn, and the collection of tasks that are only given in the form of photo or video makes teachers difficult and exhausted to correct the task. The biology task given by the teacher at Xavier High School is a summary of watching videos, answers to questions, or reports. This is also revealed from the results of Ambarsari research (2021), which states that during online learning tasks can indeed be given practically to learners, tasks given online can also vary. The obstacle to the closing activities is that the teacher does not convey the lessons to be learned at the next meeting that requires students to study at home. The teacher only ever reminds students to learn at a time when students will carry out repeat activities.

Motivation is also always conveyed in every learning activity in class X, XI and XII IPA, this can be seen from the statement "happy learning", "keep the spirit of learning", commenting on students' answers with "answers.... True, there are others who want to add", "thank you for responding and dare to ask" or give the symbol "👍". Providing motivation is very important during online learning. Students who have high learning motivation will always be passionate in learning so that it will have a positive impact on the student's own learning achievement (Febriandar, 2018). The results of Ajar, Prasetiawan support this, & Surdaryanti (2020) research states that providing student motivation during online learning can improve student learning outcomes. The results of research from Syachtiyani & Trisnawati (2021) indicated that student learning outcomes improved along with students' learning motivation which was also high.

Based on the results of research, biological practicum activities can still be applied during online learning activities. The practicum given is an independent practicum that individual students must do. Practicums that have been applied are related to nature, such as biodiversity, making a cladogram, while practicums that require laboratory materials and tools, teachers only send practicum videos that have been done by teachers or others and ask students to observe the results of the practicum and make observation reports. This is following the results of Sholika's research, et ll. (2020), which states that biological practicums are still carried out during online learning. However, practicums are practicums that use simple tools and materials only, and some practicums cannot be done during online learning because of the tools and materials that students have to do independent practicums. It is also supported by Saraswati & Martayasa (2020), who stated that some practicums are challenging to implement during online learning. Empowerment of resources or tools and practicum materials that every student at home will support practicum activities independently (Sumardi et al. l, 2020).

Evaluation

The online assessment process provides a change both in learning and in assessment. Assessments that are usually done face-to-face must be changed by online that utilizes technology. The assessment designed by biology teachers at Xaverius Lubuklinggau High School during online learning has been thoroughly compiled from assessing attitudes, knowledge and skills. The assessment of attitudes carried out by teachers is to assess students' activeness during learning and assess student discipline from timeliness in the collection of tasks. The teacher's knowledge assessment is a daily repeat in multiple-choice and essay, midterm repeat (UTS), end of semester repeat (UAS), and assignment. The teacher's skill assessment is to assess the practicum report made by the student. The implementation of the assessment also can not be separated from some obstacles such as supervision in the assessment, difficulties in the assessment of character and attitude of students. It is also supported in the results of research Hafiz, Deniartia, & Anisa (2020), which states that during online learning, found the same student answers, unable to observe students during assessment and difficulties in affective assessments they cannot observe students directly during learning.

Factors Affecting Online Learning

The implementation of online learning can be done because there are supporting factors. This was revealed by biology teachers at Xaverius Lubuklinggau High School that the factors that support the implementation of online learning are infrastructure facilities that have been supported, quota assistance from schools and ministries, students have received biology package books, discussions between teachers about online learning, and the existence of online training and seminars.

Factors that hinder online learning are the motivation of some students who are still low, students are less active in learning, especially class X, supervision in assessment, little

biology study time, some students must get special treatment, and difficulty in assessing the character of students. Based on the results of Sadikin & Hamidah (2020) research, online learning does have special challenges. The learning process is carried out separately between teachers and students so that teachers cannot observe students directly in learning. This leads to that there is no guarantee that students are earnest in listening to reviews from teachers. According to Yunitasari & Hanifah (2020), the constraints on the online learning process are not being able to monitor students directly, cannot assess the character of students, some materials are delivered less effectively, and lack learning time. Problems arise also such as not all teachers and students master technology, and some teachers give assignments every meeting (Aji, 2020).

Based on the results of the student questionnaire given to 116 students, 113 students answered. Internal factors consist of learning interests, learning motivation, preparation and talent. The interest factor consists of 4 indicators: interest, feelings of pleasure, attention, and student engagement. Factors that influence online learning are on indicators of student engagement, students state that they are interested and eager to learn biology but they are embarrassed and afraid to ask teachers. This is in accordance with the results of research Meidawati (2019) and Sadikin & Hamidah (2020) that online learning has a positive impact in students' learning interests, online learning also keeps students in the spirit of learning, increasing students' interest in learning.

Motivational factors consist of 6 indicators: the desire and desire to learn, the appreciation in learning, the encouragement of learning needs, expectations of future ideals, interesting activities, and a conducive environment. Factors that hinder online learning are only in conducive environmental indicators. Some students state that they are looking for a quiet place during learning, while listening to songs or sitting in study but there are obstacles such as doing new homework can learn, crowded home conditions and there are notifications on mobile phones that interfere with learning concentration. This is in accordance with the research results from Fitriyani et al. (2020) stated that online learning conducted during the Covid-19 pandemic did not hinder students' spirit in learning, although there are still many shortcomings and obstacles faced. It is also supported by Mustofa (2020), which states that online learning positively impacts student motivation. Students are still eager to learn, provide students with the need for the information needed and have flexible time to repeat and review the subject matter. It is also supported by Cahyani, Listiana, & Puteri (2020) obstacles in increasing student motivation, namely the atmosphere when studying at home.

The readiness factor of students in learning has obtained the result that the average student is ready in learning activities, from infrastructure, understanding how to use applications used in learning, preparing biology textbooks before learning. However, many X-class students lack confidence, shame, and fear of asking teachers on the mental aspect. Purwanto et al. (2020) revealed that facilities are essential to launching learning activities such as laptops, computers, or mobile phones that will facilitate online learning activities can run well.

The talent factor consists of 3 indicators, namely intellectual, motivation and creativity of students. Factors that affect online learning only in intellectual piercing, students state that some materials are difficult to understand because the material is not explained in detail during online learning. It is also supported by the results of research from Sadikin & Hamidah (2020) that the subject matter provided online is challenging to understand. The material and tasks are not enough because it needs to be explained directly by the teacher.

External factors consist of family, school and community environmental factors. Factors that affect online learning activities are the family factor. Seventy-three parents do not play a role in helping during online learning. This is following the research that According to Putria, Maula, & Uswatun (2020), supportive facilities support online learning constraints, still constrained in students who are lazy to learn, and still, many parents who are busy working they cannot guide students in learning.

The next factor is the school factor, many students answer that the teacher has provided teaching materials and made exciting learning activities, as well as helping students overcome difficulties, but the obstacle is that some teachers provide many tasks so that students do not have time to learn. Some materials are difficult to understand because some of the materials described are not detailed, and sometimes there are no question and answer activities during learning.

External factors that do not affect online learning activities are community factors. The average student states that they do not follow activities in the community. However, mass media such as the internet is beneficial for them in learning while for friends to get along during online learning activities also do not hinder them in participating in online learning activities.

Conclusion

It can be concluded that the factors that affect online biology learning are interest and motivation factors; students are interested and eager to learn even online; the obstacle is only X-class students who are less active in learning. Because they feel less confident and afraid to ask teachers, some students find it challenging to find a conducive environment because they have to while doing

homework and crowded home conditions. The lack of the role of parents in guiding students to learn, supervision of assessment, time limitations in the explanation of materials, difficulty in assessing the character of students also includes obstacles in online learning. Factors that support online learning are infrastructure facilities, pulse/quota assistance, stable networks, students who have received biology package books, discussions about online learning, and online training and seminars.

Declaration statement

The authors reported no potential conflict of interest.

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Improving the Ability of Formulating High-Level Questions Through the Discussion-Comparison Method with Critical Analysis

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Background: Prospective teachers are less able to formulate high-level questions, so teachers' skills to formulate high-level questions are still lacking, even though it really determines students' critical thinking abilities. This study aims to determine whether there is an increase in students' ability to formulate high-level questions through the discussion-comparison method 1,2 with critical analysis of articles in the Biology Education Study Program, University of Muhammadiyah Bengkulu. **Method:** This research used the Classroom Action Research (CAR) method with four cycles. **Results:** The results showed that there was an increase in the ability to formulate high-level questions of students through the discussion-comparison method 1,2 with critical analysis of articles in the Biology Education Study Program, University of Muhammadiyah Bengkulu. **Conclusion:** It is recommended for lecturers before starting learning to teach how to structure high-level questions well to their students.

Peningkatan Kemampuan Merumuskan Pertanyaan Tingkat Tinggi Melalui Metode Diskusi-Pembanding dengan Analisis Kritis

Kata kunci:
Pertanyaan tingkat tinggi;
diskusi-pembanding;
analisis kritis;

A B S T R A K

Latar Belakang: Calon guru kurang mampu merumuskan pertanyaan tingkat tinggi, sehingga keterampilan guru merumuskan pertanyaan tingkat tinggi masih kurang, padahal sangat menentukan kemampuan berpikir kritis siswa. Penelitian ini bertujuan untuk mengetahui apakah terdapat peningkatan kemampuan merumuskan pertanyaan tingkat tinggi mahasiswa melalui metode diskusi-pembanding 1,2 dengan analisis kritis artikel di Program Studi Pendidikan Biologi FKIP UM Bengkulu. **Metode**: Penelitian ini menggunakan metode Penelitian Tindakan Kelas (PTK) dengan empat siklus. **Hasil**: Hasil penelitian menunjukkan bahwa terdapat peningkatan kemampuan merumuskan pertanyaan tingkat tinggi mahasiswa melalui metode diskusi-pembanding 1,2 dengan analisis kritis artikel di Program Studi Pendidikan Biologi FKIP UM Bengkulu. **Kesimpulan:** Disarankan bagi dosen sebelum memulai pembelajaran untuk mengajarkan cara menyusun pertanyaan tingkat tinggi dengan baik kepada mahasiswanya.

Introduction

One of the important components in the learning process is the teacher's skill in asking questions, because it can increase interest, curiosity, thinking skills, and student participation in learning (Usman, 1995). According to Santos (2017), the learning process questions support students' thinking skills. While according to Alsaleh (2020) developing one of the thinking skills is the most important thing and an indicator of the quality of learning of students who have critical thinking power. Learning with one question with more than one answer or synthesis question was the lowest of the eight countries surveyed, only 10%, while other countries above 10% and the complexity level of the question made by teachers in Indonesia, more at a low complexity level of 57%, while 40%, for a high complexity level of only 3% (Jalal, According to the Ministry of Education (2019) of 1,779 questions analyzed from 34 provinces in the 2018/2019 school year, the problem items made were mostly new at level one

(knowledge, remembering) and level two (understanding). Of the 136 Referral High Schools, only 27 schools are able to compile HOTS problems as much as 20% of their USBN problems, 84 schools compile HOTS problems below 20%, and 25 schools do not know how to structure HOTS problems.

Mitana (2018) revealed an overall average value of 86.8% of LOT questions and an average score of 13.2% of HOTS questions. Teachers' ability is very low in formulating high-level questions, inseparable from the institution that produces these teachers, namely LPTK. LPTK students as prospective teachers need to be equipped with the ability to develop questions well. Thus, LPTK graduates will be able to teach well and carry out active learning to continuously improve the quality of education in Indonesia. According to Wilson & Narasuman (2020) High-Level Thinking Skills (HOTS) among Teachers is essential to be developed in the education system to prepare students for 21st-century situations and develop students to reach their full potential. Teachers must have a broad knowledge of High-Level Thinking Skills, application, analysis and evaluation in the teaching and learning process (Nachiappan et al., 2018).

One method of learning that can develop the skills of formulating student questions is the discussion-comparison method 1.2 with critical analysis of articles. The discussion method is a way of learning by raising questions about problems that need to be solved together (Nuryani, 2005). The critical analysis component of the article consists of: 1) Book title, author, publisher, and topic 2) Author's goals 3) Concepts arising from the article, 4) Unique and interesting facts, 5) Questions arising from the article, 6) Tentative answers to questions, and 7) Self-reflection. Critical analysis activities of articles will train students to formulate questions and answers well, analyze, and synthesize that will improve critical thinking and analytical thinking (Susilo, 2014). This research was conducted to find out the ability to formulate high-level questions through the discussion-comparison method 1.2 with critical analysis of articles on the students of the Biology Education Study Program FKIP UM Bengkulu.

Method

Scope and Sample of Research

The research method used is Classroom Action Research (PTK) or Classroom Action Research (CAR). This research collaborates with other Biology Lecturers as observers. The research stage there are 4 (four) stages, namely the Planning stage (Panning) or Plan, Pelakasanaan (acting, Do), Observation (observing, Do) and the stage of reflection (reflecting). The study was carried out in four cycles. Data is collected through the Critical Analysis Sheet of articles created by students, as many as four lecture topics. The course is Biological Learning Planning 3 credits. This research was conducted in the Biology Education Study Program odd semester 2019/2020. The research population is a third semester student of the Biology Education Study Program FKIP UM Bengkulu numbered 43 people. The subject of the study was an entire population of 43 people.

Research Instruments

Research instruments in the form of essay question assignments (Table 1) in writing made by students in each lecture according to the article's topic discussed.

Table 1. Question Level Research Instruments

Indicator	Descriptor
Knowledge question	Questions that use what words, where, when, who, and mention.
Comprehension question	Questions that use words describe, describe, and compare.
Aplication question	Questions that use words determine, apply, adjust, calculate, and so on.
Analysis question	Questions that use words analyze, exemplify, audit, solve, diagnose, select, detail, etc.
Synthesis question	Questions that use words analyze, exemplify, audit, solve, diagnose, select, detail, etc.
Evaluation question	Questions that use the words used compare, judge, deduce and so on.

Procedure

The steps of the discussion-comparison method 1.2 with critical analysis of the article are as follows: 1) The preparatory stages, including: a. The lecturer explains the topic to be discussed. b. Lecturer explained the rules of implementation of the discussion. c. Lecturers divide discussion groups consisting of presenter groups, comparison groups 1, comparison groups 2, and participant groups (audience). d. Lecturers explain the function of each group; 2) The stage of preparing a critical analysis of the article, including: a. Lecturers provide articles related to lecture materials to be made critical analysis by students. b. Students make critical analysis of articles in their respective groups; 3) Implementation stages, including: a. The presenter group presented a critical analysis of the articles that had been created. b. The presenter group invites the comparison group 1 to respond to the critical analysis presented by the presenter group. c. Comparison group 1 responds by commenting or asking questions. d. The presenter group responded back, as well as threw it to the group of participants. e. The comparison group 1 answered the question asked earlier. f. So on for comparison group 2; 4) The conclusion stages, including: a. Lecturers and students make conclusions from discussions. b. Lecturers inform the topic of next week's lecture.

Data Collection and Data Analysis

The data collection technique in this study is documentation on the critical analysis that students make. Documentation to retrieve data on questions compiled by students. Data on students' ability to arrange high-level questions is by calculating the number of types of question levels that students arrange in each article analyzed in each learning cycle. The data is analyzed using frequency distribution, grouping the data into several cycles, then seen an increase in each cycle (4 cycles) (Emzir, 2011).

Result

The number and percentage of questions raised by students through critical analysis of articles over four cycles can be seen in Table 2 and Table 3.

Table 2. The number of questions that students organize through critical analysis of the article.

Question Aspects	Number of Questions				Σ
	I	II	III	IV	
Knowledge question	131	120	117	111	479
Comprehension question	15	15	16	16	62
Aplication question	2	3	3	3	11
Analysis question	2	6	7	12	27
Synthesis question	0	5	5	5	15
Evaluation question	0	1	2	3	6
Total	150	150	150	150	600

Table 3. Percentage of questions that arise through critical analysis of articles.

Question Aspects	Percentage of Question			
	I	II	III	IV
Knowledge question	87	80	78	74
Comprehension question	10	10	10,6	10,6
Aplication question	1,3	2,0	2	2
Analysis question	1,3	4,0	4,6	8
Synthesis question	0	3,0	3,3	3,3
Evaluation question	0	0,6	1,3	2
Total	100	100	100	100

Discussion

Based on Tables 2 and 3 above, it is seen that there is an increase in the number of questions that arise as seen from the critical analysis of articles compiled by students from cycle 1 to cycle 4.

The total number of question formulations that arise is still dominated at a low level, namely, knowledge (479 pieces), understanding (62 pieces), and applications (11 pieces), but there have also been questions at high levels, namely analysis (27 pieces), synthesis (15 pieces) and evaluation (6) questions. The question is still dominated by low-level questions, but there has also been an increase from cycle 1 to cycle 4 by 0.6%. It is also in accordance with the results of the study that the quality of students' questions is still at a low level (43.4%) and the quality of new student questions at the level of understanding (Yuliani et al, 2014; Nuraini et al, 2017). The question of high levels, the beginning of the first cycle has not yet arisen, but in the second and fourth cycles already appear, although slightly. According to Angraini and Sriyati, 2019 students' ability to formulate questions is very lacking once only 32.08%. Although there is a very small increase, it can also be interpreted that the method of discussion comparison 1 and 2 through critical analysis of the article tends to increase students' ability to formulate questions in general.

Anderson & Krathwohl (2001) (Kemendikbud, 2019) classifies the dimensions of thought processes as follows High-level thinking skills (HOTS) are the ability to create, evaluate, and analyze. Low-level skills are applicable, understanding, and remembering. Questions that arise in the discussion-comparison learning process 1.2 with critical analysis are still low-level questions, but also high-level questions have arisen. In the learning process, especially at the student level, high-level thinking skills (HOTS) should be an integral element to foster students' critical and creative thinking (Asari et al., 2019).

Based on Bloom's taxonomy level, most appear new at the level of knowledge and understanding, but have also appeared at application, analysis, synthesis, and evaluation stages. Bloom's taxonomy can not only be used with six levels of mental learning activity, but it can also be used to determine the types of questions associated with those six mental levels to think about the level of knowledge, understanding and application, which are the first three areas of the cognitive field, as the lower level, and the analysis of thought, synthesis and evaluation steps, the last three areas of the cognitive field, as a higher level. It can be said that there is an increasing tendency for students to compile high-level questions. Plecki et al. (2015) state bloom taxonomy is closely related to high-level thinking. Although teacher use of questions is largely low-level, professional development can help teachers develop skills to design and use questions that engage students in higher-level learning processes. According to Al-Husban (2020) and Tarman & Kuran (2015) Students can identify, and explore problems, but they need support to evaluate a problem and integrate solutions into existing solution knowledge. Because of these expectations, it involves elements of uncertainty and uncertainty.

The discussion-comparing method of 1.2 with critical analysis, can improve students' ability to formulate

questions well. In addition to assessing students' critical thinking skills, interpersonal skills assessment (collaborating) also covers five aspects, namely division of labor, unselfishness, how to solve problems, tolerance and motivation while intrapersonal skills (conscientious) include three aspects of working on each stage correctly, working on all stages correctly and doing it on time (Mutrofin et al., 2017; Nabella et al., 2020). This is because through critical analysis of the article, students always formulate questions after reading the article. Critical analysis of the article one of the components does formulate a critical question and answer the question. Jensen (2011) states that writing skills in making critical analyses can improve the ability to formulate high-level questions for students' critical thinking. According to Padmanabha (2018) stated critical thinking the ability to transfer learned knowledge from a particular discipline to the cognitive field. Critical thinking is associated with developing wise individual skills, such as logical reasoning and personal judgment. Masigno (2014) states that students conducting critical analysis of biological materials is a prerequisite to be able to formulate questions for self-study. Sahin & Gezer (2014) state that biological learning should be a writing activity formulating questions enriched with visuals and verbals to help qualified young people.

Students in the learning process of discussion-comparison method 1.2 can improve the ability of students to formulate questions well. The discussion method is able to improve the formulation of scientific questions in learners by issuing opinions, asking and responding to questions (Sagala, 2004). According to Taniredja et al. (2011), the discussion method can train students to formulate questions to issue their opinions or solve problems. Nurhadi (2002) in the discussion method can stimulate students to ask questions, formulate questions that make students think. Rustaman (2005) states that the discussion method is learning that raises problems in the form of questions asked during learning. Discussion methods allow building relationships with students, stimulating their critical thinking and articulating ideas clearly (Svinivki &Mckeachie, 2016). At the time of discussion, testing attitudes towards critical thinking skills is also considered in the discussion section because discussion skills have an important place in the development of critical thinking skills in discussion (Abdulbaki et al., 2018; Şeker, 2020).

At the time of discussion the students of comparison groups 1 and 2 asked questions to the presenter group, and the presenter group answered the question. The comparison group after asking the question, after being discussed with the participant group, the comparison group also answered the question asked earlier. High-level thinking, depth of knowledge, connectedness with the world outside the classroom and substantive conversations (questions) are key (Newmann &Wehlage, 1993). From Table 5, it is seen that the questions that arise, are still dominated by low-level questions, namely level 1 and level 2, but high-level questions have arisen in cycle 2. 3 and 4. High-level questions of analysis, synthesis, and evaluation have arisen during the lecture process.

The results of reflection of Cycle I-IV, obtained the following input. The steps to improve the discussion-comparison method1.2 are as follows. Reflection for lecturer activities, namely: 1) Lecturers must explain in advance the function of each group (Presenters, Comparison, and Participants, 2) Lecturers must understand the student questions that arise, and explain well the meaning of the question. 3) Lecturers have difficulty dividing time, because the answer to the question can widen from the context of the lecture.

Reflections for student activities, namely: 1) Students are less able to formulate questions well, maybe they have not correctly completed the material from the article, 2) Students are less able to compile high-level questions; 3) Students are not used to learning on their own, so the lecture material is only focused on one source, without looking for other references.

Conclusion

The conclusions obtained from this study are: There is an increase in the number of questions that arise both in the critical analysis of the article and at the time of the discussion processing through the discussion-comparison method 1.2 with critical analysis of the article in biology education students FKIP UM Bengkulu.

Declaration statement

The authors reported no potential conflict of interest.

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