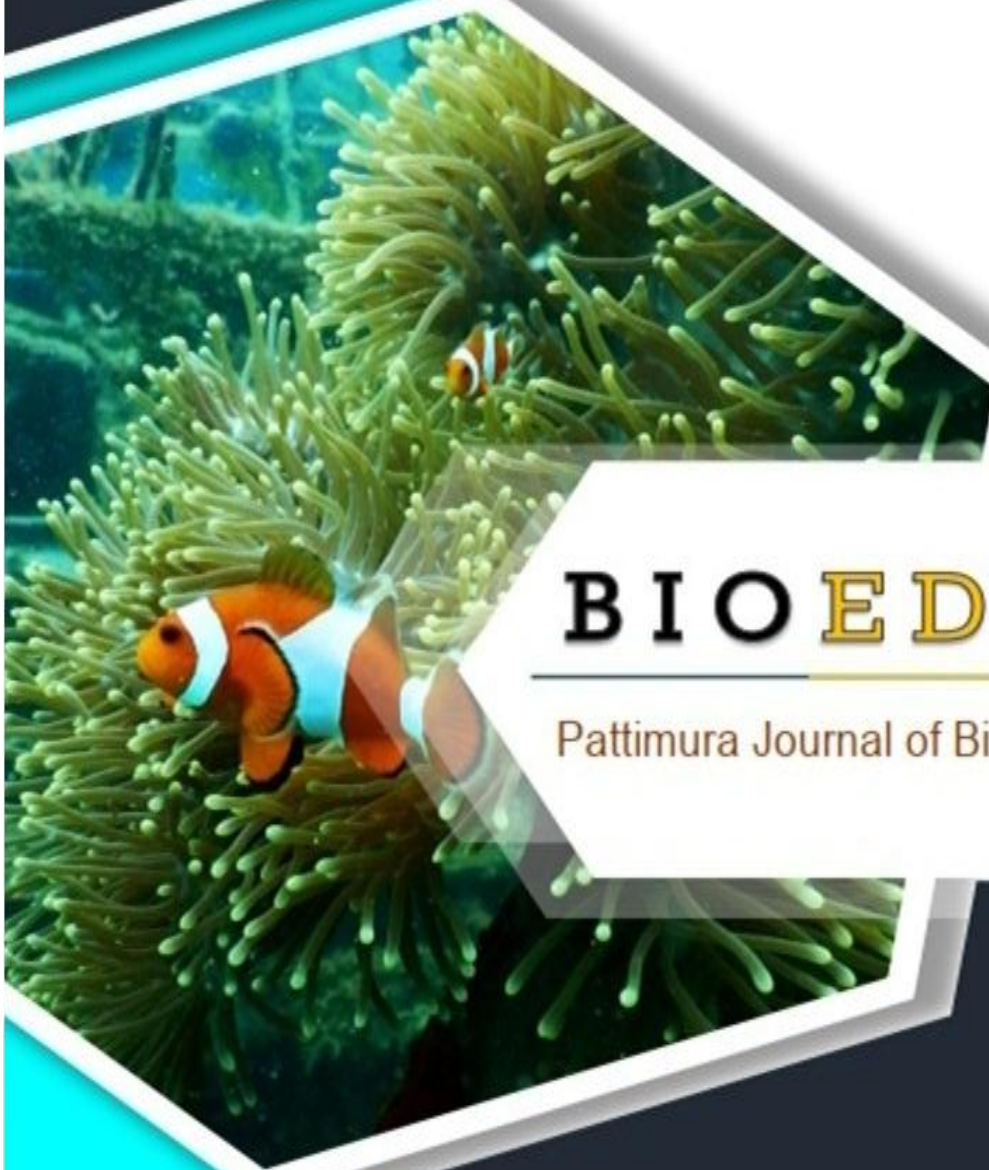


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**Research Article**

**Density and morfometric analysis of sia-sia (*Sipunculus nudus*) from Nusalaut island beach waters central Maluku**

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**ABSTRACT**

Sia-sia (*Sipunculus nudus*) has a shape resembling a worm, is an organism that usually lives in coastal areas, especially around seagrass areas, this biota tends to inhabit the bottom of the water especially in the substrate so that it is categorized as an infauna benthic organism and is able to inhabit areas with soft and hard substrates. This is a deskriptive type of research, to describe or describe information about the density and morphometrics of Sia-sia from the coastal waters of Nusalaut Island, Central Maluku. The results of the study on the density of Sia-sia on the island of Nusalaut, differ according to location, based on the results of the density calculation obtained. Each location shows the total average value of Absolute Density (KA) is 0,0063 ind/m<sup>2</sup> (Low) and Relative Density (KR) is 100%. The Absolute density level (KA) in Abubu Vilage is 0,0068 ind/m<sup>2</sup> (Low), the absolute density level (KA) in Ameth Village is 0,0064 ind/m<sup>2</sup> (Low) and the absolute density level (KA) in Akoon Village is 0,0058 ind/m<sup>2</sup> (Low), Based on the results of the Sia-sia morphometric research from Nusalaut Island, the Results vary from each village with Sia-sia morphometric average length of 12,14 cm, width 2,15 cm and weight of 31,6 g, followed by Akoon village with Sia-sia morphometric average length of 11.6 cm, width 2,21 cm, and a weight of 33,6 g, and the last one is Ameth Village with an average length of Sia-sia morphometric that is 13,02 cm, width 2,26 cm, and weight 36 g.

**Keywords:** sia-sia, density, morphometric

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**INTRODUCTION**

Indonesia has sea waters that are wider than land, therefore Indonesia is known as a maritime country. Indonesian marine waters are rich in various marine biota, both flora and fauna. The breadth and diversity of the living bodies inside all of which form the dynamics of life in the sea that are mutually sustainable (Bengen, 2001). Bappenas (2016) states that exploration and expeditions are still very much needed to reveal the existence and potential of Indonesian marine biota, especially for Eastern Indonesia. One of the potential resources that can be

utilized is Sipuncula. The presence of Sipuncula in coastal ecosystems is relatively less well known when compared to Polychaeta marine worms, because polychaeta have known uses and economic values, namely as bioindicators of pollution and natural food. It is different with Sipuncula of certain types that can be used as food ingredients, one of which is Sipuncula nudus (Pamungkas, 2010).

Sia-sia is known by different terms according to its distribution on each island, in the Bangka Belitung archipelago it is called Kekuak (Fakhrurrozi, 2011), on Morotai island it is Komoco, on Rhum island in (Banda islands) it is called Kariong (Pradina, 1993), in the Kei Islands, Southeast Maluku, it is called Kian, in Suli, Central Maluku, it is called utu tina, and on the islands of Nusalaut and Saparua, Central Maluku, it is called sia-sia. People on the island of Nusalaut, use the Sia-sia sea worm as a daily side dish for the community when the fish trouble season arrives. Sia-sia is usually consumed fresh (kohokoho, the general name for the Maluku people), fried, stir-fried in soy sauce, and satay. called colo-colo. Its body contains a large amount of sand, therefore it must be cleaned before consumption. In addition, not a few people do not know or know but have never tasted it (Riky et al. 2018; Silaban, 2012).

Sia-sia Fresh contains nutrients including protein, fat, carbohydrates, vitamins A, B1, B6, B12, E and minerals P, I2, C2, Mg, C which are almost equivalent to the nutritional content of fish (Ardean et al. 2018). In China sea worms have long been used as traditional medicine in treating tuberculosis, regulating stomach and spleen function, and restoring health caused by pathogens (Zhang & Zi, 2011). Morphologically, this animal is very similar to a worm (Worm-Like-looking). This biota is even called the peanut worm because its shape resembles an earthworm. In addition, some literature calls this animal the usegmented marine worm, the body is divided into the main body (trunk) and trunk (introvert) which are usually pulled inward and backward (Silaban, 2019). Sia-sia usually living in coastal areas, especially around seagrass meadows, this biota tends to inhabit the bottom of the water, especially in the substrate so that it is categorized as an infauna benthic organism and is able to inhabit areas with soft and hard substrates. On soft substrates, these biota tend to bury themselves in sandy and muddy areas. While on hard substrates, Siasia is able to live between coral crevices and also inhabits gastropod shells and empty tubes where polychaetes live (Culter, 1994).

Population density is the relationship between the number of individuals per unit area or volume of space occupied at a certain time. Odum (1996) states that the density value of a species depends on the ability of the species to occupy a large space or place so that it has the ability to reproduce more. This indicates that the habitat can be occupied by organisms in large numbers. Research on the population density of Sia has been done by previous researchers. However, the density of Sia-sia in the coastal waters of Nusalaut Island is not yet known, because no one has done this research before. Morphometrics is a method of measuring morphology including length, weight, and scale of physical condition based on body morphology standards that are adapted to Sia's life phase. According to Langer et al. (2013), the systematic morphology of an animal is determined by morphological measurements, namely length and weight so that it has authentic evidence and is the easiest to identify. Morphometric studies are a collection of measurement data that represent variations in shapes and sizes. Morphometric variations of a population in different geographical conditions can be caused by differences in genetic structure and environmental conditions. Therefore, the distribution and morphometric variations that appear are a response to the physical environment in which the species lives (Tzeng et al. 2000).

Sufficient morphometric data was obtained by selecting specimens that were considered to have established morphological characters (body size). The specimens used to be measured are at the young to adult level with a body size of 10-40 cm (Collins, 1985). Haryono (2001) states that each species has a certain geographic distribution which is controlled by the physical conditions of its environment. Therefore, the distribution and morphometric variation that appears is a response to the physical environment in which the species lives.

## METHODS

a) Density analysis procedure:

- Preparation

The series of activities before starting the research such as consultation, collecting references, and preparing the equipment used for research.

- Observation

After preparing everything needed in the research, the next step is to make observations in the field to get the appropriate research location.

- Determination of research locations and stations

Determination of the location and research station is done after the observation stage.

- Observation and sampling

Observations were made at the lowest tide. Vain observations and sampling were carried out using the observation method and the cruise method with the purposive sampling technique, then the plot to be used in this study was 1 x 1 m<sup>2</sup>, with an observation area of 100 x 50 m = 5000 m<sup>2</sup>.

b) Morphometric Analysis Procedure

Modification of work procedures from previous research (Ardean, 2018).

sample preparation

- Samples were taken in the waters of the villages of Akoon, Ameth and Abubu.

Morphometric Stage on Sia-sia

- After the sample has been prepared, the first thing to measure is the intact sample, the sample is measured using a ruler measuring 30-50 cm
- Then measure the width of the sample that is still intact, using a caliper.
- Then measure the total weight of the sample which is still intact, using a scale.

## RESULTS AND DISCUSSION

### 1. Description of Research Location:

Nusalaut Island or the island which is also called Nusahulawano Island (golden island) is a small island among six groups of islands in the Maluku region. Geographically, Nusalaut Island is bordered to the north by Saparua Island, to the south by the Banda Sea, to the east by the Seram Sea and Serua Island, and to the west by Molana Island. Most of the population on the island of Nusalaut make a living as farmers and fishermen. This is because most people live on the coast and have forests/hamlets that can be used as fields for farming. The total population on Nusalut Island is 6,185 people.

### 2. Description of Environmental Physical-Chemical Factors

Measurement of environmental physico-chemical factors in the coastal waters of the Nuslaut Island, especially in Ameth Village, Akoon Village and Abubu Village in this study included water temperature, water salinity levels, (pH) water, and substrate. the results of observations in the table below

**Table 1.** Description of Environmental Physical-Chemical Factors

Lokasi	Temperature °C	Salinity (‰)	pH	Substrate
Ameth	28,6-30,9	31,2-35,3	7,7-8,2	sand stone
Akoon	27,2-29,7	30,8-34,2	7,6-8,1	sand stone
Abubu	29,7-31,5	32,3-36,7	7,8-8,4	sand stone

#### 1. Temperature

Based on measurements made using a thermometer, the results show that the highest temperature is found in Abubu Village, which is in the range of 29.7-31.50C and followed by Ameth Village with values ranging from 28.6-30.9 0C. The lowest temperature measurement value is in Akoon Village, which is 27.2-29.70C.

#### 2. Salinity

Based on the results of salinity measurements carried out using a refracto meter, the results showed that the highest salinity was found in Abubu Village, which ranged from 32.3-36.70/00 and followed by Ameth Village with values ranging from 31.2-35.30/00. The lowest salinity value was found in Akoon Village, which ranged from 30.8-34.20/00.

#### 3. pH

Based on the results of pH measurements carried out using a pH meter, the results show that the highest pH is found in Abubu Village which ranges from 7.8-8.4 and is followed by Ameth Village which ranges from 7.7-8.2. The lowest pH value was found in Akoon Village, which ranged from 7.6-8.1.

#### 4. Substrate

Based on the results of visually observing the substrate by observing the sediment surface in 3 villages, the results showed the same results, namely sandy rock.

#### Density sia-sia of Nusalaut Island

The results of the calculation of the waste density from the coastal waters of the island of Nusalaut can be seen in Table 2 below.

**Table 2.** Density of sia-sia in Nusalaut Island

Village	KA (ind/m <sup>2</sup> )	KR (%)
Ameth	0,0064	100
Akoon	0,0058	100
Abubu	0.0068	100

Based on the results of density calculations obtained, each location shows the total average value of Absolute Density (KA) is 0.0063 ind/m<sup>2</sup> (Low) and Relative Density (KR) is 100%. The absolute density level (KA) in Abubu Village is 0.0068 ind/m<sup>2</sup> (Low), the absolute density value for Ameth Village is 0.0064 ind/m<sup>2</sup> (Low) and the absolute density level (KA) in Akoon Village is a value of 0.0058 ind/m<sup>2</sup> (Low).

#### Morphometric

The results of the measurement and calculation of morphometrics sia-sia from the coastal waters of the island of Nusalaut can be seen in Table 3 below.

**Table 3.** Morphometric analysis sia-sia of Nusalaut Island

Village	Length (Cm)	Width (cm)	Weight (g)
Abubu	12,14	2,15	31,6
Akoon	11,6	2,21	33,6
Ameth	13,02	2,26	36

Based on the results of sia-sia morphometric analysis from the Nusalaut island, the results vary from each village. Abubu Village with Sia-sia's morphometric average length of 12.14 cm, width 2.15 cm and weight of 31.6 g, followed by Akoon Village with Sia-sia's morphometric average length of 11.6 cm, width 2.21 cm and weighs 33.6 g, and the last one is Ameth Village with an average length of Sia's morphometric that is 13.02 cm, width 2.26 cm, and weight 36 g.

## DISCUSSION

Based on the measurement results of environmental parameters in the coastal waters of Nusalaut Island, especially in Ameth Village, Akoon Village and Abubu Village which include water temperature, water salinity levels, (pH) water, and substrate, the highest temperature is found in Abubu Village, which ranges from 29.7-31.50C and followed by Ameth Village with values ranging from 28.6-30.9 0C. The lowest temperature measurement value is in Akoon Village, which is 27.2-29.70C. The temperature in the sea is an important factor for the life of marine organisms. Water will regulate the body temperature control of organisms (Boyd, 2015). The best growth is obtained when the body temperature of aquatic animals approaches the temperature of their environment, because the energy normally required to regulate body temperature will be used for growth (Parker, 2012).

The results of the study regarding salinity measurements were carried out using a refracto meter, the results showed that the highest salinity was found in Abubu Village, which ranged from 32.3-36.70/00 and was followed

by Ameth Village with values ranging from 31.2-35.30/00. . The lowest salinity value was found in Akoon Village, which ranged from 30.8-34.20/00. Salinity affects production and distribution, length of life and migration orientation. Salinity is a very important factor that gives organisms the ability to adapt to the environment. As [sidiq et al. \(2015\)](#). [Nontji \(2002\)](#) states that the high and low salinity values in the sea are influenced by several factors, such as evaporation water circulation patterns, rainfall and river flow. Based on the results of pH measurements carried out using a pH meter, the results show that the highest pH is found in Abubu Village which ranges from 7.8-8.4 and is followed by Ameth Village which ranges from 7.7-8.2. The lowest pH value was found in Akoon Village, which ranged from 7.6-8.1. Seawater has a very large buffering capacity to prevent changes in pH. A slight change in pH from the natural pH will give an indication of a disturbed buffer system. This can cause changes and imbalances in CO<sub>2</sub> levels that can endanger the life of marine biota ([Rukminasari et al., 2014](#)). High and low pH is influenced by fluctuations in O<sub>2</sub> and CO<sub>2</sub> content, not all living things can withstand changes in pH values, for that nature has provided a unique mechanism so that changes do not occur but in a slow way. A pH level less than 4.8 and greater than 9.2 can be considered polluted ([Sary, 2006](#)).

Based on the results of visually observing the substrate by observing the sediment surface in 3 villages, the results showed the same results, namely rocky sand. In coastal areas that have a sandy bottom substrate, very few living organisms are found. Because the sand beach does not provide the right substrate for organisms to attach to, due to the waves that continuously move the basic substrate particles. Groups of organisms that are able to adapt to sand substrate conditions are macro infauna organisms (1-10 cm in size) which are able to dig burrows in the sand, and micro meiofauna organisms (0.1-1 mm in size) which live among sand grains in interaction space ([Riniatsih, 2009](#)).

The results of the calculation of the density of sia-sia from the coastal waters of the island of Nusalaut based on the results of the density calculation obtained, each location shows the total average value of Absolute Density (KA) which is 0.0063 ind/m<sup>2</sup> (Low) and Relative Density (KR) that is 100%. The absolute density level (KA) in Abubu Village is 0.0068 ind/m<sup>2</sup> (Low), the absolute density level (KA) in Ameth Village is 0.0064 ind/m<sup>2</sup> (Low) and the absolute density level (KA) in Akoon Village is 0.0058 ind/m<sup>2</sup> (Low), indicating that the area has good conditions as a place to live and there has been no significant competition for space, food or a place to live for Nat. The results of the density of the three villages are classified as low because they are at number 0, which is 0 - 1 Low, 1-2 moderate and > 2 High on the density index. Absolute Density (KA), which is the data obtained is the number of density estimates in the form of the number of individuals of a species per area containing the species, and Relative Density (KR), is the density calculation data obtained from the density of a species per the total density of all species and times 100%, Krebs (1978). The difference in population density is due to different environmental conditions at each research station, while the difference in population in each observation is due to the influence of weather and high and low sea waves ([Azmi et al., 2017](#)). Based on observations, there are several environmental factors that determine the presence of sia-sia such as the state of the substrate, the power of the waves and the high and low sea water during the waves.

Based on the results of the futile morphometric analysis from the island of Nusalaut, the results vary from each country. Negeri Abubu with an average waste mofometric length of 12.14 cm, a width of 2.15 cm and a weight of 31.6 g, followed by Akoon Country with an average waste mofometric length of 11.6 cm, a width of 2 .21 cm and a weight of 33.6 g, and the last one is the Land of Ameth with an average length of wasted mophometric that is 13.02 cm, width 2.26 cm, and weight 36 g. According to [Doherty & McCarthy \(2004\)](#) states that components that have the same coefficient are an indication of size variation and components that have positive and negative coefficients are indicative of shape variations. Normal salinity of water ranges from 28-32 ([Perainginangin et al., 2015](#)). The pH value in normal waters is between 7.6-8.4 ([Nursaiful, 2004](#)). The basic substrate is the main factor affecting the life, development and diversity of Macrozoobenthos ([Hynes, 1976](#)).

## CONCLUSION

Based on the results of the futile morphometric analysis from the island of Nusalaut, it can be concluded that there are variations from each village. Abubu Village with an average waste mophometric length of 12.14 cm, a width of 2.15 cm and a weight of 31.6 g, followed by Akoon Village with an average waste mophometric length of 11.6 cm, a width of 2 .21 cm and a weight of 33.6 g, and the last one is Ameth Village with an average length of wasted mophometric that is 13.02 cm, width 2.26 cm, and weight 36 g.

## REFERENCES

- Ardian, S. D., Putri, R. M. S., & Suhandan, M. (2018). Measurement of yield, morphometric and proximate composition of the characteristics of the caterpillar (*Sipunculus nudus*) from Bintan waters. fishery product technology study program, Faculty of marine and fishery sciences, Raja Ali Haji maritime university.
- Ager, O. (2004). *Aquaculture, the marine life information*. Network for Britain and Ireland.
- Bengen, D. G. (2001). Synopsis of coastal ecosystems and natural resources. Bogor Agricultural Institute: center for the study of coastal and marine resources.
- Culter, E. B. (1994). *The Sipuncula: Their systematic, biology and evolution*. Cornell Univ. Press Ithaca, N. Y: 453 pp.
- Doherty, D., & McCarthy, T. K (2004). Morphometric and Meristic characteristics analyzes of two western Iris Populations of arctic char, *Salvelinus alpinus* (1). *Journal of biology and Environment: proceedings of The Royal Irish Academy*. 104(1), 75-85.
- Haryono. (2001). Variations in morphology and morphometry of dokun fish (*Puntius lateristriga*) in Sumatra. *Journal of Biota*, 1(3), 109-116.
- Hearling, R. (2001). Morphometric studies and food preferences of *Luligo edulis* caught with a "scoop net" in mahia waters on the island of Ambon.
- Hynes, H. B. N. (1976). *The ecology whit of running water*. Liverpool University Press, England.
- Krebs, C. J. (1978). *Ecology of experimental analysis of distribution and abundance*. Second edition. New York: Harper and Row publishers.
- Langer, S., Triphati., & Khajuria. (2013). Morphometric and meristic study of golden mhaser (*Tor putitora*) from jhajar strem India. *Journal of Animal verterinary and Fhishery Sciences*, 1(7), 1-4.
- Mardiana. (2011). Characteristics of fatty acids and cholesterol of crab (*Portunus pelagicus*) due to the steaming process. [thesis]. Bogor: Faculty of Fisheries and Marine Sciences, Bogor Agricultural University.
- Nursaiful, A. (2004). *Marine Aquarium. Self-Help Spreader*. Depok.
- Nontji, A. (2009). Rehabilitation of seagrass ecosystems in coastal resource management. National Workshop I for Seagrass Ecosystem Management. 18 November 2009. Jakarta, Indonesia.
- Odum, E. P. (1999). *Ecology basics*. Gadjah Mada University Prees. Yogyakarta.
- Parker R. (2012). *Aquaculture Science*. New York: Delmar.
- Pamungkas J. 2010. Sipuncula: A controversial marine biota. *Oceana Journal*. 35(1): 7-10. B
- Riniatsih, (2009). Basic substrate and oceanographic parameters as determinants of the presence of gastropods and bivalves in determining the presence of gastropods and bivalves on Sluke Beach, Rembang Regency. *Journal of Marine Science, Department of Marine Science, Faculty of Fisheries and Marine Science, Diponegoro University, Tembalang Campus, Semarang*.
- Rukminasary N., Nadiarti., & Awaludin K. (2014). The effect of the degree of acidity (pH) of seawater on the concentration of calcium and growth rate of *Halimeda* sp. *Torani: Journal of Marine and Fisheries Science*, 24(1), 28-38.
- Romimohtarto, K., & Juwana, K. (2009). *Marine Biology*. Jakarta : Bridge.
- Sary. (2006). *Lecture Materials on Water Quality Management*. Vedca Polytechnic. Cianjur.
- Silaban B, (2012). Chemical composition and utilization of "wasted" sea worms consumed by the people of Nusalaut Island, Central Maluku. *Jurnal Triton* (2), 1-9
- Silaban, R. (2019). Studies on ethnotechnology and the use of waste (*Sipunculus nudus*) of people on the island of Nusalaut, Central Maluku district.
- Tree of Life Web project. 2008. *Sipuncula. Peanut worms*. January 09 2008 (temporary), <http://tolweb.org/sipuncula/2487/2008..>
- Trueman, E. R., & Foster-Smith, R. L (2009). "The mechanism of brouwing of *Sipunculus nudus*". *Journal of zoology*.
- Turan, C. (1998). A note on the examination of morfometric deference among fish populations: The truss system. *Journal of The University of Mutafa Kemal, Faculty of Fhisheries, Hatay-Turkey*
- Tzen. T-D., Chiu, C-S., & Yeh, S-Y. (2000). Morphometric variation in red-spot prawn (*Metapenaeopsis barbata*) in different geographic waters of Taiwan. *Journal of Fisheries Research*, 53, 211-217
- Zhang C. X., Zi R. D., & Qiu X. C. (2011). Anti-inflamantory and anti-nonceptive activities of *Sipunculus nudus* L. extract. *Journal of Ethnopharmacology*, 137(1), 1177-1182.



**Research Article**

**Fat levels analysis of mantis shrimp (*harpiosquilla raphidea*) in the intertidal zone in the waters of the state of Suli, Central Maluku**

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**ABSTRACT**

Mantis shrimp (*Harpiosquilla raphidea*) is a type of predatory shrimp. Mantis shrimp is a type of crustacean with high nutritional value, but it is not widely known by the people of Eastern Indonesia, especially the people of Suli. This research was conducted in May 2021 and was tested for fat content at the Basic Chemistry Laboratory, Pattimura University, Ambon, with the type of descriptive research. This study used the Soxhlet method, which is the method used for fat extraction with N-Hexane as a fat solvent. The results of this study showed that the fat content of white mantis shrimp was 3.33% and black mantis shrimp was 5.56%. The fat content of white mantis shrimp is 3.33% and black mantis shrimp is 5.56%.

**Keywords:** mantis Shrimp, fat

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**INTRODUCTION**

Maluku waters are waters rich in benthic organisms. This type of organism is widely used by the population for food needs and can provide impetus to find new fishery resources at sea. The existence of these resources certainly provides special hope for people living in coastal areas to utilize these resources for consumption (Supusepa, 2018). Food is anything that comes from biological sources and water, which is intended as food or drink for human consumption. Food or food consumed basically functions as a source of energy, maintains or replaces damaged body cell tissue, regulates metabolism and regulates various balances and plays a role in the body's defense mechanism against various diseases. Foods that contain water, vitamins, minerals, calories, and carbohydrates are often found in fruits, vegetables and fish. Marine animals that have broad potential to support human nutritional needs other than fish are shrimp (Pujawan et al., 2012).

There are many types of shrimp including jerbung shrimp (*Penaeus merguensis*), Flower shrimp (*Penaeus sp*), tiger shrimp (*Panaeus monodon*), giant prawn (*Machrobrachium sp*), dogol shrimp (*Metapenaeus monoceras*), brushfan shrimp (*Panulirus sp*), shrimp corallbarong (*Panulirus sp*) and mantis shrimp (*Harpiosquilla raphidea*). The type of shrimp that can be used by the community as food but is not widely known



is mantis shrimp. Mantis shrimp has the potential to be used as a source of community nutrition (Astuti & Arestyani, 2013). Mantis shrimp is a type of marine crustacean that is very popular for consumption. Mantis shrimp is a predatory shrimp capable of attacking prey five times larger than its body size. The body surface of the mantis shrimp is yellowish (Astuti & Arestyani, 2013). Fat is a group of organic bonds consisting of the elements Carbon (C), Hydrogen (H) and Oxygen (O) which have properties that can dissolve in certain solvents. The function of fat is as a producer of energy and as a builder or shaper of the body composition (Mamat et al., 2014).

## METHODS

The type of research used in this research is descriptive, which aims to reveal the results of the analysis of the fat content of mantis shrimp in the waters of the State of Suli and its implementation in animal physiology courses. Fat content analysis of mantis shrimp (*Harpiosquilla raphidea*) in the intertidal zone. The sampling location was in Suli Village and the fat content analysis was carried out at the Basic Chemistry Laboratory of the Faculty of Mathematics and Natural Sciences, Pattimura University. Time This research was conducted on May 1 – May 31, 2021 with the research location of the Laboratory of Basic Chemistry, FMIPA, Pattimura University and used a descriptive type of research that aims to determine the fat content of mantis shrimp in the intertidal zone.

## RESULTS AND DISCUSSION

Based on the table above, it is explained that the fat content of each sample is different. The white mantis shrimp sample had an average fat content of 3.33%, and the black mantis shrimp sample had an average fat content of 5.56%. The highest fat content in black mantis shrimp is around 5.56%. However, the difference between white mantis shrimp and black mantis shrimp was around 2.23%. When compared with white mantis shrimp (*Harpiosquilla raphidea*) and black mantis shrimp (*Harpiosquilla raphidea*), the black mantis shrimp (*Harpiosquilla raphidea*) has a higher fat content of 5.56%.

**Table 1.** The results of the analysis of the fat content of the mantis shrimp

type of Mantis Shrimp	Fat level (%)		Average Fat Content (%)
	U <sub>1</sub>	U <sub>2</sub>	
White Mantis Shrimp	3,3641	3,2960	3,33
Black Mantis Shrimp	5,6429	5,4832	5,56

The fat content of mantis shrimp (*Harpiosquilla raphidea*) was analyzed using the Soxhlet method which was carried out at the Basic Chemistry Laboratory, Pattimura University, Ambon. The comparison of the fat content of white mantis shrimp and black mantis shrimp. The fat content of the white mantis shrimp is 3.33%, while the fat content of the black mantis shrimp is 5.56%. Black mantis shrimp fat is higher than white mantis shrimp fat. Data on the average fat content of white mantis shrimp (*Harpiosquilla raphidea*) and black mantis shrimp (*Harpiosquilla raphidea*) can be seen in table. It can be said that the average fat content of white mantis shrimp and black mantis shrimp is different. The fat content of white mantis shrimp at 3.33% and black mantis shrimp at 5.56% is quite small when compared to the previous study by Situmeang (2017) the fat content of 12.35%. The fat content of mantis shrimp varies greatly depending on the type, age level, habitat and feed. The total fat content of sea shrimp is not different from that of shrimp in fresh water, which is 1.0-1.1 grams (Gazali. et al., 2020).

## CONCLUSION

Based on the results it can be concluded that the fat content of white mantis shrimp and black mantis shrimp meat is 3.33% and 5.56%, respectively.

## REFERENCES

- Astuti I. R., & Arestyani, F. (2013). Potential and economical prospects of mantis shrimp in Indonesia. *Aluaculture Media*, 8(1), 52-59.
- Gazali Muhammad Tengku, Sitinjak. G. R. F., Simanulang, W. (2020). Description and chemical composition of the meat and carapace of the rama-rama shrimp (*Thalassina anomala*). *Journal of Fisheries and Marine Affairs*, 25(2), 138-144.

- Mamat Primary, Muakkir Baits, Nurutl. (2014). Analysis of protein and fat levels in smoked julung fish (*Herminampus far*). Originating from Kayua District, North Maluku, using the Kjeldhal and Gravimetric methods. *As-syifa*, 06(02), 178-186.
- Situmeang, N. S., Purnama, D., & Hartono, D. (2017). Structure of the Mantis Shrimp (Stomatoda) Community in Bengkulu City Waters. *Enggono Journal*, 2(2), 2-3.
- Supusepa, J. (2018). Inventory of types and potentials of gastropods in Suli Country and Tial Country. Department of Marine Science. Faculty of Fisheries and Marine Sciences, University of Pattimura.



**Research Article**

## Application of the science model community-based problem solving technology in improving learning outcomes, science process skills, and students scientific attitudes

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### ABSTRACT

The STS (science technology and society) learning model teaches students to pay attention to problems that then emerge as other impacts of the use of new technologies in social life. Whereas the Problem Solving learning model teaches students to be trained in problem-solving using creative ways. The purpose of this study was to analyze the effect of the application of STS based problem-solving learning models on the learning outcomes, science process skills, scientific attitude of senior high school 6 Ambon. The research was conducted from January to February 2020. The research design was a quasi-experimental study using a non-equivalent group design. Data were analyzed using descriptive and inferential statistics using the ANCOVA and ANOVA tests. Descriptive statistics are used to explain the range of research data on cognitive learning outcomes, science process skills, and scientific attitudes in the table. ANCOVA test is used to analyze the effect of learning models on cognitive learning outcomes. ANOVA test is used to analyze the effect of learning models on scientific process skills and scientific attitudes. The results showed that the distribution of cognitive learning outcomes, science process skills, and scientific attitudes of students in the experimental class taught using STS based problem solving learning models were better than students taught using conventional learning models (STAD). ANCOVA statistical test shows that the significant value is 0,000 <0.05. This shows that the learning model influences students' cognitive learning outcomes. ANOVA statistical test showed that the significant value was 0,000 <0.05. This shows that the learning model influences the science process skills and scientific attitude. The stages in the STS based problem solving learning models can accommodate cognitive learning outcomes, process skills, and scientific attitudes of senior high school 6 Ambon on Environmental Friendly Technology material.

**Keywords:** *problem solving, learning outcomes, science process skills, scientific attitudes*

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### INTRODUCTION

The learning science, teachers need to apply technology according to the needs of students in the community. In connection with one of the important objectives of learning science, namely the emergence of individuals who are always

responsive to the development of science and technology, as well as sensitive to social issues that arise as a result of these developments. So, one of the learning approaches, namely Science, Technology and Society (STS) needs to be applied in studying science. The (STS) approach in learning can certainly accommodate this important goal, because in this (STS) (science technology and society approach) approach, students are also taught to pay attention to problems that then arise as another impact of the use of new technologies in social life. The impact of the development of science and technology here is not only a negative impact, but also a positive impact. It should be noted that science and technology and society have a reciprocal relationship and influence each other. According to [Mansour \(2009\)](#) (STS) is an interdisciplinary field of study that seeks to explore and understand the many ways modern science and technology shape modern culture, values and institutions on the one hand, and on the other hand how modern values shape science and technology. [Kapici et al. \(2017\)](#) in his research explains that science, technology and society strategies involve students' ideas and include consideration of various points of view, collaborative investigation, and problem solving. In addition to these two explanations, the science curriculum also contains relevant scientific concepts and processes that can be found in everyday life.

In realizing the goals of science education, it is very necessary to enrich knowledge; implementation of constructive learning, collaborative inquiry, problem solving; improvement and innovation of the learning process ([Satria, 2018](#); [Kapici et al. 2017](#)). The science, technology and society (STS) approach carries the theory of constructivism, where in this approach students build their own understanding of learning materials. In addition, this STS approach also accommodates a contextual teaching and learning approach, where students are directly invited to understand science according to real conditions that occur in their surrounding environment. Through the STS approach, the environment is not only in the form of a physical environment where students can study abiotic natural phenomena (non-living things) and biotic natural phenomena, but also study their impact on the community environment. [Smitha & Aruna \(2014\)](#) make it clear that STS accepts the responsibility to increase interaction with the community and then has a responsibility to future generations to provide knowledge and technology that have a long-term impact on future generations. [Simiti \(2017\)](#) adds that technology is part of applied science that transforms understanding and discovery of science into applications for society.

Therefore, when practicing the STS approach, teachers must be able to encourage students to design technology that can be applied and beneficial to society. One of the benefits for the people of Maluku today is an electric mosquito repellent. The manufacture of this simple technology is based on the community's need for a mosquito repellent that is easy to use but safe for the environment. Mosquitoes disturb people's lives through epidemics that are transmitted through bites. One solution to prevent mosquito bites is to use electric mosquito repellent. This type of insect repellent does not emit smoke or leave chemical particles on the furniture in the room. One of the materials that can be used in the manufacture of mosquito repellent or natural larvicides is to utilize organic waste in the form of seeds and fruit skins from the genera *Lansium*, *Nephelium* and *Durio*. Organic waste is considered to have a higher level of safety because it is easily biodegradable in nature so that it does not pose a serious residue hazard and is certainly more selective by not poisoning living things and other environments that are not targeted ([Kardinan, 2005](#)).

Maluku province is generally a fruit-producing area. In fact, every year there are always fruits of the genus *Lansium*, *Nephelium* and *Durio* abundantly from various villages in Maluku and Ambon city. This has many positive impacts for the community, but on the other hand it also has an unfavorable impact on environmental cleanliness. One of the negative impacts of the presence of seeds and fruit peels in the Ambon city area is the volume of waste that accumulates. This happens because most people, in this case are traders and fruit consumers, just throw away the seeds and skin. If not managed properly, the seed and skin waste will cause problems for the environment, namely making the environment dirty and causing unpleasant odors. To overcome this problem, there is a need for innovation in organic waste management by involving the wider community so that organic waste can be utilized into products of economic value and high volume of organic fruit waste, it is necessary to carry out research activities aimed at increasing added value for durian and *langsas* skin waste through processing into electric mosquito repellent.

The results of research that has been carried out by [Santi \(2011\)](#) revealed that one of the potentials of durian and *langsas* skin is the high content of essential oils. Durian peel essential oil contains flavonoid compounds, saponins, and polyphenols which are toxic to pests and mosquitoes so that they can be used as environmentally friendly vegetable pesticides ([Asmaliyah et al. 2010](#)). While the research conducted by [Mirawaty et al. \(2012\)](#) that electric mosquito repellent made from *langsas* fruit peel extract with several concentrations was able to kill *Aedes aegypti* mosquitoes and the concentration of *langsas* peel extract which was most effective in killing *Aedes aegypti* mosquitoes was 25%. [Riyadi et al. \(2018\)](#) also reported the same results, namely the potential of rambutan seeds as natural larvicides in *Aedes aegypti* mosquito larvae.

So far, the teaching and learning process that has taken place at Junior high school 6 Ambon has not applied the STS approach in a real way to the community. The STS approach used is still theoretical in the classroom, but has not

been able to create products that are beneficial for the survival of the community. At the same time, durian and langsat are currently abundant in the market. Therefore, the manufacture of electric mosquito repellent products using simple technology is very appropriate. If students have experienced this STS-based learning process, students can have complete science process skills. According to [Rauf et al. \(2013\)](#) teachers must be able to use various learning approaches in order to be able to develop science process skills. These science skills are very important in science learning because they serve as the basis for developing other cognitive abilities such as logical thinking, reasoning, and problem solving skills. In addition, according to [Siahaan et al. \(2017\)](#) science process skills not only focus on the transfer of knowledge, but also emphasize the investigation process to solve problems in real-life situations. As long as students complete the investigation process and develop scientific skills, students have actually taken the steps of the scientific method framed in a problem solving-based STS approach. Because process skills are related to the scientific method, scientific work also contributes to these scientific process skills.

If the use of organic waste from fruit peels into an effective and efficient electric mosquito repellent product is carried out by students, then the next step that can be done is to develop teaching materials based on superior products produced by students. This is related to research innovations that are produced to take advantage of the potential of regional superior products, in an effort to overcome inequality and realize justice and improve the welfare of the community. Based on this, one of the superior products besides being used by the community can also be developed for class VIII students who study the concept of environmentally friendly technology. Based on these explanations, the community science technology approach can be combined with problem solving strategies so as to improve student learning outcomes, science processing skills and students' scientific attitudes in the process of processing organic waste into electric mosquito repellent products in science class students of Junior high school 6 Ambon.

## METHODS

This study uses a quasi-experimental type of research because in this study the character, motivation, hobbies, origin of the students cannot be uniformed or conditioned to be the same. The research design used is the non-equivalent group design (Table 1).

**Table 1.** Research design

E	Y1	X1	Y2
K	Y1	X2	Y2

Information:

- E : experimental group
- P : control group
- Y1 : pretest
- Y2 : posttest
- X1 : acombination of problem solving-based STS models
- X2 : conventional learning strategies

Population in this study were all students of class IX Jonior high school 6 Ambon in the 2018/2019 academic year. The sample in this study were students in grades IX<sub>1</sub> and IX<sub>2</sub>. One class as a control class while the second class as an experimental class. Class selection is done randomly using lottery. This research used test and non-test instruments. The instruments developed are in the form of test questions and scoring rubrics. Items are prepared referring to competency standards in accordance with the provisions. The items compiled are essay questions that are used to measure problem solving abilities and students' cognitive learning outcomes. The next instrument to be developed is the rubric. The rubric developed in this study is a list of criteria used to measure test results. There are 2 kinds of rubrics developed, namely the science process skills rubric and scientific attitude. The problem solving-based STS learning model is carried out with the following steps: (1) problem identification, (2) choosing factual problems, (3) analyzing solutions to solve problems, (4) finding solution information, (5) implementing solutions , (6) product evaluation. Meanwhile, conventional learning is carried out according to the stages usually carried out by teachers.

Data analysis used inferential statistics, namely ANCOVA and ANOVA tests. ANCOVA test was used to determine the effect of problem solving based STS learning model and conventional learning model on cognitive learning outcomes. The ANOVA test was used to determine the effect of the problem solving-based STS learning model and the conventional learning model on the process skills and scientific attitudes of students. If the criteria for probability or significance value <0.05, it can be said that there is an influence between the independent variables on the dependent variable partially, but if the significance is >0.05, it can be said that there is no significant effect between each

independent variable on the dependent variable. Before the ANCOVA and ANOVA analyzes were carried out, a prerequisite test was performed using the normality and data homogeneity tests. For data analysis, the SPSS program was used.

## RESULTS AND DISCUSSION

### Student cognitive learning outcomes

Cognitive learning outcomes of students in problem solving-based and conventional STS classes consist of pre-test and post-test (Tables 2 and 3).

**Table 2.** Cognitive learning outcomes of students in conventional class

Pre-Test			Post-Test		
Interval	Frekuensi	Frekuensi Relative	Interval	Frekuensi	Frekuensi Relative
8-13	1	2.941	40-48	1	2.941
14-19	1	2.941	49-57	2	5.882
20-25	11	32.35	58-66	7	20.59
26-31	18	52.94	67-75	7	20.59
32-37	2	5.882	76-84	11	32.35
38-43	1	2.941	85-93	6	17.65
Total	34	100	Total	34	100

**Table 3.** Cognitive learning outcomes of students in problem solving-based STS class

free-test			Post-test		
Interval	Frekuensi	Frekuensi Relative	Interval	Frekuensi	Frekuensi Relative
16-22	1	3.125	83-85	1	3.125
23-29	4	12.5	86-88	0	0
30-36	8	25	89-91	0	0
37-43	12	37.5	92-94	3	9.375
44-50	6	18.75	95-97	13	40.625
51-57	1	3.125	98-100	15	46.875
Total	32	100	Total	32	100

Measuring cognitive learning outcomes, students are encouraged to show their best abilities. The results of the descriptive analysis in Table 2 and Table 3 show an increase learning outcomes using both problem solving-based and conventional STS models. This is in accordance with the opinion of [Hadijah & Anggereni \(2016\)](#) that evaluation of learning outcomes is carried out to measure the magnitude of behavioral changes obtained by students in completing learning objectives.

### Students' science process skills

The ability of students' science process skills in problem solving and conventional elementary classes was observed during the learning process (Table 4).

**Table 4.** Students' science process skills in problem solving and conventional STS class

Conventional			Experiment		
Interval	Frekuensi	Frekuensi Relative	Interval	Frekuensi	Frekuensi Relative
58-59	21	61.76	83-84	12	37.5
60-61	0	0	85-86	0	0
62-63	0	0	87-88	0	0
64-65	0	0	89-90	0	0
66-67	13	38.24	92-92	20	62.5
Total	34	100	Total	32	100

Students' science process skills in problem solving and conventional (STAD) based STS classes are carried out during the learning process. Science process skills are a process of carrying out scientific activities related to science to understand phenomena that occur in society (Pardhan, 2000; Rustaman & Nuryani, 2014). The results of the descriptive analysis in Table 3 show that the problem solving-based STS students' science process skills are better than conventional learning (STAD), this happens because the problem solving-based STS learning syntax is able to accommodate students' science process skills.

### **The effect of learning models on students' cognitive learning outcomes, process skills, and scientific attitudes** **Prerequisite Test**

Prior to the analysis for testing the hypothesis, the normality and homogeneity of the data were first tested. The normality test of the data used the One Sample Kolmogorov-Smirnov Test, the results showed that the data were normally distributed (Table 6). The homogeneity test of the data used Leven's Test of Quality of Error Variances, the results showed that the data came from a homogeneous population (Table 5).

**Table 5.** Data normality test

Dependent variable	Kolmogorov Smirnov			Level of confidence	Information
	Statistic	df	Sig.		
Cognitive learning outcomes	1.617		.111	α=0.05	Normal
Science process skills	1.603		.092		
Scientific attitude	1.852		.062		

**Table 6.** Data homogeneity test

Dependent variable	Levene' Test			Tingkat Kepercayaan	Information
	Statistic	df	Sig.		
Cognitive learning outcomes	2.579		.310	α=0.05	Homogen
Science process skills	.015		.904		
Scientific attitude	2.681		.060		

### **Hypothesis**

The results of ANCOVA and One Way ANOVA tests to determine the effect of problem solving-based STS models and conventional learning models on cognitive learning outcomes, science process skills, and scientific attitudes are shown in Table showed that F value was 44,476 with a significant value of 0.000 <0.05. Based on these results, there is an effect of the learning model on the cognitive learning outcomes of students on environmentally friendly technology materials in class IX science senior high school 6 Ambon. In addition, the results of the LSD test (Table 9) show that there is a notation difference between the conventional learning model (STAD) (notation a) and the problem-solving-based STS learning model (notation b) on the cognitive learning outcomes of senior high school 6 Ambon. This proves that students who are taught using the problem solving-based STS learning model have better cognitive learning outcomes than students who are taught using the conventional model.

**Table 7.** Hypothesis testing of cognitive learning outcomes for senior high school 6 Ambon

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected model	9721.228 <sup>a</sup>	2	4860.614	52.350	.000
Intercept	14693.101	1	14693.101	158.249	.000
pre_test	79.943	1	79.943	.861	.357
model_pembelajaran	4129.503	1	4129.503	44.476	.000
Error	5849.439	63	92.848		
Total	488688.000	66			
Corrected total	15570.667	65			

**Table 8.** LSD test of cognitive learning outcomes for senior high school 6 Ambon students

Class	Mean	Notation LSD
Control (STAD)	72.9412	a
Experiment (STS-based problem solving)	97.1250	b

The results of the study (Table 7) show that the learning model has an effect on students' cognitive learning outcomes, and the results of the LSD test (Table 8) also show that there is a notation difference between the problem solving-based STS learning model and the STAD model (in the control class) on students' cognitive learning outcomes. Research conducted by [Subekti \(2017\)](#) shows that the application of problem solving learning models in science learning has succeeded in changing teaching activities that are teacher centered to student centered. According to [Purwanti & Manurung \(2015\)](#), problem solving provides experiences for students to solve problems, develop responses, and improve students' thinking process. [Akcaay & Akcaay \(2015\)](#) explained that learning using the STS model helps students understand science concepts, students have the opportunity to choose real problems for investigative activities, also helps teachers use more explicit teaching methods than traditional learning. According to [Nworgu & Yager \(2004\)](#) the focus of STS learning is that students can construct science concepts, solve common problems in everyday life using technology, and clearly demonstrate new uses for this knowledge.

Based on the findings of this study, it is known that the STS and problem solving learning models have the same focus, namely problem solving and can improve student learning outcomes. Therefore, the problem solving-based STS learning model in this study was also able to improve student learning outcomes compared to the learning model commonly used by teachers (STAD). In addition, the results of the LSD test (Table 9) show that there is a difference in notation between problem solving and conventional STS based learning models. This shows that the problem solving-based STS learning model has the advantage of different learning stages when the STS learning model and problem solving stand alone in the lesson plan. The learning stages in question are identifying problems, choosing factual/real problems, analyzing solutions to solve problems, seeking information to obtain solutions, implementing solutions, and evaluating products.

Through the stages of identifying and selecting problems students are given the experience to study, collect and then select contextual problems related to the concept of environmentally friendly technology. According to [Sastiawan et al. \(2019\)](#) students are able to identify problems because students are given the opportunity to observe directly on learning resources. The stages of analyzing solutions to solve problems help students to understand science concepts to solve problems that have been formulated by students, in addition to science concepts, students also combine science concepts with technology to solve these problems. [Agustini et al. \(2013\)](#) explained through analytical activities helping students to compare results with existing theories to reach the right solution, so that students' mastery of concepts can be achieved at this stage of analysis. [Dwipayana \(2017\)](#) also adds that problem solving skills can provide new experiences for students. Therefore, Problem Solving-based STS learning can provide new experiences for students such as problem identification and problem solving skills so as to improve student learning outcomes compared to conventional learning.

The results of the ANOVA test (Table 10), showed that F value was 719,665 with a significant value of 0.000 < 0.05. Based on these results, there is an effect of the learning model on the value of the science process skills of students on Environmentally Friendly Technology in class IX Science Senior high school 6 Ambon. In addition, the results of the LSD test (Table 11) show that there is a notation difference between the conventional learning model (STAD) (notation a) and the problem solving-based STS learning model (notation b) on the science process skills of senior high school 6 Ambon students. This proves that students who are taught using the problem solving-based STS learning model have better science process skills scores than students who are taught using the conventional model.

**Table 9.** Hypothesis of science process skills for senior high school 6 Ambon

Source	sum of squares	df	Square mean	F	Sig.
Between groups	12029.894	1	12029.894	719.665	.000
In Group	1069.821	64	16.716		
Total	13099.715	65			



**Table 10.** LSD test of science process skills for senior high school 6 Ambon

Class	Mean	Notation LSD
Control (STAD)	61.4735	a
Experiment (STS problem solving)	88.4875	b

The results of the study (Table 9) show that the learning model has an effect on students' science process skills, and the results of the LSD test (Table 10) also show that there is a notation difference between the problem solving-based STS learning model and the STAD model (in the control class) on science process skills. student. Santi's research (2014) reports that science process skills can be improved using the STS learning model. The research of Guritno et al. (2015) reported that problem solving learning can improve student learning outcomes. This is in accordance with the findings in this study that the problem solving-based STS learning model can affect students' science process skills. Indicators that appear when learning using the problem solving-based STS learning model are observation, prediction, classification and communication. Observation indicators appear during the problem identification stage. At this stage the teacher invites students to make observations in the real world of students related to contextual phenomena that occur.

According to Lu et al. (2016), the observation step on process skills is an early stage that can improve science process skills, this is because at the observation stage students can ask questions and formulate hypotheses well. Agustina & Saputra (2016) reported that the calcification stage is one of the advanced stages when students make observations. The classification of the findings of this study is that students can classify problems and solutions according to their type. After that the skills that appear next during the learning process are communication skills. Communication skills are used to present products that have been made by students. According to Lepiyanto (2014) communication activities can be raised in situations of communicating the results of observations, and when explaining the results of observations to other students. According to Osman et al. (2007) the biology learning process can shape students' conscious attitudes towards science and technology as a whole through the right learning process. One of the learning processes applied is the problem solving-based STS learning model.

ANOVA test (Table 12), shows that the F value is 151,811 with a significant value of 0.000 <0.05. Based on these results, there is an effect of the learning model on the scientific attitude of the students of class IX Science senior high school 6 Ambon. In addition, the results of the LSD test (Table 13) show that there is a difference between conventional notation (STAD) (notation a) and problem solving-based STS learning model (notation b) on the scientific attitudes of high school 6 Ambon senior students. This proves that students who are taught using the problem solving-based STS learning model have a better scientific attitude than students who are taught using the conventional model.

**Table 11.** Hypothesis of scientific attitude of senior high school 6 Ambon students

Source	sum of squares	df	Square mean	F	Sig.
Between groups	7481.077	1	7481.077	151.811	.000
In Group	3153.850	64	49.279		
Total	10634.926	65			

**Table 12.** LSD test of scientific attitude of senior high school students 6 Ambon

Class	Mean	Notation LSD
Control (STAD)	63.9971	a
experiment (STS Problem solving)	85.3000	b

The results of the study (Table 11) show that the learning model has an effect on students' scientific attitudes, and the results of the LSD test (Table 12) also show that there is a notation difference between the problem solving-based STS learning model and the STAD model (in the control class) on students' scientific attitudes. Mandra's (2012) proves that there are differences in the scientific attitudes of students who are taught using the STS learning model and students who use conventional learning models. Meanwhile, research by Rahmawan et al. (2016) showed that the application of problem solving learning models can increase students' curiosity in learning. Some of these studies show that the STS learning model and problem solving learning model can improve students' scientific attitudes in the learning process.

Therefore, the findings in this study using the problem solving-based STS learning model can affect students' scientific attitudes compared to conventional learning. The scientific attitude in this research consists of indicators of curiosity, critical, perseverance, creative, honest, open-minded, and cooperative. The stages of identifying problems in the problem solving-based STS learning model can foster student curiosity and be critical of the selection of contextual

problems to be solved by students. According to Hunaepi (2016), students' scientific attitudes, especially curiosity, are formed through observations of contextual phenomena based on local wisdom. Meanwhile, Yudhayanti et al. (2015) explained that students who have a high scientific attitude have a positive contribution to curiosity, so they are more active in asking and knowing more than other students. Scientific attitude, perseverance, open-mindedness, honesty and cooperation during learning are needed at the stage of analyzing solutions to solving problems and seeking information. According to Anwar (2009), an open-minded attitude shows that students have a habit of listening to opinions, arguments, and even criticism from other friends. Through an honest, diligent and open-minded attitude, you can cultivate a good cooperative attitude. According to Sukaesih (2011), optimal cooperation between group members in the group provides the opportunity for group members to interact with friends who are more capable. Research by Akpinar et al. (2009) proved that scientific attitudes have an influence on students' views about science and technology.

## CONCLUSION

Based on the research that has been done, it can be concluded that the problem solving-based STS model has an effect on improving cognitive learning outcomes, science process skills, and scientific attitudes of students of class IX Science senior high school 6 Ambon. This is related to the learning stages of the problem solving-based STS model, namely identifying problems, choosing factual/real problems, analyzing solutions to solve problems, seeking information to obtain solutions, implementing solutions, and evaluating products.

## REFERENCES

- Agustini, D., Subagia, I. W., & Suardana, I. N. (2013). The effect of social science technology learning model on material mastery and student problem solving skills in science subjects at MTS. Patas Country. *Journal of Graduate Program Ganesha University of Education Science Education Study Program*, 3(3):1-10.
- Agustina, P., & Saputra, A. (2016). Analysis of basic science process skills for prospective biology teacher students in the plant anatomy course (case study of biology education study program students UMS 2015/2016 Academic Year. *National Seminar on Science Education*, 71-78
- Akcay, B., & Akcay, H. (2015). Effectiveness of Science-Technology-Society (STS) Instruction on Student Understanding of the Nature of Science and Attitudes toward Science. *International Journal of Education in Mathematics, Science and Technology*, 3(1): 37-45.
- Akpinar, E., Yildiz, E., Tatar, N., & Ergin, O. (2009). Student' attitudes towards science and technology: an investigation of gender, grade level, and academic achievement. *Procedia Social and Behavior Sciences I*, (2009), 2804-2808.
- Anwar, H. (2009). Scientific attitude assessment in science learning. *Journal of the Rainbow Science*, 2(5), 103-114.
- Asmaliyah, Wati, E. E., Utami, S., Mulyadi, K., Yudhistira., & Sari, F. W. (2010). Introduction of plants producing botanical pesticides and their traditional uses. Ministry of Forestry Forestry Research and Development Agency Center for Forest Productivity Research and Development.
- Dwipayana. (2017). The influence of the social science technology learning model on the problem solving ability and self-efficacy of students. *Scientific Journal of Education and Learning*, 1(2), 100-109.
- Guritno, T. A. M. R., Masykuri, M., & Ashadi. (2015). Chemistry learning through problem solving and guided inquiry models is viewed from the basic science process skills and scientific attitudes of students. *Journal of Inquiry*, 4(2), 1-9.
- Hadijah., & Anggereni, S. (2016). Development of a test instrument for cognitive learning outcomes for physics subjects on the topic of momentum and impulse in class XI high school. *Journal of Physical Education*, 4(1), 30-34.
- Hunaepi. 2016. Literature review on the importance of scientific attitude. Proceedings of the 2016 National Science and Mathematics Education Study Center Seminar "Assessment of Higher Order Thinking Skills", Mataram, 12 March 2016:548-550.
- Kapici, H. O., Akcay, H., & Yager, R. E. (2017). Comparison of science-technology-society approach and textbook oriented instruction on students' abilities to apply science concepts. *International Journal of Progressive Education*, 13(2), 18-28.
- Cardinan, A. (2005). Mosquito repellent and insect repellent. Depok: AgroMedia Pustaka.
- Lepiyanto, A. (2014). Analysis of science process skills in practicum-based learning. *Bioeducation*, 5(2), 156-161.
- Lu, S. S., Handayani., Suciati., & Marjono. (2016). Improving science process skills in biology learning through the application of the bounded inquiry lab model. *Bioeducation*, 9(2), 49-54.
- Mansour, N. (2009). Science-Technology-Society (STS): A new paradigm in science education. *Bulletin of Science, Technology and Society*, 29(4), 287-297.
- Mirawaty., Supriadi, J., & Jaya, B. (2012). Test the effectiveness of Langsat skin extract (*Lansium domesticum*) as an electric mosquito repellent against the *Aedes aegypti* mosquito. *Journal of Academic Chemistry*, 1(4), 147-152

- Nworgu, B. G., & Yager, R. E. (2004). The STS constructivist reform: some discordant notes. *African Journal of Educational Studies in Mathematics and Sciences*, 2(1), 19-25.
- Osman, K., Iksan, Z. H., & Halim, L. (2007). Attitudes towards science and scientific attitudes among science students. *Journal of Education*, 32, 39-40.
- Pardhan, H. (2000). Experiencing science process skills. Alberta : CMASTE.
- Purwanti, S., & Manurung. (2015). Analysis of the effect of problem solving learning models and scientific attitudes on physics learning outcomes. *Journal of Physical Education*, 4(1), 57-62.
- Putri, A.T., Idrus, I., & Yennita. (2017). Correlation analysis of scientific attitudes and students' cognitive learning outcomes through the PBL model. *Diklabio: Journal of Biology Education and Learning*, 1(1), 1-9.
- Rahmawan, A. A., Utomo, S. B., & Sukardjo, J. S. (2016). Application of problem solving learning model to increase curiosity and achievement in learning chemistry in basic law materials and chemical calculations for students of class X-TP 3 SMK Muhammadiyah 2 Sragen in the 2015/2016 academic year. *Journal of Chemical Education*, 5(3), 92-96.
- Rauf, R.A. A., Rasul, M. S., Mansor, A. N., Othman, Z., & Lyndon, N. (2013). Inculcation of science process skills in a science classroom. *Asian Social Science*, 9(8), 47-57.
- Riyadi, Z., Julizar., & Rahmatini. (2018). Effectiveness test of ethanol extract of rambutan seeds (*Nephelium lappaceum* L.) as a natural larvicide on *Aedes aegypti* mosquito larvae. *Andalas Health Journal*, 7(2), 233-239.
- Rustaman, Y., & Nuryani. (2005). *Biology Teaching and Learning Strategy*. Malang: UM PRESS
- Sastiawan, R., Ruyani, A., & Karyadi, B. (2019). Problem solving abilities in class X MA Suka Negeri Begkulu Selatan students through environment-based learning. *Pendipa: Journal of Science Education*, 3(1), 84-89.
- Satria, E. (2018). Projects for the implementation of science technology society approach in basic concept of natural science course as application of optical and electrical instruments' material. *Journal of Physics*, 983, 1-6.
- Santi, D. K. (2014). Improving process skills and science learning outcomes using the Science Technology Society (STS) learning model for class VI students of SDN 1 Kalinanas-Wonosegoro. *Scholaria*, 4(3), 122-131.
- Santi, L. Y. (2011). The effectiveness of durian peel extract (*Durio zibethinus* Murr) as a mosquito control *Aedes* spp. Thesis is addressed to the Faculty of Public Health, University of North Sumatra (USU), Medan
- Siahaan, P., Suryani, A., Kaniawati, I., Suhendi, E., & Samsudin, A. (2017). Improving students' science process skills through simple computer simulations on linear motion conceptions. *Journal of Physics*, 812, 1-5.
- Smith. E. T., & Aruna, P. K. (2014). Effect of science technology society approach on achievement motivation in biology of secondary school students of Kasaragod District. *IOSR Journal Of Humanities And Social Science*, 19(4), 54-58.
- Simiti, M. (2017). Civil society and the economy: Greek civil society during the economic crisis. *Journal of Civil Society*, 13(4), 357-373.
- Subekti, P. (2017). Application of problem solving learning model to improve science learning outcomes for Class V students. *Brilliant*, 2(2), 130-139.
- Sukaesih, S. (2011). Analysis of scientific attitudes and student responses to the application of practicum-based learning models. *Journal of Educational Research*, 28(1), 77-85.
- Yudhayanti, D., Sunarno, W., & Sajidan. (2015). Biology learning with the model of science, technology and society in terms of scientific attitude and creativity. *Journal of Inquiry*, 4(4), 16-25.



**Research Article**

**Bacterial contamination test on plates, spoons, and glass at a food stall (angkringan) Surakarta City, Central Java**

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**ABSTRACT**

Cutlery is an important component that can affect the health of the digestive tract. Plates, glasses and spoons are eating utensils that are often used by the community. In the city of Surakarta, Central Java, there are many roadside food stalls that are in great demand by the community, namely Angkringan. The purpose of this study was to determine bacterial contamination of cutlery (pring, glass and spoon) at a food stall (Angkringan) in Surakarta City, Central Java. This research is a descriptive observational study, bacteriological examination of cutlery begins with swab sampling, bacterial examination using the Total Plate Number method, and confirmed by Gram staining. The results of the examination of the number of bacterial colonies were compared with the standard reference of Permenkes No. 1096/MENKES/PER/VI/2011, which is 0 colonies/cm<sup>2</sup>. The results showed the average bacterial contamination in angkringan food stalls in Surakarta City, as follows: plate 10230 colonies/cm<sup>2</sup>, glass 9560 colonies/cm<sup>2</sup> and spoon 3960 colonies/cm<sup>2</sup>. All cutlery that was inspected did not meet the standards of Permenkes No. 1096/MENKES/PER/VI/2011.

**Keywords:** *bacterial contamination, cutlery, total plate count.*

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**INTRODUCTION**

Cutlery is all kinds of tools used to process and serve food such as plates, spoons, forks, glasses and so on. The cleanliness of cutlery is influenced by washing, drying and storing the cutlery. Cutlery must be clean, free of toxic substances, and free from microorganism contamination (Amanda & Rachmaniyah, 2021). If cutlery is contaminated with bacteria, it can cause infections in the gastrointestinal tract, including gastritis, diarrhea, typhoid, and others (Farah Fadhillah, 2017). Bacteria that contaminate cutlery are *Enterobacter aeruginosa*, *Serratia marcescens*, *Escherichia coli* (Darna et al., 2018), *Proteus mirabilis*, *Salmonella typhosa*, *Shigella dysenteriae*, and *Klebsiella pneumonia*. (Ananda & Khairiyati, 2017). In the city of Surakarta, Central Java Province, there are many street food stalls known as Angkringan, it has become a culture for many people to like to eat at these angkringan because they serve a varied and always warm menu. Bacteriological tests of cutlery need to be carried out to determine the cleanliness of the cutlery from bacterial contamination (Farah-Fadhillah, 2017). The Total Plate Number is the method of choice that can be used to determine bacterial contamination on cutlery (Atimiati, 2012; Inayah & Muharram, 2020; Khaldun & Baharuddin, 2018). Bacterial contamination standards according to Permenkes No. 1096/MENKES/PER/VI/2011 is 0 colony/cm<sup>2</sup>. The purpose of this study was to determine the bacterial contamination of cutlery used by the "Angkringan" stall in the city of Surakarta, Central Java province. Swab with colony growth indicator when planted on agar media.

## METHODS

Type of research is descriptive observational, bacteriological test on cutlery using the Total Plate Number method. The research population is all "Angkringan" food stalls in Surakarta City, Central Java Province, the research technique uses quota sampling, the size of the research sample is 27 samples. cutlery, plates, glasses, and spoons. Sampling was carried out by means of a swab with the following conditions: the plate was swabbed on the inner surface where the food was placed, the spoon was swab on the outer and inner surfaces, the glass was swab on the outer surface of the lip of the glass, with a swab area of 1 cm<sup>2</sup> using a sterile cotton swab, then inoculated into a tube containing 0.9% NaCl which has been labeled (Lado et al., 2020; Marisdayana et al., 2017; Nikmah, 2018). The swab sample that has been obtained, was subjected to bacteriological examination with total plate number, the swab sample was diluted to a dilution of 10<sup>-2</sup>, then inoculated on NA media by pour plate, then incubated at 37°C for 24 hours. After 24 hours the growing bacterial colonies were counted (Novi et al., 2015; Permatasari, 2017). The growing colonies were subjected to gram staining. Gram staining was carried out as confirmation that the colonies growing on NA media were bacterial colonies (Sancoko & Rahmawati, 2019; Tumelap, 2011), using 3 replications.

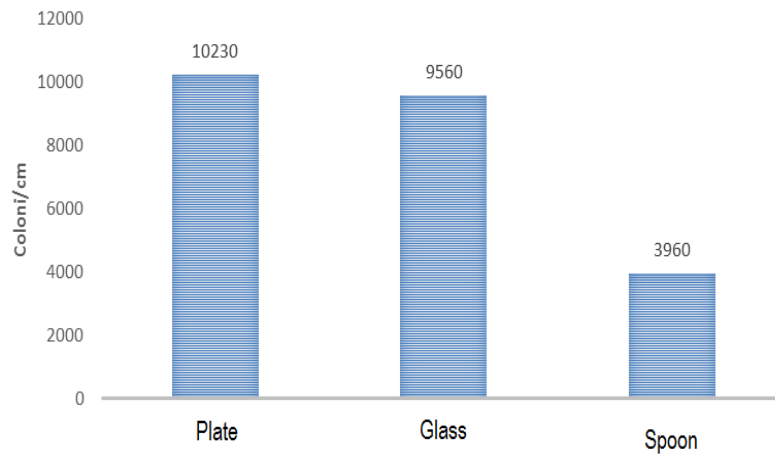
## RESULTS AND DISCUSSION

### Student cognitive learning outcomes

The results of the examination of the number of bacteria on cutlery, plates, glasses and spoons (Figure 1), showed that the highest mean bacterial contamination was found on plates (10230 colonies/cm<sup>2</sup>), then glasses (9560 colonies/cm<sup>2</sup>), and the lowest on spoons (3970 colonies/cm<sup>2</sup>). Bacterial contamination on plates, of the nine samples examined had a fairly large range, namely between 2500 to 38000 colonies/cm<sup>2</sup>, the same thing also happened to bacterial contamination on glasses which had a range between 2400 to 31000 colonies/cm<sup>2</sup>, while on spoons has the smallest range between 1200 to 7200 colonies/cm<sup>2</sup> (Table 1).

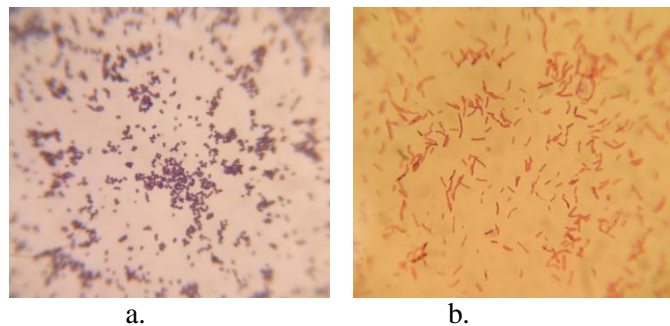
**Table 1.** Number of bacterial colonies on cutlery (plates, glass, and spoons)

Sample	Average number of colonies per sample (100 Coloni / cm <sup>2</sup> )	Average contamination per cutlery (100 Coloni/cm <sup>2</sup> )
Plate	P.1	25
	P.2	140
	P.3	29
	P.4	380
	P.5	31
	P.6	56
	P.7	95
	P.8	117
	P.9	48
Glass	G.1	42
	G.2	48
	G.3	310
	G.4	100
	G.5	130
	G.6	95
	G.7	43
	G.8	24
	G.9	68
Spoon	S.1	72
	S.2	46
	S.3	25
	S.4	68
	S.5	30
	S.6	31
	S.7	45
	S.8	12
	S.9	28



**Figure 1.** Bacterial contamination of cutlery (plates, glass, spoons colonies/cm<sup>2</sup>).

After Gram staining and microscopic examination of each sample, several types of bacteria were found, including Gram-positive bacteria in the form of purple cocci, arranged in clusters, and Gram-negative bacteria with red rods in a scattered arrangement (Figure 2).



**Figure 2.** Microscopic view of bacteria that contaminate cutlery with Gram stain, at an Angkringan in Surakarta City, Central Java (a: Gram positive coccus bacteria, b: Gram negative stem bacteria).

Observations from each of the 9 plates, glasses, and spoons showed that all samples were positive for bacteria. Based on the author's observations, this is due to several factors, including external contaminants, washing factors, and storage. Bacterial contamination of cutlery occurs through dust in the air carrying bacteria and sticking to cutlery. The location of Angkringan is located on the side of the road and is open, some Angkringan are only shaded by a tent roof, this can cause air that carries bacteria to contaminate cutlery and some of the food served. How to wash cutlery is also a factor that determines the contamination of cutlery, in general the Angkringan washes cutlery not with running water, using water that has been stored in a bucket and will only be replaced when the water looks dirty, even though using soap. [Yulianto & Nurcholis \(2015\)](#) stated that the washing medium with running water was better than the washing method with immersion media (tub). This is because in the washing process with running water, all the dissolved dirt will flow without contaminating the cutlery again, while in the soaking process it is possible that the dirt from the rinsing of cutlery will accumulate in the soaking water, thereby contaminating other equipment to be washed.

The results of this study are in accordance with research conducted by [\(Amanda & Rachmaniyah, 2021; Nikmah, 2018; Permatasari, 2017\)](#) which states that eating utensils used in roadside food stalls are generally contaminated with bacteria from various groups, although the type of bacteria is unknown. that pollutes it. [Sancoko & Rahmawati \(2019\)](#) stated that the process of washing and storing cutlery must meet the requirements to always be clean before use. Contaminants left behind due to improper washing of equipment will become a medium for microbial growth. According to [\(Marisdayana et al., 2017; Nikmah, 2018\)](#) eating utensils, especially those in direct contact such as glasses and spoons can cause disease transmission. [Amanda & Rachmaniyah, 2021; Inayah & Muharram, 2020](#) states that eating utensils that are not clean and contain microorganisms can transmit disease through food or what is called foodborne disease.

The results showed that the cutlery used in several angkringan in Surakarta City was not clean and paid less attention to the sanitation of cutlery. For this reason, it is necessary to have basic knowledge about hygiene and sanitation of

cutlery to traders and provide understanding to the public to better maintain cleanliness when eating and drinking at angkringan food stalls. Further research is expected to identify the types of bacteria that contaminate the cutlery.

## CONCLUSION

The results showed that all the cutlery examined were contaminated with bacteria, with the average bacterial contamination as follows: plates 10230 colonies/cm<sup>2</sup>, glasses 9560 colonies/cm<sup>2</sup> and spoons 3960 colonies/cm<sup>2</sup>. Found Gram positive bacteria in the form of coccus and Gram negative in the form of rods. All cutlery (plates, glasses, and spoons) at several angkringan in Surakarta City, Central Java do not meet Minister of Health Regulation No. 1096/MENKES/PER/VI/2011, which is 0 colonies/cm<sup>2</sup>.

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## REFERENCES

- Amanda, Rachmaniyah, R. (2021). Bacteriological quality of cutlery, personal hygiene, and sanitation of coffee shops in Kendangsari Surabaya in 2021. *Journal of Sanitation Hygiene*, 1, 26–32.
- Ananda, B. R., & Khairiyati, L. (2017). Germs numbers in several tableware washing methods. *Medical Laboratory Technology Journal*, 3(1), 6. <https://doi.org/10.31964/mltj.v3i1.153>
- Atimiati, W. D. (2012). The presence of grilled pomfret germ numbers and grilled tableware. *Indonesian Journal of Public Health*, 1(09), 1047–1053.
- Darna, Turnip, M., & Rahmawati. (2018). Identification of enterobacteriaceae members in traditional foods of Pangkong Cuttlefish. *Journal of Labora Medika*, 2(2), 6–12. <http://jurnal.unimus.ac.id/index.php/JLabMed>
- FarahFadhilla. (2017). The relationship between sanitary hygiene and bacteriological quality in tableware traders in the area around the Undip Tembalang Campus. *Journal of Public Health*, 3(3), 769–776.
- Inayah, I., & Muharram, A. (2020). Relationship between washing process and bacteriological quality of tableware (literature study). *Sulolipu: Communication Media for Academicians and Society*, 20(2), 212. <https://doi.org/10.32382/sulolipu.v2i20.1849>
- Khaldun, S., & Baharuddin, A. (2018). Comparative Study of germ counts on tableware in washing with immersion and flowing water. *Proceedings of the National Seminar on Multidisciplinary Synergy of Science and Technology*, 1(April), 332–339. <http://journal.uin-alauddin.ac.id/index.php/biogenesis>
- Lado, R. Y., Kristen, E. R., & Febriani, H. (2020). Analysis of sanitary hygiene and the presence of *Escherichia Coli* bacteria on tableware (dishes) at Warung Lesehan in Babarsari area. *Formal Journal (Scientific Forum) Respati Public Health*, 5(1), 20. <https://doi.org/10.35842/formil.v5i1.298>
- Marisdayana, R., Harahap, P. S., & Yosefin, H. (2017). Cutlery washing techniques, personal hygiene against bacterial contamination on cutlery. *Journal of Endurance*, 2(3), 376. <https://doi.org/10.22216/jen.v2i3.2052>
- Nikmah, M. (2018). Microbiological examination of food samples at RSUD Dr. Soetomo Surabaya. *Journal of Environmental Health*, 10(3), 283–290.
- Novi., Sulasmi., & Haderiah. (2015). Study of bacteriological quality of tableware in restaurants in Makassar City. *Journal of Hygiene*, 1(2), 125–128.
- Permatasari, N. (2017). Overview of bacterial contamination on children's tableware at Teratai Kindergarten UNM Makassar in 2017. Department of Environmental Health, Hasanuddin University FKM, 1–94. [http://digilib.unhas.ac.id/uploaded\\_files/temporary/DigitalCollection/YWUzODAzN2VmNjBmNDU1MzYyNTI3ZDk1YTExZDYxMWNiM2NkOWY0Yw.pdf](http://digilib.unhas.ac.id/uploaded_files/temporary/DigitalCollection/YWUzODAzN2VmNjBmNDU1MzYyNTI3ZDk1YTExZDYxMWNiM2NkOWY0Yw.pdf)
- Sancoko, A. H., & Rahmawati, V. (2019). Building a marketing strategy for culinary SMEs phenomenological studies of Angkringan in Surabaya. *Journal of Finance and Business*, 17(2), 96. <https://doi.org/10.32524/jkb.v17i2.579>
- Tumelap, H. J. (2011). Bacteriological condition of tableware in restaurant Jombang Tikala Manado. *Journal of Environmental Health*, 1, 20–27.
- Yulianto, A., & Nurcholis. (2015). Implementation of hygiene and sanitation standards in improving food quality at the food & beverage department @Hom Platinum Hotel Yogyakarta. *Journal of Science Treasures*, 6(2), 31–39.



**Research Article**

**Inventory of plants by the community of Waur Village, Kei Besar District, Maluku Province**

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**ABSTRACT**

Indonesia is one of the countries with very diverse natural resources, including the richness of plant species. The ancestors of the Indonesian people have used these natural resources very wisely, such as knowledge about traditional medicine. Indonesia is also inhabited by around 300-700 ethnic groups, each ethnic group has a different culture, tradition and local wisdom. This study aims to determine the types of medicinal plants, the organs used and how to process medicinal herbs by the people of Waur Village, District. Kei Besar, Southeast Maluku Regency, Maluku Province. This research is a qualitative descriptive study with data collection techniques through observation, interviews and documentation. The research data were then analyzed descriptively and presented in the form of descriptions and tables. The results of the study show that there are 20 species of plants that are used by the people of Waur Village, Maluku Province. The most widely used organs are leaves and the most widely used method of processing ingredients is boiling.

**Keywords:** *inventory, medicinal plants, herbs*

**To cite this article:**

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**INTRODUCTION**

Indonesia is one of the countries with very diverse natural resources, including the richness of plant species. Total of about 17 thousand Islands, Indonesia is estimated to have 35 thousand types of high-level plants and 3500 species of which have medicinal properties. The ancestors of the Indonesian people have used these natural resources very wisely. Among them, we know a lot about heritage, such as knowledge about traditional medicine (Badrunasar & Santoso, 2016). Indonesia is also inhabited by about 300-700 ethnic groups, each ethnic group has a different culture, tradition and local wisdom (Kartawinata, 2010 in (Silalahi, 2016)). The ancestral heritage of the Indonesian nation in terms of medicine that we still know is herbal medicine to refer to plant ingredients that are used for medicinal purposes. has medicinal properties. Jamu comes from the ancient Javanese language, namely jampi and usodo which means healing efforts using herbs, prayers and spells. The use of plants or medicinal herbs as healing has been done since hundreds of years ago this can be seen from the evidence of writing on the leaves lontar, inscriptions and temple reliefs (Badrunasar & Santoso, 2016).



Waur Village is one of the located in Kei Besar District, Southeast Maluku Regency, Maluku Province. The people have also long practiced the use of traditional medicine by using medicinal plants in healing diseases. This knowledge has long been practiced by the community and passed down from generation to generation orally. Knowledge about this treatment is currently only known by very few people, generally only known by parents. However, this knowledge is slowly being eroded and displaced by advances in the health sector, such as easier access to chemical drugs and health facilities that are increasingly accessible. In addition, modern life that is instantaneous and practical is increasingly being adopted by the community, it is feared that it will eliminate local knowledge, especially regarding knowledge about the use of medicinal plants. Prevent this loss of knowledge, it is necessary to research the inventory of medicinal plant species used by the people of Waur Village. This study aims to determine the types of plants used as medicine, the organs used and the way of processing drugs by the people. This research is expected to provide information about the types of medicinal plants used by the people of Waur Village as an effort to save local knowledge and can then be used for further research in the laboratory such as isolation of bioactive compounds which can later be used as medicinal ingredients in the future.

## METHODS

This research was conducted in November-December 2021. This research is a qualitative descriptive study with data collection through observation, interviews and documentation. The sources in this research are people who know and practice traditional medicine using medicinal plants to treat disease. Interviews were conducted referring to the interview sheets that had been made and were open. The types of plants mentioned by the resource persons are then recorded, documented and the names of the plants are searched in Indonesian. Identification is done by matching plant species with relevant reference sources. The research data were then analyzed descriptively and presented in the form of descriptions and tables.

## RESULTS AND DISCUSSION

### 1. Species of plants used as medicinal plants

Based on the results in table 1. It is known that there are 20 plant species in 16 families that are used by the people of Waur Village to treat diseases. The most common species found were from the Fabaceae family with 3 species, followed by the Piperaceae and Zingiberaceae families with 2 species each and the other families with one species each. The results of this study are in line with the results of research (Manar & Zuhud, 2019) which reported the most common medicinal plant families found on the Dramaga campus of IPB Bogor, namely the Fabaceae and Euphorbiaceae families. The number of medicinal plants reported in this study is far more than research (Hastuti et al., 2022) which reported that there were 13 types of medicinal plants found in Golo Ketak Village, Gelo District, West Manggarai Regency, NTT. The difference in the use of medicinal plants in each region can be influenced by how much information is received and practiced by the community in treating diseases in their area. Usually people only practice knowledge in drug processing based on information obtained from generation to generation because it has proven its efficacy (Elfrida et al., 2017).

Some of the plant species used as medicinal plants come from the forest and grow wild, but some of them have been cultivated. Plants that have been cultivated are generally because their benefits are widely known, either as medicinal ingredients, as cooking spices or because they have economic value. Plants that have been cultivated such as lemongrass, temulawak, turmeric, soursop, betel, areca nut besides having benefits as medicinal plants are also used for other purposes such as cooking spices or others.

**Table 1.** Types of medicinal plants, diseases treated, organs used, processing methods, status of plants used by the people of Waur Village.

NO	Local Name	Indonesia	Scientific	Family	Type of disease	Organs	Methods	Plant status
1	Rumput Kaki Kuda	Pegagan	<i>Cantella asiatica</i>	<i>Mackinlayaceae</i>	Heart, jaundice	Leaf	mash / knead.	Wild
2	Salam	Daun salam	<i>Syzygium polyantum</i>	<i>Myrtaceae</i>	High blood, lower blood sugar	Leaf	Boiled	Wild/cultivated
3	Pandan	Daun pandan	<i>Pandanus amaryllipolius</i>	<i>Pandanaceae</i>	High blood pressure	Leaf	Boiled	Wild/cultivated
4	Arbei Hutan	Arbei hutan	<i>Rubus flexus</i>	<i>Rosaceae</i>	Hoarse throat	Leaf	chewed	Wild
5	Tomat	Ciplukan	<i>Physalis</i>	<i>Solanaceae</i>	Jaundice	Leaf, root	Boiled	Wild

	Hutan		<i>angulata</i>					
6	Daun muka manis	Tumpang air/suruhan	<i>Piperomia pellucina</i>	<i>Piperaceae</i>	Gout	Leaf	Boiled	Wild
7	Sukun	Sukun	<i>Arthrocarpus altilis</i>	<i>Moraceae</i>	Clean white blood	Leaf	Boiled	Cultivated
8	Pohon lingua	Angsana	<i>Pterocarpus indicus</i>	<i>Fabaceae</i>	Lower body temperature	Leaf	Squeeze and then make a compress	Wild
9	Serei	Sereh	<i>Cymbopogon citratus</i>	<i>Poaceae</i>	Internal disease	Stem	Boiled	Cultivated
10	Kumis kucing	Kumis kucing	<i>Orthosiphon aristatus</i>	<i>Lamiaceae</i>	Malaria		Squeeze with a little water and then drink	Cultivated
11	Bengkoang	Bengkoang/bengkuang	<i>Pachyrhizus erosus</i>	<i>Fabaceae</i>	Internal disease	Bulbs	Diblender	Cultivated
12	Sirih	Sirih	<i>Piper betle</i>	<i>Piperaceae</i>	Eliminate body odor	Leaf	Boiled	Cultivated
13	Benalu jeruk	Benalu jeruk	<i>Lorantus sp.</i>	<i>Lorantaceae</i>	Breast cancer	Leaf	Boiled	Wild
14	Pinang	Pinang	<i>Areha catechu</i>	<i>Arecaceae</i>	Diabetes	Root	Boiled	Wild/cultivated
15	Kunyit	Kunyit	<i>Curcuma longa</i>	<i>Zingiberaceae</i>	Indigestion	Rhizome	grated	Cultivated
16	Pica Piring	Kaca piring	<i>Gardenia jasminoides</i>	<i>Rubiaceae</i>	Breast cancer	Leaf	Boiled	Cultivated
17	Tanaman Alifuru	Daun ungu	<i>Graptophyllum pictum</i>	<i>Acanthaceae</i>	Heals swollen bodies due to falls, and can also be used as medicine for massage	Leaf	pasted	Cultivated
18	Gayam	Gayam	<i>Inocarpus fagifer</i>	<i>Fabaceae</i>	Diabetes	Bark	Boiled	Wild
19	Sirsak	Sirsak	<i>Anona muricata</i>	<i>Anonaceae</i>	High blood and back pain	Leaf	Boiled	Cultivated
20	Temulawak	Temulawak	<i>Curcuma Xanthorrhiza</i>	<i>Zingiberaceae</i>	Internal disease	Rhizome	Boiled	Cultivated

## 2. Organs used in medicine

Based on table 1, it is known that the plant organs used in medicine are roots, stems, bark, tubers, rhizomes and leaves. The most widely used part is the leaf. The results of this study are in line with research (Yansip et al., 2017) which reported that the most widely used organ as medicinal plants by the people of Yanim Dan Braso Village, Kentuk Gresi District, Jayapura Regency, namely leaves as much as 66.7%. Leaves are organs that are classified as easy to find and always available, besides that, taking and using them is easy and simple. The use of leaves as medicinal herbs also does not have a negative impact on plants, because after they are taken, new leaves will grow as substitutes. We recommend that the use of other organs such as roots, stems, rhizomes, tubers or all parts of plants as medicinal ingredients should be limited because they will interfere with ecological, physiological and plant growth processes (Wakhidah et al., 2017). Leaves are the most commonly used organs in traditional medicine because they contain a lot of water, have a soft texture, besides that they are also a place for the accumulation of photosynthetic results so that they contain elements that are useful for healing diseases (Handayani in Yowa et al., 2019). In line with this, Wardiah et al. (2015) stated that leaves are widely used as medicinal ingredients because they contain chlorophyll which contains antioxidants, anti-inflammatory and healing substances.

## 3. How to process medicinal herbs

Based on table 1, it is known that the use of medicinal herbs is boiled, grated, ground, kneaded and pasted. Most use by boiling. Plant parts that are usually boiled are leaves, rhizomes, bark and stems. People mostly process plants by boiling because the process is considered easier and the plant extracts from medicinal plants are not so concentrated when compared to the grated process and then consumed directly. The results of this study are in line with the research of Irawati et al. (2018) which reported that processing by boiling and then drinking is the most widely used processing by the people of Jimbaran Village, South Kuta District, Badung Regency, Bali in utilizing garden plants as alternative medicinal ingredients. In addition, Due (in Hizqiyah et al., 2016) mentions that the boiling process will speed up the healing process because the compounds in plant organs will spread and blend with water due to the heating process so that it can be directly processed in the body's metabolism. Meanwhile, plants whose processing is kneaded and then

affixed or used as compresses such as *linggua* leaves and *alifuru* leaves are useful for external treatment such as to reduce heat or to heal swollen bodies due to falls, and can also be used as medicine for massage.

## CONCLUSION

Based on the results study, it can be concluded that there are 20 types of medicinal plants in 17 families that are used by the people of Waur Village in treating diseases. The most commonly found family is the Fabaceae family. The plant parts used as medicinal ingredients are roots, stems, bark, rhizomes, tubers and leaves. The most widely used organs are leaves. The processing of medicinal ingredients by the people of Waur Village is by boiling, grating, kneading, chewing, pounding, pasting and blending. Most of the herb processing is done by boiling.

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## REFERENCES

- Badrunasar, A., & Santoso, H. (2016). *WILD PLANTS* (1st ed.). Ford Press.
- Hastuti, Herlina & R.S Amis. (2022). Inventory of Medicinal Plants in Golo Ketak Village, Boleng District, District. 14 (12) 103–112. <https://doi.org/10.25134/quagga.v14i1.4803>.
- Elfrida et al, 2017. (2017). Ethnobotany of medicinal plants based on local knowledge of the Javanese in Sukarejo Village, East Langsa District in 2016. *Jeumpa*, 4(1), 21–22. Ethnobotany of plants with drug effectiveness based on local knowledge on the java tribe in sukarejo village, langsa timur district. *Jeumpa Journal* ([ejurnalunsam.id](http://ejurnalunsam.id))
- Hizqiyah, I. Y. N., Rustama, A., Rahmawati, A., & Pasundan, U. (2016). Ethnobotany Study of Medicinal Plants by the Community in Nanggulung Village, Cipeundeuy District, West Bandung Regency Ida. *Mangifera Edu: Journal of Biology and Biology Education*, 1(1), 27–31. <https://doi.org/10.31943/mangiferaedu.v1i1.60>
- Irawati, I., Kriswiyanti, E., & Darmadi, A. A. K. (2018). Utilization of Garden Plants as Alternative Medicines in Jimbaran Village, South Kuta District, Badung Regency, Bali. *Journal of Biological Sciences*, 70(1), 64–70.
- Manar, P. Al, & Zuhud, E. A. M. (2019). Inventory of Medicinal Plants at Dramaga Campus of IPB, Bogor, West Java. 57th TOI POKJANAS, 41–46. 6.cdr manuscript ([uhamka.ac.id](http://uhamka.ac.id))
- Silalahi, M. (2016). Ethnomedicine Studies in Indonesia and its Research Approach. *Journal of Educational Dynamics*, 9(3), 117–124. <https://doi.org/10.51212/jdp.v9i3.344>
- Wakhidah, A. Z., Pratiwi, I., & Azzizah, I. N. (2017). Study on the Utilization of Plants as Medicines by the Community of Marimabate Village in Jailolo District, West Halmahera. *Pro-Life Journal*, 4(1), 275–286.
- Wardiah, W., Hasanuddin, H., & Mutmainnah, M. (2015). Medical Ethnobotany of the South Pulo Breueh Residential Community, Pulo Aceh District, Aceh Besar District. *Journal of Tropical EduBio*, 3(1), 29–32. Medical ethnobotany of pulo breueh selatan community, pulo aceh district, aceh besar regency. *Tropical Edubio Journal* ([unsyiah.ac.id](http://unsyiah.ac.id))
- Yansip, S. M., Tambaru, E., & Salam, M. A. (2017). Types of Plants Efficacious Traditional Medicines in Yanim and Braso Villages, Kentuk Gresi District, Jayapura Regency. *Biome: Makassar Biology Journal*, 2(2), 1–11. <https://doi.org/10.20956/bioma.v2i2.2027>
- Yowa, M. K., Boro, T. L., & Denong, M. T. (2019). Inventory of plant species with traditional medicinal properties in Umbu Langang Village, Umbu Ratu Nggay Barat District, Central Sumba Regency. *Journal of Biotropical Science*, 16(1), 1–13.



**Research Article**

## The effect of picture and picture learning model on learning outcomes of junior high school madani Makassar students

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### ABSTRACT

The picture and picture learning model is a learning strategy through the use of image media as learning media which are paired and sequenced logically. This learning model involves students to participate in learning activities that are innovative, creative, and fun. In addition, the picture and picture learning model is to organize the learning experience so that it can be used as a reference or guide for learning designers and teachers in planning teaching and learning activities. This research is an experimental and non PTK research. The data from this study were analyzed through descriptive statistical analysis and independent T-test which were first carried out by the process of normalization and homogenization of data. This study aims to examine the effect of the picture and picture learning model in improving learning outcomes at Madani Junior High School Makassar. The results showed that the picture and picture learning model had a significant influence on the learning outcomes of class VII Junior High School Madani Makassar. This learning model has proven to be effective in providing opportunities for students to work together with fellow students through structured, group tasks, so that open interactions and effective interdependence relationships occur among various group members.

**Keywords:** *learning outcomes, models, picture and picture learning*

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### INTRODUCTION

Learning is an activity that is carried out intentionally or unintentionally for each individual, resulting in a change in attitude, mentality, and knowledge. The learning process requires interaction with the surrounding environment which can be done by seeing, discovering and also imitating. The main purpose of learning can be achieved through several learning models in the school environment, while the learning model can be defined as a systematic procedure or form of approach in organizing learning experiences to achieve learning objectives. Aqib (2009) suggests that the learning

model is a conceptual framework that describes a systematic procedure in organizing learning experiences so that it can be used as a guide for learning designers and teachers in planning teaching and learning activities. Picture and picture is a cooperative learning model and prioritizes cooperation by using picture media that are sorted and paired into a logical sequence (Kurniasih & Sani, 2015). The same thing according to Huda (2013) who reported that picture and picture is a learning strategy through the use of image media as learning media that are paired and ordered logically. This learning model involves students to participate in learning activities that are innovative, creative, and fun. Innovative is every learning must provide something new, different, and always attract the attention of children. While creative is learning that can trigger interest in producing something or solving problems using selected or determined methods.

Some of the advantages of the picture and picture learning model are (1) the material taught is more focused because at the beginning of learning the teacher explains the competencies that must be achieved and the material briefly first; (2) students catch the teaching material faster because the teacher shows pictures of the material being studied; (3) can develop students' reasoning power to think logically through image analysis; (4) can increase students' responsibility because the teacher asks the reason for the students to sort the pictures; (5) learning is more memorable because students can observe directly the pictures that have been prepared by the teacher (Istarani, 2011). Learning outcomes are changes in behavior that occur after following the teaching and learning process in accordance with educational goals. Learning outcomes can reflect the level of student success in studying school subject matter which is expressed in scores obtained from test results regarding a certain number of subjects (Susanto, 2016). Learning outcomes are influenced by internal factors (internal factors) and external factors (external factors). Internal factors are physical, psychological, and fatigue factors. External factors include family factors, school factors and community factors eg teachers, curriculum, and learning models (Slameto, 2013). Based on the foregoing, this research was conducted to examine the effect of the picture and picture learning model in improving the learning outcomes of junior high school Madani Makassar.

## METHODS

This research was conducted in September-December 2021. This research is located in junior high school Madani Makassar Class VIIA & VIIB which is located on Jalan Batua Raya 5 No.10 Panakkukang District, Makassar City. This research is an experimental study consisting of all seventh grade students of Madani Junior High School as the population in the study, while the sample in this study consisted of two homogeneous classes, namely class VII A (20 students) and class VII B (20 students). The data analysis technique used in this research is in the form of descriptive analysis and inferential statistics. Descriptive statistical analysis is intended to describe the score of student learning outcomes in each treatment group. The guidelines used to categorize student learning outcomes are to follow the procedures from the Directorate of Guidance to the Directorate General of Primary and Secondary Education, as shown in Table 1 below:

**Table 1.** Criteria for categorizing student learning outcomes score

Mastery level (%)	Category of learning outcomes
90-100	Very high
80-89	high
70-79	Medium
<70	Low

Overall descriptive tests and inferential statistics were applied through the use of SPSS 20. Inferential statistical test was used to determine the effect of the picture and picture learning model on learning outcomes of Junior High School Madani Makassar. The type of analysis used is the t-test which is first carried out by the normality test analysis. The normality test is carried out using the Shapiro Wilk.

$$W = \frac{1}{D} \left[ \sum_{i=1}^k a_i (x_{n-i+1} - x_1) \right]^2$$

Explanation:

$$D = \sum_{i=1}^n (x_i - \bar{x})^2$$

- $a_i$  = coefficient test
- $x_{n-i+1}$  = value  $n-i+1$  in data
- $x_i$  = value  $-i$  in data  $-i$
- $\bar{x}$  = mean

## RESULTS AND DISCUSSION

The table 2 above shows the use of the picture and picture learning model in class A which has an average (mean) of 84.7000 and has a minimum value of 42.00 while the maximum value of 95.00 with Std. Division 12.81898. Class B has an average (mean) of 82.2000 and has a minimum score of 40.00% while the maximum value is 88.00% with Std. Division 13.41876. This shows that the learning outcomes of Class VII students of Madani Makassar Junior High School are in the high category (according to the category of Table 1). In the table 2 also describes the completeness of high student learning outcomes while using the picture and picture learning model. The learning model has increased student cooperation during the learning process so as to achieve satisfactory results. This is in accordance with Yusal (2020) who said that the results of good student learning mastery are satisfactory learning outcomes in accordance with learning objectives, where students carry out learning models that have been happily applied and a good cooperation system. The application of a complete learning model is one of the factors that determine success in teaching and learning achievement.

**Table 2.** Results of descriptive analysis of learning outcomes picture and picture learning model descriptive statistics

	N	Range	Minimum	Maximum	Mean	Std. Deviation
Class A	20	53.00	42.00	95.00	84.7000	12.81898
Class B	20	48.00	40.00	88.00	82.2000	13.41876
Valid N (listwise)	20					

Normality test in research aims to determine the data of a study has a normal distribution or not. Data that is normally distributed is a must as well as an absolute requirement that must be met in the use of parametric statistical analysis. Based on Table 3 below, it shows that the use of the picture and picture learning model has resulted in data that is normally distributed and is considered to be able to proceed to other statistical tests because it has a significance level of  $> 0.05$ ; with a significance level of 0.116 (class A) and 0.200 (class B) through the Shapiro-Wilk. The significance level values based on the Kolmogorov Smirnov test are 0.084 (class A) and 0.114 (class B).

**Table 3.** Normality test results learning outcomes picture and picture learning model tests of normality

	Kolmogorov-Smirnov <sup>a</sup>			Shapiro-Wilk		
	Statistic	Df	Sig.	Statistic	Df	Sig.
Class experiment	.181	20	.084	.924	20	.116
Control	.214	20	.114	.883	20	.200

a. Lilliefors Significance Correction

Based on the results of the homogeneity test of student learning outcomes at Junior High School Madani Makassar (Table 4), it shows that the research data is considered homogeneous so that it can be continued to the independent T-test stage. The research data is considered homogeneous when it has Mean  $> 0.05$ , while the results show that the learning outcomes data through the use of the picture and picture learning model obtain on Mean value of 0.868 or a significance level of  $> 0.05$ .

**Table 4.** Results of homogeneity of learning outcomes of picture and picture learning model Test of homogeneity of variances

		Levene Statistic	df1	df2	Sig.
Learning outcomes of class VII A & B	Based on Mean	0.028	1	38	0.868
	Based on Median	0.017	1	38	0.897
	Based on Median and with adjusted df	0.017	1	37.998	0.897
	Based on trimmed mean	0.018	1	38	0.895

T-independent analysis was used to determine the difference in mean between two independent groups or two unpaired groups with the intention that the two data groups came from different subjects. The results of the independent T-test (Table 5) show that the use of the picture and picture learning model has a significant effect on the learning outcomes of class VII Junior High School Madani Makassar. This is evidenced by the results of the Independent sample t-test  $<0.05$  (0.048). The same thing happened to [Nurlianti & Tilora \(2020\)](#) who reported that the use of the picture and picture learning model was very good in improving student learning outcomes and motivation at school.

**Table 5.** Independent T-Test of Class VII Madani Junior High School Makassar

Explanation	Class A	Class B
<i>Descriptive Analysis</i>		
Range	53.00	42.00
Minimum	42.00	40.00
Maximum	95.00	88.00
Mean	84.7000	82.2000
<i>Shapiro Wilk</i>		
Sig	0,116 > 0,05	0,200 > 0,05
Homogeneity Test of Levene's		
<i>Based On Mean</i>	0,868 > 0,05	0,868 > 0,05
<i>t-independent</i>		
Student learning outcomes of class VII A and VII B	Sig 0,048	Sig 0,048

## CONCLUSION

The use of picture and picture cooperative learning model has a significant influence on the learning outcomes of class VII Junior High School Madani Makassar. This learning model has proven to be effective in providing opportunities for students to work together with fellow students through structured, group tasks, so that open interactions and effective interdependence relationships occur among various group members.

## REFERENCES

- Aqib, Z., 2009. Classroom Action Research. Bandung: CV. Yrama Widya
- Fitriani, A., Indrowati, M., & Karyanto, P. (2015). Students' critical thinking skills in biology learning through the application of accelerated learning for class X SMA Negeri Karangpan dan Karanganyar. *Journal of Biological Education*, 7(2), 56–67.
- Gusviani, E. (2016). Analysis of the emergence of spiritual attitudes and social attitudes in science learning activities for grade IV SD using KTSP and the 2013 curriculum. *Eduhumaniora*, 7(2), 1–10.
- Huda, M., 2013. Teaching and Learning Models. Yogyakarta: Student Library
- Heong, Y. M, Othman, W., Yunos, J. B. M., Kiong, T., Hassan, R., & Mohamad, MM (2011). The level of Marzano higher-order thinking skills among technical education students. *International Journal of Social Science and Humanity*, 1(2), 121–125.

- Huda, M., & Rahman, L. (2020). The relationship between critical thinking skills and learning outcomes of elementary school students. *Journal of Character Education: Journal of Child and Character Education*, 2(2), 42–47.
- Husnah, M. (2017). The relationship between the level of critical thinking on student physics learning outcomes by applying the problem-based learning model. *Journal of Physics and Science Learning*, 1(2), 1–12.
- Istarani, 2011. A joint article on elementary learning design. West Java: CV Jejak publisher, member of IKAPI.
- Insyasiska, D., Zubaidah, S., & Susilo, H. (2015). The effect of project-based learning on learning motivation, creativity, critical thinking skills, and cognitive abilities of students in biology learning. *Journal of Biological Education*, 7(1), 9–21.
- Istiyono, E., Mardapi, D., & Suparno, S. (2014). Development of high-level physics thinking skills test (PysTHOTS) of high school students. *Journal of Educational Research and Evaluation*, 18(1), 2–5.
- Kurniasih, I. & Sani, B., 2015. Variety of Learning Model Development to Improve Teacher Professionalism, Jogjakarta: The word pen.
- Klein, J., Taveras, S., King, SH, Commitante, A., Bey, LC., & Stripling, B. (2009). *A Guide To project-based learning in middle schools: Inspiring students to engage in deep and active learning*. NYC Department of Education.
- Kusuma, M., Rosidin, U., Abdurrahman., & Suyatna, A. (2017). The Development of higher-order thinking skill (HOTS) assessment instrument in physics study. *Journal of Research & Method in Education*, 7(1), 26–32.
- Leiwakabessy, F., Hetharia, M., & Manuputty, R. (2018). Development of biological teacher capabilities in the development of test instruments based on high order thinking skills (HOTS) In high school in Ambon city that have applied 2013 Curriculum. *Proceeding Book of The 3rd International Seminar on Education November 07th*, 2, 76–86.
- Listiani, S., & Purwanto, A. (2018). The application of a project-based learning model using used goods to improve students' scientific attitudes. *Proceedings of the Seminar and National Discussion on Basic Education*, 24–29.
- Lukitasari, M., Handhika, J., & Murtafiah, W. (2018). Higher-order thinking skills: Using e-portfolio in project-based learning. *Journal of Physics: Conference*, 983(12047), 1–7.
- Nurlianti, Tilora, M.N., 2020. Implementation of the Picture And Picture Learning Method by a Fiqh Teacher at Madrasah Ibtidaiyah Al-Rasyid Simpang Tiga Sungai Luar, Batang Tuaka District. *Journal of PGMI Partners*, 6(1):38-49
- Narahaubun, S. S, Rehena, J. F., & Rumahlatu, D. (2020). Empowering students' critical thinking skills, information literacy, and cognitive learning outcomes through the RBL-TPS model. *Indonesian Journal of Biological Education*, 6 (2), 243–256. <https://doi.org/10.22219/jpbi.v6i2.11456>
- Primandari, P., Sulasmono, B. S., & Setyaningtyas, E. (2019). The difference in the effect of the cooperative model type TGT and STAD with cheerful interactive multimedia on social attitudes and cognitive learning outcomes in thematic learning in grade 5 SD. *Basicedu's Journal*, 3(3), 83–91.
- Susanto, 2016. *Theory of Learning and Learning in Elementary Schools*. Jakarta: Prenada Media Group
- Slamet. 2013. *Learning and the factors that influence it*. Jakarta: Rineka Cipta.
- Yusal, M.S. & Carding, C., 2020. Improving Student Learning Outcomes Through Problem Posing Learning Methods at Makassar National High School. *BIOMA: Journal of Biology and Its Learning*, 2 (2): 60-66