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Project Based Learning (PjBL) Based on Science Practice Tools on Measuring Instrument Material

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Abstract: This learning aims to make students better understand the implementation of measuring instruments in science learning in everyday life. The research method used in this study is a project based class experiment. This method invites students to analyze directly the problem to improve students thinking skills. Students are asked to divide groups and practice from each measuring instrument given. The tools and materials used are scales, ruler, vernier caliper, screw micrometer, and thermometer, while the materials used are glasses, hot water, andice water, coins, marbles, rice, and sweet potatoes. From the results of measurements that have been made, it is found that each measurement of the five measuring instruments is of the same value and also has a different value, but not too far away, the results only range from a few numbers.

Keywords: Measuring Instruments; PjBL; Ruler; Scales; Screw Micrometer; Thermometer; Vernier Caliver

Introduction

In the globalization era, education is required to have quality, this can be realized by the availability of human resources that have quality and quantity as well as supporting facilities and infrastructure (Mu'minah, 2021; Priantari et al., 2020). Furthermore, in the 21st century, humans are required to have abilities in various fields including the ability to think critically, the ability to think creatively, the ability to communicate and collaborate, as well as the ability to master information and communication technology (Yuliati & Saputra, 2019). In the development of information technology knowledge, the curriculum plays a very active role in responding to challenges in the world of education. There needs to be a change in the world of education and the 2013 curriculum becomes a means of supporting the nation's future through the best young generation (Mastati, 2017). Learning should be able to equip students with the ability to think logically, analytically, systematically, critically and creatively in solving problems and have an attitude of appreciating the usefulness of knowledge and being able to obtain, manage and utilize information to survive in conditions that are always changing, uncertain and competitive. (Lestari et al., 2020). Success in learning can be influenced by several factors, including the application of learning models based on learning characteristics (Batubara et al., 2022).

A learning model is a set of methods, strategies, and a unified whole between methods, which is explained by the teacher from start to finish (Samala et al., 2022). Choosing the right learning model can make the teaching and learning process effective and efficient. Apart from that, students can also learn well because the learning methods used by teachers make the delivery of material more interesting and better (Li et al., 2018). One of the appropriate learning models that can make the teaching and learning process effective and efficient is Project Based Learning (PjBL).

PjBL is a learning strategy that builds students' own content knowledge and shows new understanding through various representations (indrawan et al., 2019). Project Based Learning (PjBL) is a form of learning that

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focuses on students. they are actively involved in the learning process (Nurhidayah et al., 2021). PjBL can help students build the skills such as collaboration, communication, critical thinking and creativity to allow students to learn about and reflect on real-world problems through well-designed projects and self-evaluation (Kim, 2021).

Learning that applies Project Based Learning (PjBL) in the learning process becomes a meaningful experience because it allows students to understand a concept, solve problems by completing projects, and provides opportunities for critical and creative thinking (Made et al., 2022). The research results show that PjBL models motivate students to learn material that exists in everyday life while enhancing creativity (Thomas, 2000; Tiantong & Siksen, 2013). PjBL is one of the scientific learning models that gives students the freedom to plan learning activities, carry out projects collaboratively, and ultimately produce work products for presentation to others (Sumarni, 2015). Unlike traditional learning models, the process in PjBL is mainly student-driven learning, involving students in learning knowledge and skills through developing inquiry processes where instructors just act as facilitators or motivators (Sumarni et al., 2016). Therefore, the role of the instructor is to facilitate learning by supporting, guiding and monitoring the learning process (Wijayati et al., 2019).

Method

Project Based Learning (PjBL) is a collaborative and innovative project that focuses on solving problems related to student or community life. The research method used in this study is a project-based classroom experiment. Where the application of measuring instruments uses scales, rulers, vernier calipers, screw micrometers and thermometers. Measurements are carried out twice to determine the use and benefits of measuring instruments.

Result and Discussion

Description of Measuring

Instruments Measuring are very important tools in everyday life. Many activities we do involve measuring instruments such as measuring length, area, width, height, weight, temperature, diameter, speed, and depth (Inabuy et al., 2021). Activity measures almost every day we do but we do not realize it. One example in the process of buying and selling in the market, traders use balance sheets to find out the size of objects sold is also a reference to determine the price of objects to be bought and sold. However, in some cases that when we measure the length of an object but the measuring instrument we use is not brought, in this case we can use our hands to measure the object.

Various Measuring

The instruments, there are many kinds and forms of measuring instruments both in terms of models, prices, and the level of sophistication of measuring instruments, but in this project based learning model there are only a few measuring instruments that we will use, namely balance sheets, bars, caliper, micrometers, couplers, and thermometers.

Scales

Scales is one of the measuring instruments that are often used in our daily lives, the balance has the function of measuring the mass of an object. The balance sheet has international standard (SI) units, namely grams, ounces, ponds, and kg, in the current era the balance sheet has several forms, some are digital scales and some are manual scales in the calculation, which can be seen in table 1.

Table 1. Unit Weight

10 grams	1 ons
5 ons	1 pond
1 kg	1000 gram
2 ponds	1 kg
1 kwintal	100 kg
1 ton	1000 kg

From the explanation above according to the order of the smallest to the smallest international standard units are grams, ounces, ponds, kg, quintals, and tons. To see what the scales sheet forms, let's see Figure 1 and Figure 2.

Figure 1. Digital Scale Sheet

Figure 2. Manual Scale Sheet

Ruler

Ruler is a measuring instrument used to measure length, height, and width. Ruler in international standard have unitsof cm, meter, and km. The ruler is very useful to find out the area of field, the volume of objects that can be measured using the ruler, but if we

do not use the ruler inmeasurement, alternative solution is to measure using hands. The shape of the ruler is shown in Figure 3.

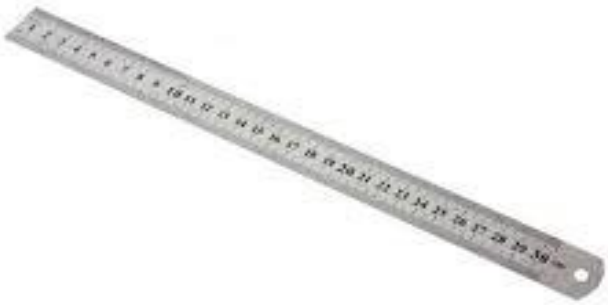

Figure 3. Ruler

Vernier Caliper

The vernier caliper is a measuring instrument used to measure thickness, depth, outer diameters and inner diameters, this measuring instrument has an accuracy of 0.1 mm or 0.01 cm with such a large accuracy capable of measuring objects that are not too small and not too large mediumsize such as, glass diameter, nut diameter, and marble diameter. The shape of the vernier caliver term can be seen in Figure 4.

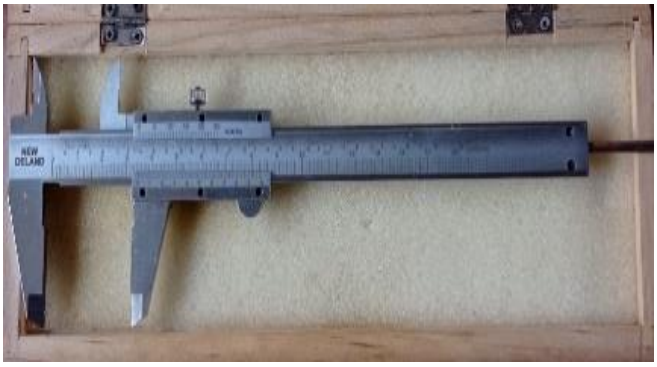

Figure 4. Vernier Caliper

How to calculate measurement results using Vernier Caliper
Measurement Result = Main Scale +(Nonius Scale ×Accuracy)
Information
Vernier Caliper Accuracy = 0.1 mm or 0.01cm

Screw Micrometer

Screw Micrometer is a measuringinstrument that can measure the thickness of very small objects because this tool has an accuracy of 0.01 mm. Objects that can be measured using screw micrometer the thickness of the paper, metal plate, and ball diameter. The shape of the screw micrometer can be seen in Figure 5.

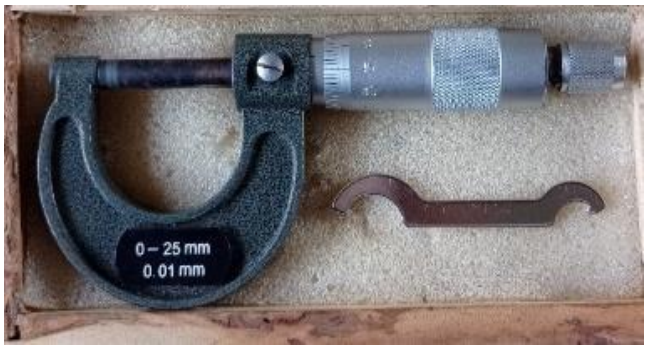

Figure 5. Screw Micrometer

How to calculate measurement results using a screw micrometer

Measurement Result = Main Scale +(Nonius scale ×Accuracy)
Information
Accuracy of screw micrometer = 0.01 mm

Thermometer

Thermometer is one type ofmeasuring instrument used to measure milk, this tool is very useful when we want to know the temperature of objects, cold and hot room temperatures. The use of thermometers in their use, namely measuring water temperature in coffee brewing (barista) and temperature measurement in hatching eggs, is only a small example of the use of thermometers. To see the shape of the thermometer see Figure 6.

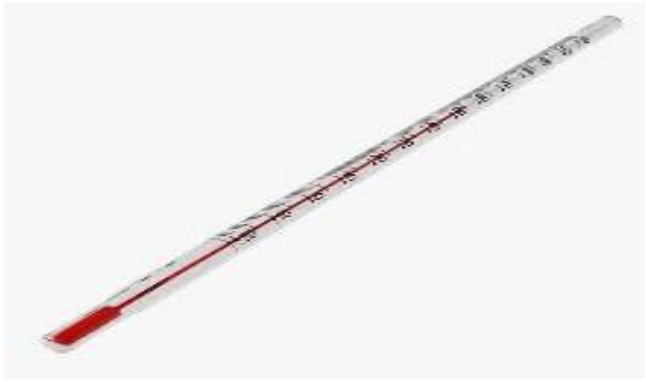

Figure 6. Thermometer

Tools and Materials
Tools
1. Digital Scales and Manual Scales
2. Ruler
3. Vernier Caliper
4. Micrometer coupler
5. Thermometer

Materials
1. Glass

2. Hot water
3. Ice water
4. Marbles
5. Sweet potato
6. Coin
7. Rice

Experimental Results

From the results of experiments carried out by measuring the materials used in the experiment in Table 2.

Table 2. Measurement Results

		The object being measured	Measure result 1	Measure result 2
Scales	Digital	Marbles	6 grams	6 grams
		Coin	3 grams	3 grams
		Sweet potato	69 grams	69 grams
	Manually	Sweet potato one crackle	70 grams	70 grams
		Rice one crackle	55 grams	50 grams
Ruler		Paper	Length 29,7 cm width 21cm	length 29,7cm Width 21 cm
Vernier calipers		(Gellas) Outer Diameter	6,3 cm	6,37 cm
		(Gellas) Inner Diameter	5,54 cm	5,67 cm
		depth bottle cap	5,69 cm	5,68 cm
		outer Diameter	2,95 cm	2,95 cm
		inner Diameter	2,71 cm	2,66 cm
Micrometer coupler		coin thickness	3,09 mm	2,08 mm
		Marbles diameter	16,19 mm	16,23 mm
Thermometer		ice water temperature	19°C	20°C
		Warm water temperature	64°C	63°C

Conclusion

From the results of measurements that have been made, it is found that each measurement of the five measuring instrments is of the same value and is also of different value, but not too far away, theresults only range from a few numbers because every measurement result that is done many times will produce different results, different differences in this measurement are natural things to do by everyone because none of the measurement results are the same.

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