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Light Bulb Substitute Lens for Measuring Liquid Bias Index

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Abstract

The purpose of this study is to determine the characteristics of practicum tools developed and prove that the bulb lamp can be used as an innovation replacement of convex lenses, and determine the index of refraction of liquids. This type of research is research and development. The research was conducted at SMK Ma'arif Semarang. The characteristics of the practicum tool are developed as follows: 1) the practicum tool that is created is a form of innovation which utilizes household items such as bulbs that are no longer used; (2) practicum tools can overcome the problems of limitations on marginal schools; (3) The refractive index practicum tool is well designed and practical. The result of feasibility of practicum index of refractive bias obtained percentage of 92,5% with very feasible category. The results of the study showed the refractive index value of water, alcohol and vinegar respectively of 1.8, 1.84 ,; and 1.85. Lamp bulb can be used as a substitute for the convex lens and determine the refractive index of the liquid, but there is a difference between n table with n measured when practicum with a mean of 0.46, this is due to the limitations of practicum tools.

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INTRODUCTION

Physics is a science based on experiments. Theoretical knowledge of physics accompanied by practical work can ensure the effectiveness of physics teaching learning, besides the stages of the lab can develop and support the mastery of the concepts of learners and even learners are able to apply their understanding in different situations.

Based on observations that do in a school that SMK Ma'arif Semarang shows during teaching and learning activities took place most learners tend to be silent and not answer questions raised by educators. In the learning of physics concept comprehension with direct learning experience can be done through practicum activity. Practicum is an activity undertaken to solve or prove a theory, which includes observing, measuring, so obtained data which then used to draw conclusions (Rahayu, et al., 2016). Learners are more happy and active when practicum. However, practicum is rarely done due to the limited tools available in schools. Especially for optical materials, there is no practicum tool to determine the refractive index of liquids, because in general the experiment is to determine the refractive index of glass. The lack of facilities and infrastructure of laboratory tools in the laboratory can be handled by utilizing the learning resources in the surrounding environment as an integral part of the community. Innovation of this practicum tool can clarify the teaching materials provided educators to learners so that learners more easily understand the material or questions presented by educators. The practicum also attracts the attention of learners and can foster interest in following Physics learning (Octaviani, et al., 2017). Enhancement of learners' understanding of the learning of physics, especially optical materials determine the refractive index can be done by practicing the refractive index of liquids (Susanti, et al., 2015). As an educator we are required to innovate in every way to achieve the learning objectives.

The word "Innovation" is often translated into new things or innovations. Innovation is also used to express discovery. In addition innovation is an idea, goods, events, methods, perceived or observed as something new for a person or group of people (society) whether in the form of results, *invention* (discovery something really new) and *discovery* (the discovery of something that actually already exist, but not yet known by people). Innovation is held to achieve a specific goal or to solve a particular problem. Innovation undertaken aims to prove whether the bulb can be used as a substitute for convex lenses and determine the refractive index of liquids (Gunawan, et al., 2017).

The refractive index of a substance is a measure of the speed of light in a liquid compared to when in air (Zamroni, 2013). Refractive index is the ratio of the speed of light in a vacuum to the rate of light in the medium. The speed of light in a medium such as glass, water or air is determined by the index of refraction n, defined as the ratio of the velocity of light in void c to that rate in medium v. Mathematically can be expressed:

$$n = cv \ .$$

The equations connecting the distance of the shadow to the object distance, the radius of curvature, and the refractive index can be derived by applying snellius law to refraction on light and using a small angle approach. It can be expressed by the following equation:

$$n1s+n2s'=n2-n1R$$

Some of the refractive index values of the liquids are presented in Table 1 (Agustina, et al., 2017)

Table 1. Refractive index for light sodium (sodium) yellow(λ= 589nm)

Fluid	Refractive Index
Water	1.472 1.4731.628 1.371
Alcohol	1.36
Turpentine	
Glycerin	1.501
Gasoline	
CarbonDisulfides	1.333
Acetic Acid	

Several methods can be used to determine the refractive index of various substances liquid or solution such as the use of prismatic hollow*(hollowprism)*that can measure fairly accurately the refractive index (Idris, et al., 2017). But the use of such methods is quite complicated. In addition to measuring the refractive index of liquids can use the method of refraction using *plan parallel* (Zamroni, 2013). Therefore, this study

attempted to utilize a bulb as a substitute for a convex lens to determine the refractive index of a liquid.

METHOD

Method used in thisis *researchresearch and development* (R & D). The R & D method is a process or steps to develop a new product or refine an existing product, which can be accounted for (Carnawi, et al., 2017*)*. The steps of this research are the potential and problems (the problems contained in SMK Ma'arif Semarang with the potential of utilizing household items that are not used to be used as a practicum tool in the school) data collection (data collection phase begins with observation to determine the condition of learners, teaching and learning activities), product design (designing products according to the existing problems in the school), design validation (design validation is a process to determine the feasibility of the design to be made) , the revision of the design (the stage of improvement of the results of evaluations made by the validator), product testing (trials conducted several stages of feasibility testing conducted by media and material experts), product revision I (product revision phase I to fix deficiencies after product testing) trial usage (trial usage is done directly to the participant d (revision of product II (final revision stage before the tool is used on a large scale) (Parmin, et al., 2016). The subjects of this research are practicum of refractive index of liquids. The object studied is the feasibility of practicum tool refractive index of liquid. Respondents in the study are material experts, media experts, and 10 students of class XI SMK Ma'arif Semarang. Methods of data collection in the form of documentation, questionnaire validity, worksheet sheet.

RESULTS AND DISCUSSION

Characteristics of PracticumPracticum

Tools The developedtool is the result of innovations that utilize bulb lamps as convex lenses, then the series of practicum tools can be utilized to measure the refractive index of a liquid in schools that have limited practicum tools. The bulb lamp used is a round lamp with a *Philips* 15 W. Lens is a clear object bounded by two curved fields. Two curved fields that restrict cylindrical and spherical lenses. The cylindrical lens is the focus of light from the source of a distant point on a line, while the ball-shaped lens curved in all directions focuses light from a source far from a point (Anhar, et al., 2017).

Characteristics of the development of practicum tools in this study is based on observations and expert analysis. The resulting characteristics are (1) the practicum tool that is made is a form of innovation that utilizes household items such as bulbs that are no longer used; (2) the practicum tool is designed in such a way as to overcome the problem of the limitations of practicum equipment in peripheral schools, so that learners can do practicum with practicum tool made; (3) Practical tools are designed as in Figure 3.1, consisting of several parts of the ruler (serves to measure the distance of objects and shadow objects), the screen (serves to capture the shadow of objects), light bulb (serves as a substitute for convex lenses), diaphragm arrow , light source (made of flashlight).

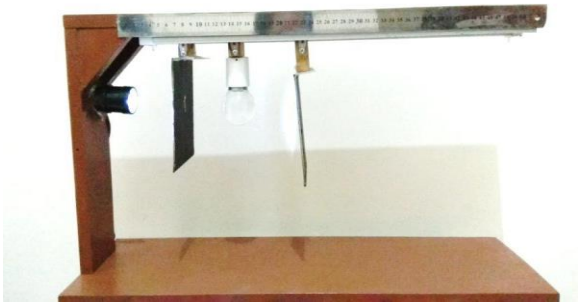

Figure 1. Series of Practicum Tools Index of the Bias Index (Front)

Figure 2. Series of Tools Practicum Index of Bias (Side)

Test Results Validity

Test of the validity is divided into two parts namely the test of the validity of the material and the test of validity and media. Questionnaire of validity test is used to determine the feasibility level of practicum of refractive index of liquids, so that information is obtained that the practicum tool is made feasible or not used as a tool of physics practice with material refractive index. Assessment results of the validity test of the liquid refractive index practicum index are shown in Table 2 as follows.

Table 2. Assessment of Validator Tools Practicum Index Liquid Bias Index

No	Expert	Percentage%	Criteria
1	Media	94	Very Eligible
2	Matter	91	Very Eligible
Total Percentage		92.5	Very Eligible

The overall results obtained are 92.5% with very decent category. Based on the results of the data analysis above, it can be concluded that the index practicum index of bias made has a level of validity that is very feasible to be used as a tool of practice in physics learning.

Trial Results Learners

Data collection was conducted at SMK Ma'arif with 10 students as a limited class test. Learners experiment using three types of liquid water, alcohol, and vinegar. Each liquid is experimented 4 times with variation of object distance 5, 7, 9, and 11 cm. The results of the experiments of learners can be seen in table 3.1, table 3.2, and table 3.3.

Table 3. Refractive index with no water

S (cm)	S' (cm)	n table	n measure	**n**	**n**	**n**
5	11	1,33	1,84	1,8	0,04	0
7	9.5		1,75		-0,05	
9	7.5		1, 81		0,01	
11	7		1,80		0	

The results of experiments that have been done to prove that bulb lamps can be used as an alternative to convex lenses, this is based on the results of a practicum performed and supported by the results of theoretical calculations. The lens experiment at a distance of 5 cm will form a shadow at a distance of 11 cm from the lens, where the resulting image is real, inverted, and enlarged this according to the calculation using the theory of refraction. Thus, it can be said that the bulb lamp can be used as a convex lens. Next practice learners test the refractive index of each liquid in the form of water where the results of the practicum can be seen from table 3.1. Based on table 3.1, the average result of measuring is 1.8 with result of measurement (1,8 ± 0). The result of index refractive index with the result of refractive index table (provision) there is difference of 0,47.

Table 4. Refractive index with alcohol

S (cm)	S '(cm)	ntable	N measuring	n	n	n
	7.5		1,81		-0,03	1. 5 10 1.36 1.89 1.84 0.05 -0.0025
11	6,5		1,87		0,03	

The result of using liquid substance in the form of Alcohol can be seen in table 3.2. Based on table 3.2, the average result of measuring is 1,84 with result of measurement (1,84 ± -0,0025). The result of index refractive index with the result of index of refractive table (provision) there is difference of 0,48.

Table 5. Refractive index with vinegar

S (cm)	S' (cm)	n table	N measure	n	n	n
5	10	1,37	1,89	1,85	0,04	0
7	9.5		1,75		-0,07	
9	7.5		1, 81		0,01	
11	7		1,80		0,02	

Practicum then determine the refractive index by using vinegar as a liquid, the result of lab can be seen in table 3.3. The results on the practicum obtained a mean of measuring 1.85 with the measurement results (1.85 ± 0). The result of index refractive index with the result of refractive index of the table (the provision) there is a difference of 0.44

Based on the results it is known that there is difference between n table with n measuring during practice with average 0,46, this is due to the limitations of practicum tools such as the bulb not perfectly rounded so that the radius of each side is different, and the glass thickness is neglected, in fact the glass has a refractive index of 1, 52.

CONCLUSIONS

Based on the results of research and data analysis can be drawn conclusion that is the characteristics of practicum tool developed as follows : 1) a practicum tool that is created is a form of innovation that utilizes household items such as light bulbs that are no longer used; (2) practicum tools can overcome the problems of limitations on marginal schools; (3) The refractive index practicum tool is well designed and practical. The result of feasibility of practicum index of refractive bias obtained percentage of 92,5% with very feasible category. The bulb can be used as a substitute for the convex lens and determine the refractive index of the liquid, but there is a difference between n tables with the measurement at practicum with a mean of 0.46, this is due to the limitations of the practicum tool Based on the above conclusions, it can be given the following suggestions , the bulb lamp should be completely rounded and the skin is thin to get a more accurate index accuracy.

REFERENCES

Agustina, K., Kristiyanto, W. H., & Noviandini, D. (2017). Learning Design of Problem Based Learning Model Based on Recommendations of Sintax Study and Contents Issues on Physics Impulse Materials with Experimental Activities. *International Journal of Active Learning*, 2(2), 68-81.

Anhar. US, Sara ID, and RH Siregar, "Design of Prototype of Solar Cells Concentrated Using Fresnel Lens", *Online Journal of Electrical Engineering*, Vol 02, No 3, pp. 1-7, 2017.

Carnawi, C., Sudarmin, S., & Wijayati, N. (2017). Application of Project Based Learning (PBL) Model for Materials of Salt Hydrolysis to Encourage Students' Entrepreneurship Behaviour. *International Journal of Active Learning*, 2(1), 50-58.

Gunawan, D., Utanto, Y., & Maretta, Y. A. (2017). An analysis on indonesian teachers' reasoning in resolving moral dilemmas. *Man In India*, *97*(2), 829-841.

Idris. N, Sarina, Maswati and D. Susilayani "Development of Bias Index Measuring Tool Using Hollow Prisms from Ordinary Commercial Glass Sheets and He-Ne Lasers for Quality Testing of Cooking Oils", *Physics Review*, vol. 1, no.2, pp. 39-46, 2017.

Octaviani. P, B. Subali, and SS Edy, "Development of Multipurpose Optical Kit Kit (APE-KOS) for Improving Science Process Skills", *Journal of Inovasi Pendidikan IPA*, Vol. 3, No 02, pp 189-200, 2017.Response Assessment

Parmin, Sajidan, Ashadi, Sutikno, & Maretta, Y. A. (2016). Preparing Prospective Teachers in Integrating Science and Local Wisdom through Practicing Open Inquiry. *Journal of Turkish Science Education*, *13*(2), 3-14.

Rahayu. A. R, V. Serevina, and Raihanati, "Development of Light Refractory Set for Physics Learning in SMA", *Proceedings of National Seminar on Physics*, Vol. 5, No.-, pp. 1-5, 2016.

Susanti, WE, and Prabowo, "Development of Liquid FluidAs A Physics Learning In Sub Material Reflection and Refraction", *Journal of Physical Education Innovation,* Vol 04 , No 02, pp. 102-106, 2015.

Utanto, Y., Widhanarto, G. P., & Maretta, Y. A. (2017, March). A web-based portfolio model as the students' final assignment: Dealing with the development of higher education trend. In *AIP Conference Proceedings* (Vol. 1818, No. 1, p. 020063). AIP Publishing.

Yohana, I., Sudarmin, S., Wardani, S., & Mohyaddin, S. N. B. (2018). The Generic Science Skill Profile of Fourth Grade Students on Acid And Base Topic in Guided Inquiry Learning Model. *International Journal of Active Learning*, 3(2), 110-116.

Zamroni. A., "Measurement of Liquid Refractive Index throughMethod RefractionUsing Parallel Plan", *Journal of Physics*, vol. 3, no. 2, pp. 108-111, 2013.