Retraction

Retraction: Analysis of the skills of physics teacher candidates in designing simple Arduino-based physics experiments (J. Phys.: Conf. Ser. 1175 012051)

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This article has been retracted by IOP Publishing in light of admission from the authors that this paper includes data and results from [1] without permission or reference.

As a member of the Committee for Publication Ethics (COPE) this has been investigated in accordance with COPE guidelines and it was agreed the article should be retracted. The authors all agree to this retraction.

[1] Seminar Nasional Quantum #25 (2018) 2477-1511 (5pp)

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Analysis of the skills of physics teacher candidates in designing simple Arduino-based physics experiments

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Abstract. Physic teacher candidates are expected to have skills in developing practical tools which aim to improve students' understanding of activities in the laboratory. This study aims to describe the ability of physics teacher candidates in designing simple Arduino-based physics experiments. This research is a descriptive study of the products of physics experiment courses. The product produced by the candidate of physics teacher after obtaining expert assessment in the correct category and feasible to use in learning with achievement score of average validity reached 87.8%. Based on the results of the observation and interview, it was found that physics teacher candidates who were highly motivated to conduct laboratory activities actively and physics teacher candidates had high curiosity skilled in making simple practicum tools for physics experiments.

1. Introduction
Practicum activities in physics learning at school are one alternative to train science process skills for students at a school. The skills of physics teachers in designing and developing a set of simple experiments are fundamental in increasing students' understanding of concepts and practicing scientific skills in laboratory lab activities[1]. Practicum activities in the laboratory are very suitable to support students in applying concepts and studying more deeply the subject matter through learning by doing [2]. Practicum activities are a way that can help students remember and understand the subject matter at a higher level because it is done directly[3]. Practical tools are learning media that contain or carry concepts from the material being studied. The use of this teaching aid will help facilitate students to understand a concept. So that with the presence of teaching aids in learning indirectly will realize learning activities that involve all aspects of the students through physical and mental activity. These are examined through students' lenses as they engage in the tasks and activities and are also observed when students interact with teachers and parents around these key elements: (i) contextualised content knowledge in the teaching and learning of physics concepts; (ii) technological and pedagogical knowledge focussing on the use of school-based and home-based internet systems; and (iii) school-based pedagogy for the development of classroom teaching and learning skills[4].

Pre-service education is education obtained by someone before entering the workforce as a teacher. During the education process, teaching practice becomes one of the debriefings in addition to material training and other knowledge[5]. The debriefing needs to be done, so that prospective teachers always
improve his ability as a professional teacher. Teacher candidates are taught how to plan learning plans, evaluate learning, learning media and practicum tools.

Technological development can be used as learning media that can support success in learning. Microcontroller technology that utilizes computers as a brain can be used in making practicum tools, one of which is straight motion, where the output of the microcontroller is very precise so that the data can be more accurate[3]. Arduino microcontroller functions as the main system device that controls and processes the entire engine system. This system is able to produce a stable output voltage of 240 V AC and 5 V DC. Mobile electronic devices can use a power source from the machine by connecting an adapter or Universal Serial Bus (USB) cable to the port in a vending machine. Electricity vending machines developed are used by different loads. Standard coin acceptors are used to determine whether the coin is genuine or fake. This can provide a system of electricity sources in public places. This system provides a stable power source of 240 V AC and 5 V DC to charge various mobile electronic devices[6].

2. Methods
This study was designed descriptively in physics experiment courses with 20 physics teacher candidates as the research sample. Data collection is carried out during the even semester of 2017/2018 academic year. Data collection methods are carried out using questionnaires, observations, and interviews. The final stage of the Arduino-based physics practicum product is the work of the prospective desert physicist to be tested to the validator. Validation sheets are shown to find out the effectiveness of tools that have been designed and made by a group of physics teacher candidates. A list of questions for interviews is used to collect data for each specific skill of a physics teacher candidate in a group. The interview can check whether the prospective physics teacher is doing maximum performance in making Arduino-based physics practicum tools.

3. Result and Discussion
The study in this study focused on 3 designs of practicum tools created by students, GLBB, circular motion and electronic semiconductor. The process of making practicum tools starts in consultation with lecturers of physics experiment courses. Making tools in groups, and performing the validation of the products that have been compiled. Validation is carried out on 3 experts who will assess the appearance, practicality of practicum tools, suitability of results with theoretical physics, results of clearly readable tools, and sensor performance. The product of the physics teacher candidates' work is reflected as in Figure 1, Figure 2, Figure 3 and Figure 4.

Figure 1. Kit GLBB

Figure 1. Kit GLBB designed to be able to record time in objects automatically. GLBB KIT uses an Arduino device which has a type microcontroller ATMega 328 and the voltage source used at 5 Volts. Designing the GLBB KIT can record time automatically used use of Arduino Uno as main controller, the micros function activate time and sensor photodiode as a time trigger[7]. Automatic time recording is expected to make the GLBB practicum more practical, the time is automatic and the distance that has been determined is expected to help students in understanding the concept of GLBB.
Figure 2. Kit Circular Motion

Figure 2. Kit Circular Motion created to assist teachers and students in carrying out circular motion practicum. Variables that appear later will be processed with a simple visual basic program so that data can appear on the laptop screen so as to facilitate students in repeating practicum activities. Because according to research [8] practicum activities in the laboratory are thought to be able to improve students' science process skills.

Figure 3. Electronic Semiconductor

Electronic semiconductor, this tool is designed to help students understand the value of semiconductor devices, such as resistors, transistors, capacitors, and diodes. The group of students who made this tool during the interview said that the accuracy of the equipment made was close to 99%, so that it could be used to evaluate the value of semiconductor devices.

Figure 4. Kit Free Fall Motion

The accuracy of the free fall motion experiment set is obtained by comparing the measurement results of the standard measuring instrument. The measurements produced by the stopwatch are used as a comparison of measuring instruments. Obtained results of accuracy in measuring time between 0.933 to 1 and an average speed of 0.978.

Tools produced by physics teacher candidates are tested to experts to be assessed in terms of display tool design. Practical tool design is more practical, the relevance of the results of the practicum tool with theoretical physics, the results on the practicum tool can be read clearly, the performance of sensors in
the practicum tool is good. Tools produced after the results of the expert test with an average percentage 87.8% of success.

### Table 1. Results of The Practicum Tool Validation

| Group | Experiment Set       | Validation criteria                                                                 | Validation Score | % |
|-------|----------------------|--------------------------------------------------------------------------------------|------------------|---|
| 1     | GLBB                 | • Display tool design                                                                 | 20               | 18.76 | 93.8  |
| 2     | Circular Motion      | • Practical tool design is more practical                                            | 20               | 18   | 90    |
| 3     | Electronic Semiconductor | • The relevance of the results of the practicum tool with theoretical physics     | 20               | 16   | 80    |
| 4     | Kit Free fall motion | • The results on the practicum tool can be read clearly                               | 20               | 17.64 | 88.2  |

The results of the interviews obtained with the description of the skills obtained by the physics teacher candidates at each stage of the experimental completion process can be seen in Table 2.

### Table 2. Interview Aspect

| Aspect Interviews | Interview Description |
|-------------------|-----------------------|
| Selection of physics subject matter, practicum tools and materials | We choose tools that are often used for practicums that are limited in number, and can be made easily and inexpensively |
| Skills create basic circuit design | Our group made circuit designs using the necessary sensors according to the variables to be measured |
| Modify a simple experimental tool | We are fixated on the example of the difficulty of modifying the tool |
| Laboratory-scale experiments | We conducted laboratory scale tests more than 3 times |
| Improvement of experimental tools | We make experimental improvements from aspects of appearance, use and practicality |

Physics teacher candidates have difficulty modifying tools, because most of them are fixated on existing examples. some results outside the set target are some groups able to combine Arduino devices with visual basic-based programming so that the results make it easier for students to understand physics theory. By using a simple framework students will be accustomed to forming critical thinking and behavioral investigations that are relevant to practicum, which focuses on the repeated cycle of comparisons between data sets[9]. It aims to help students understand the variables and basic thinking that is carried out during the experiment [10].

### 4. Conclusion

The conclusion of the interview stage and the observation obtained the results of the analysis of physic teacher candidates skills in designing proper Arduino-based practicum tools. Based on the results of the representation, the physic teacher candidates skills in developing Arduino-based practicum tools are excellent while the modification and application of the sensor are still not useful. These results indicate that prospective physics teachers still need more training related to sensor material so that they can
design and modify sensor-based practicum tools. Findings in the field of physics teacher candidates have curiosity and high motivation to conduct laboratory activities actively and are interested in practicing so that they are skilled in making Arduino-based practicum tools for physics experiments.

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