

## **Assistance in Making Dynamic Electricity KITS Based on Scientific Argumentation Skills for Physics Teachers in Sidoarjo Senior High School**

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**Abstract:** Physics learning cannot be separated from studying abstract concepts and practical activities. The limited equipment in the laboratory is one of the obstacles to the lack of optimal learning activities, especially in practical activities. Therefore, teachers must be more creative and innovative in utilizing the tools around them so they can be used as practical tools. The other obstacle is scientific argumentation skills that still need to be better trained or not contained in the learning materials. The solution is Synergize with the Physics Senior High School Teachers in Sidoarjo to conduct activities to assist them in Making Dynamic Electricity KITS Based on Scientific Argumentation Skills. This activity was prepared from May 2022 until July 2022. Preparations consist of field studies, prototyping KITS, and compiling worksheets. Then, the teachers are assisted through the training to make Dynamic Electricity KITS on August 11, 2022. Thus, the teachers can make practical tools and arrange student worksheets according to these tools based on scientific argumentation skills. They can apply their tools in learning at their school. The result of this activity was the high school physics teacher's response to the material and demonstrations, which were very enthusiastic and interesting. This is evidenced by the average response questionnaire results of 3.44 with the maximum value of the questionnaire being 4. The maximum value obtained based on the questionnaire responses is 3.66, and the lowest is 3.28.

**Keywords:** Physics Practicum Tools; Dynamic Electricity; Physics Senior High School Teacher

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### **INTRODUCTION**

Teachers must have the ability and competence to understand the knowledge conveyed to students adequately. One of the most basic competencies teachers must have is mastery of the field of study, both disciplines and teaching materials for the school curriculum (Marzuki et al.,

2019). Mastery of these competencies usually differs for each teacher (Anwar, 2019). However, there is one way that can be mastered quickly and well by teachers, namely by holding various kinds of training that support these competencies (Dibarbora, 2021; Harris & Sass, 2011; Silva et al., 2020). This

training needs to be carried out because the field of education that continues to develop requires all educational institutions to improve all facilities and infrastructure, as well as teacher competencies to have good quality (Yohamintin *et al.*, 2021). The development of the quality of education and the professionalism of educators, especially teachers, must be carried out (Zati & Anifah, 2019). Considering the rational situation in today's technologically-paced world. The development of this competence is highly correlated with the nature of educators who are teachers. Educators are education experts with the benefits and indispensable positions to realizing the 2025 education vision. They are producing educated and competitive Indonesian people. Professional teachers do not only focus on their main job but also guide, shape, protect and assess students, as stated in the Law on Teachers and Lecturers (Eliza *et al.*, 2022).

In some areas, teachers have organizations that facilitate teachers in those areas to have good competence and become professional teachers. This organization is called the Subject Teacher Consultation (MGMP). The problems of the MGMP are the lack of work programs and academic activities. The lack of teacher participation in teacher competency training also is a problem of MGMP. In addition to the many factors that influence the increase in teacher competence, some teachers still do not realize that they can learn a lot from MGMP activities. Thus, MGMP activities can be a place for Teachers to share the problems they face in the classroom and the learning process (Fatmawati & Rustaman, 2020). However, several things can hinder the process, namely the busyness of the teacher in learning, the relatively far distance of residence from the MGMP location, the lack of coordination between the MGMP leaders, and the lack

of coordination between the university and the MGMP (Hw *et al.*, 2017). Therefore, the collaboration between universities and MGMP is very important to improve the competence, motivation and innovation of Teachers.

One area with an MGMP organization is Sidoarjo, especially the MGMP for Senior High School Physics Teachers. The Department of Physics, Universitas Negeri Surabaya (Unesa), collaborated with the MGMP Physics Teachers of Sidoarjo Senior High School related to assist in making effective and efficient dynamic electric KITS. This assistance aims to improve the competence of teachers in experimental-based learning, especially in the material for making media or learning KITS for dynamic electricity. The selection of materials was based on the complaints of high school teachers that it was challenging to create and demonstrate learning media for dynamic electricity materials. Explanation of the contents during the mentoring is carried out using a scientific argument-based method. This advantage is it can create a learning atmosphere in the classroom most effectively when teachers and mentors engage in dialogical interactions to explore ideas, constructs, and concepts (Asterhan *et al.*, 2015; Chi, 2009; Johnson & Johnson, 2009). In addition, scientific argumentation-based learning is more effective in acquiring science process skills than traditional teaching approaches (Gultepe & Kilic, 2015). Thus, this community service will examine the assistance process in manufacturing dynamic electricity KITS based on scientific argumentation skills for MGMP Physics Senior High School Teachers in Sidoarjo.

## **METHODS**

The Community Service Team discussed and communicated with the Chair of the Sidoarjo Physics MGMP. The discussion discussed the problems of high school

physics teachers throughout Sidoarjo and alternative solutions expected from the MGMP. After discussing through social media, it was agreed that the main problem to be solved by the Community Service Team of the Physics Department, FMIPA Unesa, was the manufacture of simple practicum tools. The procedure for its implementation is in the form of training. The method used in the training and extension is the lecture-question-answer method, demonstration and practice.

### **Lecture-Q&A**

This method was chosen to explain the principles and process of making simple, practical tools, especially for dynamic electrical materials, and practising the basics of scientific argumentation skills. So, the teachers can understand and master it. The material provided is about the technique of making simple practicum tools and the preparation of student worksheets based on scientific argumentation skills.

This method can more easily understand the trainees (Alderman, 1922; Papadogiannakis, 2019). Training participants can ask questions when the team explain the principles of working and making simple, practical tools of dynamic electrical concepts based on scientific argumentation skills. In addition, participants can ask questions about their experiences, examples of existing conditions and possible modifications.

### **Demonstration**

This method was chosen to demonstrate a process for making a simple, practical tool for dynamic electrical concepts. This method is used because it shows, performs, and informs the trainees of the materials (Dorgu, 2015). This material is demonstrated to provide convenience and understanding to the teachers. This demonstration is carried out by trainers or instructors from the Community

Service lecturer team assisted by interested students in Community Service activities. Thus, participants can observe the implementation of the materials provided perfectly. The demonstrated material included making simple practicum tools and preparing student worksheets for dynamic electricity concept based on scientific argumentation skills.

### **Practice**

In this method, the trainees will practice making simple practicum tools that the instructor has demonstrated. It is about producing simple, practical tools and student worksheets based on scientific argumentation skills. The results of making practical tools and student worksheets are then applied to learning at school.

### **Partner Participation**

Partners of Community Service activities, namely the Physics MGMP of the Sidoarjo Senior High School, participated actively, provided a place, and gathered or invited all MGMP members to participate in the training. They provided a place for training activities in Sidoarjo at the SMAN 3 Sidoarjo. In addition, they provide electricity networks, fans, sockets and some presentation equipment for training activities. The Community Service Team provided tools and materials assisted by several Unesa students.

## **RESULTS AND DISCUSSIONS**

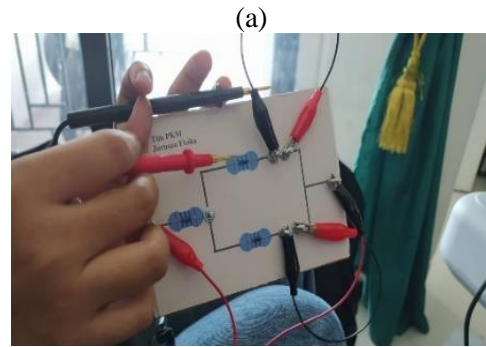
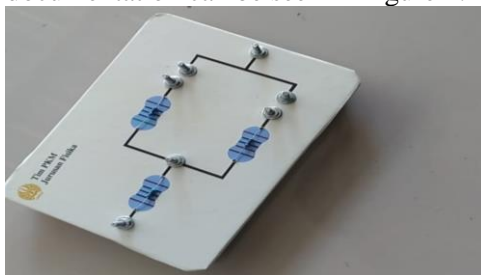
The Community Service activity started with an interview/discussion regarding the training needs for post-pandemic teachers with the Chair of the Physics MGMP of the Sidoarjo Senior High School. After the discussion, the topics that will be discussed are media and laboratories. Then, the Community Service Team discusses specific topics or themes of training activities until the community service team can finish their

proposal and submit it. After the Community Service proposal was approved, students and alumni assisted the community service team in prototyping Ohm's Law and Kirchoff's Law teaching kits. To know the constraints of making tools and alternative problems, the team conducts testing activities and prototyping. The activity can be seen in Figure 1.



Figure 1 Prototyping Dynamic Electricity

The activity was continued by testing the practical tools. Community service assistants are asked to experiment with a ready-made tool prototype. Furthermore, the prototype tool is refined and labelled to appear attractive. The documentation can be seen in Figure 2.



(a)  
 (b)  
 Figure 2 (a) Documentation of Dynamic Electricity KITs Picture; b) Documentation of Dynamic Electricity KITs Trials

There are 3 types of circuits made, namely series, parallel, and mixed resistance circuits, as shown in Figure 4. The practicum kit consists of 3 types of circuit boards, batteries, battery holders, and multimeters. After the prototype tool was tested successfully, the PKM team and students made 10 sets of practicum kits.

The practicum kit duplication was taken about 3 weeks. Then, the Community Service team made a worksheet based on science argumentation skills that will be presented to the training participants as an example of a learning tool that could be applied with the practicum kit.

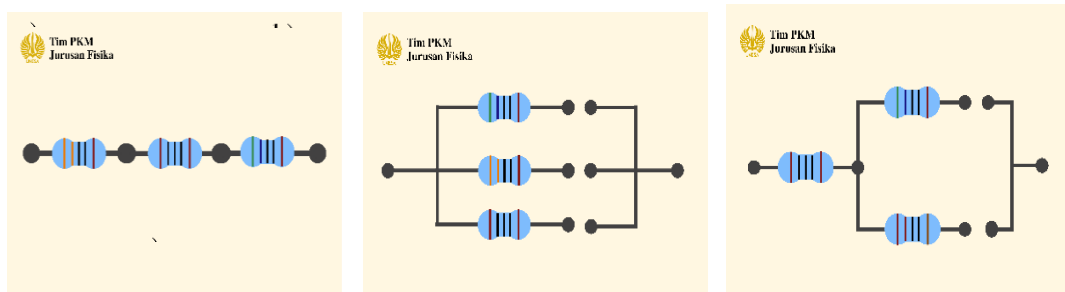


Figure 4 Experimental Design (a) Series Circuit, (b) Parallel Circuit and (c) Series-Parallel Circuit

The documentation of the practicum kit doubling activity can be seen in Figure 5

and the finished practicum kit can be seen in Figure 6.

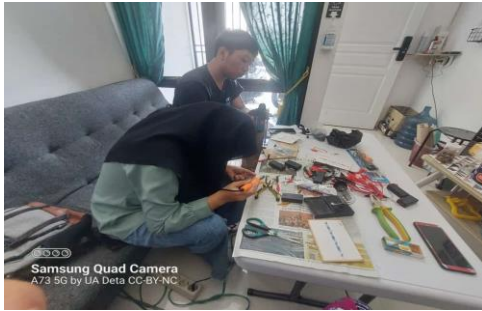


Figure 5 Documentation of Practicum Kit Duplication Activities



Figure 6 Dynamic Electrical Practicum Kit

After the materials, worksheet, and practical tool kits are ready, the

Community Service Team coordinates with the Physics MGMP chair in Sidoarjo Senior High School to schedule the training activity. From the discussion, its activity will be held on 11 August 2022, in SMAN 3 Sidoarjo, from 8.00 until 16.00.

This training activity was attended by 54 members of Physics MGMP in Sidoarjo Senior High School. When the Community Service team delivered the theory to the MGMP members, the Community Service team was assisted by students and alumni to ask the teachers to group up and try the Practicum Kits that had been made. When doing group activities, each group was very enthusiastic and tried the dynamic electric practicum kit that had been made. The question and answer between the teacher and the teacher and the companion is very interactive and attractive. This can be proven by photo documentation during materials delivering can be seen in Figure 7. Documentation of group activities can be seen in Figure 8.



(a)



(b)



(c)



(d)

Figure 7 Material Delivered from The Community Service Team



Figure 8 The Enthusiasm of The Teachers in The Practicum Activity

The understanding of each group is different, and some groups can immediately practice and try the Practicum Kit. Some groups need help measuring the practicum kit's voltage and current. However, this obstacle can be solved because the Community Service team and Unesa students help teachers to

use the practicum kit properly and correctly.

In general, participants were very enthusiastic about participating in community service activities. Quantitatively, the satisfaction and enthusiasm of the teachers are shown by the questionnaire survey results in Figure 9.

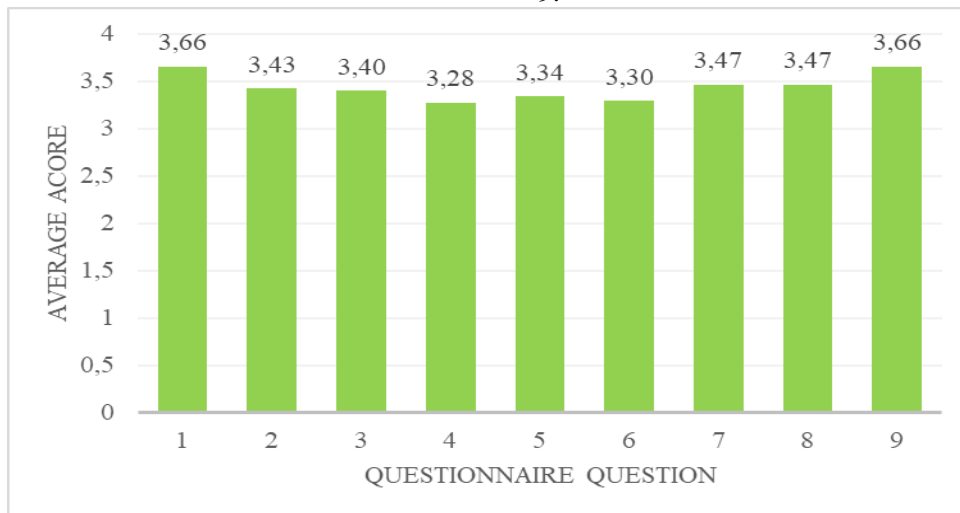


Figure 9 Results of the Training Participants' Response Questionnaire

Based on the results of the response questionnaire, it is known that the response of the training participants was excellent. The average score of the questionnaire response of 3.44 indicates this. Furthermore, a maximum score of 3.66 was obtained in the first and ninth questionnaire items, namely items about the benefits and implementation of

training. This is in line with the results of activities carried out by (Fadillah *et al.*, 2018; Saputri *et al.*, 2017; Setiyani *et al.*, 2021). In community service conducted by Saputri *et al.*, (2017), teachers have been able to make simple visual aids, and the teacher's ability has increased in carrying out experiments in class. The average response to satisfaction with

community service activities is quite good, with an average value of 3.46. Besides that, Community Service conducted training on the making and use of math and science teaching kits for elementary and junior high school teachers in Tanjung Saleh with the results that teachers were able to make attractive teaching KIT and make it easier for students to learn (Fadillah et al., 2019). And in the Manipulative Teaching Kit Making Training activity, the teachers were very enthusiastic about participating in the workshop activities. This is indicated by the many questions, sharing about the learning that has been done and participating in trying to make tools (Setiyani et al., 2021).

This training trains teachers' skills in designing and making simple practicum tools according to the subject matter. Besides that, it also trains the preparation of worksheets as a practicum guide using tools that have been made based on scientific argumentation skills. So that learning physics becomes more meaningful and can train students' scientific argumentation skills.

This activity certainly contributes to the development of physics education in physics learning, especially in the independent curriculum. This activity combines the development of teacher skills in increasing creativity in creating practicum-based learning with simple tools around and in implementing learning that develops students' scientific argumentation skills. The object of this activity is still limited to high school physics teachers in Sidoarjo and only on dynamic electricity material. For the future, it can be developed with targets in other areas and a wider range of material.

## CONCLUSION

The training activities of the Community Service Team of the Unesa Physics Department with the Physics MGMP in Sidoarjo Senior High School went successfully and optimally. Making

dynamic electrical practicum tools and their duplication takes about three weeks to obtain adequate and efficient results. This practical tool is made reasonably cheaply with materials and tools that are easy to find. During the mentoring implementation, the MGMP teachers' response to the materials and demonstrations of the Community Service Team was very enthusiastic. This is evidenced by the average response questionnaire results of 3.44, with the maximum value of the questionnaire being 4. The maximum value from the response questionnaire is 3.66, and the lowest is 3.28.

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