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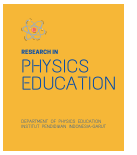

ARTICLE

Analysing science teachers' difficulties in teaching the concept of electricity in junior high school

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Abstract

Electricity is a material that is considered difficult for science teachers to provide understanding to students so as to encourage researchers to find out what are the obstacles for science teachers in teaching the concept of electricity in junior high schools. The focus of this research is trying to uncover what obstacles are experienced by science teachers in teaching electricity in terms of facilities and infrastructure, preparation of lesson plans, learning processes, and assessment of learning outcomes. This study uses a case study research design with quantitative and qualitative approaches with the subject being a science teacher who is a member of the science teacher community in Garut Regency. Based on the results of the study, it can be concluded that: (1) teachers experience obstacles in terms of facilities because of inadequate teaching aids and also the absence of laboratory personnel so that activities in the laboratory are limited, (2) teachers also experience obstacles in terms of lesson planning, the obstacles experienced are the teachers are not yet creative in developing learning media for dynamic electricity, there is also no development of modules and worksheets, (3) in the implementation of electricity learning the teacher has difficulty in delivering electricity material related to equations/formulas because the teacher's understanding of dynamic electric formulas is limited and students' mathematical abilities are low, (4) in the assessment and evaluation of learning teachers experience obstacles in developing affective and psychomotor assessments, the ability of teachers to develop tests is low, and the use of various forms of assessment instruments.

Keywords: Science teahcer, electricity, difficulties in teaching electricity

1. Introduction

Natural Sciences or science is literally a science that studies events that occur in nature (Darmaji, Kurniawan, and Irdianti 2019). Science puts forward a scientific approach, an approach using a learning model that applies the principles of observing, asking, trying, processing and communicating.

The success of science learning certainly cannot be separated from the role of the teacher as a demonstrator, class manager, mediator and facilitator and evaluator (Aldahmash et al. 2019). In carrying out these roles, teachers should have mastery of knowledge and skills in facilitating these teaching materials. There are six competencies that teachers should have, namely pedagogical competence, personality competence, social competence, and professional competence (Trabona

et al. 2019). One of the science-physics concepts that are difficult for students to learn is electricity. The difficulty of understanding the concept can be seen from the difficulty of students solving problems related to dynamic electricity, or applying the concept of dynamic electricity in everyday life. The characteristics of complex dynamic electrical concepts such as there are many theories, laws, mathematical calculations, symbols, formulas and circuit drawings are predicted to be a source of student difficulties. In addition, the conception of some abstract dynamic electrical concepts such as electric current, voltage and electric power is difficult for students to understand.

Although teachers and researchers in science education know that the concept of electricity has its own challenges when taught in the classroom, so far research in science education has rarely revealed the location of the obstacles for teachers in teaching the concept of Dynamic Electricity. Therefore, this study wants to reveal the obstacles of science teachers when teaching the concept of electricity. Through in-depth knowledge of the barriers of science teachers in teaching dynamic electricity concepts, prospective teachers and school teachers are expected to give more detailed or in-depth attention in teaching dynamic electricity concepts. Through this research, researchers also try to uncover the efforts made by teachers in overcoming obstacles or difficulties in teaching the concept of dynamic electricity. This will be very useful for other teachers to apply in different classes or modify it to make innovations in overcoming students' difficulties in understanding the concept of electricity. Based on the description that has been explained above, the title of this research is analysis of science teachers' difficulties in teaching the concept of electricity in junior high schools.

2. Literature Framework

2.1 Pedagogical content knowledge (PCK)

PCK is defined as a mixture of content and pedagogy into an understanding of certain topics, problems or issues that are compiled, presented and adapted to various interests and abilities of students which are then applied in the learning process (Fithriyyati, Maryani, et al. 2018). PCK is explained as the result of a combination of several aspects, namely: general pedagogical knowledge, subject matter knowledge and general contextual knowledge. A science teacher must have competencies that not only teach or transfer material to students but also must be able to pay attention to the characteristics of students as audiences and the right way to teach certain materials to students.

PCK means a combination of two knowledges which are the basis for the implementation of learning by teachers, namely Content Knowledge and Pedagogical Knowledge. A science teacher must master this competency to carry out science learning, so teaching materials are needed as a teacher reference in exploring PCK (Aydeniz and Gürçay 2018). The teaching materials in question can be in the form of handouts, books, modules, worksheets, or other types of teaching materials that can support teacher competence. A science teacher will not succeed in teaching science concepts if the teacher does not master the content, master the educational foundations (methods, strategies, approaches, models or theories), and can combine pedagogical knowledge with knowledge of the content.

The components of PCK develop independently of each other to the stage of teaching experience, while the most important problem in the development of PCK is the lack of various types of knowledge acquired in separate periods in the form of methodology, teaching experience and the inability to integrate the knowledge base into one (Aldahmash et al. 2019). PCK is a combination of pedagogical competence and professional competence.

The indicators that include the PCK component are the components of students' basic knowledge, learning difficulties, conceptions, and students' ability development (Ekiz-Kiran, Boz, and Oztay 2021). Components of mastery of curriculum indicators which include the basis of education and curriculum development. The teaching method, providing motivation to students, then learning planning and finally the implementation of learning, the things mentioned above are indicators in the mastery component of the learning process. Meanwhile, the assessment aspect becomes an indicator

in the knowledge component. As for the components of teaching resources, the indicators are concept maps, difficult materials and material sequences. Components of knowledge about learning objectives indicators which include learning objectives and applications or orientation. Both PK and CK both must be owned by educators, knowledge of PK and CK for teachers is important because mastery is one of the demands of competency standards (Ekiz-Kiran, Boz, and Oztay 2021). PCK is not just pedagogical knowledge as studied in psychology, but this knowledge includes how educators are able to organize material and subject content so that it is easily taught and can be accepted by students.

2.2 Characteristics of Electricity Concepts

Meanwhile, dynamic electrical material is a central area of the science curriculum at the elementary, secondary and higher education levels. Besides that, the concept of electricity is very abstract and complex, so a model, an appropriate analogy is needed so that abstract electrical material can be seen by students so that they can understand the concept of electricity well. Students' understanding of dynamic electricity is strongly influenced by the use of terminology in everyday life, such as power, flow, and voltage which often conflict with scientific concepts. This happens because the concepts are very abstract. There are several obstacles for science teachers in teaching the concept of dynamic electricity, namely in the teacher's conceptual understanding of the Dynamic Electricity material which is still lacking so that teachers find it difficult to determine the appropriate learning model and how to analogize the abstract concept of Dynamic Electricity in analogy to life that is real nature (Sakdiah, Mursal, and Syukri 2018).

Dynamic electricity is electricity that is not fixed or can be called moving. Electricity that does not stand still is called electric current. There are two electric currents, namely direct or DC electric current and alternating electric current or AC. Direct current or DC has a value that does not change or is constant over time, which means wherever we pay attention to the current at different times it will get the same value while alternating current is a current that has a value that changes with time units with characteristics that will always repeated for a certain period of time. The quantities contained in dynamic electricity are those found in Ohm's law. Electricity can be described as an "energy supply" where electric current comes from a continuous flow of electrons flowing from the negative pole to the positive pole, from high potential to low potential from a potential difference source (voltage)(Taqwa and Rivaldo 2019).

If an object with more positive electric charge has a lower potential than two places that have a potential difference, a current can appear, if they are connected together with a conductor. Electrical resistance current, in a circuit that has not been connected to a power source such as a battery, then all points in the circuit are at the same electric voltage and therefore the electric field becomes zero inside and also on the surface of the conductor. Since the electric field is zero, there is no transfer of electric charge through the wire, so there is no electric current. However, if the ends of the conductor wire are connected to a battery, all points are not at the same voltage. The battery causes a potential difference between the ends of the circuit and creates an electric field in the wire. The electric field produces forces on the conduction electrons in the wire causing the electrons to move in the wire which then produces a current (Sakdiah, Mursal, and Syukri 2018). The direction of the flow of electricity has a different direction from the direction of the flow of electrons, the direction of the flow of electricity flows from the positive pole to the negative pole and the direction of the flow of electrons flows from the negative pole to the positive pole. A particle can become positively charged when it loses electrons and becomes negative when it gains electrons from another particle.

Dynamic electricity has a resistance called a resistor which functions to regulate the size of the electric current flowing through a circuit. The size of the resistor is called the resistance with the unit ohm with a measuring instrument called an ohmmeter. Each type of material has a different level of resistance. Based on the resistivity properties, a type of material is divided into three, namely

conductors, insulators and semiconductors. The conductivity value in a wire resistance is the opposite of the resistivity value, therefore the conductivity value of a wire resistance is smaller than the resistivity value. The smaller the conductivity value of a conducting wire is a good conductor, such as copper which is used to conduct electricity. The resistivity value for each conductor has a different value depending on the constituent material, purity, treatment and temperature (Taqwa and Rivaldo 2019). Ohm's law is a formula used in calculating the quantity in electric current. Ohm's law states that the difference in voltage across a conductor is directly proportional to the amount of current passing through it. A conductor is said to obey Ohm's law if its resistance value does not depend on the magnitude and polarity of the potential difference applied to it. Ohm's law function is used to determine the relationship between voltage and current and can be used to determine an electrical load resistance without using an ohmmeter.

3. Research Method

3.1 Research design

This research uses a case study research design (Bijsterbosch et al. 2019), with quantitative and qualitative approaches. In the quantitative approach, the data or information collected will be analyzed using descriptive statistics or percentages on each data and then presented in the form of a bar chart (Lambert, Whipple, and Kleinstäuber 2018). Meanwhile, the qualitative approach method is a research method based on post positivism philosophy, which is used to examine the condition of natural objects (as opposed to experiments). The researcher in this study is the key instrument. This research is also an investigative process to understand social problems or human problems, based on creating a complete holistic picture formed in words, reporting the views of informants in detail, and arranged in a natural setting (Bijsterbosch et al. 2019).

3.2 Sample and participants

The population in this study were all science teachers at one junior public school in Garut. Meanwhile, the sample in this study were 15 participants (Science teachers at junior high school and equivalent) who came from public and private schools who were members of science teacher community at Garut Regency. All participants are science teachers who are still actively teaching at the junior high school equivalent of seventh rayon in Garut regency for the 2021/2022 academic Year. The criteria for science teachers who become participants are 5 senior teachers, 5 middle-senior teachers, and 5 new teachers who are members of the Science teacher community. The age of the youngest participant was 27 years and the age of the oldest participant was 44 years with the mean age for all participants was 35.3 years (SD=6.31). The participants' teaching experience ranged from 1 year 6 months to 18 years 3 months.

3.3 Instruments

The research instrument used was a questionnaire sheet of 20 closed statements and an interview guide of 18 questions. The questionnaire grid and interview questions consist of four aspects: Learning Planning Barriers, Learning Implementation Barriers, Assessment and Evaluation Barriers, and Assessment and Evaluation Barriers.

Questionnaire is a data collection technique that is done by giving a set of questions or written statements to respondents to answer (8). Scoring using a Likert scale in the form of a checklist with gradations of (SM) very inhibiting, (M) inhibiting, (TM) not inhibiting, (STM) being very non-inhibiting. The statements presented in the questionnaire are all negative statements because what this study wants to reveal is about the obstacles of science teachers in teaching dynamic electricity in junior high schools.

Interviews are used to find out things from respondents who are more in-depth with a small number of respondents (8). Interviews in this study were conducted in a structured manner in which

the researchers set their own problems and questions that would be asked to reveal the data with an interview guide. To ensure that the instrument prepared by the researcher is suitable for use, the instrument is assessed by 2 competent experts in the fields of Physics and Physics Education. Based on the results of the assessment, this research instrument was suitable for use with revisions. After the recommendations given by the expert validator, the researcher revised the instrument made in accordance with the validator's suggestion so that this research instrument was suitable for use.

3.4 Data analysis

The data in this questionnaire were analyzed using a qualitative descriptive technique, namely calculating the scores obtained by percentages. The analysis is to find out how big the level of barriers for teachers to teach Dynamic Electricity at junior high school or equivalent. The data are grouped based on the Ideal Mean (Mi) and Ideal Standard Deviation (SD) using the ideal mean and standard deviation equations. After the data is grouped into each category, then look for the percentage of each data. Furthermore, the results of the data analysis were grouped into five categories, namely very high, high, medium, low and very low.

The interview data analysis technique used in this study was done by Thematic Analysis which aims to identify goals so that they can find patterns in an event and also explain the extent to which the incident occurred from the researcher's point of view obtained through the data that has been collected by the researcher (Gumilar and Ismail 2021). The thematic analysis stage is understanding the data by reading and rereading the interview transcript then compiling a code that can identify data that has the potential to be in accordance with the research question and provide a brief summary of some of the data and the last is the determination of the theme which is carried out after reviewing all the codes and groups that have been identified. has been formed related to research which will later produce several tentative themes. When the tentative themes have been compiled, each theme is calculated based on its relevance to the research question so that a conclusion can be obtained that can answer the research questions.

4. Result of the research

4.1 Difficulties in the context of facilities of laboratory activities

In dynamic electricity learning, it is necessary to have support in terms of facilities and infrastructure so that students can understand the material. But in reality, teachers still have obstacles to demonstrate physical phenomena related to dynamic electricity. There are even some schools that do not yet have a science laboratory. This is as revealed in the following interview results.

> *"Learning dynamic electricity does need adequate facilities because in this electricity learning students need to experience directly the process or occurrence of dynamic electricity...(P-1)".*
>
> *"...for the facilities here, there are still lack of other obstacles, if in city schools usually children bring their own, by the teacher the children are assigned to bring this tool and this tool, but if in the area it is a bit difficult so schools have to prepare while schools also completely limited (P-5).*
>
> *"…Then regarding the facilities and infrastructure, whether it is adequate or not, my school is not yet adequate, there is no science lab, especially the electric KIT (P-3)".*

In addition to inadequate teaching aids, the main theme in this aspect is the limited activities in the laboratory due to the absence of laboratory staff in the school. This is also an obstacle for teachers, because teachers sometimes prepare themselves or can even be assisted by students in preparing teaching aids. This causes a lot of time for teaching and learning activities to be taken up for the preparation. This is as revealed in the following interview results:

"…the school doesn't have a laboratory assistant, it's more likely that the teacher who prepares it is assisted by students……"(P-1).

"...because there are no laboratory assistants at school, so students only help" (P-4).

"... if you want to practice the tools and materials are prepared by the teacher and students and carried out in the classroom" (P-5).

The limitations of facilities and infrastructure do not necessarily dampen the enthusiasm of teaching science teachers, they overcome the obstacles experienced by taking the time the day before to prepare teaching aids that will be used for practicum or if the school does not have teaching aids the teacher asks students to independently prepare their teaching aids at home, Of course, teaching aids are simple and easy to obtain so as not to burden students. As revealed in the following interview results:

"For the preparation, so before two days or one day maximum, usually one day before learning I check, try to first check the equipment in the laboratory whether it is still functioning or not then later on which one is still functioning and can be used, then used for practicum…P-2)"

"Students have to check this with the things they brought from home, secondly, I prepared a kit box in the lab and then tried it one by one whether it went well or not, whether it still works or not, after that I made a checklist again if they work. then record the tools so that later when the practicum does not lack tools, the children don't damage the tools...(P-3)".

4.2 Difficulties in the context of planning lesson plan

In addition to the context of facilities and infrastructure, the obstacles experienced by teachers in the dynamic electricity learning process are in terms of the preparation of learning devices. The results of the questionnaire showed that 6.67 percent of teachers stated that learning planning was very inhibiting, 66.67 percent said it was inhibiting, 20.00 percent said it did not hinder, and 6.67 percent did not hinder it at all. The biggest obstacle for science teachers in lesson planning is how to choose methods and media that are appropriate to school conditions and student characteristics.

In more detail, the percentages in Figure 1 refer to a number of obstacles faced in the aspect of Dynamic Electricity learning planning, namely the preparation of the Dynamic Electricity Learning Implementation lesson plan that is not suitable for student learning conditions, the teacher's ability is not sufficient in preparing students psychologically for learning. Dynamic Electricity material, the learning method used in Dynamic Electricity material that is not suitable for student learning conditions, provides effective learning on Dynamic Electricity material that is not in accordance with student learning conditions, teachers have difficulty in choosing appropriate media for Dynamic Electricity material, teacher abilities are not sufficient in determine the basic competencies to be achieved in the Dynamic Electricity material, the teacher's ability is not sufficient in determining the basic competencies to be achieved in the Dynamic Electricity material, the teacher's ability to convey the scope of the Dynamic Electricity material is not in accordance with the syllabus, teaching aids to carry out the teaching and learning process. Dynamic Electricity lessons are not owned by the agency, the teaching aid kits available to carry out Dynamic Electricity lessons are still incomplete, and the number of teaching aid kits used in Dynamic Electricity lessons is insufficient when compared to the number of existing students so that Dynamic Electricity learning does not run optimally.

Complementing the data generated from the questionnaire above, the results of the interviews revealed three themes related to the learning planning process, namely the existence of a learning model to support student activities, the development of learning media for dynamic electricity that is not creative, and there is no development of modules and worksheets. In planning the learning process the teacher has chosen a learning model to support student activities in the learning process, as revealed in the following interview results:

"… the model for this material that has been used by Project based learning has been used for inquiry (P-1)".

"… for the model I prefer to use STEM…(P-3)".

However, from interview data, it was found that the development of learning media used by teachers for dynamic electrical materials was not creative. As revealed in the following interview results:

"The media that are usually used that are already known to students are measuring instruments such as ammeters, voltmeters and switches or fuses (P-4).

"... I use projector, books, and worksheets (P-5)".

Similar to learning media, in the provision of teaching materials, data revealed that there was no development of teaching materials carried out by teachers in the dynamic electricity learning process, as seen from the following interview:

"The teaching materials used are textbooks, modules, internet and worksheet…(P-1).

"… the second material we might use is the material already in the apparatus lab. The science there is complete...(P-3)".

Some of the obstacles experienced by teachers in learning planning above occur because there are still some science teachers who do not fully understand the concept of dynamic electricity and there are also some science teachers who do not fully understand the correct and safe use of electric teaching aids. This can be seen from the following interview data:

"...skills from teachers are also needed because sometimes teachers don't know how to use the facilities, they have both at school and simply at home…(P-3)".

"...many students find this discussion difficult, then there are also teachers who have difficulty conveying this discussion...(P-4)".

4.3 Difficulties in the context of doing teaching process

In the context of the implementation of dynamic electricity learning, it is known that 6.67 percent of teachers stated that they felt very hampered, 53.33 percent said they felt hampered, 33.33 percent said they were not hampered and 6.67 percent were very uninhibited. One example of the obstacles experienced is in classroom management which tends to run as it is because some teachers have not been able to use properly selected learning media, teachers have not been able to relate dynamic electrical material to everyday life which can motivate students to be enthusiastic during the learning process. learning and fun for students.

The percentages in Figure 2 refer to teacher barriers in the context of learning implementation. There are five substances that represent this percentage: the teacher's ability is not sufficient in using learning media that is in accordance with the Dynamic Electricity material; the teacher's ability is not sufficient in relating the Dynamic Electricity material to everyday life; teachers find it difficult to convey Dynamic Electricity material due to lack of knowledge about Dynamic Electricity material so that learning goes as it is; the teacher's ability is not sufficient in teaching the concept of Dynamic Electricity with the selected media; and the ability of teachers is not enough in managing the classroom atmosphere so that it can be conducive when learning takes place.

Apart from the questionnaire data which revealed that teachers had obstacles in the learning process, the interview data revealed four important themes regarding the dynamic electricity learning process carried out by the teacher, namely the use of a scientific approach, limited understanding of

the teacher's dynamic electric formula, low students' mathematical abilities, and the existence of a learning contract between students and teachers. In the dynamic electricity learning process that has been carried out by the teacher, interview data reveal that there is a use of a scientific approach, this can be seen in the following interview excerpts:

> *"Scientific learning itself has actually been carried out during practical learning…(P-3)".*
>
> *"I have done a scientific approach to dynamic electrical materials with the inquiry model…(P-5)".*

In addition, in the implementation of learning, teachers still have difficulty in conveying dynamic electricity material related to equations/formulas because the teacher's understanding of dynamic electric formulas is limited, this is obtained from the following interview results:

> *"What is considered difficult in dynamic electricity, especially in applying formulas related to dynamic electricity…(P-1)".*
>
> *"…the difficulty encountered in teaching the concept of dynamic electricity in my experience is mainly in explaining the circuit resistance calculation…(P-4)".*

Another difficulty experienced by science teachers when teaching dynamic electrical concepts related to formulas and calculations is the low mathematical ability of students. Students will be enthusiastic in participating in learning when the form of learning is practicum but when entering the count students become less enthusiastic in participating in learning. This can be obtained from the results of interviews as follows:

> *"The most often experienced difficulty is that students' mathematical abilities are still lacking while this material is quite a lot of calculations…(P-2)".*
>
> *"...sometimes the children are happy during the practicum but then they are faced with questions that use formulas, the children are confused again, dizzy again like that…(P-3)".*
>
> *"For the difficulties I experienced in teaching the concept of dynamic electricity, namely when applying the concept... Children are less skilled in counting…(P-5)".*

From some of the difficulties described above, various efforts have been made by the teacher so that the learning objectives can be achieved. Efforts have been made, among others, by repeating material that is considered difficult and providing additional assignments at home so that students have plenty of free time to study dynamic electricity at home, either in groups or alone. Then the teacher also communicates with the mathematics teacher so that some children who are less in their calculations pay more attention to them. The data from interviews that support the description above are as follows:

> *"… repeating the lesson that was considered difficult, then with another model or other method so that students understand more (P-4)".*
>
> *"…students are given the first task to study in groups at home and then asked to look for videos related to dynamic electricity learning usually from YouTube or other sources then more to assignments at home (P-1)".*
>
> *"…chat with the math teacher and ask for help for certain students to be guided so that they can take part in dynamic electricity learning well (P-2)".*

Another general effort so that during the implementation of learning is conducive, at the beginning of learning the teacher makes a learning contract between students and teachers that is mutually agreed upon. Interview data showing these efforts are:

"...when I started the lesson at the beginning, I entered into a learning contract where there were rules that had to be understood and carried out...(P-3)".

"In order to keep the class conducive, at the beginning of the first meeting, I made a study contract with the students...(P-5)".

4.4 Difficulties in the context of evaluation process

Based on the results of the questionnaire analysis, it was revealed that 13.33 percent of teachers stated that they were very hampered in assessing and evaluating learning. In addition, 40 percent of teachers stated that they were inhibiting, 26.67 percent of teachers said they did not inhibit them, and 20 percent of teachers stated that they were not very inhibiting. The biggest obstacle for science teachers in the assessment is from an affective aspect, namely when they have to determine the criteria to be assessed which must be in accordance with the basic competencies, indicators and objectives of dynamic electricity learning. In addition to the affective assessment, the teacher also has difficulty in determining the assessment in terms of psycho-motor besides the difficulty in determining the assessment criteria, he also has difficulty in assessing one by one students during teaching and learning activities. One teacher must be able to assess many students' affective and psycho-motor (35 people) at the same time. Furthermore, teachers must also facilitate students and must also condition students so that during learning activities students remain conducive.

In more detail, these percentages refer to the four substances of the statements in the questionnaire, namely the teacher's ability is not sufficient in conducting assessments using various cognitive, affective and psycho-motor assessment tools, the teacher's ability is not sufficient when providing feedback on the process and learning outcomes of the material. Dynamic Electricity, the teacher's ability is not sufficient when carrying out follow-up activities in the form of giving individual assignments according to student learning conditions, and the teacher's ability is not sufficient when carrying out follow-up activities in the form of giving assignments in groups according to student learning conditions. In line with the data obtained from the questionnaire above, the interview data also revealed three themes, namely the teacher's ability to develop limited affective and psycho motor assessments, the teacher's ability to develop tests was low, and the use of various forms of assessment instruments.

From the data, it was found that the teacher's ability to develop affective and psycho-motor assessment was limited and also the ability to develop cognitive tests was also low. This is obtained from the following interview results:

"…difficulty in compiling instruments with a fairly high level, usually C3 and above to C6, especially in compiling HOTS assessments" (P-1).

"The difficulty is determining what criteria are in accordance with the characteristics of dynamic electrical material on students' attitudes (P-2)".

"For psycho-motor itself, perhaps what is a bit difficult is that we unite the rules of assessment in taxonomy words in psycho-motor assessment verbs to the rubrics we use…(P-3)".

Technically, teachers also have difficulty carrying out affective and psycho-motor assessments simultaneously due to time constraints with a large number of students in one class.

"The difficulty in carrying out the assessment that I encountered was of course an assessment in attitude, because this is an automatic one-on-one attitude, yes…students need foresight, then the development of media skills is actually still difficult why…because here skills have to monitor students one by one carefully P-4)"

To overcome difficulties in terms of assessment and evaluation of learning, especially in terms of affective assessment, the teacher works with students to assess their friends and of course in accordance with the criteria that have been given by the teacher. As obtained in the following interview data:

> *"…I use peer assessment in the affective domain, but sometimes the students are not objective in their affective assessment. So, we have to learn together how to lead students how to assess affectively, peer assessment well (P-3)"*

In addition, teachers also continue to try to use various forms of assessment instruments, both cognitive, affective and psychomotor. At the end of the lesson the teacher reflects on learning both orally and in writing, in order to find out how far the learning achievements have been and become evaluation material for the next lesson. As seen in the following interview excerpt:

> *"The instrument made includes three aspects, namely cognitive, affective and psycho-motor…(P-1)".*
>
> *"…I use a cognitive work instrument in the form of questions that multiply the knowledge of students obtained from the practicum through an instrument in the form of questions and a checklist where students can assess their psycho-motor skills…well then the third instrument is a checklist to assess attitude…(P-3)".*
>
> *"For my own feedback on the assessment process, I usually use oral and written…(P-3)"*

5. Discussion

From the research data, it was found that there were teacher obstacles in the facilities and infrastructure in the teaching process of dynamic electricity concepts which caused limited activities in the laboratory. These findings are in line with previous research (Indrawati and Nurpatri 2022) that teachers' understanding of laboratory activities is limited due to limited facilities and infrastructure.

The existence of facilities and infrastructure plays an important role in teaching dynamic electricity because it will be able to explain something abstract to be more real. In this case, the availability of teaching aids is very necessary because the laws and concepts found through practical activities will be easily absorbed and understood by students so that the new abilities acquired are embedded in a meaningful way (Holmes and Lewandowski 2020). If laboratory facilities and infrastructure as well as the intensity of laboratory use are hampered, it will have an impact on students' experience and learning outcomes especially on students' understanding of dynamic electrical concepts (Holmes and Lewandowski 2020).

In addition to facilities and infrastructure barriers, another obstacle experienced by science teachers in teaching dynamic electricity is the learning planning process. The ability to develop Learning Implementation Plans (RPP) that are suitable for students' conditions is the main thing in a learning process so that the learning process can run well and provide meaningful experiences to students. A science teacher must have a good PCK where PCK itself is a combination of understanding teaching material and understanding how to educate combined into a unified whole so that it becomes an understanding of a particular topic, problem, or issue that is compiled, presented and adapted into a various interests and abilities of students which are then applied in the learning process (4). The ability to plan appropriate learning with the characteristics of the material and students can be a representation of how the teacher's PCK in the concept of dynamic electricity.

Furthermore, a science teacher is not only able to plan lessons but also must be able to conduct and manage how the learning process takes place. In this study, teachers had obstacles in understanding dynamic electric formulas even though they had tried to take a scientific approach. In addition, this limitation is also in line with the limitations of students in terms of mathematical ability. This problem of teacher understanding is a crucial problem because the most important problem in developing PCK is the lack of various types of knowledge gained, teaching experience and the teacher's inability to integrate basic knowledge into what will be taught (Semenikhina et al. 2021).

Finally, this study reveals empirical data that teachers face limitations in developing affective and psychomotor assessments, and tests even though teachers try to use various forms of assessment

instruments. This is in line with the results of research conducted by researcher (Indrawati and Nurpatri 2022) which revealed that one of the obstacles for science teachers in teaching physics concepts is the assessment process. Of course, the evaluation process is very important because through evaluation the teacher can determine whether the students who have been taught have competencies that are in accordance with what has been determined. Thus, the teacher can provide follow-up according to the condition of the students whether to be given enrichment or whether it is necessary to provide remedial programs to improve students' understanding (16) including the concept of dynamic electricity.

6. Conclusion and implication

Inadequate facilities and infrastructure, including the availability of laboratory staff, have limited activities in the laboratory. This condition causes the practicum activities are not achieved optimally. Whereas practicum activities in dynamic electricity are needed to support students' understanding of the abstract concept of dynamic electricity.

In terms of learning planning, teachers face obstacles in terms of choosing media and teaching materials, where teachers are less able to develop creative and innovative media and teaching materials to attract students' motivation in learning to understand the concept of dynamic electricity. In the implementation of learning, teachers experience obstacles in teaching dynamic electricity because the teacher's understanding of dynamic electricity is limited so that they are less able to relate dynamic electricity material to everyday life. In addition, the low mathematical ability of students is an obstacle for teachers in delivering dynamic electrical material related to formulas and calculations. From the aspect of assessment, teachers experience obstacles, especially in terms of conducting affective and psychomotor assessments of students. In addition to the difficulty in determining what criteria will be assessed in accordance with the learning objectives, the teacher also has difficulties in carrying out the assessment because affective and psychomotor assessments are carried out simultaneously in every meeting with a large number of students in one class. Meanwhile, in cognitive assessment, teachers also experience obstacles in developing questions for students' cognitive tests.

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