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The Relationship between Learning Style toward Mastery of Concepts and Problem-Solving Skill Introduction to Nuclear Physics for Pre-Service Teacher

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Abstract: Many factors that influence the students' learning achievement include learning styles. If the teacher presents learning according to the student's learning style, it will have an impact on maximum student learning outcomes. Student learning outcomes could be in the form of problem-solving skills and mastery of students' preliminary concepts of nuclear physics. Problem-solving ability is an important ability that must be possessed by students in facing the era of the industrial revolution 4.0. Therefore, the purpose of this study was to obtain an overview of learning styles, problem-solving abilities, and mastery of student teacher concepts for this physics introduction. The method used in this research was a case study with a sample of 35 physics teacher candidates at a private university in the city of Palembang. The learning applied is traditional learning with an interactive multimedia-assisted presentation method. The results showed that the predominant primary learning style of nuclear physics students was auditory, while the average problem-solving ability and mastery of preliminary nuclear physics concepts were 76.09 and 72.41, respectively, with very high categories. The results of this study become input in the development of the nuclear physics preliminary lecture.

Keywords: Learning style; Mastery concept; Problem solving

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Introduction

Learning intends to change student behavior through interaction with the environment (Slameto, 2003). Interactions that occur in learning activities include interactions between students and students, students and teachers or students with learning media (David, 2012). Interaction is an important part of learning activities because the interaction provides direct experience for students in processing information so that it becomes new knowledge for students.

Each student has a different way of processing the information he receives. The difference in the way students' process information is influenced by the potential and ability of students to understand the information. Information processing consists of several activities including collecting stimuli, collecting and organizing data, solving problems, and finding concepts that become learning objectives.

The involvement of students in information processing aims to make the knowledge obtained by students more meaningful and last longer in students' memories. Student involvement in information processing is an effort to construct students' own knowledge. Therefore, students learn through information processing to help students gain new knowledge.

Information processing by students using all their abilities is called learning style (Papilaya & Huliselan, 2016). The application of learning according to students' learning styles can increase students' interest, motivation and learning attitudes. Thus, students will

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more easily understand the concepts given if learning is in accordance with their learning style.

Learning styles consist of four dimensions: divergent, assimilation, convergent and accommodation (Kolb & Kolb, 2005). Students who have a convergent learning style have the ability to conduct investigations (Tulbure, 2011) while students who have a divergent learning style have better abilities in responding to statements or questions in discussion activities.

Learning styles according to Felder and Silverman consist of four dimensions, namely, Active/Reflective, Sensing/Intuing, Visual/Verbal, and Sequential/ Global (Wang & Mendori, 2015). The interpretation of the information is presented using the Visual/Verbal dimension. Students who have a visual tendency (visualizer) prefer to present information in the form of diagrams, flow charts, pictures while students who have a verbal tendency (verbalizer) prefer to present information in the form of written text (Kolekar, Pai, & Pai, 2017). Visualizer and verbalizer are distinguished by using measuring tools that are used as learning preferences when information is presented (Awla, 2014).

In addition, some experts divide learning styles into three, namely, visual, auditory, and kinesthetic (Hamdani, 2015; Rahman & Ahmar, 2017; Willis, 2017). Learning styles affect student learning outcomes(Halim A & Melviana, 2017). However, learning style has no significant effect on problem solving ability (Unaifah, & Suprapto., 2014). These two statements contradict each other because problem solving ability is an important learning outcome in physics learning

Mastery of concepts is an important learning result shown by the ability to understand phenomena in everyday life scientifically in theory or practice (Ratna, 2011). Understanding students' concepts is shown by the ability to solve problems encountered in everyday life. This is in accordance with the purpose of learning physics, namely, so that students have mastered the basic concepts of physics as a provision for the development of science and technology.

Mastery of concepts arranged hierarchically from the lowest order to the highest order, which consists of remembering, understanding, applying, analyzing, evaluating, creating (Anderson et al., 2001; Haolader et al., 2015). Therefore, students' mastery of concepts is trained in stages according to the level of student development. The results of the study show that there is a relationship between learning styles and students' mastery of concepts (Gunawan et al., 2016; Halim & Melviana, 2017).

The concept of splitting and merging nuclei is an essential concept in nuclear physics courses. For a better understanding of nuclear physics concepts, students need good math skills. In addition, students are also required to be able to change the form of representation into other forms of representation. Therefore, learning activities should be able to accommodate the diversity of students, both learning styles and students' mathematical abilities.

Based on the description above, the purpose of this study was to determine learning styles, problem solving abilities and mastery of the concept of division and integration of the nuclear of prospective teacher students, as well as the influence of learning styles on students' conceptual understanding. The representation of the material presented to students based on learning styles will help students to change various representations so that they can improve students' understanding of concepts. On the other hand, problem solving requires students' ability to illustrate various situations to help students understand the problem well so that problem solving is as desired, therefore, it is necessary to conduct research to determine the effect of learning styles on students' understanding of concepts and their impact on students' problem solving abilities.State the objectives of the work and provide an adequate background, avoiding a detailed literature survey or a summary of the results.

Method

The research method used in this study was a case study with a population of all students of even semester physics teacher candidates who are contracting a nuclear physics introduction course. All members of the population were made up of 35 students. The learning used in this study is a direct learning model with the help of presentation and demonstration media. The presentation of the material is in the form of ppt while the demonstration uses Phet simulation media with the subject of breaking and combining the nuclear. The design of this research can be seen in the Table 1.

Table 1. One Group Pretest-Posttest Design

Class	Treatment	Posttest
Experiment	X	T

Notes:
X: Learning using direct learning model assisted by presentation media
Q: Posttest mastery of concepts and problem-solving skills

The instrument used in this study was a learning style test given before the learning activity, and a concept mastery test and problem-solving ability given after the learning activity. The test instrument for mastery of concepts and problem-solving skills is in the form of an essay consisting of 5 questions. The instrument trial was conducted on eighth semester

students who had passed the nuclear physics introduction course. Analysis of the results of the instrument trial used the anates. The results of the instrument trial obtained reliability of 0.71 with a level of ease of questioning 0.65. The results of this trial show that the questions used are valid and reliable with the category of easy questions.

Correlation data analysis was used to find out how the relationship between learning styles and conceptual understanding and problem-solving abilities of prospective teacher students was using the product moment correlation equation.

Research design and method should be clearly defined.

Result and Discussion

Implementation of learning according to schedule. Technical implementation of learning is explained before the implementation of research. At the end of course, a test was conducted to find out student's understanding of concept and problem-solving skill. Participants who took the test as shown Figure 1.

Figure 1. Students are carrying out conventional learning assisted by learning media

As shown in Figure 1. Students enthusiastically pay attention to follow learning and learning materials according to their respective learning styles.

Based on the results of the learning style test, it could be desribed that the characteristics of the students' nuclear physics preliminary learning style are shown in Figure 1. The nuclear physics learning style of prospective physics teacher students was auditory by 34% same as visual.

Based on Figure 2. Most of the students' learning styles were auditory. Auditory learning style prefers to learn by listening to lectures, or listening to music, or listening to songs. Learners who have an auditory learning style usually prefer to learn by listening to lectures, conducting discussions, and assignments (Ula, 2013). Auditory learners can learn independently using various learning resources such as TV, radio, or other video tutorials.

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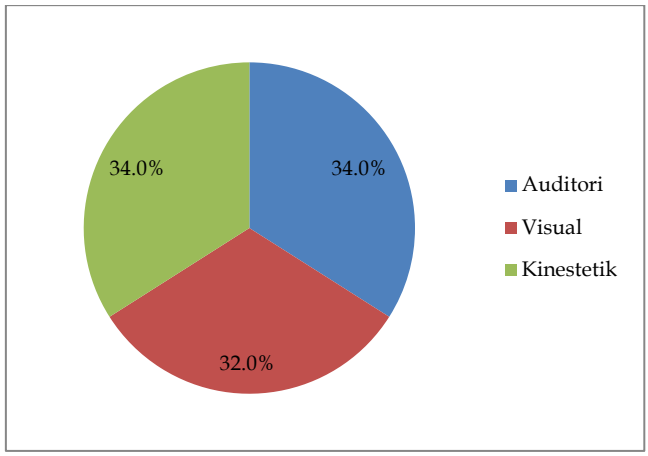

Figure 2. Learning Style of nuclear physics for prospective teacher students

Judging from the concept of splitting and merging were in the form of abstract physics concept. Independent learning and discussion skills in digging up information about the material presented are important activities to understand the material presented. In the discussion students provide responses to the problems given and provide reasons to show that the responses given have a strong basis.

The results of this study also indicate that students' learning habits in the classroom will affect the formation of students' learning styles (Cimermanová, 2018). Students who always receive traditional learning with lectures are more likely to have an auditory learning style. This is indicated by student activities in learning by doing practice questions and applying concepts or formulas in solving problems that are usually given in textbooks. Thus, students who are always involved in laboratory activities will tend to prefer measurement activities and tabulate measurement results. Tabulation of measurement results will encourage students to analyze experimental data as new knowledge. The involvement of the students in the learning process has an effect on the success in solving the given preliminary problems of nuclear physics. Student success in problem solving affects student learning satisfaction. Therefore, students' learning styles significantly affect students'

engagement and satisfaction in learning (Almasri, 2022).

Based on the results of the learning style test, students with visual learning styles tend to use video tutorials more often. This is supported by the results of interviews with students who stated that they often follow tutorials on YouTube to solve certain problems. Students with visual style are more interested in new things. The tutorials that are followed are not only tutorials on learning materials but also tutorials that are hobbies. Students with tutorial learning styles are motivated by challenging activities. In learning the concept of nuclear reactions, students with visual learning styles tend to be active in seeking information to solve the problems presented.

The results of the test of concept understanding and problem solving abilities based on students' learning styles are shown in Table 2. Learning styles affect student learning outcomes (Chiou et al., 2017). The relevance of learning styles to learning methods will affect student learning outcomes. Therefore, the learning style is applied to an intelligent and adaptive learning system by providing a set of learning activities to the students (Hamada & Hassan, 2017). Moreover, learning styles are also applied in the development of multimedia by presenting material in the form of text or images. The results show that interactive multimedia based on learning styles can significantly improve students' critical thinking skills (Yulianci et al., 2021). This result is different from results (Permatasary et al., 2018) which state that there cannot be a significant difference in student learning outcomes based on learning styles. Indeed, there is no treatment of differences in learning styles in the implementation of learning, such as the use of materials according to the learning style of each student or the use of methods suited to the student's learning style. Based on the results of this study, it can be stated that appropriate treatment is required according to the student's learning style to achieve maximum learning results by applying the learning style.

Improving students' understanding of concepts is carried out by increasing students' enthusiasm for the given concepts through the use of media to convey and present material. This is shown by the results of the students' conceptual understanding tests, which are significantly higher than in conventional learning (Rezeki et al., 2021). The learning process doesn not only force the students to remember the given concepts, but also the importance of understanding concepts to increase students' interest in learning. (Fitriani & Indriaturrahmi, 2019). Applying learning styles helps students process and organize the information provided (Bire et al., 2014) Therefore, the students' overall understanding of the preliminary concepts of nuclear physics is good.

Students with visual learning styles have the highest average concept understanding test results and problem solving abilities. On the other hand, the results showed that students with kinesthetic learning styles got the highest results compared to auditory or visual students (Almomani, 2019). These results indicate that material visualization is effective in helping students to understand concepts and problem solving (Wirjawan et al., 2020). In solving the problem, the expert group starts understanding the problem by paying attention to the right laws and equations according to the given problem and then using mathematics to solve the problem (Ince, 2018). Problem visualization is the first step to solving problems before using problem-solving strategies (Kuo et al., 2013). Visualization can help students make the problems they face more real so they are easier to understand and solve. This result is an evaluation of the subject matter that has been delivered (Docktor et al., 2016).

Table 2. Test Results of Students' Concept Understanding and Problem-Solving Skills

Learning style	Concept understanding	Problem solving skill
Auditory	70.00	75.00
Visual	75.00	80.00
Kinesthetic	72.00	73.00
Average	72.41	76.09

The first step in solving a problem was to identify the problem. At the problem identification stage, students are faced with a nuclear division phenomenon through a description of the phenomenon, visualization or interactive simulation according to the group of students' learning styles. Students observe the phenomena presented and then are given several questions to ensure students understand the problems presented. Students' understanding of the problems presented will help students answer each of the questions presented. Students' answers at this stage are hypotheses of the problems presented. The ability to formulate hypotheses well is a skill needed by students in the 21st century. Therefore, problem solving is an important skill that must be possessed by 21st century students (Hidayat et al., 2017).

Efforts to improve the ability to solve nuclear reaction problems by providing examples of enrichment and solving more complex problems. Giving examples of completion of this enrichment aims that students have a variety of knowledge that can be transferred to different situations and problems, while the complexity of the problem aims to improve problem solving skills gradually based on the experience of solving simple problems.

Based on Table 2, the results of the mastery of the concept of nuclear division and merger are in the high category. The high achievement of students' concept

understanding test results shows that students learning according to their learning styles can help students understand core learning concepts.

Learning of nuclear cleavage assisted by phet simulation. The use of phet simulation aims to increase student interaction with learning media. The use of learning media can increase student learning activity and creativity (Tapilouw & Setiawan, 2008). In addition, the use of learning media can help students learn so that it will affect the level of student learning independence (Mina et al., 2017).

The use of interactive learning media can help students learn independently without depending on the presence of the teacher. With interactive learning media students can learn freely and fun so as to increase understanding of concepts and problem solving skills. Students can be creative with the concepts presented to observe each phenomenon presented.

The application of nuclear splitting and merging learning helps students make direct observations. Laboratory activities for this reaction are rarely carried out in real life because they are dangerous for life and also expensive. However, by using interactive multimedia, the phenomenon of nuclear reactions, merging and learning of atomic nuclei can be presented in detail so that it is more concrete, which is the advantage of interactive media, namely presenting abstract phenomena to be more concrete.

By using simulation-assisted presentation model learning stimulates students' higher-order thinking in real-world problem-oriented situations. The process of preliminary learning of nuclear physics through simulation-assisted presentations on radioactive atomic reactions can enable students to help students understand abstract concepts to become more concrete, thereby increasing students' understanding of preliminary concepts of nuclear physics. Thus for students to produce meaningful knowledge because students can find their own preliminary concepts of nuclear physics so knowledge lasts a long time.

In solving problems, students with auditory learning style tend to answer questions based on general mathematical formulas. Therefore, students who have an auditory learning style tend to solve problems using mathematical equations. Thus, students with auditory learning styles better understand the problem by applying mathematical equations. The ability to apply mathematical equations helps students to graph mathematical equations so that they help students change the form of mathematical representations into graphic representations or vice versa change graphic representations into graphic or verbal representations.

Students with visual learning styles are more likely to use picture illustrations as a tool to solve problems. Visual students have better mental modeling abilities to help solve problems, especially abstract problems. Students with visual learning styles are accustomed to making free-body diagrams to describe phenomena in a given problem. In addition, students with visual style have qualitative abilities in a problem they are facing better because they are assisted by the visualization of the given phenomenon or concept.

Students with a kinesthetic learning style are more likely to learn by doing practical activities. Practical activities are learning activities that aim to train students' psychomotor skills in addition to cognitive abilities. Students who are familiar with practical work have the ability to carry out procedural activities. Therefore, the ability of students who have a kinesthetic learning style tends to procedural knowledge of phenomena.

The first step to solve the problem is to focus students on the problem, which is an important step in the problem solving. The results showed that focusing students on the problems contributed the most to improving students' problem-solving abilities (Putu Wira Sanggara1, Aris Doyan, 2019), while the results of other studies showed that the response assessment contributed the most to improving the problem-solving abilities (Melawati et al., 2022).

Practical activities also train students to take measurements, display data and convert data representations into a data trend graph. Students are trained to draw conclusions based on table data or based on the tendency of graphs from data. Therefore, the understanding of students' concepts with kinesthetic learning styles has increased.

Students are given the freedom to solve the given nuclear division problem according to their respective abilities. In solving the core division problem students identify the given quantities and determine the right mathematical equation to solve the problem. If the equation is considered to be in accordance with the given problem, the next step is to execute the problem solving by giving the given quantities. Problem solving like this tends to students with auditory learning styles. Students construct their knowledge through problem solving (Smith et al., 1994).

Students with visual learning styles will form mental models of nuclear division problems. The shape of the nucleus will be illustrated by colliding balls so that there is a split in the nucleus. Students with visual learning styles can explain quantitatively the process of nuclear division by other particles.

Observation of nuclear reaction phenomena through animated videos that will interactively motivate students to take part in learning so that learning feels fun. Fun learning can focus students' learning so that it can improve student learning

outcomes including understanding concepts and students' problem solving abilities (Pols, 2020).

Conflicts faced by students will encourage students to make assumptions about the problems at hand. These students' predictions will motivate them to explore to collect data that will provide information on the answers to the problems they face. On this occasion students are given the opportunity to behave as experts in collecting data to build student knowledge through measurement (Sabella & Redish, 2007). In taking measurements, students are guided by a series of questions designed to focus students' attention on important issues, increase student discussion in groups and convince students of the differences and similarities between predictions and observations.

The results of this study also show that the ability to apply mathematics to change the representation of a concept helps students understand abstract concepts. The nuclear reaction material applies many mathematical formulas so that students' mathematical abilities are very helpful in solving problems. Therefore, efforts to improve students' ability to apply concepts need to be supported by learning or debriefing the mathematical concepts used in nuclear reaction learning.

Based on the questionnaire given to the students, it was found that the average student agreed with the presentation learning assisted by the simulation of the nuclear reaction concept. Students' motivation to participate in learning affects student learning outcomes.

Conclusion

The characteristics of the primary physics pre-study style for prospective physics teacher students were auditory learning styles, while the average problem-solving ability and concept mastery of students was an average of 72 and 74 with very high categories so that learning with the help of interactive multimedia had a positive effect on the students'learning outcomes.

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