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Component Display Theory (CDT) Learning Model Design in Basic Physics Lectures

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Abstract: One learning model that encourages implementation is Component Display Theory (CDT) which educators can apply as a way to obtain optimal problem solving abilities. The urgency of research requires developing a CDT learning model by adding one aspect, namely Creation, which is expected to perfect the three existing aspects. The theoretical basis is constructivist and cognitive theory, where constructivism is a view that perceives activities in reorganizing, interpreting and creating knowledge. The aim of the research is to design a CDT model for physics learning? The method used in this research uses a Research and Development approach using a 4D model with stages including Define, Design, Develop & Disseminate. The research results explain that the results of the needs analysis show that the current use of the CDT learning model still needs to be designed clearly to encourage increased student understanding, especially in terms of problem solving skills. Based on the analysis data, it was found that there was a significant correlation between the ability to remember (Remember) and the ability to find problems in learning with a percentage of 50.9%. Furthermore, the ability to find and the ability to apply has a correlation of 66.7%. Therefore, it can be said that learning procedures using the CDT model contribute significantly to the construction of students' understanding so that when linked to creative abilities, students are able to better understand learning completely and comprehensively by 59.4%, which means it provides significance in increasing participants' problem solving skills. educate. On the other hand, the remembering stage, when linked to the creation stage, contributes to an increase which is categorized as quite low when compared to the other stages, amounting to 11.5%. Therefore, in implementing learning, there needs to be coherent and measurable learning management that can encourage increased student learning.

Keywords: CDT Model; Physics Learning; Problem solving skill

Introduction

Science is a systematic approach to seeking understanding of nature, involving the discovery and development of knowledge that can be applied in everyday life (Morrison et al., 2021). According to Bloom, understanding concepts is crucial in developing intellectual abilities, which are consistently emphasized in higher education (Fulmer, 2015). This emphasizes that learning physics is not just rote memorization, but requires understanding concepts and their application (Ibrahim et al., 2017). Physics learning must adhere to the principles of process and product (Song et al., 2022). Limited observation results reveal that in physics learning, educators often use a less diverse approach, with around 60% of 191 educators not using variation in learning design. Therefore, students tend to have a less active role in building their own knowledge, which ultimately results in low physics problem solving abilities. The low level of students' problem solving abilities can be seen in three aspects, namely low ability to identify concepts (14.47%), design problems (24.43%), and evaluate answers (20.46%). This data shows that students need a more representative learning approach

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that focuses on improving problem-solving abilities. Therefore, physics learning must empower students, namely by encouraging them to build their own knowledge (Lewis, 2022).

Effective learning models are closely related to how educators understand the development of students' conditions in the classroom. Active learning can encourage learning effectiveness and encourage interaction between students (Zimmer et al., 2021) and (Akmal & Festiyed, 2023). One learning model that is able to encourage implementation is Component Display Theory (CDT) which can be applied by educators as a way for students to learn actively and gain optimal problem solving abilities. CDT is a taxonomy consisting of performance and content, in this case it is expected to be able to remember, apply (use) and discover (find) content Merrill, M. D. (2018). Several studies obtained explain that the CDT learning model can encourage increased learning outcomes, but do not explain how far it can encourage increased students' creative abilities (de Jong et al., 2022). Apart from that, the courage of educators to develop students' creativity in an effort to improve the quality of learning still needs to be developed (Vrieling et al., 2012). Furthermore, the application of the CDT model can support the implementation of more interesting learning, but on the other hand, the application of the model studied does not look at the students' ability to create their knowledge, so it cannot ensure the students' complete level of understanding, (Rivera-Vargas et al., 2021) and (Sari et al., 2023).

Therefore, the novelty of this research is that it is necessary to develop a Component Display Theory (CDT) model with an emphasis on adding creative aspects, where the addition of this aspect emphasizes constructivist and cognitive theories. These two theories emphasize that the learning carried out needs to provide stimulation and encouragement in the formation of knowledge in a structured and systematic manner so that it can encourage increased problem-solving abilities through the process of creating the construction of knowledge obtained in learning. In addition, this research has never been carried out and reported before, so research is needed regarding the development of a more comprehensive CDT model to ensure higher quality learning by educators. Based on the research and concepts above, it is urgent in this research to develop a CDT learning model by adding one aspect, namely Creation, which is expected to be able to perfect the three existing aspects. The theoretical basis used is constructivism and cognitive theory, with constructivism as a view that emphasizes the active role of students in assembling, interpreting and creating knowledge individually (Maruyama, 2022) and (Novia et al., 2023). The concept promoted by Jean Piaget states that true learning is not something given by educators, but rather is a process that arises from within the students themselves (Philipsen et al., 2019). The aim of the research is to analyses how the CDT model design is developed in physics learning.

Based on the description of the studies above, the Component display theory (CDT) model developed focuses on adding the creation stage to the pre-existing CDT model stage, then this stage will cover every procedure in the model. This is done so that the learning system given to students can be more interesting and meaningful to encourage them to enjoy learning. On the other hand, the implementation of this model can also provide a more constructive perspective of thinking to students in solving every problem in the material they receive.

Method

This research was carried out using a Research and Development approach using a 4D model with stages including Define, Design, Develop & Disseminate (Thiagarajan et al., 1974). The product design development model is implemented using the 4D Development Model as presented in Figure 1.

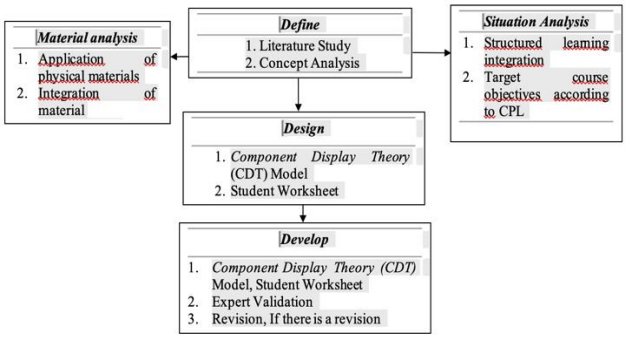


Figure 1. 4D Model

By figure 1, the implementation of research first examines related to the analysis of needs and urgency, the need to develop the model to the response or object of research. The next stage of collecting research data is using a Validation Sheet. Testing requires a research instrument to validate the feasibility of the Component Display Theory (CDT) Model which consists of construct and content validation.

Result and Discussion

Definition Stage (Define)
Analysis of situations and needs

Analysis of the development of learning models can include a series of steps, including adoption, adaptation,

and even creative efforts to create innovative learning models that can be used in the teaching process. Findings from field research show that there is a mismatch between what is taught to students and how they experience the learning process in that material. The impact is a lack of effectiveness in delivering learning, which makes students less active and less innovative in solving problems during the learning process. As a result, students' learning achievement is negatively affected. In addition, the findings show that educators do not fully understand the steps required in the learning process. The teaching process is still very centered on educators, so that educators dominate more than students, with different levels of involvement between the two. Therefore, educators need the ability to choose and implement learning models that combine more efficient teaching methods, according to the material being taught (Marlina & Hamdani, 2023) and (Fauziah & Sukmawati, 2023). Additionally, the interview results show that the use of current learning models is still not optimal in increasing students' understanding. This is caused by difficulties in implementing the existing learning model steps in the field as seen in Figure 2.

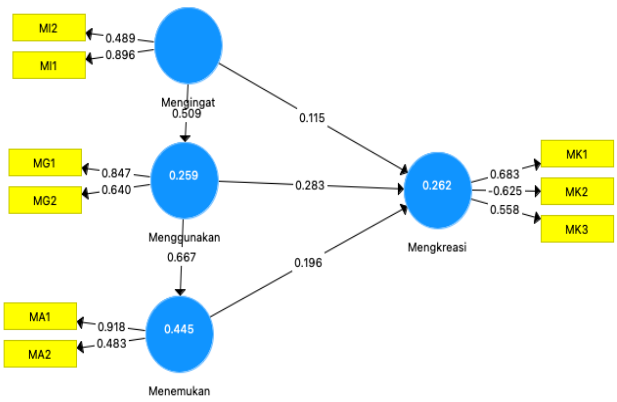


Figure 2. Needs analysis.

In accordance with the data above, it shows that the pattern of developing learning steps requires providing clear and comprehensive management so that students are able to construct understanding in learning. Based on the analysis data, it was found that there was a significant correlation between the ability to remember (Remember) and the ability to find problems in learning with a percentage of 50.9%. Furthermore, the ability to find and the ability to use/apply has a correlation of 66.7%. Therefore, it can be said that learning procedures using the CDT model contribute significantly to the construction of students' understanding so that when linked to creative abilities, students are able to better understand learning completely and comprehensively by 59.4%, which means it provides significance in increasing participants' problem-solving skills. educate. On the other hand, the remembering stage, when linked to the creation stage, contributes to an increase which is categorized as quite low when compared to the other stages, amounting to 11.5%. according to (Anjani et al., 2023) show that the use of media or learning models can influence learning. This is in line with the data shown in figure 3.

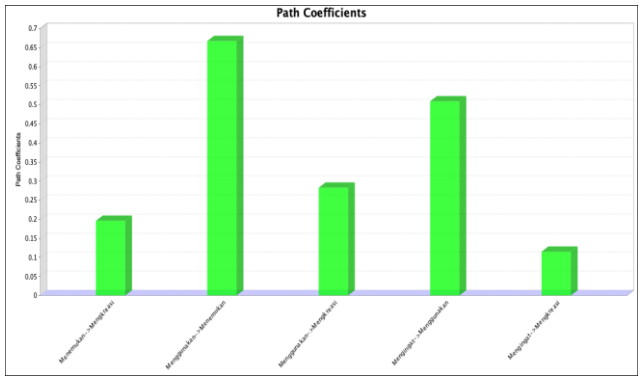


Figure 3. Coefficient between variables

If you pay attention to the aspects above which are related to the relevance of these variables, they are presented in Figure 3. This data shows that the relationship between the variables remembering and creating has a relatively smaller correlation coefficient with other variables with a coefficient score of 0.12 or 11.5%. This illustrates that there needs to be an initial stage in forming students to understand the material provided, starting with providing stimulation to remember, use and discover so that students can more easily construct the ability to create the material obtained. Meanwhile, the variable that has the highest percentage in supporting the construction of students' understanding is the using and finding variable of 0.667 or 66.7% which directly contributes to encouraging increased students' understanding. In line with (Ritonga & Istiyono, 2023) and (Sapulete et al., 2023) show that The application of models and approaches in learning both discovery and contextually can encourage the creativity of students in a real way. Next, if you review the relevance of each variable presented in table 1.

The data in table 1 shows that the four variables have quite specific relevance in encouraging students' abilities to participate in classroom learning. On the other hand, this stage also proves that the process of learning steps in class is very necessary in helping students understand the material provided during learning. However, if you pay close attention to each variable, the smallest specific contribution effect in encouraging increased understanding and construction of knowledge is at the Remembering - Using -

Discovering - Creating stage of 0.067, so it is necessary to collaborate on learning patterns between each variable which is expected to be able to provide sufficient stimulation great in understanding the material given. Furthermore according to (Nurdiyanti & Wajdi, 2023; Oxana et al., 2023) suggests that learning literacy oriented to scientific procedures can influence on improving learning metacognition by collaborating on various learning media.

Table 1. Relevance of CDT Model Variables

Variable	Specific indirect effects
Remember > use > find	0.34
Use > find > creating	0.13
Remember > use > find > creating	0.07
Remember > use > creating	0.14

According to Ülen et al. (2014), innovation can emerge through various combinations of learning models. A learning model is a series of concepts that are arranged systematically and are often used in the learning process to facilitate interaction between teachers and students (Wendell & Lee, 2010). The main function of the learning model is to facilitate the learning and teaching process in the classroom (Ülen et al., 2014). Because of the importance of learning models, educators must be careful in designing, selecting, and implementing learning models that suit the characteristics and context of their students (Saputra et al., 2019; Akmal & Festiyed, 2023; Fauziah & Sukmawati, 2023). The learning model needs to be designed in such a way that it can reflect the learning environment and guide students during the learning process, as stated by (Sitinjak & Mawengkang, 2018) and (Kahar et al., 2021).

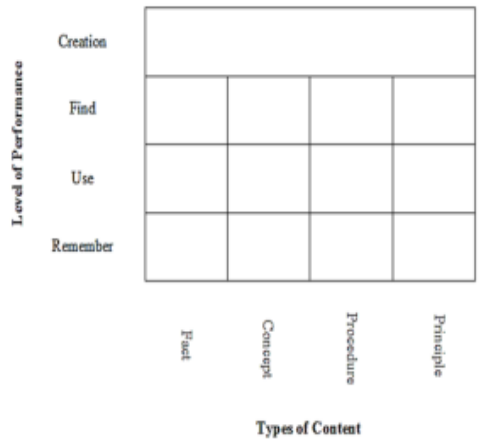
Constructivism comes from Vygotsky's theory which explains that cognitive aspects often arise when previous beliefs are processed through processes that are not always in line with solutions for understanding new information. Piaget's (1970) theory provides a strong foundation for understanding how students act and think at various stages of development. Furthermore, according to Piaget, students not only have their own view of the world (which is different from that of adults), but this view is also very strong and consistent. (Puspitasari & Munawi, 2018) suggest that there are three implications of Piaget's hypothesis, namely: (1) Students interpret what they hear based on their personal knowledge and experience rather than just accepting the information presented. (2) Knowledge is not just data that needs to be captured, described, remembered, retrieved and applied at different times. Knowledge is actually formed through interactions with various environments, individuals and objects. (3) Learning theories that do not consider resistance to learning tend to be inadequate. This is in line with Piaget's view that students have strong reasons not to just accept what is presented from the outside.

Material Analysis

Physics is a branch of science that has significant importance for students to study and master, considering that the applications of physics knowledge are often found in everyday life. One important aspect of physics is the study of fluids, which are closely related to natural phenomena. Fluid material includes the concepts of the law of hydrostatic pressure, Pascal's law, Archimedes' law, and so on. In our daily routine, there are many situations where fluid concepts are used, such as in the manufacture of car jacks and the construction of ships. Static fluid material helps students to develop critical thinking skills, identify problems in everyday life, and find solutions based on relevant theories and concepts. Because students' experience in this matter is still limited, there is often an inaccurate understanding of fluid concepts. Research conducted by (Chen et al., 2020) (Ritonga & Istiyono, 2023; Ülen et al., 2014) shows that students still face difficulties in explaining related phenomena such as floating, drifting and sinking.

Design

The result of this development is teaching material in the form of a CDT learning model design for teaching physics. The final result of this development is a learning model design that has been equipped with implementation steps and procedures in the learning process, which aims to stimulate interest in learning and have the potential to improve learning outcomes. These findings are consistent with research conducted by (Lee, 2015), which shows that the development of learning models can influence students' interest in learning. The following is a display of the CDT learning model in Figure 4.



Phase Learning	Explanation
Remember	This phase is a phase where educators convey learning objectives and provide material related to facts, concepts, procedures, and principles as well as problem topics. The given problem is based on reality that can interest learners naturally.
Use	This phase is a stage of practice and discussion in groups. Furthermore, students are divided into groups of 2-4 students to discuss worksheets that have been given, identify problems that have been presented and solve problems using concepts and procedures that have been learned. Educators oversee distributing worksheets and directing the learning process.
Find	This phase is a stage where students can conclude for themselves related to the learning that has been done and find a new abstraction related to concepts, procedures, and principles. Educators are tasked with guiding students in using concepts as a means of finding new concepts that are desired.
*Creation**	After students have done all the phases above, educators facilitate and inspire students and guide in developing innovation or creative thinking using the knowledge they have gained before.

Figure 4. CDT Learning Model Procedure

This learning model that has been designed has involved input from various experts and can be considered as an appropriate guide in the context of further learning. In the view of (Purnamasari et al., 2018), the teaching materials that have been developed include phases that have been assessed and all of these phases are considered very good. This opinion is also confirmed by (Saparini et al., 2016), who emphasizes that the use of physics learning models that are integrated with learning media can improve learning outcomes. Based on the findings that have been collected previously, it can be concluded that the CDT learning model that has been developed can encourage students' independent learning and enable them to develop flexible understanding, so that they can find solutions to overcome various challenges in the learning process. Furthermore, it is in line with (Anjani et al., 2023; Sari et al., 2023) Explain that the integration of learning with the use of models and the implementation of instruments by the applied learning design can encourage more meaningful learning stimuli.

Conclusion

The results of the research obtained can be concluded that the design of the Component Display Theory (CDT) learning model developed is needed in learning, which means that it is able to provide significance in improving student learning with the level of relevance of each variable able to encourage students' ability to participate in learning in class.

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Author Contributions
Conceptualization, methodology, writing-original draft preparation, formal analysis, investigation, and visualization, M. S. K.; Writing-review and editing, validation, supervision, and resources, R. B. A; Conceptualization, methodology and Instrument, M. M.; Validation, supervision, and resources, M. F.

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Conflicts of Interest
The authors declare no conflict of interest.

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