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Development of Scientific Attitude Profile Evaluation Using Accumulation, Demonstration, Exercise, Reflection and Create (ADERiC) Learning Models Based Self-Efficacy

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Abstract: Learning is a process of interaction between students and their environment so that changes in behaviour for the better occur. This research aims to develop and evaluate a scientific attitude profile evaluation tool that uses the Accumulation, Demonstration, Exercise, Reflection, and Create (ADERiC) Learning Model based on Self-Efficacy. Through a Research and Development (R&D) approach using a 4D model, this research designed and tested this evaluation tool in the context of physics learning. The research results show that the application of the ADERiC model evaluation tool significantly increases students' involvement in the learning process, as well as strengthening their ability to solve problems and develop a positive scientific attitude. Evaluations carried out through the instruments developed indicate an increase in students' self-efficacy along with the use of innovative learning models. These results confirm that the integration of ADERiC in physics learning can facilitate deeper conceptual understanding as well as the practical application of physics, contributing to improving the effectiveness of teaching and learning in schools. This research succeeded in designing and validating an evaluation tool that is able to measure these aspects effectively.

Keywords: Learning Evaluation; Model ADERiC; Scientific Attitude; Self-Efficacy

Introduction

Science is related to ways of systematically finding out about nature, in the form of discoveries, collections of knowledge related to everyday life (Akib et al., 2018; Dheghu et al., 2019). Observation results showed that in evaluating learning, educators usually use learning evaluation tool designs that are not on target with the expected output with a percentage of 60-65% non-conformity. Apart from that, if you pay attention to the scientific attitude of students as a whole, it shows that 57-73% are still classified as lacking, this is because in learning educators still do not fully use learning models and methods that can attract students to be actively involved (Suastra, 2019; Zheng et al., 2020). On the other hand, students' Self-Efficacy in each learning material they follow still tends to be uncertain or in this case students still feel doubtful about what they have understood (Alten, 2019; Bartimote-Aufflick et al., 2016), therefore the assessment of students has not been able to be described optimally and measurably.

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Learning is a process of interaction between students and their environment so that changes in behavior for the better occur. In the learning process, the main principle is the process of involving all students' potential. This process demands a critical attitude from educators and learners (Lieskovský, 2022). Motivating and engaging students in the active learning process is a challenge even for experienced educators (Hossain, 2019; Zaki, 2020). One of the problems facing the world of education is the problem of weak learning processes and learning evaluation. One example can be presented with findings regarding representation in the use of motivation, media and methods that suit the characteristics of students to optimize students' sensory sensitivity (Kim, 2022; Zaki, 2020) and findings regarding the majority of educators not being interested. and unwilling to use authentic assessments or performance-based assessments (Arifin, 2021; Ortega-Sánchez, 2019).

The Accumulation, Demonstration, Exercise, Reflection and Creation (ADERiC) Learning Model is a learning model that originates from processing/accumulating information, demonstrating information with the help of media, providing exercises, reflecting on learning, and creating existing concepts. This model is expected to be able to provide solutions to every problem found in the field so that it can massively improve students' skills and is able to encourage more varied learning collaboration and can facilitate the process of absorbing each indicator of the achievement of the problem. Furthermore, the ADERiC learning model is used as part of physics learning in the classroom. Students are required to be able to encourage their ability to solve problems by mastering physics concepts through the various learning resources they have, where after using this model an evaluation of their scientific attitude profile based on self-efficacy will be carried out. Apart from that, students elaborate existing concepts with the help of learning media to make it easier to understand and apply physics concepts. It is hoped that in this process students will be able to provide a clear picture of the physics concepts they have received so that they can design a new framework of thinking in understanding and applying a concept they have acquired through the learning experiences they have gone through (Kahar et al., 2021; Khoiri et al., 2019; Kusumawati et al., 2019).

Strengthening the model and approach provided requires various indicators and complex learning objectives by comparing learning outcomes and performance from various dimensions, not just results and is an authentic assessment (Khan, 2022; Oxana et al., 2023). One indicator that is able to give students confidence in the material obtained is by using the Self-Efficacy indicator according to Bandura (1991) which is categorized into 3 dimensions including: Level/magnitude (level) measuring students' confidence regarding their ability to face learning difficulties or responsibility. which he carries in various variations of complexity; Generality includes students' self-confidence in completing their tasks or responsibilities in all activities and being able to master the situation; Strength can be measured by the level of certainty that students can complete the tasks or responsibilities they carry out and can obtain positive results (Bandura, 1991; Ghorbanzadeh, 2019). If these three aspects are designed correctly, they can stimulate students to be confident in what they understand from the material.

Based on the research and concepts above, it is very urgent in this study to develop a learning evaluation tool based on Self-Efficacy according to (Bandura, 1991) which is able to encourage the improvement of students' scientific attitudes by using the ADERiC model as an integrated learning part. novelty in the study emphasizes the use of evaluation tools based on Self-Efficacy. The reason for this integration is expected to see the extent of students' scientific attitudes so that various steps can be taken to improve student learning outcomes. The problem formulation in this research: designing an evaluation profile of students' scientific attitudes towards learning?; analysing the validity of the evaluation of students' scientific attitude profiles?. The aims of this research are; to design an evaluation of the profile of students' scientific attitudes towards learning?; and to analyses the validity of the evaluation of students' scientific attitude profiles?.

Method

This research adopts a Research and Development (R&D) approach based on the 4D model developed by (Sivasailan & Thiagarajan, 1974), which includes the Define, Design, Develop, and Disseminate stages, the development model used is depicted in Figure 1.

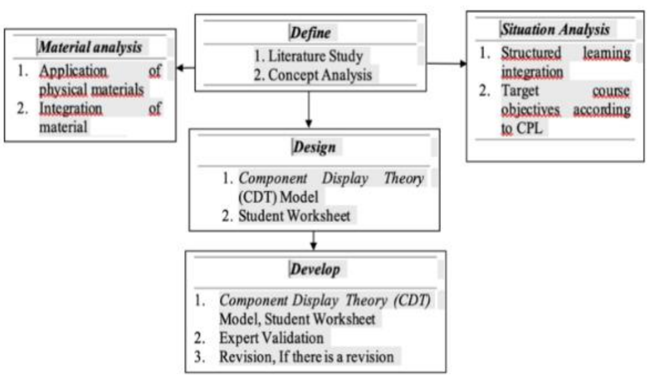

Figure 1. 4D Model

In the Define stage, this research begins with an in-depth situation analysis to identify current learning conditions and students' needs in learning physics. This is followed by a needs analysis that reviews previous literature and studies to obtain a strong theoretical and practical basis. Then, at the Design stage, this research designed an initial evaluation tool that integrated self-efficacy indicators and the ADERiC approach, with this design then validated by experts from the fields of learning, educational psychology and physics. After that, in the Develop stage, the evaluation tool is tested in a limited classroom setting to assess its practicality and effectiveness, followed by revisions based on the feedback received. The final stage, Disseminate, involves publishing the research results and holding workshops and training for educators on how to use the evaluation tools that have been developed.

The research instruments include an Evaluation Sheet designed to measure students' scientific attitudes based on the ADERiC model and self-efficacy indicators, as well as interviews and feedback from students and educators to gain a deeper understanding (Christodoulou, 2019; Trisnawati, 2019; Yang et al., 2020). Statistical data analysis techniques are used to assess the validity and reliability of the evaluation tools developed. This research aims to produce an evaluation tool that is valid, reliable, practical, and can be implemented in real educational settings, based on theoretical references from Bandura's work on self-efficacy and various studies on the implementation of the ADERiC model (Bandura, 1991).

Result and Discussion

This section describes the results of the profile evaluation development, divided into two main parts, namely the define stage, which includes situation analysis and material analysis, and the design and development stage, which includes the design of the initial profile evaluation instrument, validation by experts, and implementation of the profile evaluation. The results of this development are based on research objectives to design an evaluation of the profile of students' scientific attitudes towards learning?; and to analyses the validity of the evaluation of students' scientific attitude profiles?.

Definition Stage (Define)

In the definition stage, a beginning-to-end analysis is carried out which is divided into two stages, namely situation analysis and material analysis. These two stages are explained as follows:

Analysis of situations

The activity of analysing the development of profile evaluations can go through a process of adoption, modification, and even creativity to create new (innovative) profile evaluations that can be implemented in lectures. In accordance with the analysis carried out in the field, if we focus on aspects of the use of profile evaluations that have been used, there is still a slight overlap between what students learn and how they receive the learning process in that material. educators are unable to measure learning. Apart from that, educators do not fully understand the steps of learning, where the teaching process is still centered on the educator, which means that educators are still much busier than students, with quite significantly different levels of activity between the two. Therefore, educators must be able to select and implement profile evaluations that are integrated with Self Efficacy more efficiently according to the format. Apart from that, the results of interviews that have been conducted show that the implementation of the use of scientific attitude profile evaluation in the learning process is still less effective in encouraging an increase in students' understanding, especially in the aspect of problem solving skills, because profile evaluation in applied and translated learning tends to be difficult to measure in the field (Bhagat et al., 2021; Sugiati, 2021).

Material Analysis

Physics is one of the science subjects that is important for students to learn and master, considering that the use of physics is often found in everyday life. Fluids are part of physics which are closely related to natural phenomena. Fluid material includes the law of hydrostatic pressure, Pascal's law, Archimedes' law and others. In everyday life there are many applications of fluids, including in making car jacks and building ships. Static fluid material teaches students to think, find problems in everyday life and solve problems based on appropriate theories and concepts. The concepts that students have based on their experience are still limited so there are still conceptual errors in fluid material. The results of research (Fauziah & Sukmawati, 2023; Hash, 2021) show that students still experience difficulties in explaining floating, drifting and sinking events. Students tend to memorize every formula given by educators without understanding the physical meaning of each formula. In understanding fluid material, students more often accept the material and equations without carrying out the process of discovering a physics concept themselves. If this problem continues in teaching fluid material, then students will experience failure in understanding a concept which will later have an impact on students in solving problems related to everyday problems.

The things emphasized in developing this scientific attitude profile evaluation towards aspects of situation and material analysis are as in Table 1.

Table 1. Initial Design

<table>
<tr><th>Developed section</th><th>Display</th><th>Information</th></tr>
<tr><td>Profile Evaluation Scientific Attitude</td><td>
<table>
<tr><th></th><th colspan="2">Level/magnitude</th><th colspan="2">Generality</th><th colspan="2">Strength</th></tr>
<tr><th></th><th>Nomor</th><th>Pernyataan</th><th>Nomor</th><th>Pernyataan</th><th>Nomor</th><th>Pernyataan</th></tr>
<tr><td>Keyakinan mampu menyelesaikan tanggung jawab</td><td>+ 1</td><td>Saya yakin mampu membuktikan pernyataan yang rumit sekalipun</td><td>+ 9</td><td>Saya yakin dapat membuktikan bukan hanya pernyataan matematis, namun pernyataan mengenai analisis dan sebagainya</td><td>- 18</td><td>Saya ingin berhenti saat menemukan kendala dalam pembuktian</td></tr>
<tr><td></td><td>- 2</td><td>Saya memilih mundur jika diminta membuktikan pernyataan bikondisional</td><td>+ 10</td><td>Saya yakin dapat membuktikan dengan tepat pada konsep Secara terperinci</td><td>- 19</td><td>Saya berubah pikiran saat menemukan teorema baru yang dapat digunakan dalam pembuktian</td></tr>
<tr><td></td><td>+ 3</td><td>Saya yakin dapat membuktikan suatu pernyataan dengan beragam definisi, sifat atau teorema</td><td>- 11</td><td>Saya pesimis mampu membuktikan suatu pernyataan dengan strategi berbeda dengan yang dicontohkan</td><td>+ 20</td><td>Saya bersikeras menemukan pola pembuktian saat menemukan gap dalam pembuktian</td></tr>
<tr><td>Keyakinan mampu menguasai konsep atau situasi</td><td>- 4</td><td>Saya merasa minder membuktikan pernyataan tanpa melihat literatur</td><td>+ 12</td><td>Saya yakin dapat menyelesaikan masalah matematis dengan berbagai strategi</td><td>+ 21</td><td>Saya pantang menyerah memahami materi maupun membuktikan teorema</td></tr>
<tr><td></td><td>- 5</td><td>Saya kebingungan menentukan teorema, definisi atau sifat yang</td><td>- 13</td><td>Saya tidak langsung dapat memahami elemen suatu himpunan</td><td>+ 22</td><td>Saya akan bertanya pada dosen atau kakak tingkat jika menemui kesulitan</td></tr>
</table>
</td><td>The levels of self-efficacy are described to measure students' abilities</td></tr>
<tr><td></td><td>
ANGKET TINGKAT SELF-EFFICACY MAHASISWA
A. Petunjuk pengisian
1. Identitas Mahasiswa
Nama :
NIM :
Universitas:
2. Isilah pernyataan-pernyataan berikut pada kolom yang disediakan dengan membubuhkan tanda silang (X)
3. Pengisian angket ini tidak mempengaruhi nilai mata kuliah apa pun, maka isilah dengan sejujur-jujurnya
4. Keterangan opsi jawaban:
SL : Selalu
SR : Sering
KD : Kadang-kadang
JR : Jarang
TP : Tidak Pernah
B. Butir Pernyataan Angket
<table>
<tr><th rowspan="2">No</th><th rowspan="2">Pernyataan</th><th colspan="5">Jawaban</th></tr>
<tr><th>SL</th><th>SR</th><th>KD</th><th>JR</th><th>TP</th></tr>
<tr><td>1.</td><td>Saya yakin mampu membuktikan pernyataan yang rumit sekalipun</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>2.</td><td>Saya memilih mundur jika diminta membuktikan pernyataan bikondisional</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>3.</td><td>Saya yakin dapat membuktikan suatu pernyataan dengan beragam definisi, sifat atau teorema</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>4.</td><td>Saya merasa minder membuktikan pernyataan tanpa melihat literatur</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>5.</td><td>Saya kebingungan menentukan teorema, definisi atau sifat yang relevan dalam membuktikan suatu pernyataan matematis</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>6.</td><td>Saya bimbang dalam memulai pembuktian</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>7.</td><td>Saya yakin dapat memecahkan masalah matematis yang kompleks sekalipun dengan rinci dan koheren</td><td></td><td></td><td></td><td></td><td></td></tr>
</table>
</td><td>Clarify the parts of questions and statements to evaluate student capacity</td></tr>
</table>

Based on the data in Table 1, the points emphasized in the development of the evaluation were developed with the aim of measuring students' scientific attitudes with a special focus on self-efficacy. This evaluation tool is designed to assess the various levels of confidence that students have in their own abilities in facing learning challenges. The elements outlined in this tool aim to explore the extent to which learners believe in their ability to complete assignments, tackle difficult topics, and persevere in the face of failure. In addition, this tool also clarifies the questions and statements used to evaluate students' intellectual and emotional abilities (Abdurrahman, 2021; Divayana, 2021). These details include questions designed to test understanding, application, and integration of learned knowledge, as well as their ability to reflect on and create new concepts based on their learning experiences. The main goal of this tool is to provide comprehensive metrics that not only measure learning outcomes, but also pay attention to cognitive and emotional processes, assist educators in identifying students' strengths and development needs, and adapt teaching methods for higher effectiveness.

Design Stage

In this stage, the researcher plans to develop a profile evaluation for learning including: The resulting development product is a scientific attitude profile evaluation tool based on Self Efficacy for physics material which is developed based on the Self Efficacy stages as a guideline in providing assistance with evaluation integration information so that it can foster interest in learning. will later influence learning outcomes. In line with research (Pan, 2021; Silviariza, 2023), it is explained that the design for developing a scientific attitude profile evaluation can encourage students' interest in learning. The scientific attitude profile evaluation based on Self Efficacy that was developed has received input from several experts and is suitable for use as an evaluation tool/instrument in further learning. This is in line with (Kahar et al., 2019; Rivera-Vargas et al., 2021; Zhao et al., 2022) according to him that the evaluation of the model teaching materials developed contains phases that have been assessed and all phases are in the very well implemented category. Apart from that, it was reiterated by (Adiansyah, 2021; Irfandi, 2022) that evaluation of physics learning models that are developed integrated with the help of learning media can also produce better learning outcomes.

Expert Validation

In developing a scientific attitude evaluation tool that focuses on self-efficacy, it is important to ensure that each aspect of this evaluation tool is supported by strong empirical evidence as well as relevant theory (Darmaji, 2019; Susanta, 2021). Construct validation is a crucial step in the research process to measure the effectiveness and accuracy of the evaluation tools that have been designed. Table 2 presents the results of this construct validation, where each item in the evaluation tool is given a score based on its level of relevance and effectiveness in measuring the targeted construct. These scores help in determining strengths and areas requiring improvement in the evaluation tool, and offer critical insight into aspects such as clarity of learning objectives, theoretical and empirical support, assessment measures, as well as clarity in question formulation.

Table 2. Construct Validation

Items	Score
Learning objectives	3.00
Theoretical and Empirical Support	3.50
Assessment steps or learning measurement	3.50
Question Clarity	3.00
Mean construct validation score	3.25

Based on the data in Table 2, construct validation scores for the evaluation tool were developed, with a focus on several critical aspects of the tool's design. The validation score for 'Learning Objectives' reached 3, indicating that the learning objectives have sufficient clarity but still require improvement in the articulation of more specific and measurable objectives. Theoretical and empirical support received a score of 3.5, which reflects good support but there are still opportunities to strengthen the theoretical base and empirical evidence to make the tool more valid and reliable. The assessment or learning measurement measures also received a score of 3.5, indicating that the measurement method is well designed but still allows for improvements in precision and consistency. Question clarity was scored 3, indicating that the questions were clear enough but still needed improvement to reduce ambiguity and ensure better understanding from respondents. Overall, the average construct validation score is 3.25, which indicates that the evaluation tool is generally effective but requires some adjustments and improvements to achieve more optimal validity and reliability in measuring the intended construct .

Implementation

The implementation of the learning model is divided into three different phases. This analysis aims to measure how effective the application of the designed learning model is in real practice, by observing improvements or changes in the application of the model from one phase to the next (Sari et al., 2023) and (Nurdiyanti & Wajdi, 2023). In Figure 2, a graph is presented showing data in the form of averages and percentage of implementation for each phase, providing a visual depiction of the level of success and effectiveness of the model in the field. By monitoring progress through these phases, model developers can identify aspects that require adjustment and improve the suitability of the model to real needs in the learning environment. This data is crucial for evaluating and optimizing the proposed learning model, so the graphs displayed will provide important insight into the progress and effectiveness of implementing the model.

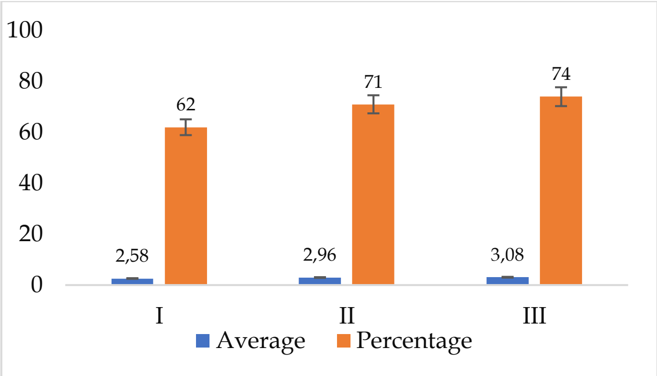

Figure 2. Analyze Implementation

Based on Figure 2, the graph displayed illustrates the implementation of the learning model through three different evaluation phases, marked as I, II, and III. In this graph, two types of data are represented for each phase: average and percentage of implementation. For Phase I, the learning model was implemented with an average score of 2.58, and the implementation rate was 62%, indicating moderate implementation. In Phase II, there was an increase with the average implementation increasing to 2.96 and the percentage reaching 71%, indicating an increase in model implementation. Phase III showed further improvement, with an average implementation rate of 3.08 and a percentage of 74%, indicating a more effective and consistent level of model implementation. The improvements seen in each phase demonstrate continuous adaptation and improvement in the model implementation process, as well as illustrate improvements in the quality of model implementation over time, which is useful for further analysis and planning in the context of education and professional development (Sari et al., 2023; Yang et al., 2020).

Based on the data found previously, it can be concluded that the evaluation of scientific attitude profiles based on Self Efficacy using the developed ADERiC learning model is able to develop students' learning independently and find flexible learning concepts so that they are able to find solutions to solve problems in learning. On the other hand, this evaluation is also able to encourage students to find where their weaknesses are so that they can encourage improvements in various aspects that are considered lacking.

Conclusion

Based on the analysis of research results examining the development of a scientific attitude profile evaluation using the self-efficacy-based ADERiC learning model, it can be concluded that the implementation of this model significantly improves students' scientific attitudes and problem-solving abilities. This research succeeded in designing and validating an evaluation tool that is able to measure these aspects effectively. The research question of how to design and assess the validity of evaluations of students' scientific attitudes was answered with the finding that the ADERiC model, which facilitates accumulation, demonstration, practice, reflection, and creation of knowledge, effectively encourages engagement and strengthens students' self-efficacy. This evaluation shows progressive improvement from one phase to the next in educational practice, reflecting the implementation of an effective model in increasing conceptual understanding as well as practical application by students.

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Author Contributions

Conceptualization, methodology, writing-original draft preparation, formal analysis, investigation, and visualization, M. S. K. and SP. SP; Writing-review and editing, validation, supervision, and resources, M.F and M.A; Conceptualization, methodology and Instrument, SW.SW and A.D.; Validation, supervision, and resources, Z.F.

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Conflicts of Interest

The authors declare no conflict of interest.

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