Development of Integrated PBL Model of Character Values Using ADDIE to Improve Physics Learning Outcomes

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Abstract

This study aims to develop a Problem-Based Learning model integrated with character values (PBL-NK) using the ADDIE framework to improve students' physics learning outcomes. This study uses a Research and Development (R&D) approach with a focus on the Development stage in the ADDIE model. This study involves the creation and validation of a learning model. Validation by experts was carried out using the Gregory formula, resulting in a consistency coefficient of 1.00, indicating a high level of validity. A small-scale trial involving ten grade X students showed an N-Gain score of 0.5321, which is categorized as a moderate increase. The results showed that the PBL-NK model improved students' cognitive, psychomotor, and affective learning outcomes. This study contributes to educational research by providing an innovative learning model that is aligned with the Merdeka Curriculum in Indonesia and supports holistic student development. Further research should explore the effectiveness of this model in wider classroom applications.

Keywords: Problem Based Learning (PBL), Character Values, PBL-NK Model, ADDIE,

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Introduction

Physics learning should not only focus on cognitive mastery, but also on character building.

Based on previous research, the Problem-Based Learning (PBL) model has been widely used to improve critical thinking skills, this is reinforced by the results of a meta-analysis study that analyzed 50 studies covering 5,210 participants, and found that the PBL model has a positive and significant effect on critical thinking skills (Liu & Pásztor, 2022). Other research results also found that problem-based learning is effective in improving students' physics learning outcomes (Oktavia et al., 2024). Based on several research results, the Problem Based Learning model is generally oriented towards improving cognitive abilities only. In fact, 21st century learning requires an approach that not only focuses on cognitive aspects, but also involves affective and psychomotor aspects (Basri et al., 2025). In addition, the results of other studies reveal that the Problem Based Learning (PBL) model has a positive impact, because it can increase student involvement, train independence in solving problems, and develop critical thinking and cooperation, so that PBL is a solution to overcome students who tend to be passive and only receive information from teachers (Masriah et al., 2023). Various studies have shown that the application of the Problem-Based Learning (PBL) model in physics learning not only improves critical thinking skills and learning outcomes, but also has an impact on the affective and psychomotor aspects of students. A study found that the results of the analysis of the implementation of character education in students through problem-based learning can be concluded as effective in increasing discipline among students (Juver & Prasetya, 2023). In addition, other studies also reveal that the integration of character education in the PBL model contributes positively to the development of students' critical thinking skills, so that this approach is a solution in building academic competence as well as character values that are in accordance with the needs of 21st century learning (Dewi et al., 2019). However, the integration of character education in PBL is still a challenge, especially in adapting it to the Pancasila Student Profile framework in the Independent Curriculum in Indonesia.

Current learning does not provide an explicit strategy that systematically integrates character values in the Problem-Based Learning (PBL) model. This creates a research gap that needs to be bridged to ensure that problem-based learning not only improves critical thinking skills, but also shapes students' character and ensures a structured development process. This study specifically emphasizes the development stage, producing a validated learning model and learning tools that explicitly integrate character values. This challenge arises because of the limitations of strategies that explicitly link cognitive aspects with character strengthening, so that their implementation has not been fully optimal in various educational contexts. Furthermore, although various studies have proven that PBL is effective in improving critical thinking skills and learning outcomes, especially cognitive, there is still a gap in understanding the extent to which the integration of character values in PBL can provide maximum contribution to physics learning outcomes comprehensively. Factors such as differences in student characteristics, variations in teaching approaches, and limitations of comprehensive evaluation instruments in measuring the development of critical thinking skills, learning outcomes, and character values are major obstacles in optimizing this model. In addition, the challenges in developing teaching modules that explicitly combine PBL with character strengthening are also an important concern. Therefore, further studies are needed that not only examine the effectiveness of PBL in improving physics learning outcomes but also design strategies that allow for more systematic, contextual, and applicable integration of character values in physics learning. To answer this challenge, the Integrated Problem-Based Learning Model with Character Values (PBL-NK) was developed which aims to improve physics learning outcomes while instilling character values that are in accordance with the profile of Pancasila students. This model is designed so that students are not only able to

solve problems scientifically, but also develop an attitude of responsibility, cooperation, and critical thinking in the learning process. Thus, PBL-NK is expected to be an innovative solution in realizing more meaningful physics learning that is oriented towards character formation. In addition, character strengthening in physics learning must also be in line with the six dimensions of the Pancasila Student Profile, namely faith, devotion to God Almighty, and noble character; global diversity; independence; mutual cooperation; critical reasoning; and creativity (Aziz & Hasanah, 2022). To answer this challenge, a Problem-Based Learning Integrated Character Values (PBL-NK) model was developed which aims to improve physics learning outcomes while instilling character values that are in accordance with the Pancasila Student Profile. This model is designed so that students are not only able to solve problems scientifically, but also develop an attitude of responsibility, cooperation, and critical thinking in the learning process. Thus, PBL-NK is expected to be an innovative solution in realizing more meaningful physics learning, oriented towards character formation, and supporting the vision of Indonesian education in producing a competent generation with Pancasila character. As a concrete step to achieve this goal, this study developed a Problem-Based Learning Integrated Character Values (PBL-NK) Model using the ADDIE development model, which ensures that the development process runs systematically and structured. This study specifically emphasizes the development stage, where the syntax or steps in the PBL-NK model and the resulting learning tools have gone through a validation process and are designed to explicitly integrate character values in every stage of physics learning. With this approach, it is hoped that students will not only gain a better conceptual understanding, but will also be able to internalize character values that are in line with the Pancasila Student Profile.

ADDIE is an instructional design model consisting of five main stages: Analysis, Design, Development, Implementation, and Evaluation. This model has been widely used in the development of technology-based learning materials and innovative pedagogy (Branch, 2009). By implementing ADDIE, this study aims to produce a structured PBL model that can be applied effectively in physics classes and supports the formation of student character. This study offers innovative value in two main aspects. First, the model developed will integrate character values explicitly in each stage of PBL. Second, the use of the ADDIE model will ensure that model development is carried out systematically and based on actual learning needs. Thus, the results of this study are expected to be a new contribution to character-based physics learning innovation, which is in line with national education policies and 21st century learning needs. To develop the PBL-NK model systematically, the ADDIE framework is used. This study specifically emphasizes the development stage in the ADDIE model, including the creation of a model book as a guide in implementing the PBL-NK model, the creation of an Independent Curriculum teaching module that is in line with the principles of PBL and character values in accordance with the elements of the Pancasila student profile in the Independent Curriculum in Indonesia, the creation of teaching materials, the creation of Student Worksheets, and the creation of assessment instrument sheets. The development stage, initial product development, validation by the first expert, product revision, and validation by the second expert are carried out in stages to ensure the quality and suitability of the products produced (Kustandi & Darmawan, 2022). The purpose of this study is to develop a Problem-Based Learning Integrated Character Values (PBL-NK) model that is in accordance with the Independent Curriculum to improve students' physics learning outcomes. In this study, product development was only focused on the syntax of the learning model.

Research Methodology

Research Approach

Study This use Research and Development (R&D) method with ADDIE (Analysis, Design, Development, Implementation, and Evaluation) development model approach (Branch, 2009). However, the research This only focus on stage development in the ADDIE model. Focus This chosen Because study aiming For produce a Problem-Based Learning Integrated Character Values (PBL-NK) model that can used in learning physics in accordance with Independent Curriculum. As for the design study This can seen in figure 1.

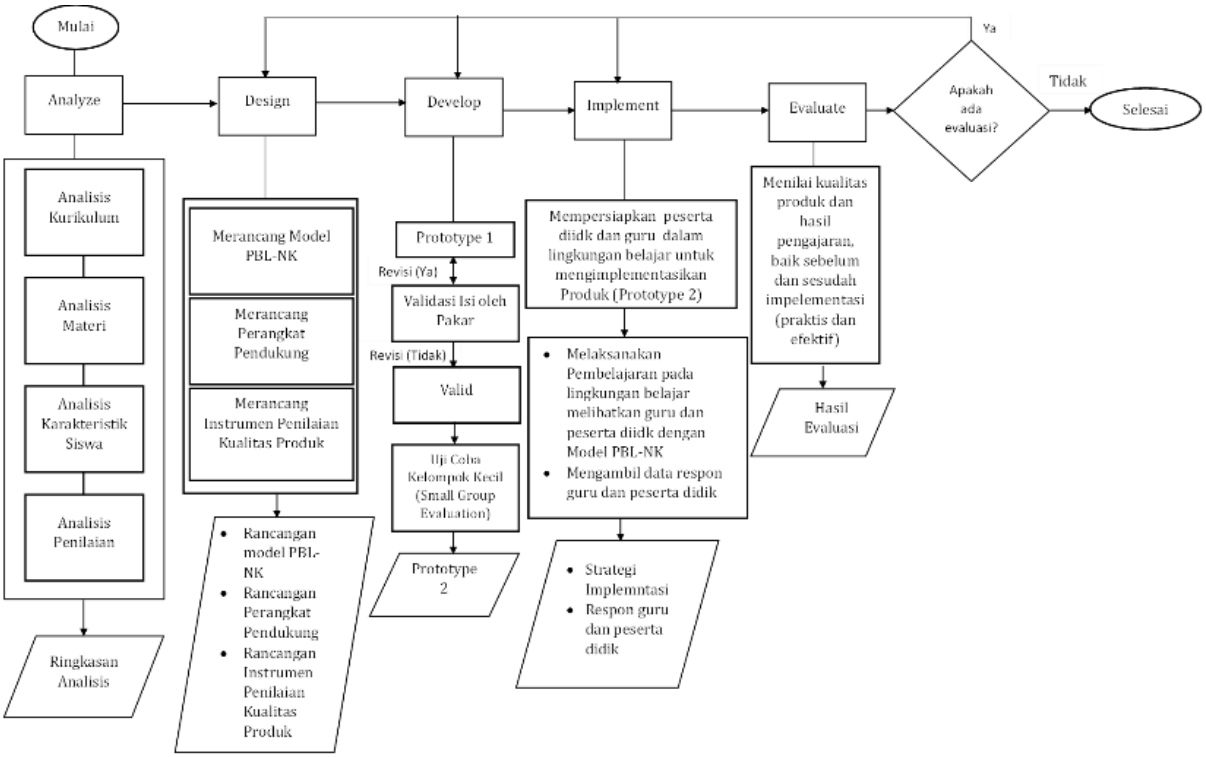


Fig. 1 ADDIE Development Model in PBL-NK Model Development

At the stage development this, research done through a number of step main after compilation design the beginning of the PBL-NK model based on study literature and results analysis needs. Design This covers structure integrated PBL learning with values appropriate character with element Profile Pancasila students in Independent Curriculum. First, carry out validation by experts namely in the model book which is guidelines The use of the PBL-NK model contains explanation syntax learning, system social, principles reaction, system supporters, impact learning, and indicators success (Joyce et al., 2015). Validation This aiming For evaluate feasibility of the developed model based on aspect construct, content, and implementation in learning physics. Next trial product in scale small For know level feasibility of learning models before testing in scale big.

Research Instruments

Instruments used in study This covering sheet model validation, as well as questionnaire evaluation expert. The data obtained from validation expert analyzed in a way descriptive quantitative and qualitative For see level validity of the developed model. If there are suggestions for improvement from experts, then the PBL-NK model will revised before implemented more carry on in stage implementation in research next.

Data Analysis Technique

Data obtained in study This analyzed using two approaches, namely quantitative data analysis

and qualitative data analysis, Analysis quantitative used For process the obtained numerical data from various instrument research, such as score evaluation validity by expert , score evaluation model implementation, score teacher and participant responses education , as well as data on the effectiveness of the analyzed model using the t-test and the n-Gain test (Singgih & Ferdinand, 2023). The results of the analysis This aiming For measure To what extent does the Problem-Based Learning Integrated Character Values (PBL-NK) model fulfill criteria validity, implementation, and effectiveness in increase results Study participant educate.

Temporary that, analysis qualitative used For understanding to findings study with digging data from interviews, as well as comments and suggestions for improvement from the validator. Qualitative data used as material reflection For do revision and refinement of the model before implemented more continue. If the results validation show that the model and device learning Still need repair, then revision done based on input experts so that the PBL-NK model is more optimal and appropriate with objective learning.

Validation results analyzed use Gregory's analysis that measures level validity based on input from the experts. The results of expert validation are processed to obtain the coefficient value between experts using the Gregory test. The formula used is:

$$\text{Validitas Isi (r)} = \frac{D}{A+B+C+D} \quad (1)$$

Information:

r : Gregory coefficient which shows the consistency coefficient of the two experts

A : the cell that shows both assessors/experts stated it was not relevant

B and C : cells that show differences in views between assessors/experts

D : cells that show that both assessors/experts meet content validity.

The agreement model between assessors (validators) for content validation used is shown in the following table:

Table 1. Cross Tabulation 2 x 2 Assessments from Both Validators

		VALIDATOR I	
		Weak Relevance (items worth 1 or 2)	**Strong Relevance (items worth 3 or 4)**
VALIDATOR II	Weak Relevance (items worth 1 or 2)	A	B
	Strong Relevance (items worth 3 or 4)	C	D

Table 1 shows results validation from two validators against an instrument, and the product developed based on level its relevance. Every grain rated with scale certain, where a value of 1 or 2 indicates relevance weak, whereas a value of 3 or 4 indicates relevance strong (Robert & Gregory, 2000).

On Table 1 consists of from two aspect assessment, namely from Validator I (column) and Validator II (row). If a grain enter to in category A, meaning second validator evaluate grain the own relevance weak . If enter to category B, meaning Validator II assesses grain the weak, but Validator I rated it strong. On the other hand, if it falls into category C, Validator II considers it strong, but Validator I considers it weak. Meanwhile, category D indicates that

both validators agree that the item has strong relevance. The more items that fall into category D, the more valid the instrument developed. However, if many items are in category A, then revisions need to be made so that the instrument becomes more appropriate and relevant to the learning objectives.

After going through validation by experts, the empirical validity of the model was tested through a small-scale trial involving 10 grade X students of SMAN 1 Jeneponto . This trial aims to identify aspects that still need to be improved based on feedback from students and the results of researcher observations. The empirical validation obtained from this trial is in line with the principle of formative evaluation in development research which emphasizes the importance of reflection and revision of the model before being implemented on a wider scale (Plomp & Nieveen N, 2013). This step is taken before the learning model is implemented on a wider scale in order to evaluate its effectiveness in actual learning conditions. Validation aims to ensure that the developed product has met the standards before being applied in learning practices. In the PBL-NK model, empirical validation is carried out through a small-scale trial involving teachers, observers , and students. This trial aims to evaluate the implementation of the model and its impact on student learning outcomes.

After designing the PBL-NK model, supporting devices, and product quality assessment instruments, the validation stage is carried out to ensure the suitability and feasibility of the product before implementation. The developed product is declared to have adequate validity if it meets the criteria of strong relevance, with an inter-expert consistency coefficient value of more than 0.75 (r> 0.75) (Marisda et al., 2023) . If these criteria are met, then the resulting product can be categorized as valid and suitable for use in the learning process (Alkin & Vo, 2018).

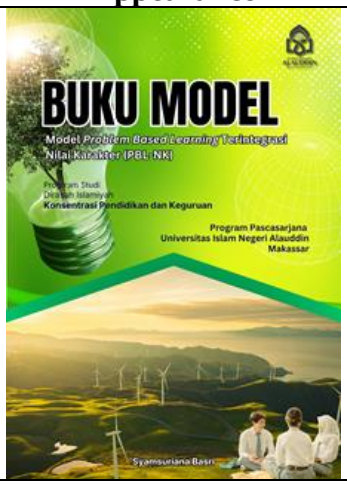
Analysis and Result

Innovation The main focus of the Integrated Problem-Based Learning Model with Character Values (PBL-NK) lies in the integration systematic mark character in every stage learning based on problem. If in conventional PBL participant educate only focused on solving problem, then in PBL-NK (Edy et al., 2024), they are also directed For apply values like not quite enough answer, work same, think critical, and creativity. This integration in line with Profile Pancasila students, who became vision main curriculum education in Indonesia (Kemendikbudristek BSKAP, 2024). In addition, PBL-NK uses approach contextual based on wisdom local, so that participant educate can connect draft physics with phenomenon real in the environment them, so that draft physics studied more near with life daily participant educate and moreeasy understood. Wisdom local own role important for teachers in teach students, because wisdom - based learning local allow student get experience Study in a way direct (Basri & Akhmad, 2022). A PBL-NK model book was also prepared as guide for teachers, researchers and observers education For implementing this model in learning physics. The PBL-NK model book contains steps learning, how to to plant mark characters, as well as guide in evaluate results Study students. With book this, teacher does not difficulty Because Already There is clear and easy instructions followed. In addition, the book this is also possible used by other schools who wish try PBL-NK method. In addition, model books also play a role as document academic explaining in a way deep about concept, basis theory, and principle development of the PBL-NK model so that it can understood in a way more comprehensive.

Prototype of Problem Based Learning Model Integrated with Character Values (PBL-NK)

In an attempt increase quality learning, required innovation that is not only focus on understanding concept, but also on development character participant educate. Character is aspect important in education Because to form attitudes, morals and skills social needs in life (Krathwohl, DR, Bloom & Masia, 1964). The Integrated Character Value Problem-Based Learning Model (PBL-NK) is present as an approach that combines learning based on problem with planting values character in a way systematically. With Thus, participants educate No only to obtain understanding academic, but also developing as responsible individual responsible, independent, and ethical. To support implementation of this model, developed a learning model explained in the functioning model book as guide for educators in implementing PBL- NK effective in class. Books This give guidelines about concepts, strategies and tools learning that can used in the learning process based on character.

Table 2 Appearance and Description PBL-NK Model Book

Appearance	Description
	Cover The Integrated Character Value Problem-Based Learning Model (PBL-NK) book is designed with combination green and yellow which reflects innovation and sustainability. The title displayed firmly, with light bulb illustration containing plant as symbol integration science and character. Luminous background symbolizes distribution science, while view turbine wind represent energy renewable. In the corner below, three people discussing describe learning collaborative in PBL.
	List of contents in The Integrated Character Value Problem-Based Learning Model (PBL-NK) book provides description systematic about Contents designed book For assist educators in implementing learning models This. Book This started with part Introduction, which explains background back, goal development, as well as PBL-NK model design. Next, the PBL-NK Model section discusses in a way deep draft basics, syntax learning, principles used, implementation strategies, and system assessments that support this model. The next section, Guidelines Use of Models, presenting guide step by step in implementing the PBL-NK model in the classroom, including stages implementation that can be followed by the teacher. Then, deep Implementation of the PBL-NK Model for Improved Learning Outcomes, provided various device learning like teaching modules, teaching materials, and sheet Work participant learn (LKPD) which can direct used in the learning process . In the section Conclusion and Bibliography, which summarizes overall Contents book as well as to list

	references used .
Model *Problem Based Learning* terintegerasi Nilai Karakter (PBL-NK) Tahap 1 Memberikan orientasi peserta didik terhadap masalah kontekstual dan stimulus nilai karakter Tahap 2 Mengorganisasikan peserta didik untuk belajar dan penetapan peran peserta didik. Tahap 3 Membimbing penyelidikan dan membangun karakter Tahap 4 Representasi dan Presentasi hasil kerja secara individu atau kelompok Tahap 5 Evaluasi, repetisi hasil kerja dan penguatan karakter	Syntax of the developed learning model from PBL model to PBL-NK model
	One of stage in the PBL-NK model which is outlined in learning, designed For push participant educate For explore problem relevant contextual with life real as well as apply mark character in accordance Profile Pancasila Students. The teacher presents problem through various method, while participant educate in a way active observe, analyze, discuss, and reflect solution from the given problem.

Validation Results Integrated Character Value Problem Based Learning Model Book (PBL-NK)

Validation model book done in two stages, which involve revision based on input from the validator as well analysis results validation use coefficient consistency. At the stage first draft The model book was assessed by two validators who provided suggestions regarding structure, syntax, and integration mark character. After revision, validation second done, and the results analysis use Gregory's formula shows mark coefficient consistency by 1 in all criteria, which exceeds the minimum limit of 0.75. With Thus, the model book is declared valid and suitable used without need validation additional. The results of the PBL-NK model validation show that all over components, including theory support, model structure, syntax, system social, principles reaction, system supporters, as well as impact instructional and accompanying, obtaining mark validation as much as 1 with valid category.

Researcher do validation model book twice and revise based on input from both validators. At the stage early, researcher submit draft model book and sheet evaluation to the validator for rated in accordance with established criteria. Based on the results of the first validity test , the validator provided suggestions and improvements which were used by the researcher as reference in revise model book. As for suggestion repair from validator And revision as following.

Table 3. Appearance Suggestions and Revision Model Validation Learning

Revised Aspects	Validators	Suggestion	Revision
Model Structure and Components	Validator 1	The description of the model components is still not systematic enough. There needs to be an explanation of the syntax, teacher and student activities.	Description model components have been revised And arranged in a way more systematic. Syntax learning has explained in a way more Details with more stages clear, and equipped with example teacher activities and participant educate on every stages, and serve model stages in form table For make it easier understanding.
		Recommended For add indicator	Indicator success has added on model book

		success on model book , so that clear PBL-NK model criteria are considered has give impact instructional.	for criteria the success of the PBL-NK model is greater clear And impact instructional can measurable.
Syntax	Validator 2	Value integration character in every PBL stages not yet depicted in a way explicit.	Value integration character in every PBL stages have been clarified with add explanation explicit on every stage. Every step in the model has equipped mark character developed in the description activity.

The second test by the validator was conducted after the revision of the model book was completed. After conducting the second assessment on the validator, the researcher analyzed the assessment by calculating the consistency coefficient. The consistency coefficient is a measure used to assess the level of agreement or consistency between experts in assessing the model book. The results of the analysis of the consistency coefficient between experts in assessing the model book based on the assessment of the two validators using the Gregory formula, which is 1 for all criteria, namely supporting theories, model structure and components, syntax, social systems, reaction principles, support systems, and instructional impacts and accompanying impacts. The overall results of the expert validation analysis are greater than the 0.75 criterion. Thus, all criteria in this model book are declared valid, so that the PBL-NK model book is suitable for use. Therefore, further validation was not carried out because no additional improvements were needed. The following is a summary of the results of the PBL-NK model book validation presented in the following table.

Table 4. Summary Results Validation PBL-NK Model Book

No	Component	Content Validation	Criteria
1	Supporting Theories	1	Valid
2	Model Structure and Components	1	Valid
3	Syntax	1	Valid
4	System Social	1	Valid
5	Principle Reaction	1	Valid
6	System Supporters	1	Valid
7	Instructional Impact and Accompanying Impact	1	Valid

After product has validated and declared worthy used , then researcher continue with validation empirical , thing This aiming For ensure that the PBL-NK model can functioning with Good in accordance with context its implementation , so that the result can give description real about to what extent the model can increase results Study participant educate as well as convenience its use in learning physics through testing direct in scale small , called a trial scale small .

A small-scale trial was conducted involving 10 students in grade X.3 who responded to the PBL-NK model through a questionnaire categorized into five levels, namely very positive, positive, neutral, negative, and very negative. The results of the analysis showed that three students considered this model very practical with a percentage of 81%-100%, while seven students considered it practical with a percentage of 61%-80%, with no responses in the moderate, less practical, or impractical categories. Furthermore, to assess the initial effectiveness of the learning model, descriptive analysis and N-Gain tests were conducted to measure the increase in student learning outcomes. The pretest results showed an average value of 53.80, which increased to 78.40 in the posttest , with an average N-Gain of 0.5321,

which was included in the moderate category. In addition to improving cognitive learning outcomes, the psychomotor and affective aspects also showed high average scores, respectively 80 and 81.67.

The results of observations on the implementation of the model indicate that the learning syntax , social system, reaction principles, and instructional impacts and accompanying impacts have mostly been implemented according to plan. The results of the teacher response questionnaire also showed that the PBL-NK model was considered practical with an average percentage of above 70%, even the language and presentation aspects reached 87% and were included in the very practical category. Overall, the results of the small-scale trial indicated that the PBL-NK model has a good level of practicality and effectiveness and is able to improve students' physics learning outcomes. Thus, this model is worthy of being applied on a wider scale.

Table 5. Results Small Scale Trial Analysis

Response Learners	Teacher Response	Pre test	Post test	N-Gain	Psychomotor	Affective
Very Practical (3 students, 81%-100%) Practical (7 students, 61%-80%) There were no responses in the moderate, less practical, or impractical categories.	Average above 70% (practical) Language and presentation: 87% (very practical)	53.80	78.40	0.5321 (medium)	80 (high)	81.67 (high)

Study This present innovation in learning physics with developing a Problem-Based Learning Integrated Character Values (PBL-NK) model based on ADDIE approach. Uniqueness main from study This is integration explicit values character in learning based on problem (PBL), which has not been Lots investigated in context education physics. Research results previously show that PBL is significant increase skills think critical and results Study participant educate (Pristianti & Prahani, 2023). However, it is still there is gap in PBL implementation that accommodates values character in a way systematic. Therefore that, research This answer challenge the with designed a more PBL-NK model holistic, no only achievement oriented academic but also the formation character participant appropriate education with Profile Pancasila students in The Independent Curriculum that applies in Indonesia. The validation results of the PBL-NK model show level high validity based on Gregory's test. Coefficient consistency inter-expert reach value 1, which indicates agreement full in validation content and construction. Some findings main from study This covering validation of learning models, trials scale small, increase results learn, and aspect psychomotor and affective. Validation by two experts show that model books, teaching modules, teaching materials, and LKPD have level validity high, with value 1 on all aspect assessment. Based on analysis validity that has been done, all component product study This stated worthy used without need validation continued. This is in line with results research that states that that instrument study must validated moreover before, before used, so that If Already valid category, then the instrument is can used (Budiarso et al., 2022).

Results test try in scale small which is validation empirical show that this model gets response positive from participant educate, with 81% of participants rate this model highly practical and 19% rated practical. N-Gain analysis shows improvement results Study with an average of 0.5321, which came in in category improvement is. This indicates that the PBL-NK model contributes in a way significant to understanding draft physics participant educate. Besides

that, the average score psychomotor And affective participant educate each reached 80 and 81.67, indicating that this model is not only increase results Study cognitive but Also aspect skills And attitude (Plomp & Nieveen N, 2013). This finding supports previous research that confirms the effectiveness of PBL in improving learning outcomes. (Ardianti et al., 2021), (Robiyanto, 2021). However, unlike the previous model, PBL-NK explicitly integrates character values, ensuring holistic student development. The use of structured ADDIE also increases the reliability and applicability of this model. Thus, this study provides a new contribution to character-based learning innovation

Findings and Conclusion

This study successfully developed and validated the PBL-NK model, demonstrating its effectiveness in improving physics learning outcomes and strengthening student character. This model is in line with the Merdeka Curriculum and can be a valuable learning innovation for education in Indonesia. Further research should investigate its wider scale implementation and its long-term impacts.

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Declaration of Conflict

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