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An Analysis of Physics Learning Motivation Using a Case Study-Based Learning Motivation Assessment Instrument

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Abstract: Learning motivation is important to support successful learning. This article discusses the analysis of high school learning motivation and the development of a learning motivation assessment instrument. This is due to the lack of instrument development based on case studies. It used a case study-based instrument developed with the 4D model. The study results show that the developed learning motivation assessment instrument is valid and reliable. Through this instrument, students' motivation to learn physics can be classified into low, medium, and high. Through analysis, the treatment of each group can be seen so that learning motivation can increase. At the low level, it can be increased by varying learning models, learning resources, and learning media. While for the second level, namely the average, it needs to be increased again by building more intense communication with students. For the highest level, it can be in the form of learning with more interesting learning resources and physics assignments.

Keywords: assessment, case study, motivation

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INTRODUCTION

Technological developments in the 21st century encourage all countries to create competent, creative, and innovative people through the education they organize (Sekarini et al., 2021). Education is one way to change the destiny of a nation. Education is the process of incorporating culture into humans or groups to turn them into civilized human beings (Aldila et al., 2020). Therefore, education in a country becomes one of the things that is very concerned about creating human resources that can advance the country.

Education cannot be separated from the learning process because the teaching and learning process is the most important part of building the quality of a country (Pristiwanti et al., 2022). The learning process is an interaction in the classroom that involves teachers as educators and students as learners (Putria et al., 2020). The learning process can be done formally or informally (Haerullah & Elihami, 2020). This process is determined by many factors, one of which is the motivation to learn from students (Choerul Anwar Badruttamam, 2018).

Motivation to learn physics is one of the important things in encouraging students to learn. It cannot be denied that learning motivation is a driving factor for carrying out activities and carrying out academic assignments to achieve learning goals, and this factor lasts for a certain period (Sudibyo et al., 2017). Learning motivation is strongly influenced by internal factors in the form of physical and psychological factors as well as external factors in the form of the environment and the conditions of the people around them (Safitri et al., 2023). The four aspects of motivation to learn physics are (1) choice or interest in the task/activities, (2) efforts made to succeed, (3) persistence or tenacity in using time for a task, and (4) self-confidence while engaging in activities (Sudibyo et al., 2017). The student's learning motivation encourages him to choose assignments from the subject that he likes and this indicates that he has the motivation to study that subject (Sudibyo et al., 2017). Efforts made to succeed mean that students who have higher motivation will try to make every effort to learn both motorically and cognitively (Sudibyo et al., 2017). Students who have persistence motivated to learn tend to be more persistent, even when facing difficulties, remain persistent, and never give up by using a lot of time to master the material (Sudibyo et al., 2017). Self-confidence motivation will encourage students to enjoy and feel comfortable when studying and taking exams, thereby producing competent students (Sudibyo et al., 2017). Based on this explanation, the synthesis of physics learning motivation indicators can be formulated in the following table.

Table 1. Indicator of the physics learning motivation

Physics learning motivation aspect	Physics learning motivation indicators
Choice or interest in tasks/activities	Fascinated by learning physics material Select to do physics material assignments first Promptly doing physics assignments Spending time examining physics material
Efforts made to succeed	Having the exertion to prevail over physical material Having mental exertion amid physics material learning Utilizing cognitive strategies for learning physics material
Perseverance and persistence in the time spent on a task	Never giving up when confronting impediments in learning physics Working hard on challenging physics assignments
Confidence while engaging in activities	Believing in having physics abilities Enjoying doing physics assignments Not becoming stressed on most physics test

(Sudibyo et al., 2017).

However, the learning motivation of students, especially in physics subjects, is still relatively low. Based on the motivation analysis result, student's motivation to learn physics is still classified as moderate and low (Sari et al., 2018). The lack of motivation to learn physics among students is due to the stigma of difficult physics subjects. In addition, the learning environment does not create active and fun learning models.

Learning motivation is an important factor in determining the success of achieving learning goals (Arimbawa et al., 2017). Student motivation arises when they are faced with a task that must be completed within a certain time, and this is related to a sense of responsibility (Susetyarini et al., 2019). Most teachers just focus on cognitive assessment and forget to measure learning motivation (Dewi, 2020). They have difficulty measuring students' motivation to learn, which causes some of them not to be motivated to learn physics. This is caused by teachers who do not know how to make instruments for the assessment of motivation to learn physics (Sudibyo et al., 2017). Even though there has been a lot of research on the development of learning motivation assessment instruments. In addition, most of the research about the development of learning motivation assessment instruments is in the form of a questionnaire.

The assessment instrument in the form of a questionnaire brings new problems in its use. Some cases of its use are that students do not answer the questionnaire based on what describes them (Sukardi, 2011). Thus, students are only looking for safe answers or just filling in without thinking about the meaning of each statement on the questionnaire. This has the impact that the results of the assessment are not data that describe the actual situation on the field. Based on this problem, it is necessary to develop an assessment instrument for learning motivation in physics using another model.

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Furthermore, one form of assessment instrument model is the case study model. The case study model invites respondents to analyze the problems presented in the questions. Usually, the problems are those that are often encountered by students. Through these problems, students are directed to make decisions in solving these problems. Various solutions are presented in multiple-choice so that students only choose one. Each answer choice has its value so that later it will have an interval score as an assessment using a questionnaire.

Based on the explanation of the problems above, it is necessary to develop an instrument for assessing students' learning motivation in the form of case study questions or study case-based learning motivation assessment (CS-LMA). This instrument presents questions that contain stories about physics learning conditions and are accompanied by answer options, which have different scoring values and illustrate the value of students' learning motivation in physics subjects. After that, we can find out what steps must be taken in admitting students according to their level of motivation. So the purpose of this study was to determine the validity of the CS-LMA and map the motivation to learn physics using the CS-LMA.

METHOD

This study aims to produce an instrument for assessing the motivation to learn physics for high school students. The method used is the 4D research method including the Define, Design, Develop, and Disseminate phases as shown in Figure 1. The define stage aims to determine the problem by using an analysis of objectives and constraints in the field (Thiagarajan et al., 1974). The design stage aims to design a prototype which is a material solution to the problem (Thiagarajan et al., 1974). This stage includes the initial design of students' learning motivation assessment instruments. Two instruments are made, which are used differently based on the time of use. The next stage is development which is a series of processes of validation, revision, limited testing, and field testing. The purpose of this stage is to determine the validity level of the instrument and its feasibility for use in class. Another purpose is to find out some of the errors that exist in the developed instrument. The final stage is dissemination, namely the stage where the developed instrument is disseminated for use as the purpose of this research is to produce an instrument for assessing students' physics learning motivation.

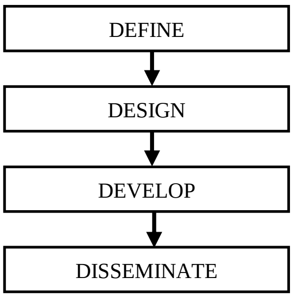

Figure 1. Research Method

The development stage has an assessment from the validator. The validators are the experts in physics education and practitioners of physics teachers at senior high schools. They assess the validity of SC-LMA based on aspects of construction, content, and language. Validity data analysis from the validator uses the V'Aiken formula. Analysis through Aiken'Vvalues can then be grouped into several categories (Pujiyanto et al., 2023) as shown in Table 2 below.

Table 2. Category of Validity

Coefficient of Validity	Category
$V \geq 0.8$	Very Valid
$0.6 \leq V < 0.8$	Quite Valid
$V < 0.6$	Invalid

(Aiken, 1985)

After the assessment by the validator, trials were carried out in small classes. Testing at this stage was carried out to determine the validity and reliability of the instrument. In addition, empirical data testing was carried out to determine the discriminating power of the physics learning motivation assessment instruments. The formula used for the analysis of the validity of the broad test was the

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Pearson product-moment correlation (Sugiyono, 2010) and the reliability used the Cronbach' Alpa formula (Arikunto, 2021). Both were carried out using the SPSS data processing application (Janti, 2014) . This instrument is stated to be valid by using Pearson product-moment correlation if the obtained $r_{count} > r_{table}$, then the instrument or question significantly correlated with the total score (valid). If $r_{count} < r_{table}$, then the instrument or question item is not significantly correlated with the total score (invalid) (Suharsimi, 2002). Criteria data are said to be reliable by using this technique if the value of Cronbach's alpha(α) > 0.6 (Arikunto, 2021).

The next stage was the use of the developed instruments in field trials. This test was carried out to show the ability of the developed instrument to differentiate students' learning motivation. The field is a student at senior high school. The sampling technique in the field trial was the cluster random sampling technique, where the sample was 15 students from one of the high schools in Yogyakarta. The scheme is:

Field class
SC-LMA Instrument → Data
15 students

Testing the data from the field test was processed using a T-score analysis that started from the Z-score analysis. The formula for the Z-score analysis is as follows:

$$\bar{Z} = \frac{X - \bar{X}}{STD}$$

information:
$\bar{Z}$ = Z-score
X = score from students
$\bar{X}$ = mean
STD = standard deviation

The transformation from Z-score to T-score used the following formula:

$$T = 10(Z) + 50$$

The students were categorized into three classes based on the scores obtained, namely, above average, average, and below average students (Stafford et al., 2013) as shown in the following table.

Table 3. T-score Criteria

Score	Criteria	Information
$T_{score} \geq 60$	Above average students	Students needing enrichment
$40 \leq T_{score} < 60$	Average students	Students needing more varied learning
$T_{score} < 40$	Below average students	Students needing a special approach

FINDINGS AND DISCUSSION

The instrument was developed with indicators of physics learning motivation, and each indicator was made into one item. Therefore, each instrument contains twelve items. Item construction raises cases that often occur in learning so students are asked to show their attitude in dealing with these cases. The attitude shown will reflect the level of physics learning motivation they have. Here is one of the items:

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Table 4. Items in the instrument (Translated)

Pre-test	Post-test
When physics teaching takes place, the teacher gives practice questions to work on. Then you are asked to write the results of your work on the whiteboard. What is your attitude towards this? A. Allow other friends to work on the whiteboard. B. Write the answers on the board completely and clearly. C. Discuss with friends first to write the answers on the board. D. Write the answers on the board with your classmates. E. Write your answer even though the answer is not necessarily correct.	When your friend answers a question from the teacher, you realize that your friend's answer is wrong. How do you feel about this? A. I will let my friend's answer be because I am sure it will be confirmed by the teacher. B. I will invite other friends to help me in justifying my friend's answer. C. I will be confident to justify my friend's answer by giving an answer that I think is correct. D. I will confirm my friend's answer after the teaching and learning activities in class are finished. E. I will ask my other friends to correct the wrong answer.

After the construction of the instrument, it was then analyzed regarding its validity and ability through expert judgment. The results of the validity of the validator were changed from ordinal data to interval data. This process used the Successive Interval Method (MSI) so that it could be analyzed using the Aiken'V formula. Based on the results of the validity analysis in Figure 2, all items could be used in research. The validity value based on the table already showed a valid category.

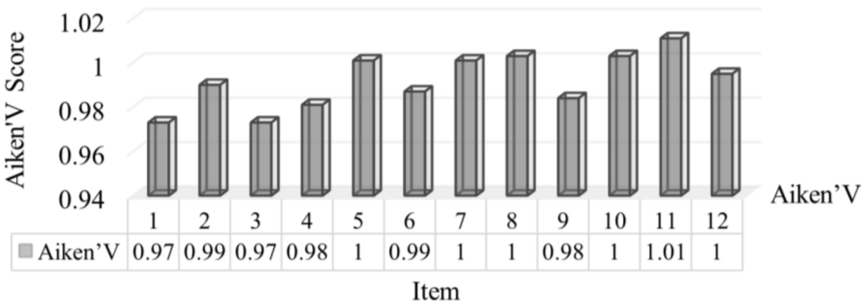

Figure 2. Validity Score

The next stage was the empirical test stage. This test was carried out to determine the value of the validity and reliability of the test. The data obtained were analyzed using the SPSS application as explained in the research methods section.

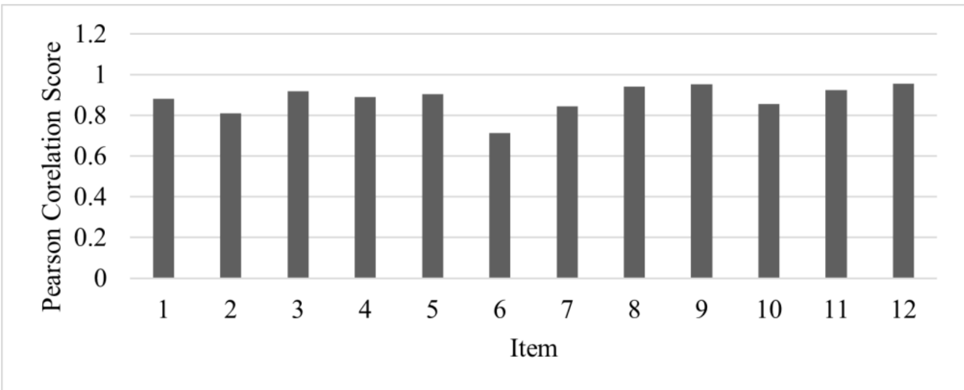

Figure 3. Pearson Correlation Score

Table 3. Cronbach's alpha

Item	Respondents	Cronbach's alpha	Reliability Criteria
2	15	0.974	Very High

Based on Figure 3, all items are very valid (Sugiyono, 2010). In addition, the level of reliability of the SC-LMA is in a high category (Arikunto, 2021). So that the SC-LMA can be used to determine the level of student motivation in field tests (Thiagarajan et al., 1974). The following table is the result of an analysis of students' motivation to learn physics from each aspect.

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Table 6. Tscore Of Motivation Learning

Aspect	T_{Score}	Criteria
Choice or interest in tasks/activities	50	Students with average abilities
Efforts or efforts made to succeed	50	Students with average abilities
Perseverance and persistence in the time spent on a task	50	Students with average abilities
Confidence while engaging in activities	50	Students with average abilities

Table 4 shows that the results of the T-score analysis show the student's motivation to learn physics is within the average criteria. At this level, it needs to be improved so that learning motivation increases towards the criteria above the criteria. Aspect 1, namely choice or interest in tasks/activities, obtained a T-score of 50. This scale requires an increase in its indicators. In more detail, Figure 5 shows the acquisition of the T-score for each indicator.

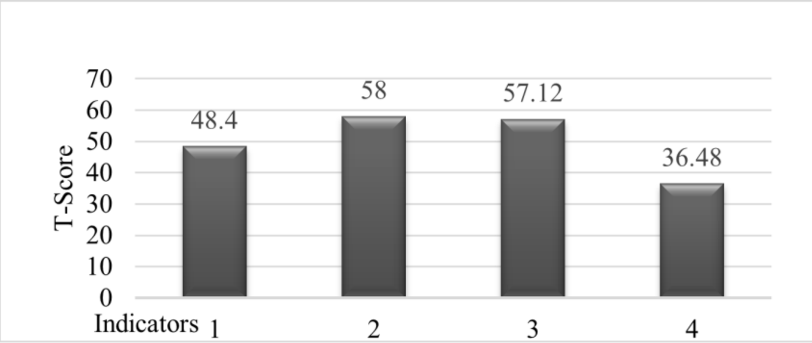

Figure 4. Choice or Interest in Tasks/Activities

In general, the results of aspects of interest in physics learning activities fall into the average category. Table 1 shows the first indicator gets a value of 48.8. This shows an indicator of interest in learning physics is not too low. The aspect of interest is important in studying physics because it can foster a visible influence on the growth of student attitudes. Based on Table 1, the second indicator, namely questioning interest in doing physics assignments first rather than other assignments, shows a value of 58. This shows that the tendency of students to prioritize physics assignments is moderate. Because solving physics assignments is difficult and needs a lot of time, they prioritize physics first. The third point, or the third indicator questions about the urgency of doing physics assignments, gets a value of 57.12. This shows that students are not too enthusiastic or fast in doing physics assignments. The fourth indicator, namely asking about the allocation of time used by students to study physics, tends to be low with a score of 36.48. This shows that students do not really like physics or last a long time with physics which incidentally has a lot of calculations. Based on this data, in increasing students' interest in learning physics, various methods are needed so that learning is not boring (P. Sari et al., 2021). Learning that promotes student activity can generate a positive response to enthusiasm for tasks in physics learning (Saharsa et al., 2018).

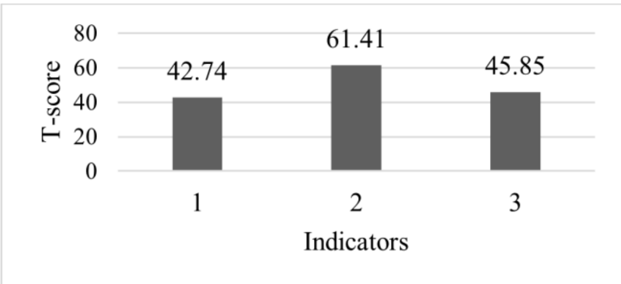

Figure 5. Diagram of Efforts or Efforts Made to Succeed Aspect

Based on Figure 5, the criteria for motivation to learn physics are in the medium category, but in the elaboration on Indicator 1, based on Tabel 1, the value is 42.74. This indicates that the tendency and effort to master physics is moderate. Learning physics is difficult, so not many students master physics completely (Asmawati, 2015). The second indicator regarding the mentality of students in studying

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physics is classified as high with a value of 61.41. Mental efforts are made to be able to work on physics problems (Widyaningtyas & Radiyono, 2013). It is undeniable that active learning activities can improve the mentality of students to be more courageous in expressing themselves in learning. The third indicator shows the moderate category. This shows that the strategies used by students to learn physics are still in the general category. There is no creativity in learning physics. To improve strategies in students' efforts to learn physics, teachers have to vary teaching methods by prioritizing active learning (Steviana et al., 2022). In addition, learning media are more varied and systematic so students do not learn from just one source (Utomo et al., 2014).

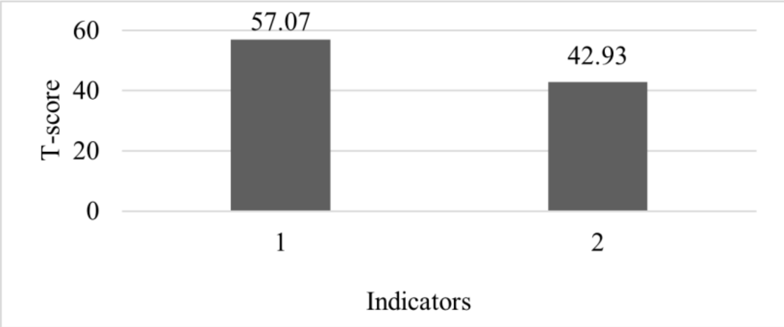

Figure 6. Diagram of Perseverance and Persistence of The Time Spent on a Task Aspects

Based on Figure 6, the aspect of never giving up spirit based on Tabel 1 is in the medium category. This shows that students will have a positive attitude toward learning physics. Learning strategies that actively involve students will encourage students to be more enthusiastic and never give up. Teaching with problem or question-based learning can make more strategies to learn about physics (Waluyo & Nuraini, 2020). The attitude of never giving up can be improved by giving assignments that are not based on questions but on a group project. In addition, students' ability to involve themselves in small learning groups can be used to improve their ability to deal with the problems presented (Maduretno & Andrini, 2018).

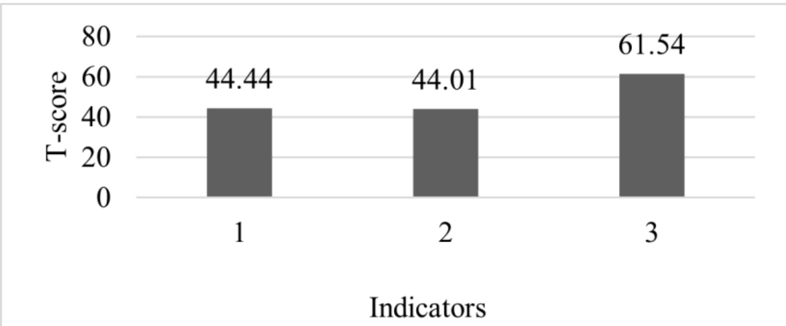

Figure 7. Diagram of Confidence While Engaging in Activities

Based on Figure 7, the aspect of confidence while engaging in activity is in the moderate category. Indicator 1, based on Tabel 1, namely asking students' confidence in learning physics, gets a score of 44.44, which is in a moderate category. The same is the case with the indicators that students enjoy doing physics assignments, which is also in the moderate category. The third indicator is better, that is, students are not worried about the upcoming physics exam. It is in a high category. To increase the motivation to learn physics in the aspect of comfort, physics teachers should prioritize the comfort of the students themselves (Rachmah et al., 2019). Communication between teachers and students goes both ways (Sutiyatno, 2018). The teacher creates a learning model to comfort students. Besides that, doing assignments is not difficult for students and it strengthens students' abilities.

Based on the mapping using the SC-LMA, increasing student learning motivation is divided into several levels. At low levels, it can be increased by varying learning models, learning resources, and learning media. The second level, namely the average, motivation needs to be increased again by building more intense communication with students. In addition, it is necessary to increase the active role of students through the project learning model. For the highest level, it is carried out with enrichment

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to maintain the stability of motivation to study physics. The steps taken can be in the form of learning with more interesting learning resources and physics assignments that are not too burdensome.

CONCLUSION

Based on the discussion above, the SC-LMA is valid and reliable for use in measuring motivation to learn physics. Increasing students' motivation to learn physics is divided into three, where overall can be improved in their way. At low levels, it can be increased by varying learning models, learning resources, and learning media. At the second level, namely the average level, it needs to be increased again by building more intense communication with students. At the highest level, it can be in the form of physics teaching with more interesting learning resources and physics assignments. Furthermore, the measurement of motivation to learn physics can be used. The further step of this research can be the dissemination of instruments to measure learning motivation, and besides that, it can be used to measure physics identity in students through learning motivation assessment. Development needs to be done in terms of presenting the problems displayed in the items so that they can be used in measuring learning motivation in subjects other than physics.

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