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Rasch Model Analysis to Identify Students' Self-Efficacy and Learning Interest and Uncover Their Influence on Student Learning Outcomes in Static Fluids

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Abstract

This study explores the relationship between self-efficacy, students' interest, and physics learning outcomes for students in classes XI IPA 1 and XI IPA 2 at SMA Negeri 16 Bungo. The learning outcomes are focused on the dimensions of conceptual and factual knowledge. Data on students' self-efficacy and interest were collected through a structured scale questionnaire, while data on students' learning outcomes in conceptual and factual knowledge were obtained through test instruments. The results indicate a positive correlation between students' self-efficacy, interest in learning, and physics learning outcomes. The correlation coefficient (r value) obtained is greater than the critical r value, with significance less than 0.05. Regression analysis reveals that the calculated F value is greater than the critical F value, and the calculated t value is greater than the critical t value, both with significance less than 0.05. Regression analysis also shows that self-efficacy and students' interest in learning affect physics learning outcomes by 68%, leaving 32% influenced by other factors not investigated in this study. For teachers, this research provides practical insights into the importance of developing students' self-efficacy and interest in the context of physics learning. By considering these aspects, teachers can design more effective teaching strategies to support students' optimal development in physics learning. In the theoretical framework, these findings support the concept that internal factors such as self-efficacy and interest play a crucial role in achieving good learning outcomes.

Keywords: Interest; Learning outcomes; Self-efficacy

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INTRODUCTION

Education is vital for all individuals, as it allows humans to transform their behavior and knowledge for the better (Astalini et al., 2019; Charli et al., 2019; Maison et al., 2019; Maison et al., 2021). Quality

education is undeniably intertwined with educators, such as teachers. Graduates from educational institutions are expected to possess competence in three dimensions: attitude, knowledge, and skills. Physics is a mandatory high school subject requiring its graduates to exhibit proficiency in these three competencies (Irvani, 2018).

In physics learning, teachers are required to provide direct experiences to students. Physics learning demands students to be active in understanding concepts, cultivating thinking patterns, and shaping personalities, using evidence from observations and various perspectives to comprehend the roles of social and individual aspects in learning (Darmaji et al., 2018; Maison et al., 2019; Neizhela & Mosik, 2015).

In pursuing physics learning competencies, various obstacles are often encountered, including errors in understanding the concepts taught by teachers (Maison et al., 2020) and the lack of self-efficacy among students. Students may lack interest in subjects perceived as difficult, such as physics, which is considered challenging and is often avoided due to requiring seriousness, perseverance, and extensive practice (Wangchuk et al., 2022). This perception arises because physics learning is considered suitable only for those with special abilities in the field (Astalini et al., 2018; Hardiyanti et al., 2018; Pathoni & Susanti, 2017).

Self-efficacy is a factor influencing individuals in making decisions related to themselves. This belief affects how someone assesses the effort required for success, the time needed to overcome challenges, and their response to failure (Arcoverde et al., 2022; Hasbullah et al., 2020). Self-efficacy involves self-motivation, thinking processes, emotional states, and actions and can be influenced by environmental conditions, depending on what individuals seek and need ((Bai et al., 2022; Bandura, 1997). Students with high self-efficacy tend to set ambitious goals, design structured plans, and commit to achieving those goals (Kapucu, 2017; Rosen & Kelly, 2023). This also affects their ability to plan anticipatory steps in case of failure. Students with high self-efficacy will have strong confidence in their ability to understand and master physics concepts (Suprapto et al., 2017).

Today's interest in learning becomes significant as the need for continuous learning and skill development rapidly evolves (Luo et al., 2022; Tatiana et al., 2022). However, students' interest in most school subjects declines significantly when they enter adolescence. As a result, interest gradually becomes less dominant as an essential factor in supporting the learning process (Schweder & Raufelder, 2021). Interest is a combination of desire and willingness that develops if there is motivation (Kwarikunda et al., 2020; Wicaksana et al., 2020). Interest can be seen in the learning process, including attention, pleasure, interest, and involvement (Ghadiri et al., 2018). In educational research, interest can be divided into two main categories: situational and individual, involving emotions such as enthusiasm, awareness, focus, and concentration (Hong et al., 2019; Walan & Gericke, 2021).

Students interested in physics are likely to have greater willingness and desire to learn this subject than less interested students (Vongkulluksn et al., 2018). However, in the preliminary research conducted in Class XI IPA at Senior High School 16 Bungo, it is evident that during the learning process, students often complain. Most students only receive material the teacher presents and lack enthusiasm in seeking knowledge independently. Student responses are still considered low based on observations. The learning process also occurs unidirectionally because the physics teacher teaches in the classroom.

The Rasch Model is an analytical tool to assess instruments more accurately,

providing insights into reliability, item analysis, respondent reliability, dimensionality, and item bias detection (Lestari et al., 2022; Maulana et al., 2023). This model is widely employed in assessing assessment instruments, offering detailed information about the test's quality (Alfarisa & Purnama, 2019; Falani et al., 2022). Leveraging its advantages, the Rasch model is employed in this study to evaluate the validity and reliability of the developed instrument, aiding in the generation of more accurate measurements.

Based on interviews with Class XI physics teachers at Senior High School 16 Bungo, the number of MIPA (Science) classes studying physics was found to be two. Class XI MIPA 1 consists of 30 students with an average physics test score of 72, and Class XI MIPA 2 consists of 30 students with an average test score of 70. These scores have not reached the Minimum Completion Criteria (KKM), which is 72. This results in students having remedial sessions after the exam for every physics lesson. Several factors influence low physics learning outcomes, including low self-efficacy and interest among students in studying physics. Indications of students' low self-efficacy are evident when students work on physics problems; they tend to ask their peers to confirm the answers provided. Teachers also state that students' interest in studying physics is low because, during learning, students talk to their friends, leading to a lack of focus on the teacher's explanations. Additionally, physics is a difficult subject for students, causing them to be less interested in studying it, as evidenced by the lack of enthusiasm and inactivity when learning physics.

The results in the classroom learning process can be influenced by students' self-efficacy and interest in learning. When students have high levels of self-efficacy and interest in learning, they are more likely to achieve better results in classroom learning. This finding is consistent with previous research that investigated the relationship between self-efficacy and students' learning interests, such as the studies conducted by Dou, Brewe, Potvin, Zwolak, & Hazari (2018), Irvani (2018) and Monika & Adman (2017). However, previous research has not specifically investigated the relationship between self-efficacy and the learning interest of high school students regarding learning outcomes in static fluids. Therefore, the researcher is interested in conducting a quantitative descriptive study that uses students' self-efficacy and learning interest as independent variables and learning outcomes as the dependent variable.

METHOD

The method used in this research is descriptive with a quantitative approach. This approach ensures that the data obtained is accurate and reliable because the analysis is conducted through testing specific theories or hypotheses. This research also employs a descriptive method with a correlational research design. Correlational research provides an opportunity to predict specific scores due to other scores and explains the relationship between the variables used (Creswell, 2016).

The sampling technique in this research employs total sampling because the population size is equal to the sample size. The research subjects are 60 students from classes XI IPA1 and XI IPA2 at SMA 16 Bungo who studied static fluids. This study utilizes the Rasch model to describe the data on students' self-efficacy, learning interests, and learning outcomes. Meanwhile, hypothesis analysis involves testing the influence of variable X on Y using correlation analysis and multiple regression with the assistance of SPSS software. The correlation test examines the significance value and Pearson coefficient, where a value below 0.05 indicates a significant relationship between self-efficacy and students' learning interest in learning

outcomes. The Pearson Correlation value aims to show the magnitude and direction of the relationship between the two variables.

The regression test involved the ANOVA table, model summary, and coefficient table. The ANOVA table and model summary were used to observe the simultaneous influence of independent variables on the dependent variable. Meanwhile, the coefficient table was used to examine the partial influence of independent variables on the dependent variable.

The independent variables include self-efficacy and learning interest, while the dependent variable is the learning outcome. The students' self-efficacy variable is adapted from previous research (Maison, Syahrial, et al., 2019; Pintrich & A, 1991), consisting of 20 questions tested for validity and reliability. The validity value is 0.7, and the reliability value is 0.872. The following are the indicators for the questions can be seen in Table 1.

Table 1 Self-efficacy indicators

Indicator	Sub Indicator	Total
Component of Expectations	Learning Control Belief Control Self-Efficacy for Learning and Performance	10
Resource Management Strategies	Time and Learning Environment Effort Regulation	6
Cognitive and Metacognitive Strategies	Metacognitive Self-Regulation	4

(Source : Maison, Syahrial, et al., 2019; Pintrich & A, 1991)

Variable interest is measured through a non-test instrument in a questionnaire adopted from the research written by Gulo & Sulandari (2016) consisting of 25 questions. The indicators for the questions are as follows in Table 2.

Table 2 Interest indicators

Interest Aspect	Indicator	Number of Items
	Interest in science	3
Liking	Interest in the teacher	3
	Success in the subject	3
Satisfaction	Finding benefits in the learning process	3
Involvement	Taking the initiative to learn	4
	Concentration in learning	2
Attention	Willingness to learn	3
Motivation/Drive	Having goals to achieve	4

(Gulo & Sulandari, 2016)

The variable of student learning outcomes is measured using a test instrument consisting of 25 multiple-choice questions about static fluids adopted from the research conducted by Anjani (2017). The indicators for the questions are as follows in Table 3.

Table 3 Learning outcomes indicators

Indicator	Total
Distinguishing the properties of fluids	2 (C1)
Constructing the relationship between force, pressure, and the area subjected to force	2 (C2)
Explaining the concept of hydrostatic pressure	3 (C1; C2)

Indicator	Total
Formulating the equations for hydrostatic pressure and atmospheric pressure on fluids	5 (C3; C4)
Explaining the concepts of Pascal's law and Archimedes' principle	3 (C1; C2)
Formulating the equation for Pascal's law	4 (C3; C4)
Formulating the equation for Archimedes' principle	5 (C3; C4)
Stating the conditions for buoyancy, floating, and sinking	3 (C1; C2)
Listing various examples of the application of Pascal's and Archimedes' laws in everyday life	3 (C1; C2)
Explaining the concepts of surface tension, capillarity, and viscosity	3 (C1; C2)
Formulating surface tension of liquid, capillarity, and viscous fluid friction equations	4 (C3; C4)
Understanding the occurrences of surface tension, capillarity, and viscosity in everyday life	3 (C1; C2)

(Anjani, 2017)

RESULT AND DISCUSSION

The descriptive data is analyzed using the Rasch model with the assistance of the Mini Step application. The descriptive data analyzed includes students' self-efficacy, learning interest, and learning outcomes. The results of the descriptive analysis of the students' self-efficacy questionnaire can be seen in Table 4.

Table 4 Descriptive statistics of self-efficacy

Entry Number	Total Score	Total Count	Measure	Model S.E.
11	0	60	3.39	1.85
12	1	60	2.16	1.03
2	2	60	1.42	0.74
13	2	60	1.42	0.74
16	2	60	1.42	0.74
14	3	60	0.96	0.62
15	3	60	0.96	0.62
1	4	60	0.63	0.55
3	4	60	0.63	0.55
10	4	60	0.63	0.55
8	7	60	-0.08	0.44
9	7	60	-0.08	0.44
17	12	60	-0.88	0.37
7	13	60	-1.01	0.36
19	13	60	-1.01	0.36
20	13	60	-1.01	0.36
18	15	60	-1.27	0.35
5	16	60	-1.39	0.35
6	16	60	-1.39	0.35
4	22	60	-2.11	0.34
Mean	7.9	60	0.17	0.59

Based on Table 4, it is evident that item 11 has become the item with the least agreement among students, as none of the 60 students chose "strongly agree" for this item. Meanwhile, item 4 has become the item with the highest agreement among students, with 22 out of 60 students choosing "strongly agree" for this item. The mean value of the measure is 0.17, indicating that items 8 and 9 are close to this mean value.

The results of the descriptive analysis of the students' learning interest questionnaire can be seen in Table 5.

Table 5 Descriptive statistics results of students' learning interest

Entry Number	Total Score	Total Count	Measure	Model S.E.
6	15	60	0.62	0.36
23	15	60	0.62	0.36
12	18	60	0.25	0.35
19	18	60	0.25	0.35
17	19	60	0.13	0.34
20	19	60	0.13	0.34
1	20	60	0.01	0.34
2	20	60	0.01	0.34
3	20	60	0.01	0.34
7	20	60	0.01	0.34
11	20	60	0.01	0.34
13	20	60	0.01	0.34
16	20	60	0.01	0.34
22	20	60	0.01	0.34
5	21	60	-0.10	0.34
8	21	60	-0.10	0.34
9	21	60	-0.10	0.34
14	21	60	-0.10	0.34
4	22	60	-0.21	0.34
10	22	60	-0.21	0.34
15	22	60	-0.21	0.34
18	22	60	-0.21	0.34
21	22	60	-0.21	0.34
25	22	60	-0.21	0.34
24	24	60	-0.43	0.34
Mean	20.2	60	0.00	0.33

Table 5 shows that Item 6 becomes the least agreed-upon interest statement by students because out of 60 students, only 15 chose "strongly agree" for that item. Meanwhile, Item 24 becomes the item with the most agreed-upon interest statement, as out of 60 students, 24 chose "strongly agree" for that item. The mean value of the measure is 0.00, indicating that Item 1, Item 2, Item 3, Item 7, Item 11, Item 13, Item 16, and Item 22 approach this mean value.

The results of the descriptive analysis of student learning outcomes can be seen in Table 6. The findings indicate that Item 9 is the most challenging for students, as only 39 out of 60 answered it correctly. Meanwhile, Items 18 and 20 are the easiest for students, as all 60 answered them correctly. The mean value of the measure is -0.63, suggesting that Items 7, 13, and 22 are close to this mean value. For more details, please refer to the Table 6.

Table 6 Descriptive statistical results of student learning outcomes

Entry Number	Total Score	Total Count	Measure	Model S.E.
9	39	60	1.22	0.32
17	39	60	1.22	0.32
24	39	60	1.22	0.32
11	40	60	1.12	0.32
19	40	60	1.12	0.32
3	42	60	0.92	0.32
5	42	60	0.92	0.32

Entry Number	Total Score	Total Count	Measure	Model S.E.
1	43	60	0.81	0.33
7	44	60	0.70	0.33
13	44	60	0.70	0.33
22	44	60	0.70	0.33
15	46	60	0.47	0.34
10	54	60	-0.72	0.46
25	54	60	-0.72	0.46
12	55	60	-0.95	0.49
4	56	60	-1.21	0.54
8	56	60	-1.21	0.54
23	56	60	-1.21	0.54
6	57	60	-1.55	0.61
21	57	60	-1.55	0.61
2	58	60	-1.99	0.74
14	60	60	-3.96	1.83
16	60	60	-3.96	1.83
18	60	60	-3.96	1.83
20	60	60	-3.96	1.83
Mean	49.8	60	-0.63	0.65

Correlation analysis is conducted to examine whether there is a relationship between self-efficacy variables and students' learning interest with students' learning outcomes. The correlation results are presented in Table 7.

Table 7 Correlation results of variables

		Self-efficacy	Learning Interest	Learning Outcomes
Self-Efficacy	Pearson Correlation	1	0.590**	Self-Efficacy
	Sig. (2-tailed)		0.000	
Learning Interest	Pearson Correlation	0.590**	1	Learning Interest
	Sig. (2-tailed)	0.000		
Learning Outcomes	Pearson Correlation	0.545**	0.454**	Learning Outcomes
	Sig. (2-tailed)	0.000	0.000	

Based on Table 7, the significance value between variables is 0.000, less than 0.05, indicating a significant correlation. The calculated Pearson correlation values (r) of 0.545 and 0.454 are greater than the tabled r value of 0.2542. Additionally, two asterisks (**) indicate a correlation at a significance level of 5% (0.05), signifying a moderate correlation.

Next, a regression analysis is conducted to examine the influence of the dependent variable on the independent variable. The regression analysis using ANOVA can be observed in Table 8.

Table 8 Regression analysis results in ANOVA

Variable (X)	Variable (Y)	F Value	Sig.
Self-Efficacy and Interest	Learning Outcomes	105.191	0.000

The ANOVA table is used to determine whether there is an influence between the dependent and independent variables. Based on Table 9, the significance values for each variable are 0.000, which is less than 0.05, and the calculated F value is greater than the tabled F value (105.191 > 2.38). Therefore, it can be

concluded that each dependent variable significantly influences the independent variable. Next, for the summary of the model results, you can see Table 9.

Table 9 Regression test results in model summary

Variable (X)	Variable (Y)	R	*R Square*
Self-Efficacy and Interest	Learning Outcomes	0.82	0.68

Table 9 shows that for X1 and X2 variables against Y, the R Square value is 0.68 or 68%, meaning that 32% is influenced by other factors not examined in this study. Furthermore, for the coefficient table, refer to Table 10.

Table 10 Regression test coefficients

Variable (X)	Variable (Y)	Variable	Regression Coefficient	t-value	Sig.
Self-Efficacy and Interest	Learning Outcomes	Constant	0.50		
		X1	0.21	3.28	0.001
		X2	0.73	13.50	0.000

Based on Table 10, the significance value is less than 0.05. The t-value is greater than the t-table (2.002), indicating an influence between the X1 variable and Y, as well as the X2 variable and Y. Interest and self-efficacy are internal factors influencing the learning process (Ismayanti et al., 2022; Widyastuti & Nurharini, 2023). Interest is an attraction to an object without external influence (Muthmainnah & Lestari, 2021; Siagian, 2015). Learning interest is crucial in creating the effectiveness of learning activities, transforming students' attitudes from indifferent to enthusiastic (Ismayanti et al., 2022).

Interest plays a significant role in motivating individuals to face learning challenges, encouraging them to focus, enjoy, and overcome difficulties (Widyastuti et al., 2019). On the other hand, self-efficacy, as another internal factor, also significantly impacts the learning process. Self-efficacy reflects an individual's belief in their ability to complete tasks or achieve certain results (Raoofi et al., 2012). Students with high self-efficacy tend to be enthusiastic and motivated and make a strong effort to complete learning tasks the teacher assigns.

Viewing interest as a form of emotion provides an additional perspective on understanding how interest can affect engagement in learning tasks and how it is related to the level of self-efficacy (Niemivirta & Tapola, 2007; Wiradarma et al., 2021). Combining high student learning interest and good self-efficacy supports optimal learning outcomes (Dewantoro et al., 2020). Therefore, understanding and developing these two factors are key to improving the quality of learning and student achievement.

Self-efficacy refers to an individual's belief in their ability to complete a task (Calafato, 2023; Kusumawati et al., 2021). In Indonesia, many educators are unaware that self-efficacy, as one aspect of psychology, can affect student achievement. High levels of self-efficacy in students tend to increase learning interest, encouraging them to be diligent and achieve good results in the learning process (Bandura, 1997; Sandi, 2017; Shamdas, 2023).

Interest also plays a crucial role in students' lives, significantly influencing their attitudes and behaviors. Students who are interested in a learning activity will be more dedicated, while those who are not interested may become less

motivated (Charli et al., 2019). This statement aligns with the findings of Guo et al. (2020), asserting that students' learning interests and self-efficacy directly impact their learning outcomes. Therefore, understanding and paying attention to self-efficacy and learning interests are important in the educational context. Encouraging the development of self-efficacy and stimulating learning interest can be an effective strategy to improve the quality of learning and overall student achievement.

CONCLUSION

Based on the research data conducted in Class XI IPA 1 and Class XI IPA 2 at Senior High School 16 Bungo, it can be concluded that the study was carried out to assess the correlation between self-efficacy and learning interest with students' learning outcomes. Based on the results, a positive and significant relationship exists between students' self-efficacy and interest in physics lessons and the learning outcomes obtained in the domains of factual and conceptual knowledge for specific questions. This is evident from the correlation values, where the calculated correlation (r) is greater than the tabled correlation, indicating a significant influence of self-efficacy and learning interest on physics learning outcomes. The calculated F-value is greater than the tabled F-value, and the calculated t-value is greater than the tabled t-value, with an influence of 68%. The author hopes that this research can assist teachers in identifying students' self-efficacy and learning interest to achieve learning competencies. For future research, the researcher recommends using a larger sample size for generalizability.

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