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The Impact of Students Assessing the Level of Difficulty Test Item on Interest and Motivation in Learning Mathematics

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ABSTRACT

According to Item Response Theory, the difficulty level is a characteristic of the test item. The difficulty level of the test items is a characteristic of the test items that are on a scale with the ability level parameter. However, this relationship has not been studied optimally, especially in students' interest and motivation in learning mathematics. This study examines the impact of student involvement in assessing the level of the difficulty test item on interest and motivation in learning mathematics with the approach of assessment as learning. The study involved 176 students from grade VII in SMP and MTs. High-level reasoning test items were adapted from TIMSS test items, while the interest and motivation instruments used a questionnaire. Data analysis used percentages and paired t test. The results showed the difference between before and after estimating the difficulty level test items to students' interest and motivation in learning mathematics. The interest and motivation of students in learning mathematics increased after estimating the level of difficulty of the test items. Therefore, to increase students' interest and motivation in learning mathematics, teachers can involve students in assessing the level of difficulty of the test items using the approach of assessment as learning.

KEYWORDS

assessing; level of difficulty test item; assessment as learning; interest to learn mathematics; motivation to learn mathematics.

INTRODUCTION

The community increasingly feels the decentralization of education, especially among teachers and students. Regulations for implementing education are autonomous from the regions down to the school and even grade levels. Curriculum 2013 rev indicates that teachers have more roles in managing the classroom learning system, including teachers' involvement in assessing students. Assessment of learning processes and outcomes in the Industrial Revolution (RI) 4.0 era is directed at test items with High-Level Reasoning (HLR) character (Altbach et al., 2009, Wibowo & Munadi, 2020). This era prioritizes Assessment as Learning (AaL), where students and teachers collaborate meaningfully before, during, and after learning (Black & William, 2009, Pee et al., 2002, Nortvedt, 2014). The AaL can stimulate student learning, while Assessment of Learning (AoL) is starting to be limited in the classroom (William, 2011, Schellekens et al., 2021). AaL involves students to increase students' interest and motivation to learn (Tempelaar et al., 2018, Alkharusi, 2008), while AoL considers students as learning objects.

Assessment directs learning in the classroom (Mahshanian et al., 2019, Herman et al., 2015). That is, the assessment results improve the process and subsequent learning outcomes. Assessment is an integral part of the learning process in the classroom (Melland & Volden, 1998, Black et al., 2015). Furthermore, the RI 4.0 era assessment places students as learning agents to participate as assessment designers, including the characteristics of the test items. One student activity is estimating the Difficulty Level of the Test Item (DLTI). DLTI assessment can use the opinions of teachers and students because teachers know more about students' abilities, and students know more about their abilities in doing a test (Rukli et al., 2021). It is in line with the results of research studies using consensus theory by involving experts where the results of the characteristics of the test items are not different from the results of computer program analysis(Kozierkiewicz-Hetmańska & Poniatowski, 2014). Direct involvement of teachers and students in the assessment process in the classroom so that students are more critical, innovative, and creative according to the character of HLR test items (Jensen et al., 2014).

Previous studies have shown that the determination of DLTI has never been considered, carried out, or used by teachers to present test items to students because teachers have limitations, especially in assessment and computer skills. On the other hand, DLTI is always discussed and complained about by many parties, including students and even parents, when receiving report cards or homeroom meetings when their grades are not good (Rukli, 2011). If this fact continues, it can reduce students' perceptions of mathematics so that motivation and interest in learning are less functional in educating the nation's children. The results showed that students' self-confidence directly affected students' interest in learning mathematics, and there was a direct relationship between self-confidence and motivation (Otoo et al., 2018). Studies show that high and low self-esteem students differ very little in their interactions with teachers (Hart, 2020). Likewise, learning achievement contributes 10% (Kunhertanti & Santosa, 2018).

Indonesian students have problems with mathematics learning achievement at the international level (Stacey, 2011). Therefore, teachers making test items similar to PISA from a natural context can increase students' interest in mathematics (Zulkardi & Kohar, 2018). The study was conducted without intervention. The quality of the test items is directly manifested in the DLTI, both in terms of the Classical Test Theory (CTT) approach (Vispoel et al., 2018, Taylor et al., 1980) as well as the Item Response Theory (IRT) approach (Luo & Jiao, 2018, Hambleton, 1989, Reise et al., 2005, Kinkner & Mckillip, 1993). Therefore, how big is the impact of student involvement in determining HLR DLTI with the AaL approach on students' interest and motivation in learning mathematics?

RESEARCH METHODS

The study used a quantitative approach to examine the impact of student involvement in determining HLR DLTI on interest and motivation in learning mathematics. The number of students involved was 176 people from several Junior High Schools (SMP) and Madrasah Tsanawiah (MTs). The selection of SMP and MTs as well as students was made randomly. Three instruments are used: the HLR test, interest, and motivation questionnaire with a four-choice Likert scale, namely one strongly disagree, two disagree, three is agreed, and four strongly agree for a positive statement. On the other hand, for negative statements, use the reverse method.

AaL involves students and teachers in one group. The teacher and students discuss HLR test items, including notes about the test items when they are done for three minutes. Teachers can ask students, and students can ask teachers. Relationships are reciprocal.

Teachers and students position themselves as learners in working on test items. There is take and give information about test items. After the exam is done and the key is decided, have another dialogue to determine the DLTI for one minute. Using a semantic differential scale with a [0.7], students and teachers, through group agreement, determine the HLR DLTI. It is done until all test items are responded to, and DLTI is determined.

HLR test items were adapted from TIMSS (Trend International Mathematics Science Study). Adaptation is made on the components of language, material and context. The number of HLR test items is 40 test items with a processing time of 120 minutes. The interest questionnaire uses indicators of feelings of pleasure, interest, attention to learning, participation in learning, desire and awareness of learning mathematics. The motivation questionnaire uses indicators of perseverance in learning, activeness in the learning process, enthusiasm for learning, and attendance in the learning process. Three experts have validated these instruments in the material, language, and psychometric fields. The validation results of the three validators indicate that the two questionnaires are suitable for use in the study.

The stages of filling out the questionnaire are as follows. First, a questionnaire of interest and motivation before students estimate the HLR DLTI. The margin value determines the responses to the questionnaire for each statement and student. Second, the interest and motivation questionnaire was administered six months after estimating the HLR DLTI. The result of the response is determined by the margin of each statement and student. Each test item percentage determines the percentage change in the level for each information. Meanwhile, the difference between before and after becomes a reference for measuring the impact of student involvement. Student margin is used for inferential test data, namely paired t-test.

The students responded to the questionnaire before and after the HLR DLTI assessment. InPre and MoPre before estimating HLR DLTI, while InPost and MoPost are carried out six months after estimating HLR DLTI. Data analysis was used descriptively in the form of percentages. In contrast, the inferential used paired t-test with a significance level of 0.05.

RESULTS AND DISCUSSION

Description of Students' Interest in Learning Mathematics

The following statements are changes in students' interest in mathematics before and after estimating. First, I always show up on time for math class. The results show a change in attendance from strongly disagree to agree strongly. Expressly, strongly agree increased by 65%. Second, I was afraid of being late for school during math class. The results show a change in absence from strongly disagree to agree strongly, expressly strongly agree that it increases by 53%. Third, I always listen to math lessons well. The results show that there is a change in listening to the lessons from the teacher from strongly disagree to strongly agree, expressly strongly agree, an increase of 66%. Although the proportion movement in all options experienced a reduction, both strongly disagree and agree. That means that there is an increase of 66%. Not all of the choices strongly disagree, but there are other options.

Fourth, I am pleased when the math teacher enters the classroom. The results show a change in enjoyment when the teacher enters the class from strongly disagree to agree strongly. Expressly, strongly agree increased by 49%. This percentage is more than disagree with 21%, strongly disagree with 10%, and agree with 8%. Fifth, Math class makes me bored. The results show a change in the boredom of learning mathematics from strongly disagree to agree strongly. Expressly, strongly agree increased by 20% but

strongly disagreed there was no change, while those who changed only disagreed with 19% who agreed with 1%. Sixth, I am very passionate about learning mathematics. The results show a change in the enthusiasm for learning mathematics from strongly disagree to agree strongly. Expressly, strongly agree increased by 48%. The percentage is more than disagree by 28% then strongly disagree 12% then agree 8%. Seventh, Mathematics contains much information but is difficult to understand. The results show a change in the difficulty of understanding mathematics from information from strongly disagrees to agreeing strongly. Expressly, strongly agree increased by 44%, although the proportion movement in all options experienced a decrease in strongly disagree 7%, disagree 20% and agree 6%. Eighth, I feel I have benefited a lot from math lessons. The results show a change in the usefulness of mathematics from strongly disagrees to agreeing strongly.

Expressly, strongly agree increased by 57%, although the proportion movement in all options experienced a decrease in strongly disagree 5%, disagree 31% and agree 22%. Ninth, I feel I benefited greatly from math lessons increased by 57%. The percentage increase came from 31% disagree, 21% agree, and 5% strongly disagree. It shows that by knowing the benefits of mathematics, students can increase their interest if they are directly involved in activities in estimating HLR DLTI with the AaL approach. Finally, the average increase in student interest after estimating the HLR DLTI was 46%.

Based on the statement excerpt, the statement that experienced the greatest increase in interest was 63%: I always listen to math lessons well, while the lowest change, namely math, makes me bored, which is only 20%. This fact shows that there needs to be an in-depth study of students bored with learning mathematics, for example, a qualitative approach.

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Description of Students' Motivation to Learn Mathematics

In the following statements, the percentage of students' motivation towards learning mathematics changes before and after estimating the HLR DLTI with the AaL approach. First, I actively participate in math lessons according to the schedule. There was an increase in active participation in mathematics lessons, with 67% in the strongly agree option. However, most of these percentages come from the choice of agreeing 50%, disagreeing 14% and disagreeing only 3%. Changes in the activity of students who strongly disagreed were small. The most increased in students agreed to agree strongly.

Second, I play handphone during math class. Strongly disagree experienced an increase of 13% but strongly agree 15%, while disagreeing experienced the highest increase of 23% and agreeing experienced a reduction of 4%. Studies show that students agree to use cell phones when learning mathematics more dominantly even though students have followed the HLR DLTI assessment.

Third, I ignore the teacher in math class. The highest percentage increase in the choice of strongly agree is 15%, offset by the option of strongly disagree at 13%. However, the percentage of disagreeing experienced a reduction of 27%, while agreeing experienced a decline is 1%. The relationship between paying attention to the three teachers teaching mathematics has a greater increase in the choices from disagreeing to strongly agreeing.

Fourth, I can not teach myself mathematics before the teacher explains it. The percentage of choosing the choice strongly agrees at 38%, but the option strongly disagrees does not change, namely 0%. The most percentage change in the selection of disagreeing was 20% while agreeing was 18%. Students in the disagree option maintained the same motivation before and after students were involved in estimating the HLR DLTI. Students strongly disagree that they still need a description of the mathematics material from the new teacher to learn mathematics.

Fifth, math is much harder to understand than I imagined. The percentage of choosing the strongly agree option increased by 32%. The increase came from agreeing was reduced by 14%, disagreeing was reduced by 11%, while strongly disagreeing was reduced by 6%. That is, students choose strongly disagree less while most agree. There shows that mathematics is more difficult to understand than I imagined. It comes from students who do not understand mathematics and think it is complicated.

Sixth, Mathematics learning is very abstract, so it is difficult for me. The percentage of choosing very much agree is 27%. The portion comes from the choices, most of which come from disagreeing 15%, strongly disagreeing 7% and the remaining 5% agreeing on choices. Students in the disagree option have experienced many changes in motivation that mathematics is complicated even though it is abstract after students assess HLR DLTI with the AaL approach.

Seventh, I try to get the highest score in math. The percentage of choosing the choice very much agrees is 59% but the option strongly disagrees only changes 11% to strongly agree while the most changes in the selection of agreeing are 31% to agree the remaining 16% of the options disagree strongly. Students trying to get the highest score on mathematics subjects changed the most on the consent to option, namely one level up to the level of strongly agree after the students assessed the HLR DLTI. Based on the description, the average increase in student motivation after estimating the HLR DLTI by 42% from 176 students involved. On average, 76 students increased their motivation though it varied from everything asked of students.

Impact on Interest in Learning Mathematics

The normality test and the homogeneity test of the interest data showed normal and homogeneous at a significance level of 0.05 in Tables 1 and 2.

Table 1 shows the value of the interest data before the HLR DLTI assessment (InPre) with sig 0.109, which is greater than 0.05 so that the data is normally distributed so that it can be continued with parametric tests. The same is true for interest data after the HLR DLTI assessment (InPost) with a sig of 0.265 greater than 0.05 so that the data is normally distributed so that it can be continued with a parametric test using the mean.

Table 1. Normality Distribution of Interest Data

Tests of Normality						
	Kolmogorov-Smirnova			Shapiro-Wilk		
	Statistics	Df	Sig.	Statistics	df	Sig.
InPre	0.062	176	0.099	0.052	176	0.109
InPost	0.053	176	0.205	0.043	176	0.265

Table 2 shows that the variance of interest data before and after the HLR DLTI assessment with a sig value of 0.426 is greater than 0.05, so the two data are feasible to be compared.

Table 2. Homogeneity of Interest Data Variance

Test of Homogeneity of Variances					
		Levene Statistics	df1	df2	Sig.
Interest	Based on Mean	0.634	1	350	0.426
	Based on Median	0.718	1	350	0.397
	Based on Median and with adjusted df	0.718	1	341.532	0.397
	Based on trimmed mean	0.661	1	350	0.417

Table 3 shows that the value of sig (2-tailed) 0.00 is smaller than 0.05, so there is a difference between the two students' interests. The average interest before is smaller than the average interest after the HLR DLTI assessment. It is concluded that there is a difference in student interest after estimating the HLR DLTI with the AaL approach, which is significantly higher than the student interest before estimating the HLR DLTI at a significance level of 0.05.

Table 3. Paired t-test of Interest Data

							T	df	Sig. (2-tailed)
		Mean	Std Dev.	Std. Error Mean	Lower	Upper			
Pair	InPost – InPre	16.580	9.665	0.729	18.017	15.142	22.758	175	0.000

Impact on Interest in Learning Mathematics

The motivational data before and after the students were involved in estimating the HLR DLTI towards mathematics had the characteristics descriptively in Table 3. The normality test and the homogeneity test of interest data showed normal and homogeneous at a significance level of 0.05.

Table 4. Normality Distrubution of Motivation Data

Tests of Normality						
	Kolmogorov-Smirnova			Shapiro-Wilk		
	Statistics	Df	Sig.	Statistics	df	Sig.
MoPre	0.021	176	0.650	0.011	176	0.750
MoPost	0.052	176	0.224	0.032	176	0.294

Table 4 shows that the value of the motivation data before the HLR DLTI assessment (MoPre) with a sig of 0.750 is greater than 0.05, so the data is normally distributed. The motivation data after the HLR DLTI assessment (MoPost) with a sig of 0.294 is greater than 0.05, so the data is normally distributed. Therefore, the two data groups can be continued with a parametric test using the mean.

Table 5. Homogeneity of Motivation Data

		Levene Statistics	df1	df2	Sig.
Motivation	Based on Mean	5.263	1	350	0.222
	Based on Median	5,712	1	350	0.117
	Based on Median and with adjusted df	5,712	1	347,299	0.117
	Based on trimmed mean	5.596	1	350	0.119

Table 5 shows that the variance of motivational data before and after the HLR DLTI assessment with a sig value of 0.222 is greater than 0.05, so the two data are feasible to be compared.

Table 6 shows that the value of sig (2-tailed) 0.00 is smaller than 0.05, so there is a difference between the two students' motivations. The average motivation before is smaller than the average motivation after the HLR DLTI assessment. It is concluded that there is a difference in students' motivation after estimating the HLR DLTI with the AaL

approach, which is significantly higher than the students' motivation to learn mathematics before estimating the HLR DLTI at a significance level of 0.05.

Table 6. Paired t-test of Motivation Data

							T	df	Sig. (2-tailed)
		Mean	Std Dev.	Std. Error Mean	Lower	Upper			
Pair	MoPost – MoPre	15.261	11.102	0.837	16.913	13.610	18.237	175	0.000

Discussion

Interest is a feeling of pleasure, attention to learning, participation in learning, and the desire and awareness of learning mathematics from students in an activity. Interests can change from one time to another, from place to place (Pauker et al., 2022, Nye et al., 2021, Roberson, 2020). The relationship between students' motivation to learn mathematics and students' interest in mathematics has been studied several times (Doño & Mangila, 2021, Roche et al., 2021). Likewise, the study of procedures and methods so that students' interest in learning mathematics increases (Thai et al., 2014, Samaray, 2021, Zhang, 2022).

The study results showed a very significant increase in interest and motivation in learning mathematics before and after estimating HLR DLTI with the AaL approach. Interest and motivation of students to learn mathematics increased by about 50%. One of the students' interests in mathematics is demonstrated by students who are always present on time during math lessons. Students often experience sleep anxiety when there are things they are not interested in doing. On the other hand, students are often late for class if they are not interested in doing other things. The involvement of students in estimating the HLR DLTI increases attendance on time to learn mathematics by 65%. Another study showed the effect of peer-to-peer mathematics learning on improving math performance. However, it was entirely mediated by students' interest in mathematics (Arthur et al., 2022).

Students are afraid to be late for school during math class. Fear can occur because students feel at a loss if they do not learn mathematics as a necessity. On the other hand, students can be afraid of learning mathematics which develops as a fear of making mistakes. However, students have high anxiety about mathematics (Escarez Jr. & Ching, 2022). The study showed that involving students in estimating HLR DLTI with the AaL approach could reduce the fear of being late in learning mathematics by 53%.

Students always listen to math lessons well. The significant increase after students estimates the HLR DLTI with the AaL approach. Students interested in mathematics can be seen by listening to material reviews from teachers or other sources of information, both offline and online. There is a strong correlation between learning math content by listening and interacting (Wilburne & Naples, 2008). Students can write, read, hear, or speak, where students learn about the world around them to learn mathematics.

Students are pleased when the math teacher enters the classroom. Many students, especially those with low math skills, are unhappy when the teacher enters the classroom. Some are even happy when the teacher doesn't come to class. With the involvement of students in assessing the HLR DLTI with the AaL approach, the students' enjoyment increased from very displeased, unhappy and happy to be very happy when the teacher entered the classroom. Students are not very unhappy or not happy is math anxiety. It shows that mathematics anxiety is a psychological factor that affects student achievement and general practice (Mutodi & Ngirande, 2014).

Math lessons make students bored. Boredom can be an obstacle in learning, including learning mathematics. Teachers need to provide varied stimuli in presenting mathematical

material so that the level of boredom does not quickly fall on students. The relationship between the level of boredom and displeasure is that the more unhappy you are, the faster you will get bored. Therefore, mathematics teachers should seek to understand mathematics disenchantment and apply teaching and learning strategies and study habits to help them overcome anxiety (Mutodi & Ngirande, 2014).

Mathematics is complicated to understand from what students imagine. This understanding can be an obstacle for students in learning mathematics. This information can come from the school environment, for example, the teacher's perception that mathematics is complicated (Oguz et al., 2016). Teachers' belief that math success depends on innate ability may be an essential barrier to creating a classroom atmosphere that encourages engagement and learning for all students (Heyder et al., 2020). The study shows that students' understanding of mathematics as a complex subject can be reduced by 32% after students participate in assessing the HLR DLTI using the AaL approach.

Students ignore the teacher when learning mathematics. Such behaviour can occur because students have difficulty understanding mathematics. There is a perception that hearing the language used in mathematics is like hearing a foreign language. This perception can be essential for mathematics teachers in understanding how students experience learning difficulties (Kotsopoulos, 2020). The involvement of students in estimating the HLR DLTI with the AaL approach can reduce the behaviour of these difficulties.

Students cannot learn mathematics on their own before the teacher explains. This shallow ability becomes the mainstream of students who cannot compete at the international level. Lack of mathematical knowledge, so the increase in Indonesian students in the PISA mathematics survey is low (Zulkardi & Kohar, 2018). Students' involvement in estimating the HLR DLTI with the AaL approach can reduce students' dependence on learning mathematics from the teacher.

Learning mathematics is so abstract that it is difficult for me. Mathematics is abstract and can have implications for the way students learn mathematics. If not precise, it can cause abstract math anxiety. The existence of an anxiety component of numerical or computational arithmetic supports the presence of anxiety specific to more abstract mathematics (Hunt et al., 2019).

Mathematics contains much information but is difficult to understand. Likewise, students feel they benefit from mathematics lessons to increase their interest in mathematics. Information on the use of mathematics is meaningful information for students. If it can be appropriately applied, it will increase student interest. Students' knowledge of mathematics's usefulness indirectly increases students' interest in mathematics (Otoo et al., 2018). Students know the benefits of mathematics can increase interest if they are involved in activities directly in estimating HLR DLTI.

Furthermore, the relationship between motivation and interest shows that students' interest in learning mathematics mediates the relationship between motivation to learn mathematics and performance in mathematics; and between the quality of mathematics teaching and mathematics (Arthur et al., 2022).

Students actively participate in math lessons according to schedule to increase motivation. The activeness of students learning mathematics can be grown from the learning method by eliminating conventional methods or lectures (Freeman et al., 2014). There is another way to involve students in the learning process. Namely, students apply themselves in determining the HLR DLTI with the AaL approach.

Students play on cell phones during math class hours. Cell phones are a communication tool in schools. Cell phones can be an obstacle and an opportunity to find additional

information for learning, not just playing. Students now widely use cell phones to find information following the RI era. Overall positive perception of students towards using mobile phones as a learning tool and integrating mobile phones into learning activities (Ahmad, 2020). Some students use cell phones while studying but still use them for refreshing after studying. Students' attitudes regarding using cell phones for off-duty activities in the classroom are a function of their instructor's teaching behaviour and the experience of boredom generated by this behaviour (Bolkan & Griffin, 2017). But that doesn't mean that cell phones don't interfere with learning if it's not controlled (Smale et al., 2021). The involvement of students in estimating the HLR DLTI with the AaL approach can reduce 13% of students using cell phones when learning in class.

Students trying to get the highest score in mathematics showed an improvement, but only those who agreed with the highest percentage to choose strongly agreed to get a high score. The choice of the level of disagreement, especially the level of dispute, the changes are minimal after students are involved in estimating the HLR DLTI with the AaL approach. AaL is an assessment system involving students and teachers in the process, not just the results, so that rigidity and fear of mathematics can be reduced or minimized. Increasing mathematics scores have problems when students feel afraid or have negative perceptions. These obstacles are still imprinted on the students, so more treatment is needed from this research study.

CONCLUSION

The involvement of students in estimating the HLR DLTI with the AaL approach influences interest and motivation in learning mathematics. All positive statements for each indicator of interest and motivation increase 35-77%. On the other hand, all negative statements experienced an increase of 10-30% from the choice of strongly agree to the selection of strongly disagree, except that mobile phones only experienced a minor change. The average increase in students' interest and motivation in learning mathematics after being involved in the HLR DLTI assessment with the AaL approach was close to 50% of the students involved. Mathematics teachers can involve students in estimating HLR DLTI with the AaL approach if the teacher will increase students' interest and motivation in learning mathematics. Even though some did not experience an increase in changes, namely, students who strongly disagreed regarding the use of cellphones being omitted when learning in class, and there was an assumption by students that mathematics was a tricky thing. That can be explored in more depth and detail with a personal approach for extreme students in both cases

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