



The Problem-Solving Skills Profile of Tsanawiyah Islamic School Students in the Vibration, Wave, and Sound Learning Materials

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ABSTRACT

The purpose of this study is to determine the profile of problem-solving instruments which applied in Tsanawiyah Islamic School on vibration, waves, and sound learning materials based on the expert validation assessment and student's responses. This study used a pre-experimental design method, namely a one-shot case study and it was implemented in Tsanawiyah Islamic School. The sampling technique used purposive sampling using one class. Data collections used problem-solving skills instrument. The expert validation results showed that all of the instrument tests were very valid and it was declared fit for use. Student's responses from 15 questions were valid because the instrument tests have difficulty level with medium category, although there was one number of the question has difficult category. The distinguishing power showed a good and a very good category although two numbers of questions were less categories. The problem-solving skills profile in Tsanawiyah Islamic School showed a good category in the expert validation noralthough student's responses although there was a shortage. The limitation of the profile problem solving skills was hindsight from expert validation and students responses. The future research must be better and it can use appropriate learning model for this research like Model SEA-MEA (Self Efficacy Academic-Means Ends Analysis).

INTRODUCTION

Problem-solving skills are one of the thinking skills which needed in the 21st century (Batlolona, 2018). Problem solving skills involve intellectual process of students to connect the old knowledge with the new knowledge to get problem solving (Arifuddin, 2017). Problem-solving skills use integrated thinking skills and basis of relevant knowledge (Nurhairani & Dara, 2018). Students apply the knowledge and abilities to achieve goals in problem solving (Setyarini, 2021). Students must be used their experiences to solve problems (Tawfik, 2020). Students can get successful problem-solving when students have metacognitive experiences (Sengul, 2012). The habit of problem-solving in daily life is the achievement which compared to learning motivation (Chen, 2020). Problem-solving skills of students can measure by connecting information and testing hypothesis (Karyotaki, 2016).

Problem-solving skills help students to solve an issue (Tsankov, 2018). Problem-solving skills are needed in carrying out investigations (Mashluhah, 2018). Complex problem-solving makes students participate, provide non-cognitive skills, and critical life (Glazewski, 2020). The problem-solving skills of students in junior high school 1 Balongpanggang are still low categorized. The difficulty experienced in understanding

problems obtained 51,61%, difficulties in preparing problem formulation plans 80,65%, difficulties in implementing problem-solving plans 48,39%, and difficulties in re-checking students work results 51,61% (Prastiwi, 2018).

Essay test of problem-solving can challenge students to solve these problems (Annisah, 2020). Essay test can make students get a good problem-solving (Toharuddin, 2017). Technology can be used in developing problem-solving skills of students (Kristanto, 2019). The online test of problem-solving can minimize the effect of language differentials (Vista, 2015). Problem solving skills profile of students by distributing tests using Google form in this research obtained a fairly good percentage. The representation indicator with understand problems sub-indicator obtained 40% with a sufficient category, execution with applying strategies for problem-solving sub-indicator obtained 37% with a sufficient category, execution with activating relevant knowledge sub-indicator got 53% with a good category, and planning in the utilizing relevant knowledge/experience sub-indicator obtained 40% with sufficient category. The purpose of this study is to determine the profile of problem-solving instruments applied in Tsanawiyah Islamic School on vibration, waves, and sound based on the validator's assessment and student's responses.

RESEARCH METHOD

This research used pre-experimental design method, especially one-shot case study and implemented in Tsanawiyah Islamic School. The instrument test has checked by two validators. Then, the instrument test shared to students by link Google form and then the result analyzed by AnatesV4. The sampling technique used purposive sampling using one class. The population in this research is students of VIII class in Tsanawiyah Islamic School Bangkalan. Samples of this research are 15 students of Tsanawiyah Islamic School Bangkalan especially VIII A. Data collections in this research used problem-solving skills instrument. The criteria of validation result explain in Table 1 and counting by 1.1 formula

$$R = \frac{S}{N} \times 100\% \dots\dots\dots (1.1)$$

Source: (Widoyoko, 2017)

Information:

- R = Average score
- S = Number of scores obtained
- N = Maximum number of scores

After knowing the value of each expert validity, then combined the expert validity results and analyzed all of the expert validators using 1.2 formula

$$M_R = \frac{\sum R}{N} \dots\dots\dots (1.2)$$

Source: (Sudijono, 2017)

Information:

- M_R = Average combined score
- $\sum R$ = Number of scores obtained
- N = The number of validators

The instrument has validly categorized if the instrument measures the mastery abilities in measured domain (Arifin, 2017). Instrument in this research has valid category after reaching more than 50% and the instrument is suitable for use (Riduwan, 2014).

Table 1. Criteria of validity coefficient.

Validity coefficient	Criteria
$75 \leq VC \leq 100$	Very valid
$50 \leq VC < 75$	Valid
$25 \leq VC < 50$	Enough Valid
$0 \leq VC < 25$	Less Valid

Source: (Riduwan, 2014)

The instrument test was also limited test to 15 Tsanawiyah Islamic School students and analyzed students responses for multiple-choice and essay tests using the Anates application. To find out the distinguishing power of the items, use 1.3 formula with the distinguishing power criteria in the Table 2 and for the difficulty level of items use 1.4 formula with the difficulty level criteria in the Table 3.

$$DP \text{ (essay test)} = \frac{SA-SB}{IA} \text{ atau } DP \text{ (objective test)} = \frac{JB_A-JB_B}{JS_A} \dots\dots\dots (1.3)$$

$$TK \text{ (essay test)} = \frac{SA+SB}{IA+IB} \text{ atau } TK \text{ (objective test)} = \frac{JB_A+JB_B}{2.JS_A} \dots\dots\dots (1.4)$$

Source: (Sundayana, 2016)

Information:

SA = Total score for the top group

SB = Total score for the lower group

IA = Total ideal score for the upper group

IB = Total ideal score for the lower group

JB_A = The number of students in the upper group who answered correctly

JB_B = The number of students in the lower group who answered correctly

JS_A = The number of students in the upper group

Table 2. Distinguishing power criteria.

Distinguishing Power Coefficient	Criteria
$DP \leq 0,00$	Very bad
$0,00 < DP \leq 0,20$	Bad
$0,20 < DP \leq 0,40$	Enough
$0,40 < DP \leq 0,70$	Good
$0,70 < DP \leq 1,00$	Very good

Source: (Sundayana, 2016)

Table 3. Difficulty level criteria.

Difficulty Level Coefficient	Criteria
$TK = 0,00$	Very difficult
$0,00 < TK \leq 0,30$	Difficult
$0,30 < TK \leq 0,70$	Enough
$0,70 < TK \leq 1,00$	Easy
$TK = 1,00$	Very easy

Source: (Sundayana, 2016)

RESULTS AND DISCUSSION

Table 4. Expert validation results of instrument test.

Validation aspects	Validation result
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Validation aspects	Validation result
The suitability questions with the aspects	97%
Tables and figures related to problems	92%
Does not give a double interpretation rise	86%
The formulation of the sentences is clear	89%
Do not depend on the previous problem	95%
Communicative	88%

This study conducted to determine problem-solving test validity. The validation of the problem-solving test was carried out by science's teacher of junior high school. The validation aspects of problem-solving test explained in Table 4 which shows that each aspect has very valid level of validity. The results of validation in the suitability questions with the aspects are 97% very valid category, the second aspect is tables and figures related to problems got 92% very valid category, the third aspect does not give a double interpretation rise got 86% very valid category, the fourth aspect is the formulation of the sentences is clearly obtained 89% very valid category, the fifth aspect do not depend on the previous problem obtained 95% very valid category, and the last aspect is communicative obtained 88% very valid category.

Table 5. Expert validation results of 15 questions.

Number of Test	Validation results
1	94%
2	93%
3	91%
4	91%
5	81%
6	94%
7	96%
8	89%
9	85%
10	89%
11	92%
12	96%
13	77%
14	91%
15	91%

Based on Table 5, there are expert validation results of 15 instrument tests and all of validation results showed that the instrument test is very valid in accordance with validity coefficient's criteria in the Table 1 which have value range 75%-100%. The expert validation results showed that the instrument test can share to students. The results of trials instrument test to 15 students through Google Form were analyzed by AnatesV4 application. Online problem-solving tests can minimize the effect of language differentials (Vista, 2015). The test analysis of the distinguishing power, difficulty level of the test, and the correlation of the test carried out online are presented in Table 6.

Table 6. The Results of instrument test analysis in 15 questions.

Number of question	The distinguishing power	Category	The difficulty level of the question	Category	The correlation	Category
1	-0,25	Less	0,33	Medium	-0,24	-
2	0,25	Medium	0,33	Medium	0,12	-
3	1	Very good	0,40	Medium	0,82	Very significant
4	0,75	Very good	0,33	Medium	0,59	Significant
5	1	Very good	0,53	Medium	0,71	Very significant
6	1	Very good	0,47	Medium	0,90	Very significant
7	1	Very good	0,40	Medium	0,72	Very significant
8	0	Less	0,20	Difficult	0,26	-
9	1	Very good	0,53	Medium	0,81	Very significant
10	1	Very good	0,40	Medium	0,88	Very significant
11	0,76	Very good	0,51	Medium	0,83	Very significant
12	0,63	Good	0,38	Medium	0,72	Significant
13	0,56	Good	0,32	Medium	0,61	Significant
14	0,73	Good	0,46	Medium	0,91	Very significant
15	0,93	Very good	0,53	Medium	0,87	Very significant

The difficulty level of the questions is a number that indicates the difficulty or easy questions for the students. Good questions are neither easy nor difficult. Easy questions do not stimulate students to enhance their efforts to solve a problem. Difficult questions cause students to despair and they have not eager to try again because they are out of reach, so students problem-solving being considered difficult and the answered is not according to the answer's key (Arikunto, 2012).

An analysis result of difficulty level and distinguishing power are very important to find out the success level of questions in measuring student's actual abilities. The difficulty level or distinction which is not good causes the problem is not able to measure student's abilities with good category. Items cannot state the difference of distinguish student's abilities, which have incorrect answers key, items have two correct answer keys, the competency measured unclear, the deception does not work, the material is too difficult for students so guess the answer, and some students are thinking that there is a piece of error information in the items, so they choose incorrect answers (Solichin, 2017).

Student's answers in the essay test were varied, even the answers "don't know". The weakness of the essay test is the lack of student's ability to understand the content or the student's inconsistency in translating the item test so that the test is not accurate. However, the advantage of this essay test is easy to arrange questions on the test (Yusuf, 2015). The problem-solving essay test can challenge students to solve these problems and provide alternative correct solutions (Annisah, 2020). The problem-solving essay test obtained good categories (Toharuddin, 2017). Examples of indicators that are difficult to answer correctly by students on multiple-choice tests based on Table 6 are the execution indicator in apply strategies for problem-solving sub-indicator. The indicator is difficult category with the lowest percentage, 0,20, and also have the distinguishing power of the test with fewer

categories. The material is too difficult for students so the students guess the answer (Solichin, 2017). The difficulty level of the test is also caused by the complexity of the test subject and the condition of the answer choices because the test often presents confuse students and the alternative answers is also homogeneous or the sentences is too difficult to understand (Hanifah, 2014).

The lowest difficulty level has the lowest distinguishing power. It means each question has a small chance to get the different values of students. The item is the best if it got 0,50 with maximum difficulty level. It means, only half of the testers give the correct answers. If the difficulty level reaches 0,25-0,75, the distinguishing power of the problem is high. The good items are neither difficult nor easy (Yusuf, 2015).

The distinguishing power used to know the difference of mastered competence's student based on certain criteria. The higher coefficient in the distinguishing items can distinguish the students who have master competencies. When distinguishing power in the question of number 8 obtained low categories with zero value based on Table 6, so the questions cannot distinguish between the students who have good competencies and fewer competencies (Arifin, 2017).

Other factors that can affect the student's grade in answering questions are the student's initial ability, student's concentration when they solved a problem, and time working the questions. Physics learning is still difficult for some students because students have poor initial Physics abilities, for example in the vibrations, waves, and sounds learning materials (Veronica, 2018). There are internal and external factors, which have effect the achievement of the material (Kallesta, 2017). The external factors from students were 1) the teacher gave less motivation and learning resources was less support 2) time of the lesson was conducted during the daytime so students become less enthusiastic and lazy to learn. Questions, which are done during the day make students less concentrated, so they have less enthusiastic in working on the questions and they answer in moderation. According to validators, questions of problem-solving are easy, but students said "it is difficult." This indicated that the results of the teacher validations with student test gave different result. There are many students who cannot answer the questions even though validators said the instrument test is very valid categorized. The understanding and experiences of the validators and students are so different, so the results are also different. The multiple-choice test was also analyzed with the quality of deception, which representation in Table 7.

Table 7. The quality of spoofing each the questions.

Number of questions	A	B	C	D
1	0--	5**	2+	8---
2	5*	7---	0--	3++
3	3++	2+	4+	6**
4	5+	3++	2+	5**
5	8**	3+	3+	1-
6	3++	7**	2+	3++
7	1-	4+	4+	6**
8	7-	4++	3**	1--

Information:
 ** : Answer's key
 ++ : Very good
 + : Good
 - : Less
 -- : Bad
 --- : Very bad

Number of questions	A	B	C	D
9	3+	8**	1-	3+
10	6**	3++	4+	2+

Based on Table 7, there are the various deceptive qualities from a very poor category to a very good category. The best deception quality obtained by answer B in question number 8. There are 4 students choose that answer. A very poor quality of deception occurred in answer D in question number 1 with 8 students who choose that answers. The effectiveness of deceit can be known by looking at the pattern of the answer distributions from students. The pattern of answer distribution is obtained by counting the number of tester who chose the answer's choice or they did not choose anything. The students who are fooled, they indicated that the quality of their deception is very good. Deception is functioning well if the voter answers at least 5% (Arikunto, 2012). A better deception, it means a better quality of the problem. So, the deception is a benchmark to see the difference between smart students and less smart students.

Student's problem attitudes are positively correlated with student's perceptions regarding their knowledge and increased thinking skills as a result of participating (Huang, 2016). The student's problem-solving abilities lie in how students use knowledge by connecting one concept to one another (Dewi, 2017). Students are successful in problem-solving when they have metacognitive experiences (Sengul, 2012). A good metacognition experience will be result in good problem-solving. Students problem-solving skills must be measured from students cognitive and metacognitive skills in connecting information and testing hypotheses (Karyotaki, 2016). Students are still individual so they have less cooperate with other students and it caused students problem-solving abilities were not maximal (Dewi S., 2016). Metacognition helped group members to solve the redesign problem instructional, especially awareness of meta social related to the expertise of other members, monitoring of understanding, and monitoring of processes (Siegel, 2012).

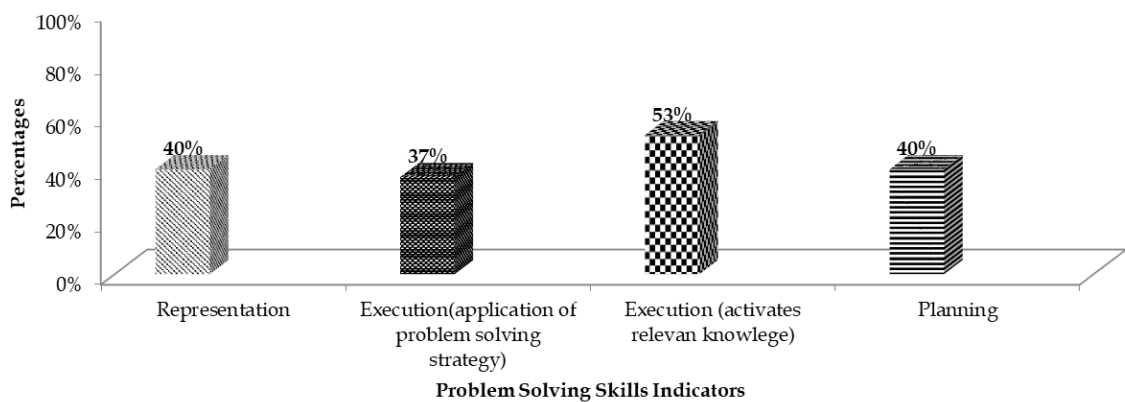


Figure 1. The diagram of the instrument test result based on problem-solving skills indicators.

Based on figure 1, There are 3 problem-solving indicators which are representation, execution, and planning. The sub-indicators of problem-solving skills indicators could be seen in the Table 8.

Table 8. Problem-Solving Skills Indicator

Indicators	Sub-indicators
Representation	Understanding the problem
Planning	Utilizing relevant knowledge/experience
Execution	- Applying a strategy for problem-solving - Activates relevant knowledge

Source: (Curtis, 2003)

An execution indicator in activates relevant knowledge sub-indicator got a good category, so students have not very good problem-solving skills. The first indicator is representation with sub-indicator understanding the problem. The examples questions of representation indicator lie in the question of number 1 that students investigate the pendulum vibration event with a different angle. Figure 1 showed that the indicator obtained 40% which is quite capable of understanding the problem. The second indicator is the execution in the sub-indicator of applying a strategy for problem-solving which students were given mathematical problems in this indicator. The percentage of this indicator was 37% which is quite capable of applying mathematical problem-solving strategies such as formulating the frequency and period of vibration's connection. Students of secondary education often find difficult to apply Mathematics in Physics (Tursucu, 2020). The research stated that students have not basic algebraic skills, so students are having difficulty in mathematical problem-solving. The third indicator is the execution which in activates relevant knowledge sub-indicator obtained 53% in a good category where it lies in question of number 5 with the question indicator is explaining the occurrence of sound waves by distinguishing louder sounds when it was chatting at night than the day. That question activates relevant knowledge of students in their daily lives. The habit of problem-solving in daily life is the center of achievement compared to learning motivation (Chen, 2020). The last indicator is planning with utilizing relevant knowledge/experience sub-indicators obtained 40% which is quite capable of linking or utilizing relevant knowledge or experience. This indicator is in the question of number 10 with indicator question is explaining the mechanism of the humans listening using a telephone from the jumble.

Based on Figure 1 and the description above, student's problem-solving indicator are not good categorized because students did not understand the problem-solving process. A finding showed that context-based learning can effectively build student's problem-solving processes (Yu, 2015). Students are studying and able to solve problems well when they understand what is learned by Gestalt's theory (Mujtahidin, 2014). The statement is related to this research and students can solve problems when the students understand both the problem formulation and the hope of problem-solving. The learning design which used by teachers can give effect to student's problem-solving skills (Akma, 2018). Complex problem-solving is a way to build students participation in content, provide non-cognitive skills and critical life (Glazewski, 2020).

Ausubel's meaningful theory can support problem-solving which stated that meaningful learning occurs when the students are linking new information with relevant concepts in one's cognitive structure (Mujtahidin, 2014). Students who have previously learned about the hearing system in animals, then students expected to link the previously

information with new information in the sound waves precisely the sonar working system in dolphins. Students who can solve problems by linking the dolphin hearing system with sound waves can be said that they have meaningful experienced learning by Ausubel's theory. Students can use their experience to solve new problems (Tawfik, 2020). Students problem-solving abilities need to train continuously in order to students can solve their problems. Strong guidance can give a positive impact in student's problem-solving skills (Atmatzidou, 2018). Problem-solving abilities can be a provision for solving problems in everyday life (Putra, 2020).

Student groups are divided into two, there are students who have skilled in problem-solving and students who have less skilled in problem-solving (Theasy, 2018). Students who have problem-solving skill used non-mathematical representations, such as charts, graphs, and diagrams, while students who have less problem-solving skill tend to use mathematical representations. Science learning which applies multiple representations can provide opportunities for students to understand concepts and communicate them well (Bahaudin, 2019). Many factors which are affect students problem-solving abilities are self-confidence, determination, sincerity, and students persistence in finding problem solutions (Theasy, 2018). Students who have high self-efficacy showed that they have persistence and ability to solve difficult problems (Citra, 2020).

Problem-solving skills improve after using the PBL approach (Anantasuk, 2019). The PBL model can improve student's problem-solving skills and science learning outcomes if implemented with a scientific approach (Cahyani, 2019). Learning which is using a scientific approach by utilizing quantum learning strategies can also optimize students problem-solving skills and regulated learning (Sudirman, 2017). Problem-solving strategies are also effectively used for communication skills, creativity, problem-solving, and students mathematical reasoning abilities (Tambunan, 2019). Student's problem-solving abilities have increased after using skills-based learning models (Ijirana, 2019). Student's problem-solving skills in science learning are sufficiently categorized after using distance learning through online tutorials with interactive discussions (Widiasih, 2018). Exploration of each student's problem-solving can be done using an instructional design model that aims to develop student's real world problem-solving (Zhong, 2019).

CONCLUSIONS

The expert validation results showed that all of the instrument tests were very valid and it was declared fit for use. Student's responses from 15 questions were valid because the instrument tests have difficulty level with medium category, although there was one number of the question has difficult category. The distinguishing power showed a good and a very good although two numbers of questions were less categories. The limitation of the profile problem solving skills was hindsight from expert validation and students responses. The future research must be better and can use appropriate learning model for this research like Model SEA-MEA (Self Efficacy Academic-Means Ends Analysis).

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