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Mathematical Problem-Solving Ability in Quantum Learning Model Assisted by Student Worksheets in Terms of Learning Motivation

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Abstract

Mathematical problem-solving skills are very important for learning and everyday life. One effort to improve students' mathematical problem-solving skills is to apply the Quantum Learning model assisted by Student Worksheets. This study aims to (1) examine the effectiveness of the Quantum Learning model assisted by Student Worksheets on mathematical problem-solving ability and (2) describe the mathematical problem-solving ability in the Quantum Learning model assisted by Student Worksheets in terms of learning motivation. This research used mixed methods with a sequential explanatory design. The samples in this study were students of class VII K as the experimental group and students of class VII J as the control group. The results showed that (1) the Quantum Learning model assisted by Student Worksheets is effective in improving the mathematical problem-solving abilities of seventh-grade students and (2) students in the high learning motivation category have high mathematical problem-solving abilities, students in the moderate learning motivation category have moderate mathematical problem-solving abilities, and students in the low learning motivation category have low mathematical problem-solving abilities.

1. Introduction

In the development of the 21st century, education has become one of the main roles in the development of human resource quality. Quality human resources in a country are reflected in the quality of education in that country. According to Etistika et al., (2016), education is currently experiencing a period of significantly increased knowledge growth. It can be acknowledged that the role of education is very important and strategic in the context of nation-building, a fact that has been recognized since the formulation of the 1945 Constitution. It is difficult for a country to compete on the international stage without quality human resources (Ningrum, 2016).

The Law of the Republic of Indonesia No. 20 of 2003 on the National Education System Chapter II Article 3 states that the purpose of national education is to develop students' potential, which can include their mathematical abilities. Mathematics has become a mandatory subject at every level of education, from elementary school to university, making mathematics a universal subject. Mathematics, as a science whose subject matter is abstract, modeled on axiomatic deductive reasoning, consistent within its system, and based on consensus (Suharto, 2017). As its main subject, in learning mathematics, one learns to solve problems, think critically, methodically, logically, imaginatively, and how to work well with others. Thus, to face the developments of the 21st century, early mathematical skills are necessary.

Students are prepared to face the developments of the 21st century with several thinking skills that must be possessed. Based on the identification by the Partnership for 21st Century Skills (2015), the skills that

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students must possess to face the developments of the 21st century include critical thinking and problem solving, creativity and innovation, communication, and collaboration. It can be mentioned that these abilities are known as the 4C skills. In its efforts to enhance the four 4C skills, this is done through an appropriate learning process. The curriculum, teaching implementation strategies, and models or methodologies integrated with 21st-century learning are all prepared by the teachers (Septikasari & Frasandy, 2018).

Amam (2017) states that if referring to the goals of mathematics education in NCTM (2000), then mathematical problem-solving is viewed as an achievable learning objective. Every student must develop their mathematical problem-solving skills. Based on standard bodies, curriculum, and education assessment Kemendikbud Ristek (2022), if the curriculum is taken into consideration, then the development of problem-solving skills becomes one of the objectives of mathematics learning in schools. These objectives also include the development of the ability to communicate information or ideas verbally, in writing, through images, graphs, maps, diagrams, and other means. This shows that the ability to solve mathematical problems is important to develop in students during the learning process at school.

How important mathematical problem-solving skills are does not mean that these skills have been well mastered by students in Indonesia. Based on the research conducted by the Programme for International Student Assessment (PISA) in 2022, which is an international student assessment program initiated by the Organization for Economic Cooperation and Development (OECD), there was a decline in international learning outcomes due to the pandemic, resulting in a 13-point decrease in Indonesia's mathematics scores compared to the PISA 2018 results.

The results of the PISA study indicate that students in Indonesia are not accustomed to solving non-routine problems, so they can only solve simple problems. Compared to measuring memory and calculation skills, the mathematics questions created in the PISA study more often assess reasoning, problem-solving, and argumentation skills. It can be concluded that the mathematical problem-solving abilities of Indonesian students, particularly at the junior high school level, are still low.

Based on the results of the researchers' observation at MTs Negeri 2 Kuningan on February 27, 2024, it was found that 28 out of 30 seventh-grade students had difficulty solving problems that encouraged students to think critically. This was obtained from the results of a preliminary study test conducted on February 27, 2024, in the seventh grade, where it was found that only 2 out of 30 students answered the questions correctly. Students who were able to answer the questions correctly could not write down the steps of their work. Based on the answers, it shows that the students have not yet met the indicators of mathematical problem-solving abilities, namely problem identification, definition, formulation, testing, and evaluation. Based on the description, it can be concluded that the mathematical problem-solving abilities of the seventh-grade students at MTs Negeri 2 Kuningan are still not optimal.

Problem-solving ability can be influenced by one of the affective aspects, namely learning motivation. Rigusti & Pujiastuti (2020) revealed that one of the supporting areas for the intellectual development of students that must be considered during the teaching and learning process in the classroom is their motivation ability. The definition of motivation is put forward by Uno (2023) that learning motivation is an internal and external drive of students who are learning, resulting in behavioral changes. The indicators of learning motivation used in this study are (1) the presence of desire and ambition to succeed; (2) the presence of drive and need in learning; (3) the presence of hope and future aspirations; (4) the presence of appreciation in learning; (5) the presence of an attractive desire in learning; and (6) the presence of a conducive learning environment that creates high learning motivation in students. With the increase in motivation, students are expected to be more diligent in their studies and achieve the desired accomplishments.

The learning model that can be implemented in teaching to improve students' mathematical problem-solving abilities is the student-centered learning model. One example of a student-centered learning model is the Quantum Learning model. The Quantum Learning model emphasizes activating all parts of the learning process, starting from both the context and content sides (Sauduran & Roulina, 2021). Furthermore, DePorter & Hernacki (2007) state that the Quantum Learning model has benefits in enhancing students' learning motivation. According to Siahaan et al. (2021), the Quantum Learning model is an educational innovation that accommodates all differences and integrates all relationships, interactions, and differences that enhance learning. The Quantum Learning model has a syntax consisting of six stages of activities that must be carried out by students, commonly known as TANDUR. TANDUR is an acronym for *Tumbuhkan, Alami, Namai, Demonstrasikan, Ulangi,* and *Rayakan*.

The Quantum Learning model requires appropriate learning media to assist students in the learning process. Learning media that can be used in implementing the learning process using the Quantum Learning model includes student worksheets. Student Worksheets contain stimuli presented in written form as a form of teacher guidance in learning (Fannie & Rohati, 2014). Astuti & Sari (2017) state that the steps presented in the Student Worksheet are arranged systematically, making it easier for students to work accurately and in accordance with the teacher's expectations. The worksheets used in the Quantum Learning teaching model must contain all the stages of the Quantum Learning teaching model itself.

In this study, researchers conducted research on mathematical problem solving ability in Quantum Learning Model Assisted by Student Worksheet in terms of Learning Motivation. The objectives of this study were (1) examine the effectiveness of the Quantum Learning model assisted by Student Worksheets on mathematical problem solving ability and (2) describe the mathematical problem solving ability in the Quantum Learning model assisted by Student Worksheets in terms of learning motivation.

2. Methods

The research approach used in this study was mixed methods research. The mixed methods research approach combines both quantitative and qualitative methods (Creswell, 2017). The research design used in this study was sequential explanatory, which involves analyzing quantitative data first and then analyzing qualitative data. The form of quantitative research design in this study was a pretest-posttest control group design. The design used in this study was presented in Table 1.

Table 1. Pretest-Posttest Control Group Design.

Group	Treatment	Pre-test	Post-test
Experiment Group	X	P_1	Q_1
Control Group	O	P_2	Q_2

Description:
X : Quantum Learning Model assisted by Student Worksheets
O : ConventionalLearning Model
P_1 : Pre-test Experiment Group
P_2 : Pre-test Control Group
Q_1 : Post-test Experiment Group
Q_2 : Post-test Control Group

This research was conducted at MTs Negeri 2 Kuningan with a population of all seventh-grade students at MTs Negeri 2 Kuningan for the odd semester of the 2023/2024 academic year, totaling 358 students. The sample was obtained using the random sampling technique, which involves taking samples randomly without considering the existing strata. The results obtained were class VII K as the experimental group with 32 students and class VII J as the control group with 32 students. The subjects in this study were obtained using the purposive sampling technique, which is a sampling method based on specific considerations according to the characteristics determined by the results of the student learning motivation category questionnaire. Two students were selected from each category of high, medium, and low learning motivation for interviews.

Quantitative data analysis begins with an initial data analysis, namely the pre-test results, which undergo statistical prerequisite tests such as normality test, homogeneity test, and mean equality test. After obtaining the posttest scores, average completeness tests, classical completeness tests, two average difference tests, paired two average difference tests, N-Gain tests, and average improvement difference tests were conducted. The qualitative data analysis in this study involves analyzing student learning motivation scale data used to categorize the levels of student learning motivation, and interview analysis is conducted to verify mathematical problem-solving abilities in terms of learning motivation. Activities carried out in data analysis include data reduction, data presentation, and drawing conclusions.

This section describes when the research has been performed. The researchers explain experimental design, equipment, data collection methods, and control types. Authors describe the research area, location, and also explain the work done. The general rule to keep in mind is that this section should describe in detail and clearly so that the reader has the basic knowledge and techniques to be duplicated.

3. Results & Discussions

This research was conducted at MTs Negeri 2 Kuningan located at Jl. Eyang Hasan Maulani, Sindangsari, Sindangagung District, Kuningan Regency, West Java. 45573. Class VII K was obtained as the experimental group given the Quantum Learning model treatment assisted by student worksheets, while class VII J was the control group given the conventional learning model treatment.

3.1 Result

3.1.1 Quantitative Data Analysis

3.1.1.1 Average Completion Test

The average completeness test is conducted to determine whether the average score of the mathematical problem-solving ability test in the experimental group reaches the criteria for achieving learning objectives of 70. The average completeness test uses a t-test with the following hypothesis:

H_0: $\mu \leq 70$ (average score of mathematical problem-solving ability test in the experimental group is less than or equal to 70)

H_1: $\mu > 70$ (average score of mathematical problem-solving ability tests in the experimental group is more than 70)

Decision-making is carried out based on the criteria of testing the data, namely accept H_0 if the value $t_{count} < t_{table}$, the value $t_{1-\alpha}$ is obtained from the t-distribution table with a probability of $(1-\alpha)$. The average completeness test of mathematical problem-solving ability data was then analyzed using the t-statistic with the following formula.

$$t = \frac{\bar{x} - \mu_0}{\frac{s}{\sqrt{n}}} = \frac{81.641 - 70}{\frac{9.829}{\sqrt{32}}} = 6.699235 \approx 6.699$$

Based on the calculation results using the t formula, the $t_{count} = 6.699$ and $t_{table} = 1.696$ were obtained, since the $t_{count} = 6.699 > t_{table} = 1.696$ H_0 is rejected. Thus, it can be concluded that the average score of the mathematical problem-solving ability test of students in the experimental group is more than 70.

3.1.1.2 Classical Completeness Test

The classical completeness test is conducted to determine whether the proportion of students with mathematical problem-solving ability test results in the experimental group reaches a criteria for the completion of learning objectives of 70 to more than 75%. The classical completeness test uses a z-test with the following hypothesis:

H_0: $\pi \leq 0.75$ (the proportion of students whose problem-solving ability test results have reached criteria for the completion of learning objectives in the experimental group is less than or equal to 75%)

H_1: $\pi > 0.75$ (the proportion of students whose problem-solving ability test results have reached criteria for the completion of learning objectives in the experimental group is more than 75%)

Decision-making is based on the criteria for testing the data, which is to accept H_0 if the calculated value $z_{count} < z_{table}$, where the value $z_{0.5-\alpha}$ is obtained from the z distribution table with a probability of $(0.5-\alpha)$. The classical completeness test of mathematical problem-solving ability data is then analyzed using z-statistics with the following formula.

$$z = \frac{\frac{x}{n} - \pi_0}{\sqrt{\pi_0 \frac{(1-\pi_0)}{n}}} = \frac{\frac{29}{32} - 0.75}{\sqrt{0.75 \frac{(1-0.75)}{32}}} = 2.041241 \approx 2.04$$

Based on the calculation results using the z formula, the calculated $z_{count} = 2.04$ and $z_{table} = 1.64$ were obtained. Since the $z_{count} = 2.04 > z_{table} = 1.64$ H_0 is rejected. Thus, it can be concluded that the proportion of students in the experimental group who achieved mastery is more than 75%.

3.1.1.3 Test of the Difference Between Two Means Post-test Data

The average difference test is conducted to determine whether the average post-test results of mathematical problem-solving ability in the experimental group are greater than the average post-test results of mathematical problem-solving ability in the control group.

Test the difference in means using the t-test with the following hypothesis:

$H_0: \mu_1 \leq \mu_2$ (average post-test results of mathematical problem-solving ability in the experimental group are less than or equal to the average test results of mathematical problem-solving ability in the control group)

$H_1: \mu_1 > \mu_2$ (the average post-test results of mathematical problem-solving ability in the experimental group are higher than the average test results of mathematical problem-solving ability in the control group)

Decision-making is carried out based on the criteria of testing the data, namely accept H_0 if the value $t_{count} < t_{table}$, the value $t_{1-\alpha}$ is obtained from the t-distribution table with a probability of $(1 - \alpha)$. The test of the difference between two means post-test data was then analyzed using the t-statistic with the following formula.

$$t = \frac{\bar{x}_1 - \bar{x}_2}{s\sqrt{\frac{1}{n_1} + \frac{1}{n_2}}} = \frac{81.641 - 74.141}{11.119\sqrt{\frac{1}{32} + \frac{1}{32}}} = 2.698077 \approx 2.70$$

Based on the calculation results using the t formula, the $t_{count} = 2.70$ and $t_{table} = 1.67$ were obtained, since the $t_{count} = 2.70 > t_{table} = 1.67$ H_0 is rejected. Thus, it can be concluded that the average score of mathematical problem-solving ability tests of students in the experimental group is higher than the average score of mathematical problem-solving ability tests of students in the control group.

3.1.1.4 Difference Test Average Paired and N-Gain Test

The paired two-sample t-test is conducted to determine whether the average post-test scores of mathematical problem-solving ability in the experimental group are the same as the average pretest scores of mathematical problem-solving ability in the experimental group.

Test the difference in means using the t-test with the following hypothesis:

$H_0: \mu_B \leq 0$ (the difference in the average post-test results of mathematical problem-solving ability in the experimental group and the average pre-test results of mathematical problem-solving ability in the experimental group is less than or equal to zero)

$H_1: \mu_B > 0$ (the difference in the average post-test results of mathematical problem-solving ability in the experimental group and the average pre-test results of mathematical problem-solving ability in the experimental group is greater than zero)

Decision-making is based on the criteria for testing the data, which is to reject H_0 if the calculated $t_{count} > t_{table}$. The table t value is obtained from the t distribution table with $dk = (n - 1)$, probability $(1 - \frac{1}{2}\alpha)$, and $\alpha = 5\%$. The difference test average paired was then analyzed using the t-statistic with the following formula.

$$t = \frac{\bar{B}}{s/\sqrt{n}} = \frac{\sum x_i - y_i\,/n}{s/\sqrt{n}} = \frac{47.1875}{11.79\sqrt{32}} = 22.63996 \approx 22.64$$

Based on the calculation results using the t formula, the $t_{count} = 22.64$ and $t_{table} = 1.696$ were obtained, since the $t_{count} = 22.64 > t_{table} = 1.696$ H_0 is rejected. Thus, it can be concluded that the average pre-test results of students' mathematical problem-solving abilities in the experimental group are higher than the average post-test results of students' mathematical problem-solving abilities in the experimental group.

The N-Gain test uses the formula proposed by Hake (1999) as follows:

$$N - Gain = \frac{Posttest\ Score - Pretest\ Score}{Maximum\ Score - Pretest\ Score}$$

Table 2. N-Gain Value Category

N-Gain Value	Category
$g \geq 0.7$	High
$0.3 \leq g < 0.7$	Middle
$g < 0.3$	Low

Based on the N-Gain calculations, the following recap was obtained

Table 3. Recapitulation of N-Gain Calculations

Group	**Experimental**	**Control**
Average	0.732676	0.594345
Criteria	High	Middle

3.1.1.5 Test of Difference in Average N-Gain Score Improvement

The test of the difference in average improvement is conducted to determine whether the average improvement in students' mathematical problem-solving abilities in the experimental group is greater than the average improvement in students' mathematical problem-solving abilities in the control group.

Test the difference in mean improvement using a t-test with the following hypothesis.

H_0: $\mu_1 \leq \mu_2$ (the average increase in mathematical problem-solving test scores in the experimental group is less than or equal to the average increase in mathematical problem-solving test scores in the control group)

H_1: $\mu_1 > \mu_2$ (the average increase in mathematical problem-solving ability test scores in the experimental group was greater than the average increase in mathematical problem-solving ability test scores in the control group)

Decision-making is based on the criteria for testing the data, which is to reject H_0 if the calculated $t_{count} > t_{table}$. The table t value is obtained from the t distribution table with $dk = (n_1 + n_2 - 2)$, probability $(1 - \alpha)$, and $\alpha = 5\%$. The Test of Difference in Average N-Gain Score Improvement was then analyzed using the t-statistic with the following formula.

$$t = \frac{\bar{x}_1 - \bar{x}_2}{s\sqrt{\frac{1}{n_1} + \frac{1}{n_2}}} = \frac{0.7327 - 0.5943}{0.1651\sqrt{\frac{1}{32} + \frac{1}{32}}} = 3.351363 \approx 3.35$$

Based on the calculation results using the t formula, the $t_{count} = 3.35$ and $t_{table} = 1.67$ were obtained, since the $t_{count} = 3.35 > t_{table} = 1.67$ H_0 is rejected. Thus, it can be concluded that the average increase in mathematical problem-solving test scores in the experimental group is greater than the average increase in mathematical problem-solving test scores in the control group.

3.1.2 Qualitative Data Analysis

The qualitative data analysis in this study contains a description of mathematical problem-solving abilities in the Quantum Learning model assisted by student worksheets based on student motivation survey results accompanied by interview results. Of the 32 students in the class using the Quantum Learning model assisted by student worksheets, 6 students were selected as research subjects, namely 2 students from each learning motivation category namely high, medium, and low.

Table 4. Research Subject

Student Learning Motivation Category	Students Code	Subject Code
High	1. E-32	1. MT-1
	2. E-25	2. MT-2
Middle	E-28	MS-1
	E-09	MS-2
Low	E-10	MR-1
	E-29	MR-2

3.1.2.1 Mathematical Problem Solving Ability of Student with High Motivation Learning

The following is one of the results of data analysis carried out on one of the subjects with high learning motivation category in question number 4.

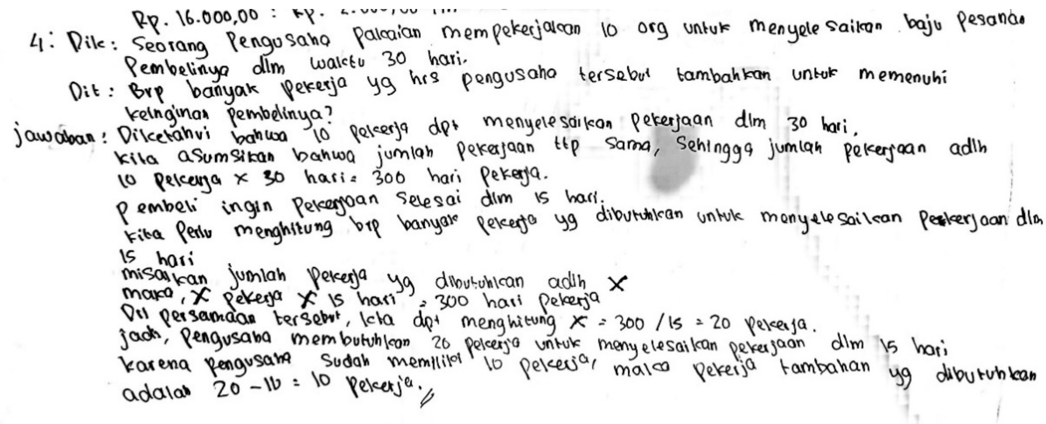
Rp. 16.000,00 : Rp. ...
4: Dik: Seorang Pengusaha Pakaian mempekerjakan 10 org untuk menyelesaikan baju pesanan Pembelinya dlm waktu 30 hari.
Dit: Brp banyak pekerja yg hrs pengusaha tersebut tambahkan untuk memenuhi keinginan pembelinya?
jawaban: Diketahui bahwa 10 pekerja dpt menyelesaikan pekerjaan dlm 30 hari.
kita asumsikan bahwa jumlah pekerjaan ttp sama, sehingga jumlah pekerjaan adlh 10 pekerja × 30 hari = 300 hari pekerja.
Pembeli ingin pekerjaan selesai dlm 15 hari.
kita perlu menghitung brp banyak pekerja yg dibutuhkan untuk menyelesaikan pekerjaan dlm 15 hari
misalkan jumlah pekerja yg dibutuhkan adlh x
maka, x pekerja x 15 hari = 300 hari pekerja
Dri persamaan tersebut, kita dpt menghitung x = 300 / 15 = 20 pekerja.
jadi, Pengusaha membutuhkan 20 pekerja untuk menyelesaikan pekerjaan dlm 15 hari
karena pengusaha sudah memiliki 10 pekerja, maka pekerja tambahan yg dibutuhkan adalah 20 − 10 = 10 pekerja.

Figure 1. Work Results of Subject with High Learning Motivation on Question Number 4

Table 5. Description of Mathematical Problem-Solving Ability of Highly Motivated Subjects

Learning Motivation Category	Student Code	Indicator				
		Facing Problem	Definition	Formulation	Testing	Evaluation
High	MT-1	C	C	C	C	C
	MT-2	C	C	C	C	C

Explanation:
C : Capable
NC : Not Capable

Subjects MT-1 and MT-2 with high learning motivation have been capable of fulfilling the five indicators of mathematical problem-solving ability, namely facing problems, definition, formulation, testing, and evaluation based on learning activities, mathematical problem-solving ability test results, and interviews.

3.1.2.2 Mathematical Problem Solving Ability of Student with Middle Motivation Learning

The following is one of the results of data analysis carried out on one of the subjects with middle learning motivation category in question number 4.

Figure 2. Work Results of Subject with Middle Learning Motivation on Question Number 4

Table 6. Description of Mathematical Problem-Solving Ability of Moderate Motivated Subjects

Learning Motivation Category	Student Code	Indicator				
		Facing Problem	**Definition**	**Formulation**	**Testing**	**Evaluation**
Middle	MS-1	C	C	C	NC	C
	MS-2	C	C	NC	NC	C

Explanation:
C : Capable
NC : Not Capable

Subjects MS-1 and MS-2 with moderate learning motivation categories are only capable of fulfilling three indicators of mathematical problem-solving ability, namely problem identification, definition, and evaluation based on learning activities, mathematical problem-solving ability test results, and interviews.

3.1.2.3 Mathematical Problem Solving Ability of Student with Low Motivation Learning

The following is one of the results of data analysis carried out on one of the subjects with low learning motivation category in question number 4.

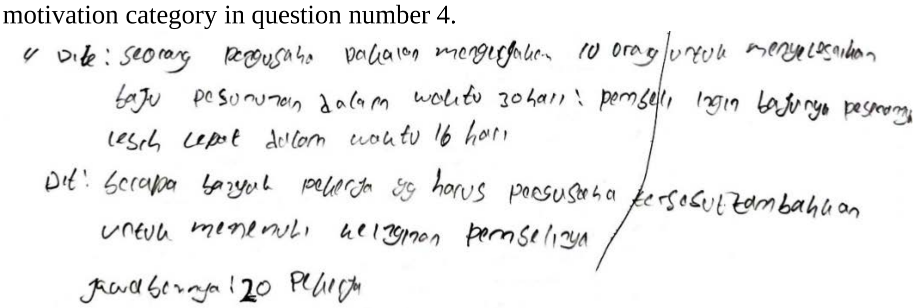

Figure 3. Work Results of Subject with Low Learning Motivation on Question Number 4

Table 7. Description of Mathematical Problem-Solving Ability of Low Motivated Subjects

Learning Motivation Category	Student Code	Indicator				
		Facing Problem	**Definition**	**Formulation**	**Testing**	**Evaluation**
Low	MR-1	C	C	NC	NC	C
	MR-2	C	NC	NC	NC	C

Explanation:
C : Capable
NC : Not Capable

Subjects MR-1 and MR-2 with moderate learning motivation categories are only capable of fulfilling two indicators of mathematical problem-solving ability, namely problem identification and evaluation based on learning activities, mathematical problem-solving ability test results, and interviews.

3.2 Discussion

The application of the Quantum Learning model assisted by student worksheets at MTs Negeri 2 Kuningan, Kuningan Regency, can encourage students in their mathematical problem-solving abilities. Learning assisted by student worksheets can increase student participation in solving a problem. The use of student worksheets as a learning medium contains syntax that aligns with the Quantum Learning teaching model. Students work in groups to solve problems by exchanging ideas and concepts they have, which can then be expressed in written form by filling out the student worksheets or orally by presenting in front of the class.

The ability to solve mathematical problems of students in the Quantum Learning model assisted by student worksheets achieved learning completeness based on the average. The results of the t-test analysis obtained a value of $t_{count} = 6.699 > t_{table} = 1.696$, indicating that learning with the Quantum Learning model assisted by student worksheets achieved average completeness. The results of the study by Riati & Farida (2022) also state that the ability to solve mathematical problems in the Quantum Learning model reaches an average level of completeness. The ability to solve mathematical problems using the Quantum Learning model assisted by student worksheets achieves classical learning completeness, with the proportion of students reaching criteria for the completion of learning objectives exceeding 75%. The results of the z-test analysis obtained a value of $z_{count} = 2.04 > z_{table} = 1.64$, indicating that learning with the Quantum Learning model assisted by student worksheets achieved classical completeness. Purwasi & Fitriyana (2019) in their research stated that the ability to solve mathematical problems with the Quantum Learning model achieved classical completeness. The average post-test score of the group using the Quantum Learning model with student worksheets assistance is 82.1, while the average post-test score of the group using the conventional learning model is 74.1. The results of the two-sample mean difference test analysis obtained a value $t_{count} = 2.70 > t_{table} = 1.67$. The results of the average difference test analysis obtained are in accordance with the researcher's hypothesis, which states that the average mathematical problem-solving ability of students using the Quantum Learning model with student worksheets assistance is higher than the average mathematical problem-solving ability of students using the conventional model. This is in line with the research conducted by Saudura & Roulina (2021) which found that students' mathematical problem-solving abilities using the Quantum Learning model had higher results than those using the conventional learning model. The results of the pre-test and post-test of mathematical problem-solving abilities in the experimental group using the Quantum Learning model assisted by student worksheets show that there is an average improvement. This is shown in the pre-test and post-test using the two-sample t-test, where the value $t_{count} = 22.64 > t_{table} = 1.696$ was obtained. As the research conducted by Ikhsan & Sugianto (2021) states, student worksheets are capable of improving students' understanding in learning.

During the learning process, subjects MT-1 and MT-2 have participated in the learning process very well because subjects MT-1 and MT-2 actively took part in their group discussions, tending to lead the discussion activities and helping to guide their classmates in the group discussion activities. Subjects MT-1 and MT-2 often express their opinions in front of their classmates and successfully complete the worksheets with their group accurately. Based on the results of the learning motivation questionnaire, it shows that subjects MT-1 and MT-2 are already able to meet the indicators of learning motivation, namely the presence of desire and ambition to succeed, the presence of drive and need in learning, the presence of hope and future aspirations, the presence of appreciation in learning, the presence of attractive desire in learning, and the presence of a conducive learning environment. As stated in Maslow's learning theory, high learning motivation can be achieved when students have met all their needs. Subjects with high learning motivation have reached the stage of self-actualization in the learning process, among other things, they are already brave enough to express their opinions and become peer tutors for their group mates. Based on the description, it can be said that subjects with high learning motivation meet all the indicators of mathematical problem-solving abilities as follows: (1) facing the problem; (2) definition; (3)

formulation; (4) testing; and (5) evaluation. Thus, students with a high level of learning motivation possess strong mathematical problem-solving skills because they meet all the indicators of mathematical problem-solving ability. This is in line with the research conducted by Rigusti & Pujiastuti (2020) that students with high learning motivation have high mathematical problem-solving abilities.

During the learning process, subjects MS-1 and MS-2 have participated well in the learning process because subjects MS-1 and MS-2 played a fairly active role in their group discussions, and they followed all stages of the student worksheets completion well. Subjects MS-1 and MS-2 tend to rarely express their opinions in front of their classmates and more often act as listeners during demonstration activities. However, subject MS-1 has dared to ask questions a few times whenever there is something he does not understand. Subjects MS-1 and MS-2 have successfully completed the student worksheets, although it was incomplete. Based on the results of the learning motivation questionnaire, it shows that subjects MS-1 and MS-2 have been able to meet five indicators of learning motivation, namely the presence of a desire and aspiration to succeed, the presence of hope and future aspirations, the presence of appreciation in learning, the presence of an engaging desire in learning, and the presence of a conducive learning environment. As stated in Maslow's learning theory, high learning motivation can be achieved when students have met all their needs. Subjects with moderate learning motivation have not yet reached the stage of self-actualization in the learning process, including not daring to express their opinions in front of the class during the demonstration stage and tend to only be listeners. Based on the description, it can be said that subjects with moderate learning motivation only meet three indicators of mathematical problem-solving ability as follows: (1) facing the problem; (2) definition; and (5) evaluation. However, both subjects did not meet indicators (3) formulation and (4) testing. This is in line with the research conducted by Rigusti & Pujiastuti (2020) that students with moderate learning motivation have lower mathematical problem-solving abilities compared to students with high learning motivation.

During the learning process, subjects MR-1 and MR-2 were less active in participating well in the learning process because MR-1 and MR-2 were seen several times busy with other activities rather than participating in their respective group discussions. Subjects MR-1 and MR-2 never express their opinions in front of their classmates and tend to rely on other members of their group. When the teacher approached each group and asked if there were any questions, subjects MR-1 and MR-2 appeared indifferent and felt they had already understood the material well. The completion of the student worksheets yielded less accurate results because the answers written were incomplete. Based on the results of the learning motivation questionnaire, it shows that subjects MR-1 and MR-2 are only able to meet three indicators of learning motivation, namely, the presence of encouragement and needs in learning, the presence of hopes and future aspirations, and the presence of a conducive learning environment. As stated in Maslow's learning theory, high learning motivation can be achieved when students have met all their needs. Subjects with low learning motivation have not yet fulfilled their self-esteem needs because students with low learning motivation do not actively participate in learning and tend to rely on other group members, resulting in less appreciation in their learning activities. Furthermore, subjects with low learning motivation have not yet reached the stage of self-actualization in their learning process. Based on the description, it can be said that subjects in the low learning motivation category only meet two indicators of mathematical problem-solving ability as follows: (1) facing the problem and (2) definition. Both subjects in the low learning motivation category could not meet the indicators (3) formulation; (4) experimentation; (5) evaluation. This is in line with the research conducted by Rigusti & Pujiastuti (2020) that students with low learning motivation have lower mathematical problem-solving abilities compared to students with high learning motivation and students with moderate learning motivation.

4. Conclusion

Based on the research results and discussions related to mathematical problem-solving abilities in the Quantum Learning model assisted by student worksheets in terms of learning motivation, the following conclusion was obtained: The Quantum Learning model assisted by student worksheets is effective in improving the mathematical problem-solving abilities of seventh-grade students because it meets the following criteria; (1) The mathematical problem-solving ability of seventh-grade students using the Quantum Learning model assisted by student worksheets reaches completeness based on the average; (2) The mathematical problem-solving ability of seventh-grade students using the Quantum Learning model assisted by student worksheets reaches completeness based on a proportion of more than 75%; (3) The average mathematical problem-solving ability of seventh-grade students in the Quantum Learning model assisted by student worksheets is higher than the average mathematical problem-solving ability of seventh-grade students in the Conventional Learning model; (4) The improvement in the mathematical problem-solving ability of seventh-grade students using the Quantum Learning model assisted by student worksheets is higher than the improvement in the mathematical problem-solving ability of seventh-grade students using the Conventional Learning model. Description of students' mathematical problem-solving abilities in terms of their learning motivation in the Quantum Learning model assisted by student worksheets is as follows. (1) Subjects in the high learning motivation category have high mathematical problem-solving abilities because they are able to meet five indicators of mathematical problem-solving abilities. Subjects in the high learning motivation category understand the problems in the questions well, enabling them to solve the questions with precise, sequential, and complete steps; (2) Subjects in the moderate learning motivation category have not yet met the five indicators of mathematical problem-solving ability. The subjects have met three indicators of mathematical problem-solving ability, namely problem identification, definition, and evaluation. Whereas the two subjects did not meet the formulation and testing indicators. The subject can be concluded to only meet three indicators well; (3) Subjects in the low learning motivation category have not met five indicators of mathematical problem-solving ability, but subjects have only met two indicators of mathematical problem-solving ability, namely facing problems and definition. Whereas both subjects did not meet the indicators of formulation, testing, and evaluation. The subject can be concluded to only meet two indicators well.

References

Amam, A. (2017). Penilaian Kemampuan Pemecahan Masalah Matematis Siswa Smp. Teorema, 2(1), 39. https://doi.org/10.25157/.v2i1.765.

Astuti, A., & Sari, N. (2017). Pengembangan Lembar Kerja Siswa (LKS) Pada Mata Pelajaran Matematika Siswa Kelas X Sma. Jurnal Cendekia : Jurnal Pendidikan Matematika, 1(2), 13–24. https://doi.org/10.31004/cendekia.v1i2.16

Creswell, J. W. (2017). Research Design Pendekatan Kualitatif, Kuantitatif, dan Mixed (3rd ed.). Pustaka Pelajar.

DePorter, B., & Hernacki, M. (2007). Quantum Learning: Membiasakan Belajar Nyaman dan Menyenangkan. Penerbit Kaifa.

Etistika Y W, Dwi A S, & Amat N. (2016). Transformasi Pendidikan Abad 21 Sebagai Tuntutan. Jurnal Pendidikan, 1, 263–278.

Fannie, R. D., & Rohati. (2014). PENGEMBANGAN LEMBAR KERJA SISWA (LKS) BERBASIS POE (Predict, Observe, Explain) PADA MATERI PROGRAM LINEAR KELAS XII SMA. Jurnal Sainmatika, 8(1), 96–109.

Ningrum, E. (2016). Pengembangan Sumber Daya Manusia Bidang Pendidikan. Jurnal Geografi Gea, 9(1). https://doi.org/10.17509/gea.v9i1.1681

OECD. (2023). PISA 2022 Results (Volume I): The State of Learning and Equity in Education: Vol. I. OECD. https://doi.org/10.1787/53f23881-en

Partnership for 21 st Century Skills. (2015). Partnership for 21St Century Skills-Core Content Integration. Ohio Department of Education, 1. www.P21.org.

Rigusti, W., & Pujiastuti, H. (2020). Analisis Kemampuan Pemecahan Masalah Ditinjau Dari Motivasi Belajar Matematika Siswa. Prima: Jurnal Pendidikan Matematika, 4(1), 1. https://doi.org/10.31000/prima.v4i1.2079

Sauduran, G. ., & Roulina, C. V. . (2021). Pengaruh Model Pembelajaran Quantum Learning terhadap Kemampuan Pemecahan Masalah Matematika. Attractive : Innovative Education Journal, 3(2), 185–194. https://attractivejournal.com/index.php/aj/article/view/447

Septikasari, R., & Frasandy, R. N. (2018). KETERAMPILAN 4C ABAD 21 DALAM PEMBELAJARAN PENDIDIKAN DASAR. Tarbiyah Al-Awlad: Jurnal Kependidikan Islam Tingkat Dasar, 8(2), 107–117. https://doi.org/10.15548/alawlad.v8i2.1597

Siahaan, K. W. A., Damanik, D. H. S., Tambunan, S. S., William, K., Siahaan, A., Haris, D., Damanik, S., Tambunan, S. S., Simanjuntak, M., Sihombing, D., Prodi, M., Kimia, P., Keguruan, F., & Pematangsiantar, N. (2021). Intelektiva : Jurnal Ekonomi, Sosial & Humaniora 16 Implementasi Model Quantum Teaching Dan Metode Snowball Throwing Terhadap Minat Dan Prestasi Belajar Kimia. 2(07), 16–24.

Kementerian Pendidikan, Kebudayaan, Riset, dan Teknologi (2022). Capaian Pembelajaran Mata Pelajaran Matematika Fase A-Fase F. Jakarta: Kemendikbud Ristek.

Suharto, S. (2017). Peningkatan Motivasi dan Hasil Belajar Siswa pada Pembelajaran Lingkaran dengan Metode Penemuan Terbimbing. Cakrawala: Jurnal Pendidikan, 11(2), 91–99. https://doi.org/10.24905/cakrawala.v11i2.841

Uno B., H. (2023). Teori motivasi dan pengukurannya: Analisis di bidang pendidikan. Bumi Aksara.