Journal of the Indonesian Mathematics Education Society
JIMES, 2025, Vol. 3, no. 1, 19-32
ISSN: 2656-3479 (print), 2656-7253 (electronic)
URL: https://journal.unesa.ac.id/index.php/jimes

Senior High School Students' Difficulties in Solving HOTS Probability Problem and Their Scaffolding Based on Learning Styles

Alifia Putri Hidayati[1*], Ali Shodikin[2]

[1] Department of Mathematics Education, Universitas Negeri Surabaya, Surabaya, Indonesia
Email: alifiaputri.21080@mhs.unesa.ac.id*

Submitted: 25 May 2025; Revised: 2 June 2025; Accepted: 3 June 2025

ABSTRACT

This study aims to identify the difficulties experienced by high school students in solving higher-order thinking skills (HOTS) questions on probability and to analyze the scaffolding provided to help students overcome these difficulties based on visual, auditory, and kinesthetic learning styles. HOTS questions require the students to think creatively, critically, and logically, which are commonly hindered by the abstract nature of the concept of probability. This qualitative descriptive study involved three students classified based on their learning styles. Data were collected using a learning style questionnaire, HOTS test questions, and interviews, and were analyzed via data reduction, data display, and conclusion drawing. The results showed that visual learners struggled with transformation and process skills, auditory learners with process skills, and kinesthetic learners with both transformation and process skills. To remedy these issues, scaffolding was created according to each learning style. Visual learners were assisted by the use of visual comparison charts and Figure-based guidelines, auditory learners responded to guided inquiry questions and oral explanations, and kinesthetic learners performed well through action tasks and movement-based simulations. These individualized scaffolding strategies allowed the students to overcome conceptual and procedural barriers, thereby improving their ability to answer HOTS probability questions more effectively. This study emphasizes the importance of adaptive support tailored to personal learning styles to increase the mathematical understanding of students.

Keywords: *HOTS, learning styles, mathematical difficulties, probability, scaffolding*

How to cite: Hidayati, A.P. & Shodikin, A. (2025) Senior High School Students' Difficulties in Solving HOTS Probability Problem and Their Scaffolding Based on Learning Styles. *Journal of the Indonesian Mathematics Education Society*, *3*(1), 19-32.

INTRODUCTION

Human Resources are currently required to have three important skills, namely critical thinking, creative thinking, and problem solving (Pratiwi et al., 2019). These abilities are known as higher order thinking skills (HOTS). According to Dewi et al. (2023), students experience various difficulties in solving HOTS problems, especially due to the lack of conceptual understanding and reasoning abilities required to tackle complex mathematical tasks. Faridah (2019) also emphasized that in order to adapt to changing times, developing creativity and problem-solving skills is crucial. Critical and creative thinking is needed to solve problems, considering that rapid developments in knowledge and technology have led to increasingly complex challenges (Driana & Ernawati, 2019).

However, the reality shows that not all students are able to master these skills, especially in dealing with HOTS questions. Learning problems are situations in the learning stage that are characterized by certain obstacles that hinder the achievement of learning goals. Most students in Indonesia still face difficulties in solving HOTS questions (Kurniawan, 2018). Organizator for Economic Co-operation and Development (OECD), through the Programme for International Student Assessment (PISA), released the latest results in 2023 showing that Indonesia's mathematics score was only 366, far below the international average of 472. As many as 82% of Indonesian students are below level two in numeracy literacy (OECD, 2022). This difficulty occurs due to students' lack of experience in solving problems with a high level of thinking (Agusta, 2020). Other studies show that most students have not been able to solve HOTS problems due to limitations in dealing with non-routine problems (Zulfa et al., 2018).

If students can solve HOTS problems, they can not only remember the formulas they have learned, but also have a much better understanding of the material and how it relates to math problems (Fauzia et al., 2019). In addition, they have the ability to study mathematical problems that have been given by the teacher (Winarso, 2014). Therefore, by giving HOTS problems to students, it is hoped that they will be trained to think specifically and use their thinking skills (Suyitno, 2020). Students must improve their cognitive thinking skills at a higher level, especially in terms of the ability to analyze learning materials that are difficult to understand.

HOTS type questions are questions that require high-level thinking skills and involve reasoning processes, so they can improve critical, logical, and creative thinking skills, and teach students to think at the level of analysis, evaluation, and creation (Mahmudah, 2018). HOTS is a series of stages of thinking used by students at a higher cognitive level. Students' ability to solve math problems, especially HOTS types, is one of several learning objectives that can be achieved (Saraswati & Agustika, 2020). Students have poor thinking skills because they are not used to solving problems with a high level of thinking (Rudyanto et al., 2019).

Probability material is often considered to be difficult for students because the topic of probability is abstract and involves deep understanding (Andam et al., 2023). Such a challenge often manifests in the form of mistakes and misconceptions that hinder students from solving problems in probability effectively. In addition, the use of various teaching strategies, such as simulations and real-life examples, can facilitate students to gain a better understanding of challenging probability concepts (Arum et al., 2018). Hence, proper scaffolding has to be provided to assist students in overcoming learning barriers on probability material and solidifying their understanding at the conceptual level (Ueno & Miyasawa, 2015).

Vygotsky in (Sujadi, et al. 2016) defines scaffolding as providing assistance to students at the beginning stage of learning and then gradually reducing it after they are able to do it to give them opportunities for taking more responsibility. The scaffolding framework is highly crucial for the learning of mathematics, especially in conditions that require higher-order thinking skills (HOTS). Sujadi, et al. (2016) also noted that scaffolding is related to the zone of proximal development (ZPD), "the Zone of Proximal Development (ZPD) is the range between the actual level of development (characterized as the capacity to solve problems by himself) and the level of potential development (characterized as the capacity to solve problems in the presence of adults or collaboration with peers who are more competent". What is meant by adults is teachers or parents. Laamena (2019) Scaffolding the learning to students' style can make learning more effective and help students develop a deeper understanding.

The technique used by a person to collect and process data from their environment is known as a learning style (Ardani, 2019). İlçin (2018) also said that learning style is a term that refers to the way a person uses new information to learn well. One of the widely used learning style approaches is the VAK (visual, auditory, kinesthetic) model, which can facilitate students' mathematical understanding through the development of learning media that are tailored to the characteristics of their learning style (Risnawati et al., 2018). Understanding an individual's learning style helps identify suitable learning activities. Research shows that visual, auditory, and kinesthetic methods affect learning outcomes and are relevant to understanding students' difficulties in solving math problems (Bire et al., 2014).

There are many research studies on problem-solving difficulties of students in mathematics. Fitri and Abadi (2021) revealed that high school students have problem-solving difficulties in probability material, and the main reason is due to weak conceptual understanding and procedural flaws. Istiqomah and Setianingsih (2014) also revealed that the application of scaffolding can help students understand story problems in linear equations with one variable. Dewi et al., (2023) noted that students encounter various difficulties in solving HOTS problems in algebra, and these difficulties may be due to the differences in students' profiles, such as learning styles. Different from other research, this research specifically investigates high school students' difficulties in solving HOTS problems on probability content from the perspective of learning styles and providing tailored scaffolding. Visual, auditory, and kinesthetic learning styles are considered because they may affect how students receive information. In this way, research is expected to better understand and help design more effective learning strategies.

From the above explanation, it is realized that the difficulties experienced by high school students in solving HOTS questions regarding topics on probability can be triggered by various factors, one of which is learning style. It is thus in this regard that this study aims to find out how learning styles affect the problem-solving capacity of students and how appropriate scaffolding supports students in overcoming difficulties. It is hoped that the results of this study are capable of providing meaningful contributions to teachers to design more responsive learning approaches, through which students can achieve more optimal learning outcomes and have better learning experiences.

METHODS

This study uses a descriptive qualitative approach that aims to describe students' difficulties in solving HOTS problems on probability material and the appropriate form of scaffolding based on students' learning styles. A qualitative approach is used to deeply understand students' experiences and responses to solving mathematical problems, especially on probability material, as explained by Sugiyono (2012).

The subjects in this study were three grade XI students of SMA Unggulan Hafsha who were selected purposively. The selection of these three students considered the results of the learning style questionnaire (visual, auditory, kinesthetics), report card grades that were classified as moderate with a range of 70-85, and the same gender to avoid bias. Each learning style is represented by one student.

Data collection techniques include: (1) a VAK learning style questionnaire consisting of 30 statements with four answer choices (SS, S, TS, STS) to identify students' dominant learning styles; (2) a HOTS test on probability material that includes indicators of difficulty understanding problems, difficulty in transformation, difficulty in process skills, and difficulty in drawing conclusions; and (3) interview guidelines aimed at delving deeper into the sources of student difficulties and the forms of assistance or scaffolding provided. All instruments were reviewed and validated through consultation with a supervising lecturer to ensure their relevance and clarity before being used in data collection.

The data were analyzed in three stages: (1) grouping students by dominant learning styles using questionnaire results; (2) identifying difficulty types from HOTS test results; and (3) analyzing interviews through data reduction, presentation, and conclusion drawing to uncover causes of difficulties and appropriate scaffolding based on Anghileri (2006). Method triangulation was used to ensure validity by comparing questionnaire data, HOTS answers, and interview results.

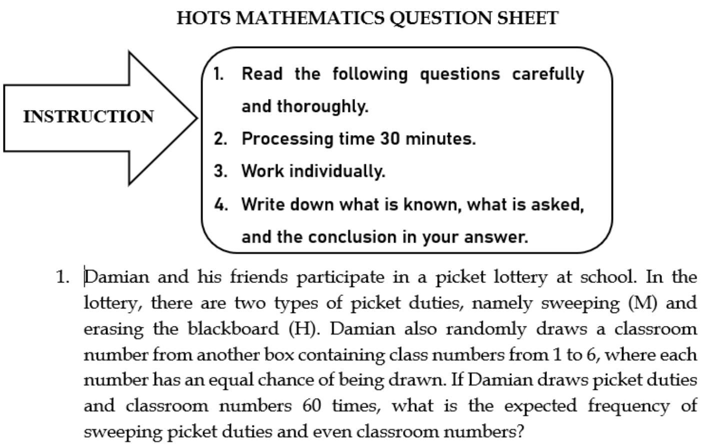
RESULTS

The researcher chose class XI-F of SMA Unggulan Hafsa Zainul Hasan as the research subject because the class had received learning about probability material and was considered appropriate for studying students' difficulties in solving HOTS problems. Of the 30 students in the class, 24 students were present and filled out the learning style questionnaire, while 6 students were unable to attend due to illness, permission, or without explanation. The learning style questionnaire was still given to the absent students. Based on the results of filling out the questionnaire, 7 students with visual learning styles, 6 students with auditory, and 11 students with kinesthetic learning styles were obtained. Of the 24 students whose learning styles had been identified, one student was selected from each learning style category as the research subject. The selection was made by considering the last report card grades and gender similarity. The selected subjects are shown in Table 1.

Table 1. Research Subjects

No	Code Name	Subject Code	Grade	Learning Styles	Gender
1.	MNU	Subject 1 (S1)	75	Visual	Woman
2.	MM	Subject 2 (S2)	75	Auditory	Woman
3.	TH	Subject 3 (S3)	70	Kinesthetic	Woman
			P = Author		

The three selected research subjects will follow a series of stages in this study to identify their difficulties in solving HOTS questions on the material of probability and obtain scaffolding that suits their respective learning styles. The first stage is the provision of HOTS test questions which are carried out individually. The HOTS questions used can be seen in Figure 1.


HOTS MATHEMATICS QUESTION SHEET

INSTRUCTION

1. Read the following questions carefully and thoroughly.
2. Processing time 30 minutes.
3. Work individually.
4. Write down what is known, what is asked, and the conclusion in your answer.

1. Damian and his friends participate in a picket lottery at school. In the lottery, there are two types of picket duties, namely sweeping (M) and erasing the blackboard (H). Damian also randomly draws a classroom number from another box containing class numbers from 1 to 6, where each number has an equal chance of being drawn. If Damian draws picket duties and classroom numbers 60 times, what is the expected frequency of sweeping picket duties and even classroom numbers?

Figure 1. HOTS Question Sheet

Subjects worked on the above questions within 30 minutes. After that, the results of the work were analyzed to identify the types of difficulties experienced and determine the form of scaffolding that suits each learning style. The following is a description of the difficulties experienced by each subject in completing HOTS questions on the material of probability, along with the scaffolding provided.

Description of Students' Difficulties in Solving HOTS Questions on Probability Material

Description of S1 Difficulties

Based on the results of the HOTS test, subject S1 experienced difficulties in the transformation stage, as indicated by errors in multiplying each opportunity by 60 separately. In addition, S1 also experienced difficulties in process skills, as seen from errors in the calculation steps, namely multiplying individual results (30 × 30). The subject made an error by first multiplying each opportunity by 60, then multiplying the two results, resulting in a final result of 900. This error can be seen in S1's work shown in Figure 2.

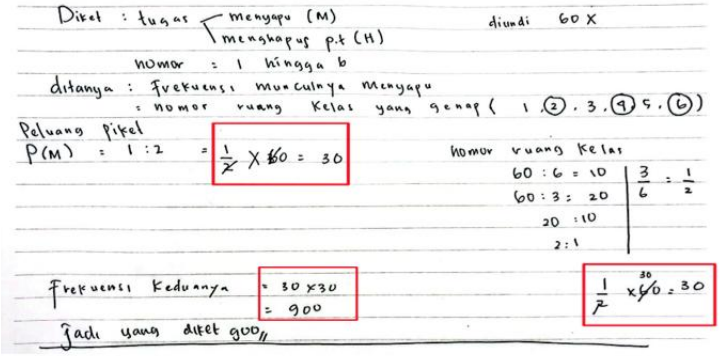


Figure 2. Results of S1 Work

Description of S2 Difficulties

Based on the results of the HOTS test, subject S2 experienced difficulties in process skills, which were indicated by inaccuracy in modeling mathematical problems and errors in calculating probability operations. S2 wrote the probability of an event as $\frac{30}{60}$, whereas the probability of an even-numbered classroom should be $\frac{3}{6}$ or simplified to $\frac{1}{2}$. Furthermore, S2 made an error in calculating the result of the probability multiplication, namely writing $\frac{1}{2}\ x\ \frac{1}{2} =$ 1, whereas the result should be $\frac{1}{4}$. This error is seen in S3's work shown in Figure 3.

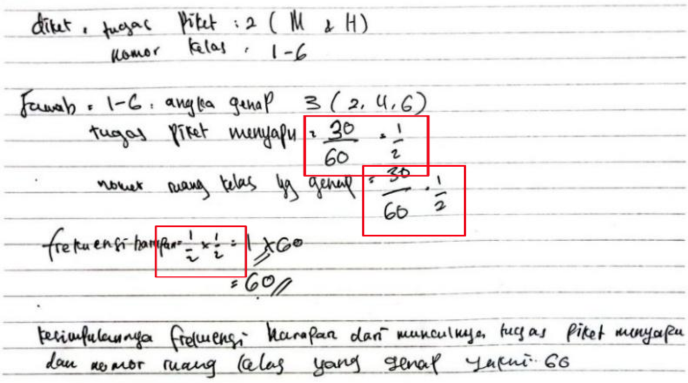


Figure 3. Results of S2 Work

Description of S3 Difficulties

Based on the results of the HOTS test, subject S3 had difficulty in performing the transformation, which was indicated by an error when multiplying each probability by 60 separately. In addition, S3 also had difficulty in process skills, which was seen from an error in the calculation steps, namely by adding up the individual results (30 + 30), not multiplying the specified probabilities. This error is seen in S3's work shown in Figure 4.

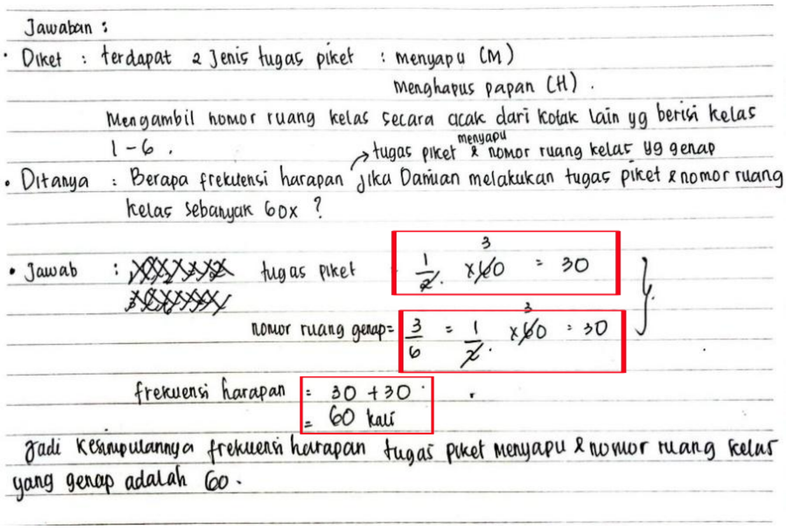


Figure 4. Results of S3 Work

Description of Providing Scaffolding to Overcome Students' Difficulties in Solving HOTS Questions on Probability Material

Scaffolding for S1 Based on Visual Learning Styles

The provision of scaffolding to subject S1 is based on the type of difficulty experienced in solving HOTS questions, and is adjusted to the learning style he has. S1 experienced difficulties in the transformation stage, which indicates that the subject has not understood how to convert opportunities to expected frequencies correctly. In addition, S1 also experienced difficulties in process skills, which are related to errors in the calculation steps. The scaffolding provided is as follows:

1. Show errors with a table (printout)

Table 2. Scaffolding S1

Wrong answer	Correct answer√
$\frac{1}{2}\ x\ 60 = 30$	$P(M) = \frac{1}{2}$
$\frac{1}{2}\ x\ 60 = 30$	$P(even\ class) = \frac{1}{2}$
$30\ x\ 30 = 900$	$P(M \cap even\ class) = P(M)\ x\ P(even\ class)$ $\frac{1}{2}\ x\ \frac{1}{2} = \frac{1}{4}$
	$F = \frac{1}{4}\ x\ 60 = 15$

P : "Look at this table. What is the difference between your answer and the correct answer?"

S1 : "The difference is that the uncolored text is multiplied by 60 in each opportunity and then the results are multiplied, while the colored text is the first and second opportunities multiplied first and then multiplied by 60."
P : "Why are the final results so different?"
S1 : "Because you multiply them separately, so the result is more."
P : "How should you calculate it?"
S1 : "The first and second opportunities should be multiplied first and then multiplied by 60."

2. Visual analogy
P : "Imagine you have two lottery boxes. One for the duty of cleaning, the other for the class number, the chance of taking the task of sweeping is half of all the tasks, the chance of taking an even class number is half of all the tasks, if we combine the two chances, we take half of the half, so it becomes a quarter."
S1 : "Oh yeah, Sis."
Ask students to explain again in their own words.
P : "Please explain again how to calculate it correctly. According to the colored steps earlier."
S1 : "So the correct answer is the steps like this, the first is to determine the probability of being on duty first, it's $\frac{1}{2}$, then the probability of the class number is also $\frac{1}{2}$, so multiply it first $\frac{1}{2}\ x\ \frac{1}{2} = \frac{1}{4}$, then multiply it by how many times it was drawn, it's 60, so $\frac{1}{4} x\ 60 = 15$."
P : "Please do the problem again on a new piece of paper."
S1 : (*Working on the problem again*).

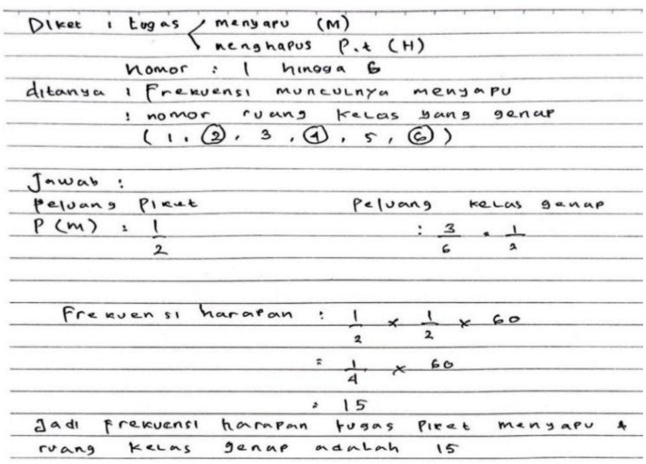


Figure 5. Results of S1 Repair

Scaffolding for S2 Based on Auditory Learning Style

The provision of scaffolding to subject S2 is based on the type of difficulty experienced in solving HOTS problems, and is adjusted to the learning style he has. S2 has difficulty in process skills, especially in changing the information contained in the problem into an appropriate mathematical model. In addition, he also made mistakes in performing probability operations, such as in the process of multiplying two simple probabilities. The scaffolding provided is as follows:

1. Reflective questions to trigger understanding
P : "Try to mention again, how many class numbers are even?"

S2 : "What do you mean, Sis."
If the student is confused or wrong, ask again more simply:
P : "Numbers 1 to 6, which ones are even?"
S2 : "2, 4, 6."
After the student answers 2, 4, and 6, continue with the question:
P : "Out of a total of 6 numbers, how many are even?"
S2 : "There are 3."
If the student answers 3, continue:
P : "So how should the probability be written?"
S2 : "$\frac{3}{6}$, Sis."

2. Provide Correction for Errors in Calculation of Expected Frequency
P : "Earlier you calculated $\frac{1}{2}\ x\ \frac{1}{2} = 1$, then multiplied by 60 to get 60. Let's think again, why is that?"
If students are confused, researchers can direct them:
P : "What is the probability that $\frac{1}{2}$ will result?"
S2 : "Hmmm." (Thinking)
If students are still unsure, researchers can explain:
P : "How much should half of half be?"
S2 : "$\frac{1}{4}$, Sis."
After students answer $\frac{1}{4}$ continue:
P : "Now, let's multiply it by 60. What is the result?"
S2 : "15, Sis?"
P : "Yes, that's right."
The students finally realize the answer should be 15, not 60.

3. Ask students to explain again
P : "Now try to explain, how to find the probability of an even class number correctly, and how to calculate the correct expected frequency?"
S2 : "So in the question, one of the class numbers is known from 1 to 6, then only even numbers are asked, well, 3 out of 6 numbers are even, so the probability is $\frac{3}{6}$ simplified to $\frac{1}{2}$, calculating the expected frequency is done by multiplying the two opportunities and then multiplying them again by the total draw, Sis."
P : "Please, do the question again on a new paper."
S2 : "Okay, ready, Sis."

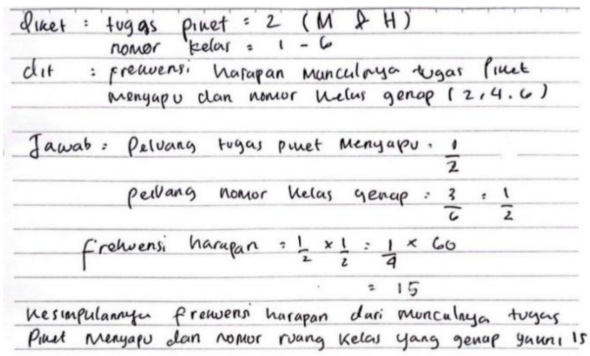


Figure 6. Results of S2 Repair

Scaffolding for S3 based on Kinesthetic Learning Style

The provision of scaffolding to subject S3 was based on the difficulties experienced in solving HOTS questions and was adjusted to his learning style. S3 had difficulty in the transformation stage, which indicated that the subject did not understand how to convert opportunities into expected frequencies correctly. In addition, S3 also made mistakes in process skills, indicated by adding up individual results, not multiplying the available opportunities. The scaffolding provided was as follows:

1. Use Coins to Show Combined Odds

   Ask students to flip a coin once and ask

   P : "What are the possible outcomes?" (Figures or numbers)

   S3 : (S3 tosses a coin and thinks about the possible outcomes) "a Figure appears, so the probability is 1 out of two or $\frac{1}{2}$."

   Now, ask students to toss a coin twice in a row.

   P : "What is the probability of getting a Figure twice?"

   S3 : (S3 tosses a coin again, and thinks about the possible outcomes). "So, $\frac{1}{2}\ x\ \frac{1}{2} = \frac{1}{4}$ of the probability, bro, if you toss it twice."

   Compare with the problem

   P : "If you understand the coin toss earlier, let's compare it to the problem you worked on. The probability of sweeping is $\frac{1}{2}$, the probability of an even class is $\frac{1}{2}$, so the combined probability is not 30 + 30, but $\frac{1}{2}\ x\ \frac{1}{2} = \frac{1}{4}$ of 60, which is 15."

2. Body movements to understand the multiplication of opportunities

   Ask students to walk forward 60 steps on the board.

   P : "Out of 60 people, only half (30) are sweeping."

   S3 : (Students move back 30 steps).

   P : "Of these 30, only half can get even classes."

   S3 : (Students move back 15 more steps)

   P : "How many are left?"

   S3 : "There are 15 left, Sis."

   P : "Now, I understand what you mean."

   S3 : "Yes, I understand, Sis."

3. Ask the students to explain again

   After the experiment, the researcher asked:

   P : "How do you calculate the combined probability correctly? And what were your previous mistakes?"

   S3 : "That's how it is, in the question there are two events that are asked, namely the appearance of a picket task and an even classroom number, so first find the probability of each, if the probability is known, the next step is to combine the two probabilities by multiplying them and then multiplying them again by the number of draws, sis. My mistake was multiplying the number of draws by the probability of the event separately, Sis, hehehe."

   P : "Please, do the problem again on a new piece of paper."

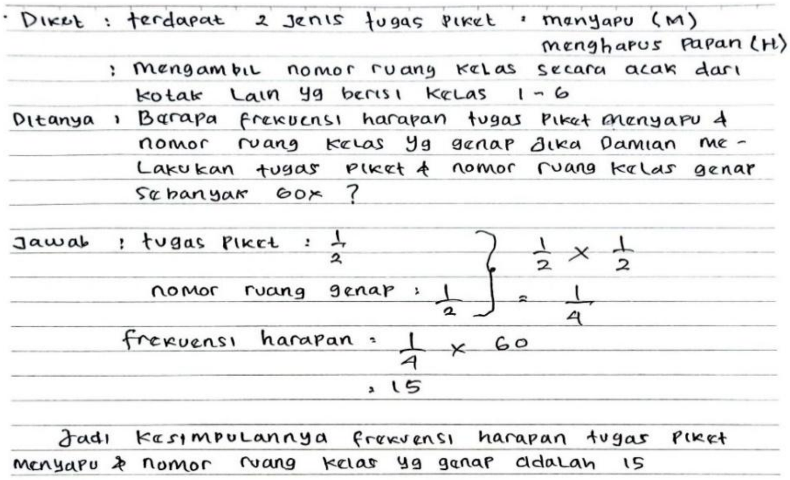


Figure 7. Results of S3 Repair

DISCUSSION

This study shows that students' difficulties in solving HOTS problems on probability material vary based on their learning styles. Visual students experience major obstacles in the aspects of transformation and process skills, such as separating information that should be combined, difficulty in arranging systematic steps, and performing calculations (Hana & Malasari, 2024; Zahro et al., 2022; Azizi et al., 2022). In contrast to (Irfan et al., 2022; Wites et al., 2022) who highlighted procedural errors, this study found that visual students' difficulties had emerged since the early stages of understanding the problem.

Auditory students also experience difficulties in process skills, especially in converting problems into mathematics models and choosing suitable solution approaches, even though they have understood the problem content (Azizi et al., 2022; Wites et al., 2022). This is contrary to the findings of Hana & Malasari (2024) who stated that auditory students do not have an understanding of the context of the problem. This means that the weakness of auditory students lies in how to process information, not in their understanding.

Meanwhile, kinesthetic students experience difficulties in both transformation and process skills, such as determining formulas, arranging steps, and performing calculations (Rihana et al., 2022; Hana & Malasari, 2024). This finding is different from (Wites et al. 2022; Buyung et al., 2023) who stated that kinesthetic difficulties occur in the early stages. This study actually shows that their main challenge lies in the process of working.

Overall, these findings emphasize the importance of scaffolding that is tailored to the characteristics of learning styles to overcome students' difficulties in solving HOTS problems on probability material. The scaffolding given to students is adjusted to the characteristics of their respective learning styles, whether visual, auditory, or kinesthetic. For students with a visual learning style, scaffolding is focused on the reviewing and restructuring stages (Anghileri, 2006), given their tendency to understand information through visual displays and clear structures. There is evidence from research by Khusnah et al., (2022) for this approach, where second-level scaffolding is given to students making mistakes in the transformation, e.g., writing the formula incorrectly so that the outcome of the calculation is inaccurate. There is also evidence from Laamena's study (2019) for the effectiveness of visual-based scaffolding, showing that the giving of visual scaffolding can help learners improve math problems.

Auditory learners learn best from listening to verbal descriptions. When using these in solving probability content HOTS problems, they cannot cope with process skills such as identifying components of probability and calculating probability accurately. Therefore, scaffolding focuses on the reviewing and restructuring stage (Anghileri, 2006), with the aim of helping students revisit and restructure their incorrect concept knowledge. This is the approach advocated by research by Khusnah et al., (2022), where review and restructuring scaffolding is offered to students who make mistakes in mathematical modeling. With this support, students are encouraged to represent mathematical notation and ideas in the right way, and thus information processing errors can be reduced.

Kinesthetic students understand mathematical concepts through direct experience. In the material of probability, they have difficulty transforming problems and calculating compound probability. The scaffolding provided refers to the reviewing and restructuring stages (Anghileri, 2006), with a movement-based approach, physical simulations, and trigger questions to build understanding. This study provides novelty by developing scaffolding that is adjusted to the kinesthetic learning style in HOTS problems, which has not been widely studied in previous studies.

CONCLUSION

This study shows that students' difficulties in solving HOTS problems on probability vary depending on their learning style. Visual students have difficulties in the transformation and process skills aspects, which are overcome through scaffolding based on error visualization, imagination, and restructuring of reasoning. Auditory students have difficulties in modeling information and probability operations, so they are given assistance through oral dialogue, interpretation of thinking steps, and simplification of information auditorily. Meanwhile, kinesthetic students experience similar difficulties in transformation and process, which are assisted through physical activities, concrete simulations, and motion reflection. An advantage of this study is the integration of the scaffolding approach with students' learning style characteristics, resulting in more effective mentoring strategies. However, the limitations of this study are the limited number of subjects and the homogeneous school context, so that the results cannot be generalized widely. For future development, similar research can be conducted in different contexts and materials, and developed in the form of applicable scaffolding media or guides for teachers.

ACKNOWLEDGEMENT

The author would like to express his deepest gratitude to SMA Unggulan Hafsa for the permission, facilities, and cooperation that have been given during the implementation of this research. Thanks, are also addressed to the students who have been willing to be participants and provide valuable contributions through their participation in data collection. The participation and support from the school and students greatly assisted the smoothness and success of this research process.

REFERENCES

Agusta, E. S. (2020). Peningkatan kemampuan pemecahan masalah matematika melalui model pembelajaran berbasis HOTS. *Jurnal Riset Pembelajaran Matematika Sekolah*, *4*(1), 58-64. https://doi.org/10.21009/jrpms.041.09

Andam, E. A., Awuah, F. K., & Obeng-Denteh, W. (2023). Probability concepts: A systematic literature review of students' learning difficulties, errors and misconceptions. *East*

African Journal of Applied Sciences and Technology, *8*(2), 114-128. https://doi.org/10.37284/eajass.8.2.3008

Anghileri, J. (2006). Scaffolding practices that enhance mathematics learning. *Journal of Mathematics Teacher Education*, *9*(1), 33–52. https://doi.org/10.1007/s10857-006-9005-9

Ardani, A., & Purwaningsih, D. (2019). Analisis pengaruh gaya belajar mata kuliah aritmatika (jarimatika dan sempoa) terhadap kemampuan komunikasi matematis. *PRISMA, Prosiding Seminar Nasional Matematika, 2*, 490-497. https://journal.unnes.ac.id/sju/prisma/article/view/29041

Arum, D. P., Kusmayadi, T. A., & Pramudya, I. (2018). Students' difficulties in probabilistic problem-solving. *IOP Conference Series: Journal of Physics: Conference Series*, *983*(1), 012098. https://doi.org/10.1088/1742-6596/983/1/012098

Azizi, F. M., Imswatama, A., & Lukman, H. S. (2022). Analisis kesulitan belajar siswa dalam menyelesaikan soal matematika ditinjau dari gaya belajar. *Jurnal PEKA (Pendidikan Matematika)*, *5*(2), 43–52. https://doi.org/10.37150/jp.v5i2.1275

Bire, A. L., Geradus, U., & Bire, J. (2014). Pengaruh gaya belajar visual, auditori, dan kinestetik terhadap prestasi belajar siswa. *Jurnal Kependidikan: Penelitian Inovasi Pembelajaran*, *44*(2). https://doi.org/10.21831/jk.v44i2.5307

Buyung, M., Angkotasan, N., & Jalal, A. (2023). Kesulitan berpikir reflektif matematis siswa dalam menyelesaikan soal sistem pertidaksamaan linear dua variabel ditinjau dari gaya belajar. *Jurnal Pendidikan Guru Matematika*, *3*(2), 148-157. https://doi.org/10.33387/jpgm.v3i2.6134

Dewi, M. P., Putra, A., & Anggraini, R. S. (2023). Analisis kesulitan siswa dalam menyelesaikan soal Higher Order Thinking Skills (HOTS) pada materi bentuk aljabar. Jurnal Ilmiah Pendidikan Matematika Al Qalasadi, 7(2), 171– 179. https://doi.org/10.32505/qalasadi.v7i2.7308

Driana, E., & Ernawati, E. (2019). Teachers' understanding and practices in assessing higher order thinking skills at primary schools. *Acitya: Journal of Teaching and Education*, *1*(2), 110–118. https://doi.org/10.30650/ajte.v1i2

Faridah, E. (2019). Analisis kemampuan berpikir kritis siswa melalui soal-soal HOTS (Higher Order Thinking Skills) mata pelajaran sejarah kelas X-IPS SMAN 2 Sidoarjo. *AVATARA, e-Journal Pendidikan Sejarah*, *7*(3). https://ejournal.unesa.ac.id/index.php/avatara/article/view/29409

Fauzia, D. P., Badarudin, B., & Supriatna, S. (2019). Peningkatkan keterampilan berpikir kritis dan sikap ilmiah peserta didik melalui model inkuiri terbimbing. *Muallimuna: Jurnal Madrasah Ibtidaiyah*, *4*(2), 57– 66. https://doi.org/10.31602/muallimuna.v4i2.1860

Fitri, A., & Abadi, A. M. (2021). Kesulitan siswa SMA dalam menyelesaikan soal matematika pada materi peluang. *Jurnal Riset Pendidikan Matematika*, *8*(1), 96–105. https://doi.org/10.21831/jrpm.v8i1.17004

Hana, A. Y., & Malasari, P. N. (2024). Kesulitan belajar matematika ditinjau dari gaya belajar siswa: Systematic literature review. *Jurnal Edukasi dan Sains Matematika (JES-MAT)*, *10*(2). https://doi.org/10.25134/jes-mat.v10i2.9461

İlçin, N., Tomruk, M., Yeşilyaprak, S. S., Karadibak, D., & Savcı, S. (2018). The relationship between learning styles and academic performance in Turkish physiotherapy students. *BMC Medical Education*, *18*, 291. https://doi.org/10.1186/s12909-018-1400-2

Irfan, M. M., Safaria, S. A., & Sangila, M. S. (2022). Analisis kesulitan belajar matematika siswa konsep Teorema Pythagoras ditinjau dari gaya belajar. *Jurnal Ilmiah Pendidikan Matematika Al-Qalasadi*, *6*(2), 122–134. https://doi.org/10.32505/qalasadi.v6i2.4824

Istiqomah, A. D. (2014). Diagnosis kesulitan siswa dalam menyelesaikan soal cerita pada materi persamaan linear satu variabel dan pemberian *scaffolding* untuk mengatasinya. *MATHEdunesa*, *3*(2). https://ejournal.unesa.ac.id/index.php/mathedunesa/article/view/8645/8717

Khusnah, K., Ekawati, R., & Shodikin, A. (2022). Student’s error in solving change and relationship-PISA problem and its scaffolding. *Journal of Mathematical Pedagogy*, *4*(1), 9–20. https://doi.org/10.26740/jomp.v4n1.p9-20

Kurniawan, A. W., & Slamet, H. W. (2018). *Analisis kesulitan siswa dalam pembelajaran matematika pada materi peluang kelas X SMK Muhammadiyah 4 Surakarta tahun ajaran 2016/2017* [Skripsi, Universitas Muhammadiyah Surakarta]. UMS Eprints. https://eprints.ums.ac.id/59224/

Laamena, C. M. (2019). Strategi *scaffolding* berdasarkan gaya belajar dan argumentasi siswa: Studi kasus pada pembelajaran pola bilangan. *Barekeng: Jurnal Ilmu Matematika dan Terapan*, *13*(2), 85–92. https://doi.org/10.30598/barekengvol13iss2pp085-092ar809

Mahmudah, W. (2018). Analisis kesalahan siswa dalam menyelesaikan soal matematika bertipe HOTS berdasarkan teori Newman. *UJMC (Unisda Journal of Mathematics and Computer Science)*, *4*(1), 49–56. https://doi.org/10.35706/sjme.v7i1.6586

OECD. (2022). *Education at a glance 2022: OECD indicators*. OECD Publishing. https://doi.org/10.1787/3197152b-en

Pratiwi, N. W., Dewi, N. S., & Paramartha, A. Y. (2019). The reflection of HOTS in EFL teachers’ summative assessment. *Journal of Education Research and Evaluation*, *3*(3), 127–133. https://doi.org/10.23887/jere.v3i3.21853

Rihana, S., Sumarni, & Riyadi, M. (2022). Analisis kesulitan siswa dalam menyelesaikan soal operasi pecahan ditinjau dari gaya belajar. *SIGMA: Jurnal Pendidikan Matematika*, *14*(1), 24–32. https://doi.org/10.26618/sigma.v14i1.7023

Risnawati, R., Amir, Z., & Sari, N. (2018). The development of learning media based on visual, auditory, and kinesthetic (VAK) approach to facilitate students' mathematical understanding ability. *Journal of Physics: Conference Series*, *1028*(1), 012129. https://doi.org/10.1088/1742- 6596/1028 /1/012129

Rudyanto, H. E., Hadi, F. R., Winanto, A., Novianto, A., Hawa, A. M., Sari, Y., & Santika, M. (2019). Open ended mathematical problem solving: An analysis of elementary students’ creative thinking abilities. *Journal of Physics: Conference Series*, 1254(1), 012077. https://doi.org/10.1088/1742-6596/1254/1/012077

Saraswati, P. M. S., & Agustika, G. N. S. (2020). Kemampuan berpikir tingkat tinggi dalam menyelesaikan soal HOTS mata pelajaran matematika. *Jurnal Ilmiah Sekolah Dasar*, *4*(2), 257-269. https://doi.org/10.23887/jisd.v4i2.25336

Sugiyono. (2012). *Metode penelitian kuantitatif, kualitatif, dan R&D*. Alfabeta.

Sujadi, I., & Dhoruri, A. (2016). *Guru Pembelajar Modul Matematika SMP: Kelompok Kompetensi B Pedagogik Teori*.

Suyitno, A. (2020). Growth of student mathematical creativity as part of 4C competence for entering the 21st century. *Journal of Physics: Conference Series*, *1567*(2), 022100. https://doi.org/10.1088/1742-6596/1567/2/022100

Ueno, M., & Miyasawa, Y. (2015). Probability-based scaffolding system with fading. IEEE Access, 3, 2136–2144. https://doi.org/10.1109/ACCESS.2015.244503

Winarso, W. (2014). Membangun kemampuan berpikir matematika tingkat tinggi melalui pendekatan induktif, deduktif, dan induktif-deduktif dalam pembelajaran matematika. *EduMa: Mathematics Education Learning and Teaching*, *3*(2). https://www.syekhnurjati.ac.id/jurnal/index.php/eduma/article/view/58

Wites, R., Rahmi, & Delyana, H. (2022). Analisis kesulitan siswa menyelesaikan soal pemecahan masalah matematika ditinjau dari gaya belajar. *Inspiramatika: Jurnal Inovasi Pendidikan dan Pembelajaran Matematika*, *8*, 150–158. https://e-jurnal.unisda.ac.id/index.php/Inspiramatika/article/view/3558

Yuliani, N. D., & Najmiah, L. (2020). Students' learning strategies based on their VAK learning style. *Intensive Journal*, *3*(2), 85–95. https://doi.org/10.31602/intensive.v1i1.1869

Zahro, R. F., Sugiyanti, & Supandi. (2022). Analisis kesulitan belajar siswa pada materi dimensi tiga ditinjau dari gaya belajar siswa. *Imajiner: Jurnal Matematika dan Pendidikan Matematika*, *4*(3), 194–200. https://doi.org/10.26877/imajiner.v4i3.9463

Zulfa, H., Saputro, D. R. S., & Riyadi, R. (2018). Analysis of difficulties in mathematics learning on students with deictic gesture type in problem-solving HOTS algebra test. *Journal of Physics: Conference Series*, *1108*(1). https://doi.org/10.1088/1742-6596/1108/1/012074