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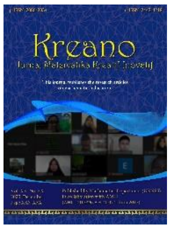

Mathematical Problem Solving in E-Learning Based on David Kolb's Learning Style

Putri Endah Wulandari[1], Akhsanul In'am[1], Zukhrufurrohmah[3]

[1]Pendidikan Matematika, Universitas Muhammadiyah Malang, Malang, Indonesia

Correspondence should be addressed to Zukhrufurrohmah:
zukhrufurrohmah@umm.ac.id

Abstract

This qualitative descriptive research aims to describe mathematical problem-solving ability in e-learning in terms of David Kolb's style study. The research subject was 54 students of Mathematics Education in the sixth semester who took the Vector Analysis course. Data collection techniques used are questionnaires, tests, and interviews. Two students from each learning style were randomly selected. Data obtained from the test results in a description analyzed and described in a narrative based on an indicator of mathematical problem-solving ability. The results showed that the assimilator learning style dominates the other learning styles. The solution of a problem mathematical for a student on the e-learning based on type assimilator learning style can be filled four phases of Polya problem solving maximally. The diverger type can only follow the necessary steps to solve the problems until they execute the strategy. Converger and accommodator types can perform the same four phases of the Polya problem-solving but must be optimized. Further research includes digging up information about learning styles outside of David Kolb and conducting observations and interviews to measure suitability with David Kolb's learning style.

Keywords: Problem-solving; e-learning; David Kolb's learning style

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Abstrak

Penelitian ini adalah penelitian deskriptif kualitatif yang bertujuan untuk mendeskripsikan kemampuan pemecahan masalah matematis pada e- learning berdasarkan dari gaya belajar David Kolb. Subjek penelitian adalah 54 mahasiswa Pendidikan Matematika semester VI yang menempuh mata kuliah Analisis Vektor. Teknik pengumpulan data yang digunakan ialah angket, tes, dan wawancara. Dua mahasiswa dari setiap gaya belajar dipilih secara acak. Data yang diperoleh dari hasil tes berbentuk uraian dianalisis dan dideskripsikan secara narasi berdasarkan indikator kemampuan pemecahan masalah matematis. Hasil penelitian menunjukkan bahwa tipe gaya belajar assimilator mendominasi tipe gaya belajar lainnya. Pemecahan masalah matematis mahasiswa pada e-learning berdasarkan tipe gaya belajar assimilator dapat memenuhi empat tahapan pemecahan masalah Polya secara maksimal. Mahasiswa dengan tipe gaya belajar diverger hanya mampu memenuhi tahapan pemecahan masalah Polya hingga pada melaksanakan strategi. Mahasiswa dengan tipe gaya belajar converger dan accomodator mampu melaksanakan empat tahapan pemecahan masalah Polya namun belum maksimal karena terdapat indikator yang belum terpenuhi. Penelitian lebih lanjut antara lain menggali informasi mengenai gaya belajar diluar David Kolb, melakukan observasi dan wawancara untuk mengukur kesesuaian dengan gaya belajar David Kolb.

INTRODUCTION

Problem-solving is one of the essential cognitive activities used in everyday life. One of the driving factors for a person's success in living his life is determined by his thinking skills, especially problem-solving skills (Zanthy, 2016). There are two types of problems in mathematics: routine and non-routine (Riffyanti & Setiawan, 2017). Non-routine problems are more complex than routine problems because they represent new events that have never been encountered before (Umrana et al., 2019; Riffyanti & Setiawan, 2017). Therefore non-routine problems require a high level of skill in interpreting the solution (Putri, 2018).

Learning about problem-solving is the spearhead of learning mathematics (Arifin et al., 2019; Fransiska et al., 2019; Umrana et al., 2019). Students must have skills in understanding a problem, such as changing the problem they understand into a mathematical model, then solving the problem and interpreting the solution obtained (Hidayat, W., & Sariningsih, 2018). According to Polya, four stages can be used in solving a problem, namely 1) Understanding a problem; 2) Making a plan to solve a problem; 3) Implementing the design, and 4) Re-check the results obtained (Kurniawan et al., 2020; Khusna et al., 2019; Aprianti et al., 2020).

Students must possess problem-solving abilities (Mariam et al., 2019). Through solving problems, students can develop ideas and build new ideas, and form skills in understanding mathematical concepts (Aprianti et al., 2020). In addition, students are also able to see the relationship between mathematics and other sciences (Mariam et al., 2019; Aprianti et al., 2020). However, the case that is often encountered today is that students can only solve the same questions as their lecturers have given them during learning (Putri, 2018; Aprianti et al., 2020). This is motivated by several factors, namely teaching styles and learning models (Oktonawiati et al., 2018; Kurniawan et al., 2020; Aprianti et al., 2020).

The existence of the Covid-19 pandemic caused learning to experience a transition. The Ministry of Education and Culture issued a policy in the form of switching learning methods from face-to-face (offline) to learning that is covered in a network (online) (Ansori & Sari, 2020; Hasrul et al., 2019). Online learning currently challenges educators to continue creating interesting learning to achieve the learning objectives that have been formulated.

E-learning (Electronic Learning) supports the development of information and communication technology to overcome these challenges (Zukhrufurrohmah et al., 2021; Putri, 2018). E-learning is an online platform-based learning model that utilizes information technology such as Zoom, Google Meet, WhatsApp, Blogs, or Websites. (Usman, 2018; Penambaian, 2020; Hasrul et al., 2019). LMS (Learning Management System) is a form of e-learning that students consider attractive (Bringula et al., 2021). E-learning is carried out by greeting students through platforms used in learning, such as LMS, Zoom Meeting, WhatsApp Group, and other applications. After that, the teacher provides instructions regarding lecture material and video links and reviews articles that follow the discussion material (Selfi & Akmal, 2021)

Some literature has shown the positive effect of e-learning from the insights of learners or students (Gautam dan Tiwari, 2016; Chang, 2016). One of them is that e-learning allows students to observe many flexible ways of learning to go to class with a much-reduced need for travel (Rawashdeh et al., 2021; Yuhanna et al., 2020). However, besides these advantages, the absence of essential personal interaction is the most obvious weakness of e-learning, not only among fellow students but also between teachers and students (Rawashdeh et al., 2021). In addition, students will also be addicted to using electronic goods.

In addition to learning models, a learning style is one variable that encourages one's learning progress. Several studies say that there are things that can influence students in accepting mathematics learning, namely learning styles (Khusna et al., 2019; Umrana et al (2019). Learning styles that can facilitate students in the learning process are learning styles of the Kolb model (Suwi et al., 2018; Khusna et al., 2019).

David Kolb emphasized that one's orientation in the learning process is influenced by four tendencies, namely concrete experience (feeling), reflective observation (watching), abstract conceptualization (thinking), and active experimentation (doing). Then from these four tendencies, Kolb formed four combinations of learning styles, namely 1) Converger, which is a combination of thinking and doing tendencies; 2) Divergent, a combination of feeling and watching tendencies; 3) Assimilator, a combination of watching and thinking tendencies, and 4) Accommodator, a combination of doing and feeling tendencies (Khusna et al., 2019; Oktonawiati et al., 2018; Azrai & Sulistianingrum, 2017).

According to several studies that have been conducted, it is proven that David Kolb's learning style influences the process of solving mathematical problems (Khusna et al., 2019). Improved mathematical problem-solving can be generated through e-learning (Rahmawati & Mulbasari, 2020). However, little research has described how students with Converger, Diverger, Assimilator, and Accommodator learning styles solve mathematical problems in e-learning. More analysis related to students' abilities and ways of solving problems in online learning settings needs to be done to gather information in designing a teaching and learning activity so that it can facilitate students during the learning process. Therefore, the formulation of the problem contained in this study is how students' mathematical problem-solving skills in e-learning are based on David Kolb's learning style. This research aims to describe the mathematical problem-solving ability in e-learning based on David Kolb's learning style.

METHOD

This research is a descriptive study with a qualitative approach that aims to describe mathematical problem-solving in e-learning based on David Kolb's learning style. The subjects of this study were 54 semesters VI students of the mathematics education department who took the Vector Analysis course online through the Learning Management System platform, elmu.umm.ac.id, and Zoom Meeting alternately. The stages carried out in this study are presented in Figure 1.

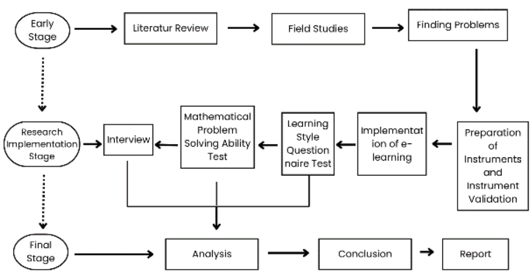

Figure 1. Research Flowchart

The data collection technique used was David Kolb's learning style questionnaire, test questions, and interviews. The questionnaire provided contains "Yes" and "No" answer choices. Furthermore, the test question sheets are in the form of non-routine question types. The instrument used has been declared valid by the validator, a lecturer in charge of the course, and another lecturer with geometry expertise who pays attention to indicators of mathematical problem-solving ability. The interview subjects were randomly selected by two students as representatives of each learning style.

The data obtained from the results of David Kolb's learning style questionnaire were analyzed quantitatively for each tendency that forms a particular learning style, which is classified into 4 (four) types, namely Diverger, Accommodator, Assimilator, and Converger. The four types of learning styles and the tendencies of each type are presented in Figure 2.

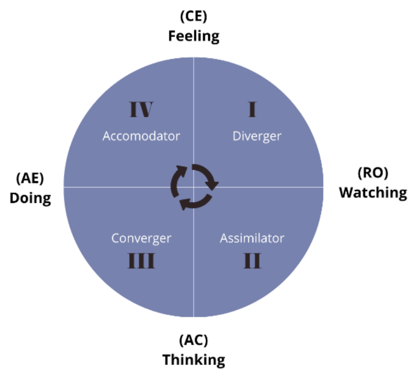

Figure 2. David Kolb's Types of Learning Styles and Domain Predispositions

The results of the work on the test questions were analyzed based on the achievement of the indicators of solving mathematical problems shown in Table 1.

Table 1. Indicators and guidelines for problem-solving assessment

Polya's problem-solving stage	Indicators
Understanding the Problem	Disclose data that is known and ask about the problems found
	Explain the problem in your own sentences
Planning Strategy	Simplify the problem
	Search for sub-goals
	Sort information
Implement Strategy	Interpret the problem in the form of a mathematical sentence
	Implement the strategy during the process and calculations take place.
Check again	Read the question back
	Check all information and calculations.
	Draw conclusions
	Ask yourself if the question has been correctly answered.

RESULTS AND DISCUSSION

Results

Learning in this study was carried out online through the Learning Management System (LMS) platform, elmu.umm.ac.id, and Zoom Meetings alternately. Discussion activities were carried out on the LMS platform and elmu.umm.ac.id. In carrying out this discussion, students were given material and problems regarding the Vector Analysis course. Students who are members of the platform are allowed to ask questions, provide answers, and express opinions (agree/disagree) on the answers or opinions of other friends. Whereas in the implementation of the Zoom Meeting class, the researcher explained the material with the help of a PowerPoint. In this lesson, students are also allowed to ask questions and express opinions. The lesson takes place for a duration of 40 minutes.

Taking research subjects to fill out the David Kolb learning style questionnaire, namely semester VI students of mathematics education at the Faculty of Teacher Training and Education, University of Muhammadiyah Malang, who are taking the Vector Analysis course on July 19, 2021, with a total of 54 students. The questionnaire is filled in individually via the Google form link[1]. David Kolb's learning style questionnaire consists of 40 statements which have been divided into four types of learning style tendencies. The data obtained from the results of David Kolb's learning style questionnaire were analyzed by adding up the "Yes" answers for each type of learning style, namely The Converger type, a combination of thinking and doing tendencies. The Divergent type is a combination of feeling and watching tendencies. Assimilator types are a combination of watching and thinking tendencies. The Accommodator type is a combination of doing and feeling tendencies.

The results of the classification of student learning styles can be seen in Table 2.

Table 2. Result Classification of Learning Styles David Kolb

Learning Style	Number of Students
Assimilator	32
Accommodation	2
Diverger	7
Converger	9
Beyond David Kolb	4

Based on the results of filling out David Kolb's learning style questionnaire on 54 students, it was found that 32 students dominantly entered the assimilator learning style group. Students who are dominant in the accommodator learning style are as many as two. Students who are dominant in the diverger learning style seven are students, and students who are dominant in the converger learning style are nine students. At the same time, the remaining four students cannot be known or are not defined in the various David Kolb learning styles because these students have the identical accumulated scores in the two types of learning styles.

If viewed from the data analysis of David Kolb's learning style questionnaire filling out, most students in the sixth semester of Mathematics Education FKIP Muhammadiyah the University of Malang have the Assimilator type of learning style. This can be proven by the number of students in the assimilator learning style type more than the number of students in the other David Kolb learning style types. Thus, students are more likely to learn through observation, doing, and thinking with various presentations from various sources.

After students are classified into each type of learning style, they are given tests in the form of non-routine descriptions to determine and describe students' mathematical problem-solving. The test will be given on 30 July 2023 through the elmu.umm.ac.id platform after the Zoom Meeting class ends. Then 2 subjects were

[1] https://forms.gle/T1Ah3x2xtqdZfbkg8

randomly selected from each learning style to be analyzed based on indicators of mathematical problem-solving. The results of this analysis were strengthened by the results of interviews conducted by researchers through the Zoom Meeting platform after the subjects completed the test questions.

Discussion

Assimilator Learning Style

In this study, there were two subjects with the codes (MAS1) and (MAS2) who had similarities in answering the questions, so the researcher only wrote down the test answers from subject MAS1. Test question number 1 is presented in Figure 3. The results of the MAS_1 written test on question number 1 is presented in Figure 4.

Based on David Kolb's learning style theory, the assimilator type learning style is a learning style based on abstract conceptualization (AC) and reflective observation (RO) or, in other words, a combination of thinking and observation (Oktonawiati et al., 2018). This allows students with the type of assimilator learning style to understand the concepts of the problems given. In Figure 3, with numbering 1, it can be seen that MAS_1 can understand the problem by disclosing known data and asking about the problems found. Based on the interview, MAS_1 can also express these problems using his own words. Through the abstract conceptualization (AC) stage, students with the assimilator learning style type can act in a structured manner and develop an idea and theory to solve a problem (Mahayukti et al., 2021). In Figure 4 with number 2, MAS_1 can simplify problems, find subgoals, and sort information.

Students with the assimilator learning style type can manipulate abstract things, such as symbols contained in mathematics (Mahayukti et al., 2021). This interest is motivated by the learning process of assimilator students at the abstract conceptualization stage. So that in this study, students with the type of assimilator learning style could interpret problems in the form of mathematical sentences. The truth of this statement is supported by Figure 4. In addition, learning that goes through the abstract conceptualization stage makes assimilator students careful in analyzing an idea they find so that the subject can carry out strategies during the calculation process. The learning process that goes through the reflective observation stage allows students with the assimilator learning style to reflect on what has been understood, planned, and implemented in solving a problem. So, in Figure 4, with numbering 3, it can be seen that MAS_1 can write the conclusions correctly.

The results of this study are relevant to research from Hanalia (2017), which states that students with the assimilator learning style type can solve problems with the four stages of Polya problem solving, namely understanding the problem, planning strategies, implementing strategies, and re-examining. Research conducted by Kablan & Uğur (2021) also states that students with an assimilator learning style in solving non-routine math problems are more successful than other types of David Kolb's learning styles. However, both of them contradict the results of other studies, which state that students with the assimilator type of learning style are only able to solve problems up to the planning strategy stage (Ratnaningsih et al., 2019; Rokhima et al., 2019).

Diverger Learning Styles

The divergent learning style is a learning style based on concrete experience (CE) and reflective observation (RO) or, in other words, a combination of feelings and observations (Oktonawiati et al., 2018). The results of the MD_1 written test on question number 1 is presented in Figure 5.

Figure 5, with numbering one, shows that MD_1 can understand the problem by expressing known and asked data from the problems found and being able to explain in his own words. Based on the interview, MD_1 had found almost the same questions before, so he did not find it difficult to understand the problem. This is in line with (Soraya et al., 2020) that students who learn through the concrete experience (CE) stage tend to reflect on the experiences they have experienced. It also affects MD_1 in planning strategy. So, if viewed based on Figure 5 with numbering two and the interviews conducted in this study, students with a divergent learning style type can simplify a problem, find sub-goals, and sort information correctly.

According to Hanalia (2017), students with divergent learning style types learn through the reflective observation stage, where at this stage the divergent students will focus on understanding the meaning of mathematical ideas. In Figure 5 with number 2, it can be seen that MD_1 can interpret the problem in the form of a mathematical sentence. However, in this study, MD_1 has yet to be able to fulfill the indicators of carrying out the strategy optimally because it experienced a calculation error. This error can be seen in Figure 5 with number 4, where $\int(-e^{-t}-1)dt$ should be $\left(\frac{1}{e^t}-t+C\right)$, but MD_1 gets the result (e^t-1+C). So that MD_1 gets the wrong solution or answer.

Based on the interview, MD_1 felt confused about finding the value of e and was unable to reduce the integral, so during the calculation process, and concluding there were errors. In addition, MD_1 also feels that there needs to be more time to re-examine the problem-solving that has been done. This research is relevant to Eko et al. (2016) and Rokhima et al. (2019), who state that divergent students need more time to fulfill the re-examination indicator.

Converger Learning Styles

There are two subjects, namely with codes (MC1) and (MC2) which have similarities in answering tests of mathematical problem-solving abilities. The results of the MC_1 written test on question number 1 is presented in Figure 6.

The converger type learning style is a learning style based on abstract conceptualization (AC) and active experimentation (AE) or in other words a combination of thinking and acting (Soraya et al., 2020). This allows students with a converger learning style to gain a conceptual understanding of the problems given. Figure 6 with numbering 1 represents an understanding of the MC_1 problem by disclosing the known data and what questions is given to the problems found and being able to convey them using their sentences.

In Figure 6 with number 2 (see appendix), MC_1 can search for sub-goals and sort information. Supported by the results of the interviews that have been conducted, MC_1 is also able to simplify the problems found. So students with a converger learning style are able to make conceptual and structured plans. This is in line with (Mahayukti et al., 2021), who state that through the abstract conceptualization (AC) and active experimentation (AE) stages, students with the converger learning style type can act in a structured manner and are capable of developing an idea and theory to complete a problem. However, the search for the right subgoals did not make MC_1 able to execute the strategy well. Searching for the value of A in Figure 6 with numbering four should yield the result $\left(\frac{3}{2}-\frac{1}{4e^2}\right)$, while the result of the MC_1 calculation is $A=\frac{1}{2}-\frac{1}{4e^2}$.

According to Wicaksono et al., (2021), this was because students needed to be more careful in the calculation process. Hence, they experienced errors or did not lead to the correct solution, unlike the test results in question number 2. In the results of test number 2, MC_1 has yet to fully fulfill the stages of planning a strategy. Test question number 2 is presented in Figure 7. Whereas in Figure 8, the rectangle is marked with a red border, it can be seen that MC_1 cannot fulfill the indicator of finding sub-objectives. The first sub-goal to be sought in problem number 2 is to find $\vec{F}(t)$, substituting $t=0$ or $t=90$ to $\vec{F}(t)$. Meanwhile, MC_1 directly substitutes the example $t=0$ to $\vec{r}(t)$.

When viewed from the results of the interviews, MC_1 felt that he had never found a similar problem, so he had difficulty finding sub-objectives to solve the problem. This is in line with the research results of Ratnaningsih et al., (2019) which state that students with a convergent learning style are still not optimal in the strategy planning stage. According to Mahayukti et al., (2021), this was motivated by a lack of understanding of the concept and a lack of examples and exercises of similar questions. In this study, students with a converger learning style wrote inaccurate conclusions. This was because the two subjects needed help in carrying out the previous stage (Eko et al., 2016).

Accommodator Learning Styles

There are two subjects, namely with the codes (MAC1) and (MAC2) which have similarities in answering tests of mathematical problem-solving ability, so the researcher only writes down the test answers from subject MAC_1. The results of the MAC_1 written test on question number 1 is presented in Figure 9.

The accommodator-type learning style is a learning style based on concrete experience (CE) and active experimentation (AE) or, in other words, a combination of feelings and actions (Oktonawiati et al., 2018). So in Figure 9, with numbering one and the results of the interviews conducted, MAC_1 can reveal known and asked data from the problems found and able to explain in their sentences. In addition, MAC_1 is also able to plan strategies by finding sub-goals, sorting information, and simplifying problems. This statement is represented in Figure 9 with numbering 2. However, in implementing the strategy, MAC_1 is only able to interpret the problem in the form of a mathematical sentence because MAC_1 makes a calculation error.

The error shown in Figure 9 (see appendix) is four circled in red, which should result from $\int(e^{-2t})dt=-\,(2e^{2t})^{-1}$. Based on the interviews, subjects with the accommodator learning style type are in a hurry to re-examine the results of the calculations and have yet to understand the concept fully. So the results of this study are relevant to Ratnaningsih et al. (2019), who state that students with the accommodator learning style type can do calculations, but there are still errors. This is due to a need for examples in working on similar questions (Mahayuktietal., 2021). Other research that is in line with this research also states that students with the accommodator learning style type make mistakes in calculations and do not double-check (Winarso & Toheri, 2021)

If viewed from the data obtained, students with the accommodator learning style type can only carry out indicators, check all information and calculations, and ask themselves whether the questions have been answered correctly. So this research is relevant to Hanalia (2017), who states that accommodator students have yet to be able to carry out the re-examination stage fully. In line with that, other studies also state that students with the accommodator type of learning style are unlikely to reach the re-examining stage (Ratnaningsih et al., 2019).

Research Findings

According to previous research, students with the assimilator learning style type have yet to be able to reflect optimally on Polya's problem-solving process due to limited time to solve problems (Apiati & Hermanto, 2020). However, based on the results of this study, students with the assimilator learning style could solve problems using the four stages of Polya problem solving, namely understanding the problem, planning a strategy, implementing the strategy, and checking again. The results of this study are relevant to other research, which states that students with the assimilator learning style type can fulfill all indicators in Polya problem-solving (Widyaningsih & Chasanah, 2020).
However, based on the results of this study, students with the assimilator learning style could solve problems using the four stages of Polya problem solving, namely understanding the problem, planning a strategy, implementing the strategy, and checking again. The results of this study are relevant to other research, which states that students with the assimilator learning style type can fulfill all indicators in solving Polya problems.

Implications

Further research related to solving mathematical problems in e-learning includes (1) Extracting information about learning styles that are beyond David Kolb's learning style, (2) Observation of student learning styles that encourages the truth of learning styles in each student, (3) Conduct further interviews to measure suitability with David Kolb's learning style.

Limitations

The limitation of this study is the need for more references regarding the elaboration of learning styles outside of David Kolb, so researchers have not been able to describe the learning styles outside of David Kolb fully. In addition, the observations made by researchers were only through online learning. So, the limitations of these places make researchers unable to observe optimally to encourage the truth of learning styles in each student.

CONCLUSION

Solving students' mathematical problems in e-learning based on the type of assimilator learning style can fulfill the four stages of Polya's problem-solving. Students with the type of divergent learning styles are only able to fulfill the Polya problem-solving stages up to implementing strategies. Students with converger and accommodator learning styles can carry out the four stages of solving the Polya problem but are not optimal because there are indicators from several stages that still need to be fulfilled.

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Appendix

1. Diketahui percepatan vektor fungsi didefinisikan dengan $e^{-2t}\hat{\imath} + e^{-t}\hat{\jmath}$. Vektor kelajuan dari vektor fungsi tersebut ketika $t = 0$ adalah $< -1, -2, 1 >$, sedangkan vektor fungsi ketika $t = 1$ adalah vektor $\hat{\imath} - \hat{k}$. Tentukan vektor fungsi tersebut.

Figure 3. Test Question Number 1

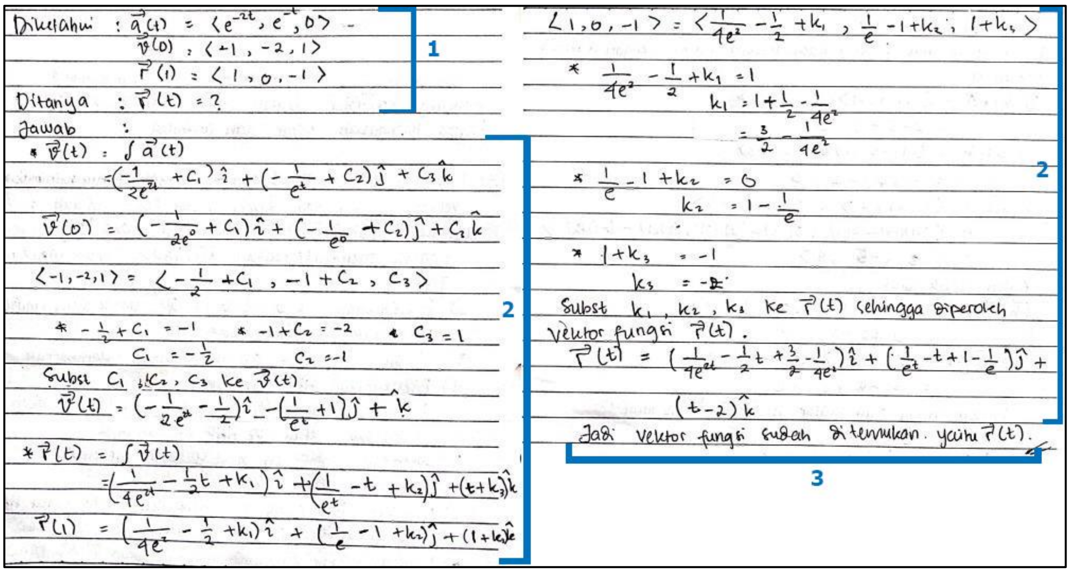
Diketahui : $\vec{a}(t) = \langle e^{-2t}, e^{-t}, 0\rangle$
$\vec{v}(0) = \langle -1, -2, 1\rangle$
$\vec{r}(1) = \langle 1, 0, -1\rangle$
Ditanya : $\vec{r}(t) = ?$
Jawab :
* $\vec{v}(t) = \int \vec{a}(t)$
$= (\frac{-1}{2e^{2t}} + C_1)\hat{i} + (-\frac{1}{e^t} + C_2)\hat{j} + C_3\hat{k}$
$\vec{v}(0) = (-\frac{1}{2e^0} + C_1)\hat{i} + (-\frac{1}{e^0} + C_2)\hat{j} + C_3\hat{k}$
$\langle -1,-2,1\rangle = \langle -\frac{1}{2} + C_1, -1 + C_2, C_3\rangle$
* $-\frac12 + C_1 = -1$, $C_1 = -\frac12$ * $-1 + C_2 = -2$, $C_2 = -1$ * $C_3 = 1$
Subst C_1, C_2, C_3 ke $\vec{v}(t)$
$\vec{v}(t) = (-\frac{1}{2e^{2t}} - \frac12)\hat{i} - (\frac{1}{e^t} + 1)\hat{j} + \hat{k}$
* $\vec{r}(t) = \int \vec{v}(t)$
$= (\frac{1}{4e^{2t}} - \frac12 t + k_1)\hat{i} + (\frac{1}{e^t} - t + k_2)\hat{j} + (t + k_3)\hat{k}$
$\vec{r}(1) = (\frac{1}{4e^2} - \frac12 + k_1)\hat{i} + (\frac1e - 1 + k_2)\hat{j} + (1 + k_3)\hat{k}$
$\langle 1,0,-1\rangle = \langle \frac{1}{4e^2} - \frac12 + k_1, \frac1e - 1 + k_2, 1 + k_3\rangle$
* $\frac{1}{4e^2} - \frac12 + k_1 = 1$
$k_1 = 1 + \frac12 - \frac{1}{4e^2}$
$= \frac32 - \frac{1}{4e^2}$
* $\frac1e - 1 + k_2 = 0$
$k_2 = 1 - \frac1e$
* $1 + k_3 = -1$
$k_3 = -2$
Subst k_1, k_2, k_3 ke $\vec{r}(t)$ sehingga diperoleh vektor fungsi $\vec{r}(t)$.
$\vec{r}(t) = (\frac{1}{4e^{2t}} - \frac12 t + \frac32 - \frac{1}{4e^2})\hat{i} + (\frac{1}{e^t} - t + 1 - \frac1e)\hat{j} + (t-2)\hat{k}$
Jadi vektor fungsi sudah ditemukan, yaitu $\vec{r}(t)$.

Figure 4. MAS_1's Written Test Result at Problem Number 1

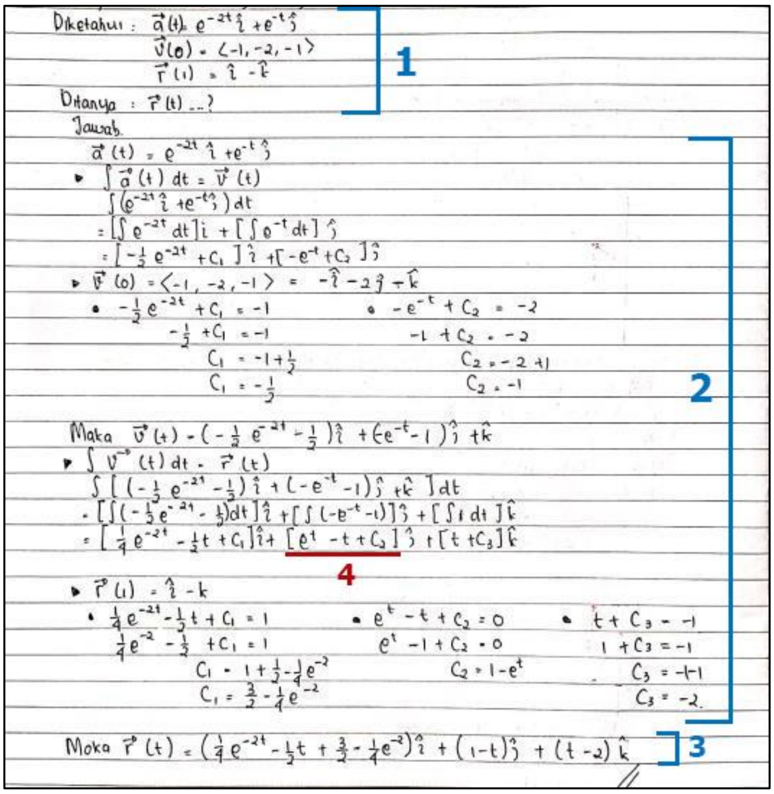
Diketahui : $\vec{a}(t) = e^{-2t}\hat{i} + e^{-t}\hat{j}$
$\vec{v}(0) = \langle -1,-2,-1\rangle$
$\vec{r}(1) = \hat{i} - \hat{k}$
Ditanya : $\vec{r}(t)$ ...?
Jawab.
$\vec{a}(t) = e^{-2t}\hat{i} + e^{-t}\hat{j}$
• $\int \vec{a}(t)\,dt = \vec{v}(t)$
$\int (e^{-2t}\hat{i} + e^{-t}\hat{j})\,dt$
$= [\int e^{-2t}dt]\hat{i} + [\int e^{-t}dt]\hat{j}$
$= [-\frac12 e^{-2t} + C_1]\hat{i} + [-e^{-t} + C_2]\hat{j}$
• $\vec{v}(0) = \langle -1,-2,-1\rangle = -\hat{i} - 2\hat{j} - \hat{k}$
• $-\frac12 e^{-2t} + C_1 = -1$ • $-e^{-t} + C_2 = -2$
$-\frac12 + C_1 = -1$ $-1 + C_2 = -2$
$C_1 = -1 + \frac12$ $C_2 = -2 + 1$
$C_1 = -\frac12$ $C_2 = -1$
Maka $\vec{v}(t) = (-\frac12 e^{-2t} - \frac12)\hat{i} + (e^{-t} - 1)\hat{j} + \hat{k}$
• $\int \vec{v}(t)\,dt = \vec{r}(t)$
$\int [(-\frac12 e^{-2t} - \frac12)\hat{i} + (-e^{-t} - 1)\hat{j} + \hat{k}]\,dt$
$= [\int(-\frac12 e^{-2t} - \frac12)dt]\hat{i} + [\int(-e^{-t}-1)]\hat{j} + [\int 1\,dt]\hat{k}$
$= [\frac14 e^{-2t} - \frac12 t + C_1]\hat{i} + [e^t - t + C_2]\hat{j} + [t + C_3]\hat{k}$
• $\vec{r}(1) = \hat{i} - \hat{k}$
• $\frac14 e^{-2t} - \frac12 t + C_1 = 1$ • $e^t - t + C_2 = 0$ • $t + C_3 = -1$
$\frac14 e^{-2} - \frac12 + C_1 = 1$ $e^t - 1 + C_2 = 0$ $1 + C_3 = -1$
$C_1 = 1 + \frac12 - \frac14 e^{-2}$ $C_2 = 1 - e^t$ $C_3 = -1-1$
$C_1 = \frac32 - \frac14 e^{-2}$ $C_3 = -2$
Maka $\vec{r}(t) = (\frac14 e^{-2t} - \frac12 t + \frac32 - \frac14 e^{-2})\hat{i} + (1-t)\hat{j} + (t-2)\hat{k}$

Figure 5. MD_1's Written Test Result at Problem Number 1

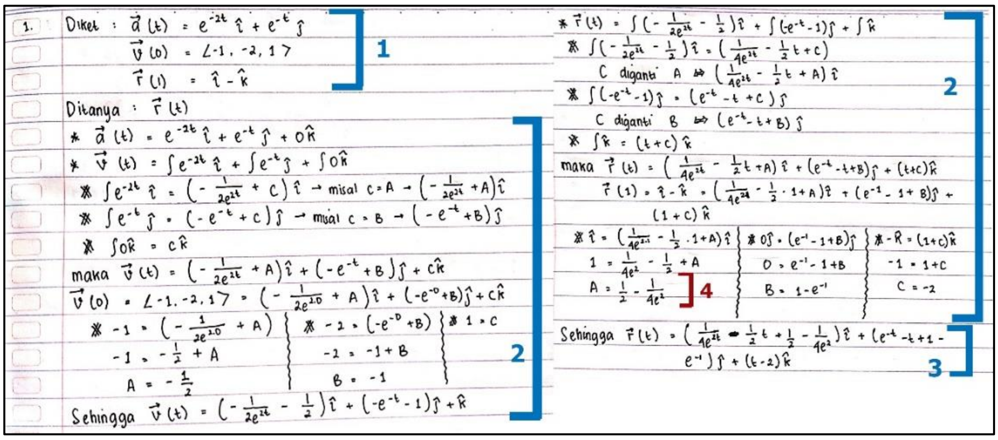

Figure 6. MC_1's Written Test Result at Problem Number 1

2. Sketch the vector function $\vec{r}(t) = 2\cos t\,\hat{\imath} + 2\sin t\,\hat{\jmath}$, then find the tangent vector at $t = \frac{5\pi}{6}$ and sketch that tangent vector.

Figure 7. Test Question Number 2

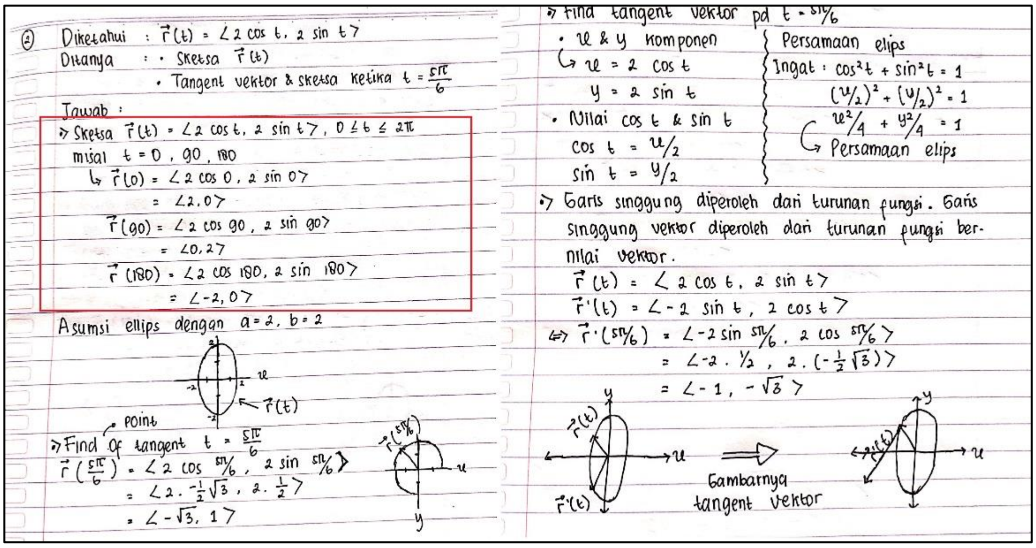

Figure 8. MC_1's Written Test Result at Problem Number 2

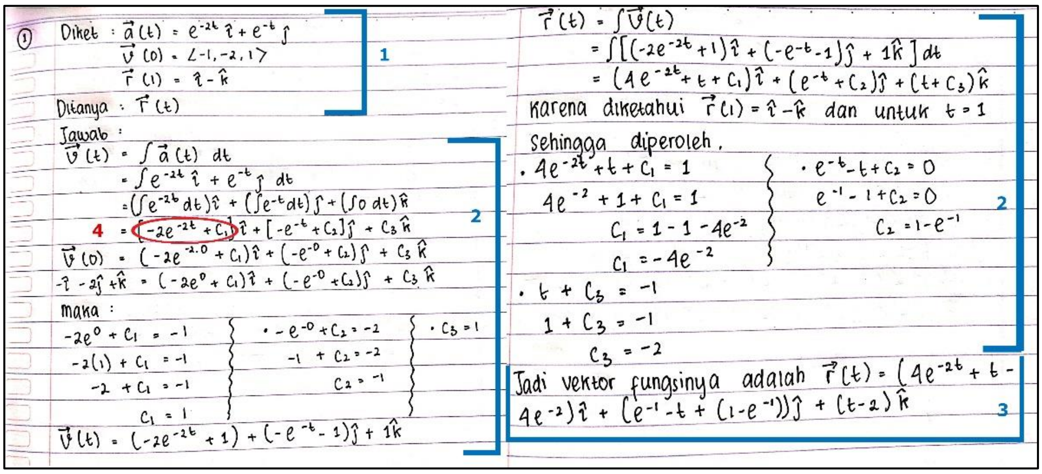

Figure 9. MAC_1's Written Test Result at Problem Number1