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Functional thinking and Kolb learning style: Case of solving linear and non-linear pattern problems

Muhammad Syawahid *, Lalu Sucipto

Mathematics Education Department, Universitas Islam Negeri Mataram, Nusa Tenggara Barat, Indonesia

* Correspondence: syawahid@uinmataram.ac.id

Abstract

Functional thinking (FT) is a part of algebraic thinking. Several studies revealed that algebraic thinking is influenced by learning style, and few studies showed FT viewed from learning style. This study aims to describe students' FT views from Kolb's learning style in solving linear and non-linear pattern tasks. The study used a qualitative approach with a case study method. It involved thirty-one students in 8th grade at an Islamic State junior high school in Mataram, West Nusa Tenggara, Indonesia. Four students were selected as research subjects for analysis of answers and interviews. The Kolb learning style inventory (KLSI) collected research data, tests, and interviews. The instrument consisted of KLSI and FT tests. Data was analyzed by reduction, presenting, and verifying. The finding showed that students with convergent, divergent, and accommodator learning styles can consist of near, far, and formal generalizations and determining inverse in FT. They represented the generalization of the relationship of two quantities symbolically. Meanwhile, students with an assimilator learning style can in FT consisting of near and far generalizations in solving figural and non-figural linear pattern tasks. They can perform formal generalizations and determine inverse-solving figural and non-figural linear pattern tasks. They are also unable to solve figural non-linear pattern tasks.

Keywords: functional thinking; generalization; Kolb learning style; linier pattern; non-linear pattern

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Introduction

Algebraic competence is essential for job and postsecondary education (NCTM, 2000). It consisted of relations among quantities, including function, mathematical relationship representation, and change analysis. A student's competence regarding and representing among amounts is called functional thinking (FT). FT is a central topic and a part of algebraic thinking to enrich students' experience in mathematics (Smith, 2008; Stephens et al., 2017).

Research in FT confirmed that elementary students can think functionally. Students in kindergarten grade performed FT by covariational, and students in first grade performed FT by correspondence (Blanton & Kaput, 2004). They can generalize the relationship of two quantities in different ways (Tanıslı, 2011) and communicate thinking skills verbally and symbolically (Warren et al., 2006).

FT research in Indonesia revealed that male and female students generalize the relationship of two quantities similarly by trial and error (Siregar et al., 2017). Elementary school students could FT consisting of recursive-verbal, correspondence-verbal, and recursive to correspondence-symbolic (Syawahid, 2022). Meanwhile, junior high school students performed FT consisting of formal correspondence, inductive correspondence, recursive to formal correspondence, and deductive correspondence (Syawahid, 2021).

Most previous research has not examined one factor in how students obtain information in learning that contributes to mathematics learning achievement. One factor that influences mathematics learning achievement is learning style (Ganesen et al., 2020; Orhun, 2007; Sujadi et al., 2019). Learning style refers to how students get and organize information (DePorter & Hernacki, 2000). It plays a significant role in students' success in learning (Ganesen et al., 2020) and influences students in learning activities (Akinyode & Khan, 2016).

The researcher intends to continue the previous study of junior high school students' FT viewed from students' Kolb learning style. Kolb (1984) described that students have a learning tendency consisting of concrete experiments involving feeling, reflective observation involving watching, abstract concepts involving the king, and active experiments involving doing. From this learning tendency, Kolb (1984) classified four learning styles: divergent, as a combination of concrete experiment and reflective observation; assimilator, as a combination of reflective observation and abstract conceptual, convergent as a combination of the abstract conceptual and active experiment;; and accommodators as a combination of active experiment and concrete experiment.

Several studies reported that Kolb's learning style influences mathematics achievement (Abosalem, 2013; Ganesen et al., 2020; Sujadi et al., 2019). Sujadi et al. (2019) described that Kolb's learning style has a contribution of 25% in mathematics achievement. Ganesen et al. (2020) found that Kolb's learning style has a contribution of 57% in algebraic mathematics achievement. Some research confirmed differences in mathematics achievement between Kolb learning style types (JilardiDamavandi et al., 2011; Orhun, 2007).

In mathematical problem-solving, students with convergent and assimilator learning styles could solve problems more correctly than those with divergent and accommodator learning styles (Rahmah et al., 2022). The other study found that students with divergent and assimilator learning styles can understand problems, plan a strategy, and perform calculations correctly (Ratnaningsih et al., 2019). Wicaksono et al. (2021) claimed that students with assimilator learning styles were in a medium category, which refers to solving a part of a problem and getting correct answers in problem-solving.

Based on the exposure above, few studies revealed FT as a part of algebraic thinking viewed from students' learning styles. Previous studies just revealed the difference in the algebraic achievement of students' learning styles (Ganesen et al., 2020) and described students problem-solving abilities based on learning style. Furthermore, this study aims to describe students' FT views from Kolb's learning style. It focuses on describing students' FT in solving linear and nonlinear pattern tasks. Students' FT in this study consists of near generalization, far generalization, formal generalization, and determining inverse.

Methods

This study used a qualitative approach with a case study method (Creswell, 2012). A case study method is used to conduct a detailed analysis of a few individuals (Fraenkel et al., 2012). Researchers are allowed to select subjects in detail (Cohen et al., 2000). This study described students' FT views from Kolb's learning style.

This study was conducted at an Islamic State junior high school in Mataram, West Nusa Tenggara, Indonesia. Participants consist of thirty-one eighth-grade students (10 male and 21 female). The selection of the students used purposive sampling following the study's aims. All participants were given a Kolb learning style inventory (KLSI) version 2.0 (Loo, 1999) consisting of a 12-item learning tendency and FT task. Four students selected as research subjects consist of one student with a divergent learning style (DLS), one student with an assimilator learning style (ALS), one student with a convergent learning style (CLS), and one student with an accommodator learning style (ACLS). The selected research subjects are based on their abilities in near and far generalization.

Instruments in this study consist of KLSI version 2.0 and FT test. KLSI version 2.0 consists of a 12-item statement that represents learning tendency involving concrete experiment (CE), reflection observation (RO), abstract conceptual (AC), and active experiment (AE). In each item, students must fill in four statements using a scale of 1 to 4. A scale of 4 described the most suitable learning tendency (CE, RO, AC, and AE), while a scale of 1 described the least suitable learning tendency. Furthermore, each score obtained in the learning tendency category (CE, RO, AC, and AE) is added up for each 12-item statement. The total score for each category (CE, RO, AC, and AE) is plotted according to the Kolb learning style quadrant.

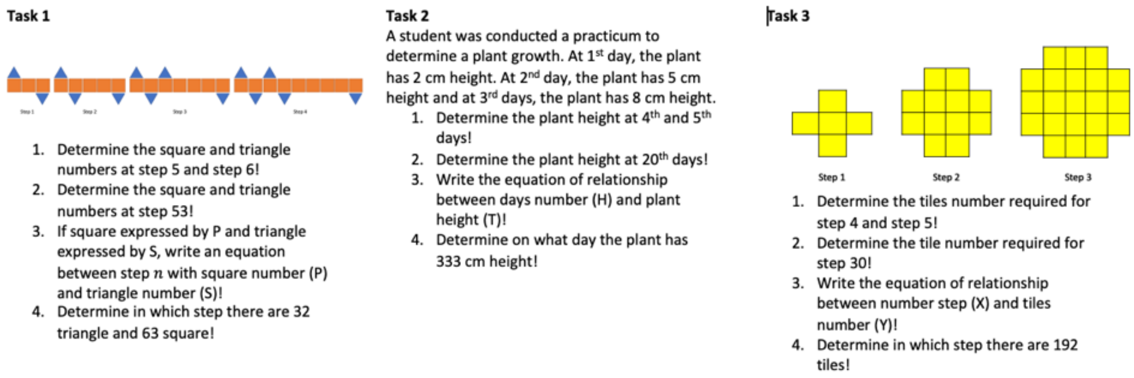

Figure 1. Functional tests

FT test consists of a figural linear pattern task, a non-figural linear pattern task, and a figural non-linear task. Each task has 4 item questions, which measure the FT indicator shown in Table 1. Figural and non-figural linear tasks were adapted from Rivera (2010), while figural non-linear tasks were adapted from Amit and Neria (2008).

Table 1. Functional thinking indicator

Indicator	Description
Near generalization	Determine the nearest quantity of the given pattern.
Far generalization	Determine a certain quantity of a given pattern.
Formal generalization	Determine the general relationship between two quantities of the given pattern by word, table, graphic, or symbol.
Determining inverse	Determine a certain quantity of independent variables of a given pattern.

Data collection in this study was carried out using a questionnaire, test, and interview. The questionnaire in this study was in the form of KLSI and was conducted to get Kolb learning style data. The test was conducted to get students' FT abilities. Meanwhile, the interview was conducted to get more information on students' clarification about their answers to the FT test. Qualitative data analysis was employed by data reduction, display data, and verification/conclusion (Miles & Huberman, 1994).

Results

This study was conducted by giving KLSI and FT tests. Based on the KLSI analysis of all participants (31 students), there are two students (6%) with divergent learning style (SDLS), four students (13%) with assimilator learning style (SALS), nine students (29%) with accommodator learning style (SACLS), and 16 (52%) students with convergent learning style (SCLS). After KLSI, participants performed the FT test consisting of a figural linear pattern task, a non-figural linear pattern task, and a figural non-linear pattern task. All tasks measured the near, far, and formal generalizations and determined the inverse. Of the 31 students, four students were taken as subject research and interviewed to get more information in-depth. These subjects were one student for each Kolb learning style.

Functional thinking students with divergent learning styles (SDLS)

In solving figural linear patterns, SDLS perform near, far, and formal generalizations and determine inverse well. She wrote answers in an orderly and systematic. Based on Figure 2 and interviews, SDLS performed formal generalization firstly to determining near and far generalization. SDLS wrote the information in task 1 (square and triangle numbers in Step 1, Step 2, Step 3, and Step 4) and observed the difference in each step. She realized that square and triangle numbers in each step have the same difference, square numbers with three differences, and triangles with one difference. For this case, SDLS used the arithmetic sequence term formula and fourth square number bases on as two subscript two $U_n = 2n + one$ and triangle number as $U_n = n + 1$. Finally, she used these formulas to determine square and triangle numbers except 53 by substituting n with 55 and 3. TSDLS used these formulas to determine the verse by substituting some numbers to get 62 square numbers and 332 triangle numbers. She got the sample number ($n = 31$) to get 62 of square number and 32 of triangle number.

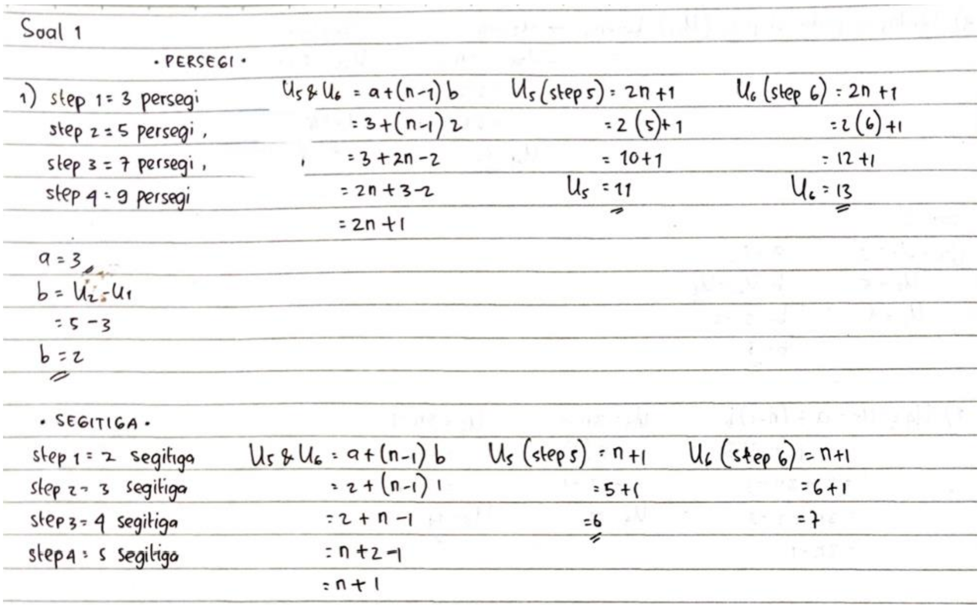

Figure 2. SDLS FT in solving figural linear pattern task

R : *"How did you get square and triangle numbers at step 5 and step 6? Could you explain?"*

SDLS : *"Firstly, I observe the figure and write square and triangle numbers in step 1 until step 4 and write them separately. I see that square and triangle numbers have the same difference and are configured in the arithmetic sequence. Finally, I use the arithmetic sequence formula to get square and triangle numbers at step 5 and step 6".*

R : *"How about square and triangle numbers at step 53? How you got it?"*

SDLS : *"Same with before, I used the formula in the first question: cap, two $U_n = 2n + 1$ for square number and $U_n = n + 1$ for triangle number. I substitute $nwith53$, and I get 107 of square number and 54 of square number".*

R : *"And then how do you determine in which step there are 32 triangles and 63 squares?"*

SDLS	:	*"I tried substituting some number in the formula before and got the same number. Namely,* $n = 31$*, then I substitute* $n = 31$ *to equal to*1 *equal to 63 and to* $U_n = n + 1$ *equal to 32.*

In solving non-figural linier pattern, SDLS used the same ways before in performing near generalization, far generalization, formal generalization, and determining inverse. Firstly, SDLS performed formal generalization using the formula of arithmetic sequence term ($U_n = a + (n-1)b$) and found the equation of plant height and days number as $U_n = 3n - 1$. Second, SDLS performed near and far generalization using the formula to get the plant height at 4th, 5th, and 20th days by substituting $n = 4, n = 5$ and $n = 20$. Third, SDLS determined inverse using the formula by substituting U_n with 333 and operated with algebraic operation to get $n = \frac{333}{3}$.

In solving figural non-linier pattern task, SDLS performed formal generalization firstly then proceeds with near generalization, far generalization, and determining inverse. In formal generalization, SDLS used the general formula of 2nd term of quadratic sequence $U_n = a + (n-1)b + \left(\frac{(n^2-3n+2)c}{2}\right)$, where $a = U_1 = 5, b = 7, c = 2$ to found the equation $U_n = n^2 + 4n$. She used the equation in performing near and far generalization by substituting n with 4, 5, and 30 to get title numbers at step 4, step 5, and step 30. The equation was also used in determining the inverse by substituting n with some number to the equation until get 192 of tiles number and found $n = 12$. To confirmed the SLDS answer, the interviews were described following.

R	:	*"How you got tiles number at step 4 and step 5? Could you explain?"*
SDLS	:	*"Firstly, I write the tiles number at step 1, step 2, and step 3 as 5,12,21 then I determine the difference. I found that the difference is different consist of 7 and 9. I decide to subtract this difference,* $9 - 7$ *and find the second difference, namely 2. Then I use the formula of quadratic sequence, namely* $U_n = a + (n-1)b + \left(\frac{(n^2-3n+2)c}{2}\right)$*, where* $a = U_1 = 5, b = 7,$ *and* $c = 2$ *and get* $U_n = n^2 + 4n$*. Finally, I substitute* $n = 4$ *and* $n = 5$ *to get tiles number at step 4 and 5".*
R	:	*"How about the tiles number at step 20? How you got it?"*
SDLS	:	*"I use same strategy with first question. I just substitute* n *with 20 to* $U_n = n^2 + 4n$ *and get 1020 of tiles number".*
R	:	*"How about 192 of tiles number? How you got in which step?"*
SDLS	:	*"I try to substitute* n *for some numbers until get 192 of tiles number and I found that at step 12, the tile has 192 numbers".*

Functional thinking students with assimilative learning style (SALS)

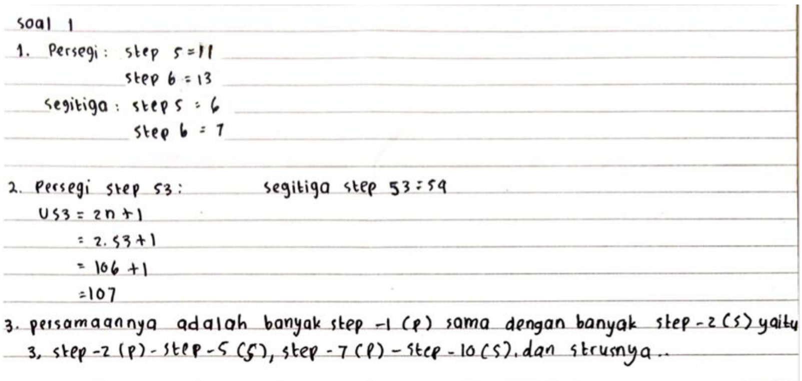

Figure 3. SALS FT in solving figural linier pattern task

Based on Figure 3 and interviews, SALS was able in performing near and far generalization in solving figural linier pattern task, but she wasn't able in performing formal generalization and determine inverse. In near generalization, SALS wrote the answer simply by writing square and triangle number for step 5 and step 6 without solution ways. Based on interview, SALS got the square and triangle number at step 5 and step 6 by adding the difference to the next step. She realized that square number always increase by 2 and triangle number always increase by 1. In this stage, SALS found the square number at step 5 by adding square number at step 4 with 2 $(9 + 2 = 11)$ and the triangle number at step 5 by adding triangle number at step 4 with 1 $(5 + 1 = 6)$. Likewise, for square number at step 6 by adding square number at step 5 with 2 $(11 + 2 = 13)$ and for triangle number at step 6 by adding triangle number at step 5 with 1 $(6 + 1 = 7)$. The following is an interview excerpt of SALS in solving figural linier pattern.

R	:	*"How you got square and triangle number at step 5 and step 6? Could you explain?"*
SALS	:	*"For square number at step 5, I add the square number before (step 4) with 2 and for step 6, I add the square number at step 5 with 2. While, for triangle number at step 5, I add the triangle number at step 4 with 1 and for step 6, I add the triangle number at step 5 with 1".*
R	:	*"How about square and triangle number at step 53? How you got it?"*
SALS	:	*"For step 53, I use the formula of n^{th} arithmetic sequence and find $U_n = 2n + 1$ for square number and $U_n = n + 1$ for triangle number. Then, I substitute n with 53 for each equation and get 107 of square number and 54 of triangle number".*
R	:	*"And then how you determine in which step there 32 triangles and 63 squares?"*
SALS	:	*"I am confused for this question and I didn't write anything for this question".*

In far generalization, SALS used the n^{th} term formula of arithmetic sequence by substituting the difference (2 for square number and 1 for triangle number) and square and triangle number at step 1. She found the general term of sequence for square number as $U_n = 2n + 1$ and for triangle number as $U_n = n + 1$. In this stage, SALS got 107 of square number at step 53 and 54 of triangle number at step 53. At formal generalization, SALS just wrote the relationship between square number at step 1 and triangle at step 2, square number at step 2 and triangle number at step 5, etc. In this stage, she doesn't understand the question in expressing the step number (step n) and square number (P) and triangle number (S).

In solving non-figural linier pattern task, SALS was able in performing near generalization and far generalization, she wasn't able in performing formal generalization and determine inverse. In near generalization, SALS observed the plant height for 1st, 2nd, and 3rd days and she found that the plant height was grown 3 cm every day. She realized that the plant height at 4th days equal to the plant height at 3rd days plus 3 cm $(8 + 3 = 11)$ and the plant height at 5th days equal to the plant height at 4th days plus 3 cm $(11 + 3 = 14)$.

In far generalization, SALS used same strategy before to get plant height at 20th days. She added the plant height by 3 cm starting from the plant height on 5th days to 20th days. This strategy was expressed in formal generalization verbally by writing that if the day increased for one day, the plant height was grown by 3cm. SALS doesn't able in expressing the relationship between days number and plant height by symbolic. She also has difficulties in determining inverse. She has an obstacle in determining in which day the plant has 333 of height. To confirmed the SALS answer, the interviews were described following.

R	:	*"How you got the plant height at 4th and 5th days? Could you explain?"*
SALS	:	*"I think the plant grown for 3 cm every day. So, I just added up the plant height at 3th by 3 cm, namely* $8 + 3 = 11$*. While for 5th days, I added up the plant height at 4th by 3cm again, namely* $11 + 3 = 14$*".*
R	:	*"How about the plant height at 20th? How you got it?"*
SALS	:	*"I added the plant height by 3 cm starting from the 5th days to 20th days and get 59".*
R	:	*"How about fourth question? How you got in which day the plant has 333 of height?"*
SALS	:	*"I can't solve this problem, I decide to not write anything".*

Functional thinking students with accommodative learning style (SACLS)

SACLS solved figural linier pattern by performed near generalization, far generalization, formal generalization, and determining inverse well. She wrote answers in a simply ways. First, SACLS performed formal generalization using arithmetic sequence term formula $U_n = a + (n - 1)b$ and found the equation for square number as $U_n = 2n + 1$ and for triangle number as $U_n = n + 1$. Second, she used these equations to performing near and far generalization by substituting n with $4, 5,$ and 53 to get square and triangle number at step 4, step 5, and step 53. These equations also were used in determining inverse by substituting some number of n to get 62 of square number and 32 of triangle number. She found the same number $(n = 31)$ for 62 of square number and 32 of triangle number.

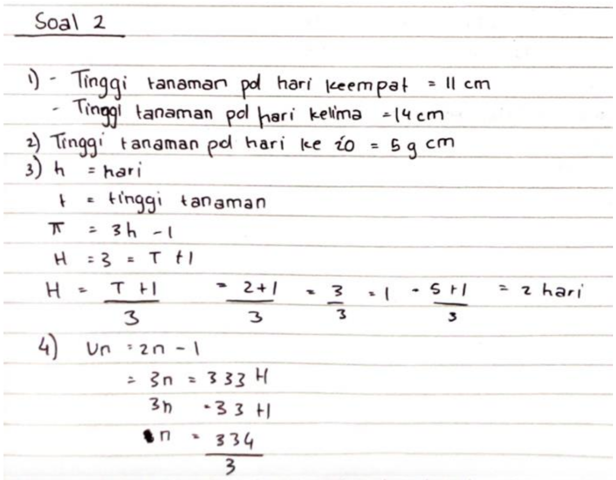

Figure 4. SACLS FT in solving non-figural linier pattern task

R : *"How you got square and triangle number at step 5 and step 6? Could you explain?"*

SACLS : *"I use formula of arithmetic sequence, $U_n = a + (n-1)b$. For square number, we have the difference equal to 2, while for triangle number we have the difference equal to 1. So, for square number, we have $U_n = 2n + 1$ and for triangle, we have $U_n = n + 1$. Furthermore, to get square and triangle number at step 5 and step 6, I substitute $n = 5$ and $n = 6$ to each equation".*

R : *"How about square and triangle number at step 53? How you got it?"*

SACLS : *"Same with strategy before, I substitute $n = 53$ for $U_n = 2n + 1$ and $U_n = n + 1$ and get 107 of square number and 54 of triangle number".*

R : *"And then how you determine in which step there 32 triangles and 63 squares?"*

SACLS : *"I just searching a certain n to get 63 squares and 32 triangles to each equation and get $n = 31$".*

In solving non-figural linier pattern (Figure 4), SACLS used the same way before in near generalization, far generalization, formal generalization, and determining inverse. First, she performed formal generalization by expressing the relationship between days number and plant height using arithmetic sequence term formula ($U_n = a + (n-1)b$). She found the equation of plant height and days number as $U_n = 3n - 1$. Second, she used the equation in performing near and far generalization by substituting $n = 4$, $n = 5$, and $n = 20$ to get 11 of plant height at 4th days, 14 of plant height at 5th days, and 59 of plant height of 20th days. The equation also was used by SACLS in determining inverse by substituting U_n with 333.

In solving figural non-linier pattern task, SACLS performed formal generalization firstly using the general formula of 2nd term of quadratic sequence $U_n = a + (n-1)b + \left(\frac{(n^2-3n+2)c}{2}\right)$, where $a = U_1 = 5, b = 7, c = 2$ and found the equation $U_n = n^2 + 4n$. She used the equation in performing near and far generalization by substituting n with 4, 5, and 32 to get 32, 45, and 1020 of tiles number for step 4, step 5, and step 30. She also used the equation in determining inverse by searching a number of n and substitute it to the equation $U_n = n^2 + 4n$ until get 192 of tiles number. In this stage, she found that n equal to 12. The following is an interview excerpt of SACLS in solving figural non-linier pattern task.

R : *"How you got tiles number at step 4 and step 5? Could you explain?"*

SACLS : *"I used the formula of quadratic sequence, namely $U_n = a + (n-1)b + \left(\frac{(n^2-3n+2)c}{2}\right)$, where $a = U_1 = 5, b = 7,$ and $c = 2$ and get $U_n = n^2 + 4n$. Then, I substitute $n = 4$ and $n = 5$ to get 32 tiles number at step 4 and 45 of tiles number at step 5".*

R : *"How about the tiles number at step 20? How you got it?"*

SACLS : *"I just substitute $n = 20$ to $U_n = n^2 + 4n$, then I get 1020 of tiles number at step 20".*

R : *"How about 192 of tiles number? How you got in which step?"*

SACLS : *"I searching for number of n until get 192 of tiles number. I get $n = 12$ for 192 of tiles numbers".*

Functional thinking students with convergent learning style (CLS)

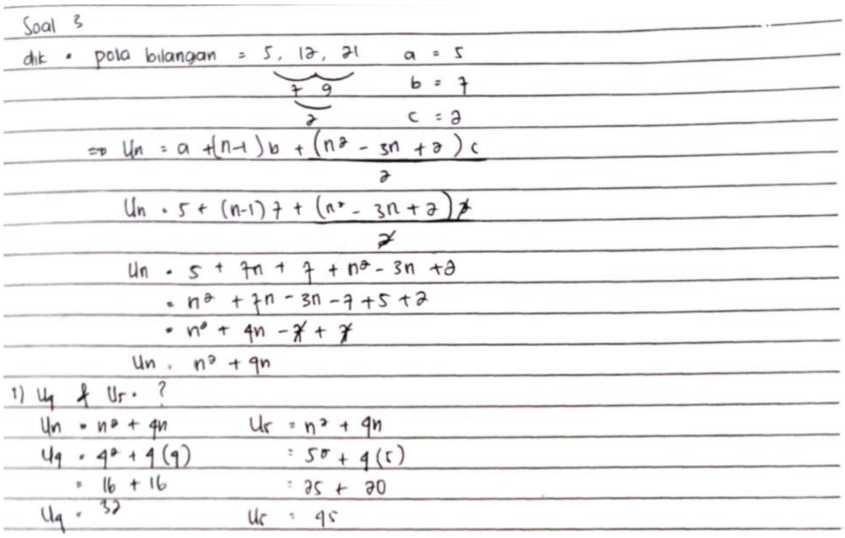

Figure 5. SCLS FT in solving figural non-linier pattern task

R : *"How you got square and triangle number at step 5 and step 6? Could you explain?"*

SCLS : *"I see in the figure and write the square and triangle number in step 1, step 2, step 3, and step 4. I determine the difference and substitute to formula of arithmetic sequence $U_n = a + (n-1)b$. I get the formula for square number as $U_n = 2n + 1$ and for triangle number as $U_n = n + 1$. Then I substitute $n = 5$ and $n = 6$ to each formula and get 11 of square number at step 5, 13 of square number at step 6, 6 of triangle number at step 5, and 7 of triangle square at step 6".*

R : *"How about square and triangle number at step 53? How you got it?"*

SCLS : *"I substitute $n = 53$ to each formula and get 107 of square number and 54 of square number".*

R : *"And then how you determine in which step there 32 triangles and 63 squares?"*

SCLS : *"I search a number of n to get $U_n = 63$ for square number and $U_n = 32$ for triangle number. Then I get $n = 31$".*

Based on Figure 5, SCLS solved all task well and correct. In solving figural linier pattern, SCLS performed FT consisting of near generalization, far generalization, formal generalization, and determining inverse. First, she performed formal generalization using n^{th} arithmetic sequence term formula $U_n = a + (n-1)b$, and found the equation of square number as $U_n = 2n + 1$ and equation for triangle number as $U_n = n + 1$. Second, she used these equations in near and formal generalization by substituting n with 5, 6, and 53. She also used these equations in determining inverse by searching for a number of n to get 63 of square number and 32 of square number. In this stage, she found $n = 31$.

In solving non-figural linier pattern, SCLS used same strategies before. First, she performed formal generalization using n^{th} arithmetic sequence term formula $U_n = a + (n-1)b$ and found the equation of plant height as $U_n = 3n - 1$. Second, she performed near and far generalization using the equation by substituting n with 4, 5, and 20. She also used the equation in determining inverse by substituting $U_n = 333$ and performed algebraic operation to get $\frac{334}{3}$ of plant height.

In solving figural non-linier pattern task, SCLS performed formal generalization firstly using general formula of quadratic sequence $U_n = a + (n-1)b + \left(\frac{(n^2-3n+2)c}{2}\right)$ where $a = 5, b = 7, c = 2$ and found the equation $U_n = n^2 + 4n$. She used this equation in performing near and far generalization by substituting n with 4, 5, and 30. She also used this equation in determining inverse by searching a number of n until get $U_n = 192$. In this stage, she found $n = 12$. The following is an interview excerpt of SCLS in solving figural non-linier pattern.

R	:	*"How you got tiles number at step 4 and step 5? Could you explain?"*
SCLS	:	*"I think the tiles number at step 1 to step 3 conjectured the arithmetic sequence then I subtracted second term by first term and third term by second term. I realized that there different difference (7 and 9). I decided to subtract these differences and get fixed difference, namely 2. Furthermore, I use the formula of quadratic sequence, namely* $U_n = a + (n-1)b + \left(\frac{(n^2-3n+2)c}{2}\right)$, *and substitute* $a = 5, b = 7,$ *and* $c = 2$ *and get* $U_n = n^2 + 4n$ *as general rule. Finally, I substitute* $n = 4$ *to get 32 of tiles number at step 4 and* $n = 5$ *to get 45 of tiles number at step 5".*
R	:	*"How about the tiles number at step 20? How you got it?"*
SCLS	:	*"Same with before. I substitute* $n = 20$*to* $U_n = n^2 + 4n$ *and get 1020 of tiles number".*
R	:	*"How about 192 of tiles number? How you got in which step?"*
SCLS	:	*"I search for* n *numbers until get 192 of tiles number by substituting these number to* $U_n = n^2 + 4n$. *I found* $n = 12$ *for 192 of the tile numbers".*

Discussion

The finding revealed that the convergent learning style were the most common learning style with 52% of participant. It promotes the previous study that the convergent learning style were the most preferred method of studying among the lower secondary school students (Ganesen et al., 2020). Based on Kolb (1984), assimilator learning style referred to combination of thinking and watching. They have a theorist's tendency and like in studying concept abstract. According to this study which revealed that the assimilator learning style have some incomplete in performing FT. They weren't able to performing formal generalization and determining inverse in solving figural and non-figural linier pattern task. They also unable to solving figural non-linier pattern task. The kind of task in this study involving mathematics context. It brings through to students with assimilator learning style has an obstacle in working with mathematical contextual.

Convergent learning style referred to combination of thinking and doing (Kolb, 1984). They like in solving applicative task and learning by trial and error. While the divergent learning style referred to combination of feeling and watching. They have an excellent in imagination ability and look at concrete situations from different points of view. This condition may have an impact to students with convergent and divergent learning style in solving mathematical contextual task like in this study. Students with convergent and divergent learning style were able solving all task well and systematically. They were able in FT consist of near, far, and formal generalization in solving figural and non-figural linier pattern task and figural non-linier pattern task. They are also able to determine inverse for linear and non-linier pattern task.

In representing the relationship between two quantities, students with divergent, accommodative, and convergent learning style are better than students with assimilator learning style. It different with Hajaro et al. (2021) was found that students with assimilator learning style have a high mathematical representation while the students with convergent learning style have a medium of mathematical representation and students with divergent learning style has low of mathematical representation. In this study, students with assimilator learning style were able in representing the relationship between two quantities in solving figural and non-figural linier pattern task verbally. They also were able in describing problem of situation. It promotes the previous study was found that students with assimilator learning style were able to describing problem situation and using mathematical solution related to the analysis of other form (Rohmanawati et al., 2021).

In solving the problems, students with assimilator learning style were able in solving a part of the problems. They were able to determining near generalization and far generalization in solving figural and non-figural linier pattern task. While they weren’t able to determining formal generalization and determining inverse in solving figural and non-figural linier pattern task. It in line with Wicaksono et al. (2021) which found that the students with assimilator learning style have a problem solving ability in medium ability where they solve a part of the problems and get correct answer.

For non-figural linier pattern task, students with assimilator learning style used recursive strategies (Lannin, 2003; Lannin et al., 2006) by observing the change in one quantity. In this case, students observe the change in plant height for each day. Some literature considers that the recursive strategy limits students finding functional relationships between variables (Tanıslı, 2011). On the other hand, students have difficulty in moving from recursive strategies to explicit strategies (Lannin et al., 2006). Students with assimilator learning style have an obstacle in performing formal generalization as manifestation of explicit strategy in determining inverse.

In solving figural and non-figural linier pattern task, students in all learning style used the sequence of difference strategy followed by known formula strategy. The sequence of differences strategy involves comparing consecutive values of the dependent variable with stepwise processes, such as calculation of differences by subtraction or identification of the gap between one value and the following one (Biza et al., 2020) while the known formula strategy involves application of the formula of arithmetic sequence as $U_n = a + (n-1)b$ where $a = U_1 \; and \; b = U_2 - U_1$. It promote the previous study that students used difference and functional strategy in solving figural linier pattern task (Amit & Neria, 2008; Erdogan & Gul, 2023).

In solving figural non-linier pattern task, students with convergent, divergent, and accommodator used known formula strategy in generalizing of relationship of two quantities (number of step and tiles number). Known formula strategy involves application of the formula was known, for quadratics sequence as $U_n = a + (n-1)b + \left(\frac{(n^2-3n+2)c}{2}\right)$ where $a = U_1, b = U_2 - U_1, c = (U_3 - U_2) - (U_2 - U_1)$ (Biza et al., 2020). It promote the previous study which revealed that students used the functional strategy in solving figural non-linier pattern task (Amit & Neria, 2008; Erdogan & Gul, 2023).

Conclusion

Kolb learning style have an important role in mathematics learning. It has 25% of contribution in mathematics achievement (Sujadi et al., 2019), specifically 57% of contribution in algebraic achievement (Ganesen et al., 2020). It became a foundation for the finding of this study where FT as a part of algebraic thinking was viewed in Kolb learning style.

Students with convergent, divergent, and accommodator learning style are able in performing FT in a good category consist of near generalization, far generalization, formal generalization and determining inverse in solving figural and non-figural linier pattern task and figural non-linier pattern task. They are able in representing the relationship of two quantities symbolically. They used difference and known formula strategy in generalizing and representing the relationship of dependent and independent variables in solving linier and non-linier pattern task. Meanwhile, students with assimilator learning style are able in performing FT in poor category. They are able in performing near and far generalization, but they aren't able in performing formal generalization and determine inverse in solving figural and non-figural linier pattern task. They also unable to performing FT in solving figural non-linier pattern task. They use recursive strategy in solving non-linier pattern task.

This study has a limitation on participant quantities. Quantitative approach with many samples may be design to determining comparison of students FT viewed from Kolb learning style statistically. This study imply that teacher need to design and develop FT with regard to students learning style. The future study may conduct to finding different strategy used by students viewed from Kolb learning style in generalizing linier and non linier pattern task.

Conflicts of Interest

The author declares that there is no conflict of interest regarding to this article. In addition, the ethical issues, including plagiarism, misconduct, data fabrication and/or falsification, double publication and/or submission, and redundancies, have been completed by the author.

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Author Contributions

Muhammad Syawahid: Conceptualization, writing - original draft, editing, and visualization; **Lalu Sucipto:** Writing - review & editing, formal analysis, and translating.

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