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# THE VARK-FLEMING MODEL AND SELF-CONCEPT: DOES IT AFFECT MATHEMATICAL CONCEPTS UNDERSTANDING

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## Abstract
Concept understanding is required for the learning process to be successful. This quantitative study investigates students' mathematical concept understanding abilities using the VARK-Fleming model and self-concept as a covariate variable. The purpose of this research is to determine the effect of the VARK-Fleming model on students' ability to understand mathematical concepts by controlling for students' self-concept and the effect of the covariate variable of self-concept on students' ability to understand mathematical concepts, as well as the simultaneous concept of the VARK-Fleming model and self-concept on students' ability to understand mathematical concepts. Sixty-four junior high school students participated in this research, with 32 learning the VARK-Fleming model and 32 learning the expository model. Questionnaires and descriptive tests were employed to collect information. The analysis of covariance was utilized for hypothesis testing (one-way ANCOVA). The findings of this research reveal that the VARK-Fleming learning model has a better effect on students' mathematical concept understanding capacity than the expository model and self-concept, both partially and concurrently.

**Keywords:** Concept Understanding, Self-concept, VARK-Fleming.

## *Abstrak*
*Kemampuan pemahaman konsep sangat dibutuhkan dalam proses pembelajaran matematika yang harus dikuasai untuk menunjang keberhasilan proses pembelajaran. Penelitian kuantitatif ini mengkaji kemampuan pemahaman konsep matematis siswa dengan mengimplementasikan model VARK-Fleming dan self-concept sebagai variabel kovariat. Penelitian ini bertujuan untuk mengetahui pengaruh model VARK-Fleming terhadap kemampuan pemahaman konsep matematis dengan mengontrol self-concept siswa dan pengaruh variabel kovariat self-concept terhadap kemampuan pemahaman konsep matematis siswa, serta pengaruh secara simultan model VARK-Fleming dan self-concept terhadap kemampuan pemahaman konsep matematis siswa. Partisipan dalam penelitian ini berjumlah 64 siswa SMP, dengan rincian 32 siswa belajar menggunakan model VARK-Fleming dan 32 siswa belajar dengan model ekspositori. Alat yang digunakan untuk mengumpulkan data adalah angket dan tes uraian. Pengujian hipotesis menggunakan analysis of covariance (one-way ancova). Hasil penelitian ini menunjukkan bahwa terdapat pengaruh lebih baik model pembelajaran VARK-Fleming dibandingkan model ekspositori dan self-concept terhadap kemampuan pemahaman konsep matematis siswa baik secara parsial maupun simultan.*

***Kata kunci**: Pemahaman Konsep, Self-concept, VARK-Fleming.*



## INTRODUCTION

Concept Understanding is a fundamental mathematical ability every student must possess (D. Y. Sari et al., 2021). The ability to grasp mathematical concepts considerably enhances other numerical understanding, such as thinking skills (Gunur et al., 2019), relational skills (Ningsih, 2017), reasoning skills (Astuti et al., 2018),

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communication skills (Putra, 2016), and many others (F. Y. Sari et al., 2022). Because every concept in mathematics subject matter is related to one another, students are expected to understand concepts in mathematics lessons thoroughly. Understanding concepts is also crucial for solving mathematical issues (Nur et al., 2021; Nurani et al., 2021; Lestari & Rukmigarsari, 2021). Mathematical concept under-standing helps absorb and understand mathematical ideas (Khofifah et al., 2021). Unfortunately, many students still struggle with concept under-standing (Kaushal Kumar Bhagat, 2016; Luritawaty, 2018; Nurdin et al., 2019; Sarniah et al., 2019).

The effectiveness of selecting a learning model will improve teachers' concept understanding ability (Pranata, 2016). The Visual, Auditory, Read, Kinesthetic (VARK) learning model is a learning model that focuses on giving direct and engaging learning experiences by utilizing the four learning modalities that students have: seeing (visual), hearing (auditory), reading (read), and moving (kinesthetic) (Hussain, 2017; Mirza & Khurshid, 2020; Nurhidayah, 2021). VARK-Fleming is a learning model that optimizes the four learning modes to make learning effective and engaging (Hariyani & Sejati, 2019). The VARK-Fleming model is learning that involves physical movement and student participation by employing the five senses they have in the learning process (Monariska & Komala, 2020).

Several researchers have researched the VARK-Fleming model, including the findings of Erawati et al. (Erawati et al., 2020; Monariska & Komala, 2020; Prihaswati & Purnomo, 2021), which discovered that employing the VARK-Fleming model can improve connection skills and mathematical proof abilities. However, the sample was at the university level, so whether this model improved mathematical abilities at the junior high school level was unknown. Also, VARK-Fleming can increase communication skills and mathematical thinking (Didit Chayono & Nuriyatin, 2019; K et al., 2021; Tahir, 2021). However, the sample utilized was at the high school level; thus, whether this model affected junior high school students' mathematical abilities was unknown.

The VARK-Fleming model used in this research adheres to Ngalimun's syntax (Ngalimun, 2012), namely stage 1, preparation. This first stage is concerned with preparing students to participate in the learning process by providing motivation and placing. Stage 2 is delivery, which refers to the range of methods and media in the learning process that maximizes the utilization of students' five senses in the form of visual, aural, read/write, and kinesthetic modalities so that the students can be actively engaged with the educational process. Stage 3 is training, which is concerned with deepening the material taught by the teacher using various methods and media in the form of material or questions connected to the material. Students receive training, which can be completed individually or in groups. Stage 4 is presentation, which is concerned with the disclosure of the findings of the students' thinking about the material learned. The results are disclosed through student presentations, which the teacher then checks. Stage 5 is the conclusion concerned with consolidating the material taught. The learning outcomes conclusion is provided as a summary created by students based on their learning styles (Hariyani & Sejati, 2019).

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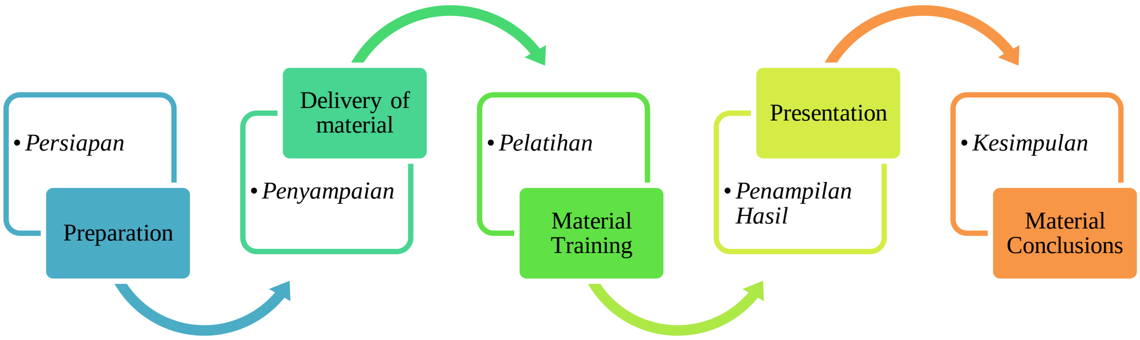


Figure 1. VARK-Fleming Cycles

Figure 1 showa depicts the syntax of VARK-Fleming. Concept under-standing ability has a strong association with self-concept. This statement is consistent with research demonstrating a favorable and substantial link between self-concept and concept understanding ability (Satriani et al., 2021; Lestari & Rukmigarsari, 2021). The self-concept is a person's views, attitudes, feelings, and expectations when confronted with and addressing problems in general, scientific, and social contexts (Andinny, 2015; Hattie, 2014; Markus & Wurf, 1986; Juniarti & Margunayasa, 2020; Pamungkas et al., 2015). A person's self-concept is established first concerning the person closest to them (Kartika, 2017). Based on past research, no researcher has investigated the influence of the VARK-Fleming model and self-concept on students' mathematical concept understanding ability. As a result, this research will disclose the impact of the VARK-Fleming model and self-concept on junior high school student's ability to understand mathematical concepts.

## RESEARCH METHODS

### a. Research Design

This research employs a quantitative approach and a quasi-experimental design. This research has one independent variable, the VARK-Fleming model, one covariate variable, self-concept, and one dependent variable, concept understanding ability. The sample was chosen randomly using the cluster random sampling technique, yielding two samples: the experimental class, which received treatment with the VARK-Fleming model, and the control class, which received treatment with the expository model. This research employs a 1 X 2 factorial design. The research design can be seen in Table 1.

Table 1. The factorial design

| Group | | | |
|---|---|---|---|
| **Experimental** | | **Control** | |
| $x_1$ | $y_1$ | $x_2$ | $y_2$ |
| $x_{1.1}$ | $y_{1.1}$ | $x_{2.1}$ | $y_{2.1}$ |
| $x_{1.2}$ | $y_{1.2}$ | $x_{2.2}$ | $y_{2.2}$ |
| $x_{1.3}$ | $y_{1.3}$ | $x_{2.3}$ | $y_{2.3}$ |
| … | … | … | … |
| … | … | … | … |
| … | … | … | … |
| $x_{1.n}$ | $y_{1.n}$ | $x_{2.n}$ | $y_{2.n}$ |

Based on Table 1, the research design for this study utilizes a 1 × 2 factorial design.

### b. Instrument of Data Collection

In this research, questionnaires and descriptive tests were employed. The questionnaires measured students' self-concept, and descriptive tests measured students' concept under-standing ability. The research

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questionnaire was adapted from (Widyastuti et al., 2020). It included subscales such as seriousness, distinguishing between qualities and deficiencies, optimism, collaboration, respecting opinions, communication skills, and understanding the function of learning mathematics. The questionnaire consisted of 30 statements with four possible responses, each with a score depending on its degree on a Likert scale, such as strongly disagree (score 1), disagree (score 2), agree (score 3), and strongly agree (score 4) (Satriani et al., 2021). The responses are chosen range from very positive to very negative. Positive and negative statement scores are inversely proportional to one another. After the validation, the questionnaire was administered to 32 students, yielding 28 valid and reliable items with a Cronbach's Alpha value of 0.850. The concept understanding ability test comprised 14 essay questions with the subject matter of exponentiation and radical forms representing 7 indicators of concept understanding ability. Additionally, 32 students were tested, and 8 questions were confirmed valid and reliable, with a Cronbach's Alpha value of 0.733. Thus, 8 questions were utilized to assess concept understanding ability.

### c. Research Participants

The demographics of the participants in this study are presented in Table 2. Based on Table 2, it can be observed that This research involved 64 students between the ages of 12 and 15, with 32 students learning with the VARK-Fleming model and 32 with the expository model. The 64 were ninth-grade junior high school students in South Lampung Regency, Lampung Province. The problems in that area were particularly pertinent to our research; hence students from South Lampung Regency were selected. It turned out that many students had difficulty understanding mathematical concepts.

Table 2. Demographic characteristics of samples

| Demographic | | **Frequency** | **%** |
|---|---|---|---|
| Sex | Male | 31 | 48,4% |
| | Female | 33 | 51,6% |
| Residence | City | 14 | 21,9% |
| | Village | 50 | 78,1% |
| Ethnicity | Javanese | 50 | 78,1% |
| | Sundanese | 10 | 15,6% |
| | Lampungnese | 4 | 6,3% |

*Note.* N = 64; the average age of 15 years ($SD$ = 0,056 $S.E$ = 0,445).

### a. Data Collecting Technique

In this research, a questionnaire and test were utilized to collect data, with the questionnaire used to examine self-concept and the test used to measure concept understanding ability. The tests employed in this research were the first (pretest) and the final (posttest). The pretest was conducted before using the VARK-Fleming model to compare the starting ability of the experimental and control classes. Following the implementation of the VARK-Fleming model, a posttest was administered to determine whether there was a significant difference between the experimental and control classes. Table 3 shows the self-concept indicators employed in this research.

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Table 3. Self-concept indicators

| No | Indicators | Description |
|---|---|---|
| 1 | Seriousness (interest, motivation, courage, and seriousness) | Seriousness, interest, motivation, courage, and seriousness in learning mathematics |
| 2 | Distinguishing personal qualities and shortcomings | Distinguishing personal qualities and shortcomings in learning mathematics |
| 3 | Optimistic | Confident in carrying out mathematical tasks |
| 4 | Collaborative and tolerant | Collaborate and tolerate others in learning mathematics |
| 5 | Respect for opinions | Respect other's and individual opinions during mathematics learning |
| 6 | Communication skills and self-esteem | Communication skills and being able to place oneself during mathematics learning |
| 7 | Understand the function of learning mathematics | Understand the function of learning mathematics |

According to Table 3, there are seven indicators of self-concept used in constructing the questionnaire, namely seriousness (interest, motivation, courage, and seriousness), distinguishing the self-qualities and short-comings, optimism, collaborating and tolerant, respecting opinions, communication skills and being able to place themselves, and understanding the function of learning mathematics(Afri, 2019). Indicators of concept under-standing ability used in this research are shown in Table 4.

Table 4. Indicators of concept understanding ability

| No | Indicators |
|---|---|
| 1 | Restate concepts that have been learned. |
| 2 | Classify objects based on certain properties following the concept. |
| 3 | Provide examples or non-examples of the concepts learned. |
| 4 | Presenting concepts in various forms of mathematical representations. |
| 5 | Explain the necessary condition of a concept. |
| 6 | Determine and use and refer to certain procedures or operations. |
| 7 | Apply concepts or algorithms to problem-solving. |

Table 4 displays the indicators of concept understanding ability employed in this research. According to Regulation of the Ministry of Education and Culture (Permendikbud) Number 59 of 2014, the indicators are restating concepts that have been learned, classifying objects based on certain properties following the concept, giving examples or not examples of concepts learned, presenting concepts in various forms of mathematical representation, explaining the necessary conditions for a concept, determining and using and referring to certain procedures or operations, and applying concepts or algorithms to problem-solving (Baiduri et al., 2021).

### d. Data Analysis

The analysis of the covariance (one-way ANCOVA) test was utilized to analyze the data in this research. The one-way ANCOVA test is a hypothesis test performed onCE the prerequisite tests have been completed. The four prerequisite tests are normality, data variation homogeneity, regression linearity, and regression coefficient homogeneity tests (Rinaldi & Novalia, 2020; Sudjana, 2003; Zunita, 2018). The data used for the prerequisite test

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consists of posttest self-concept and conceptual understanding ability. This research used SPSS 26 for Windows software for hypothesis testing and prerequisite tests.

## RESULT AND DISCUSSION

### Prerequisite Test of Analisis of Covariance (One-Way ANCOVA)

The first test that is performed is the normality test. The normality test was used to examine whether or not the research findings in questionnaires and questions in the experimental and control classes were normally distributed. Posttest data were used for the prerequisite test. Kolmogorov Smirnov and SPSS 26 were employed to calculate the normality test. Table 6 shows the results of the normality tests. The results of Table 6 show the results of the normality test of self-concept and students' concept understanding ability at the α = 0.05 level. Therefore, it can be concluded that the data obtained in the control and experimental classes are normally distributed because *p-value* is greater than α. The next prerequisite test is the homogeneity test. The results of the data variation homogeneity test can be seen in Table 7.

Table 6. The normality test result

| Tests of Normality | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Kolmogorov-Smirnov[a] | | | Shapiro-Wilk | | | |
| | **Classes** | **Statistic** | **df** | **Sig.** | **Statistic** | **df** | **Statistic** | **Sig.** |
| Self-concept | Experimental class | .139 | 32 | .121 | .923 | | 32 | .025 |
| | Control class | .106 | 32 | .200* | .968 | | 32 | .452 |
| Concept understanding | Experimental class | .139 | 32 | .116 | .949 | | 32 | .132 |
| | Control class | .103 | 32 | .200* | .958 | | 32 | .249 |

*Note*. Normality test with $n$ = 64

Table 7. Data homogeneity test results

| Levene's Test of Equality of Error Variances[a] | | | |
|---|---|---|---|
| **F** | **df1** | **df2** | **Sig.** |
| ,414 | 1 | 62 | ,523 |

Table 7 reveals that the homogeneity test of self-concept and concept understanding ability results came from the same variance or were homogeneous because the p-value (0.523) is greater than α (0.05). The regression linearity test is the next required test. The regression linearity test is satisfied if there is a linear relationship between the covariates and the dependent variable. Table 8 displays the results of the regression linearity test.

Table 8. Regression linearity test results

| Source | Type III Sum of Squares | Df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Corrected Model | 1237,418[a] | 2 | 618,709 | 19,609 | ,000 |
| Intercept | 123,966 | 1 | 123,966 | 3,929 | ,052 |
| $X_1$ (model) | 184,901 | 1 | 184,901 | 5,860 | ,018 |
| $X_2$ (covariate) | 432,278 | 1 | 432,278 | 13,700 | ,000 |
| Error | 1924,691 | 61 | 31,552 | | |
| Total | 350525,000 | 64 | | | |
| Corrected Total | 3162,109 | 63 | | | |

a. R Squared = ,391 (Adjusted R Squared = ,371)

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Table 8 shows that the covariate Sig value (X2) is less than α (0.00 < 0.05). This number suggests a linear association between the covariate variable (self-concept) and the dependent variable (concept understanding ability). The regression coefficient homogeneity test is the final prerequisite test. The regression coefficient homogeneity assumption test in this research is met if there is no linear relationship between the covariate and independent variables. Table 9 displays the results of the regression coefficient homogeneity test.

Table 9. Homogeneity test results of linear regression coefficient data

| Tests of Between-Subjects Effects | | | | | |
|---|---|---|---|---|---|
| Source | Type III Sum of Squares | df | Mean Square | F | Sig. |
| Corrected Model | 1321,494[a] | 3 | 440,498 | 14,359 | ,000 |
| Intercept | 36,427 | 1 | 36,427 | 1,187 | ,280 |
| $X_1 * X_2$ | 84,076 | 1 | 84,076 | 2,741 | ,103 |
| $X_1$ (model) | 70,245 | 1 | 70,245 | 2,290 | ,135 |
| $X_2$ (Covariate) | 516,335 | 1 | 516,335 | 16,831 | ,000 |
| Error | 1840,615 | 60 | 30,677 | | |
| Total | 350525,000 | 64 | | | |
| Corrected Total | 3162,109 | 63 | | | |
| a. R Squared = ,418 (Adjusted R Squared = ,389) | | | | | |

**Hypothetical Test of the Analysis of Covariance (One-Way ANCOVA)**

Analysis of covariance has been employed to test hypotheses (one-way ANCOVA). This test is a distinct or comparative test in which the independent variables combine factorial and numerical data, and the dependent variable is interval or ratio (quantitative) data. By removing treatment effect bias, the ANCOVA technique adjusts the dependent variable score (Montgomery, 2013). Eliminating treatment effect bias aims to reduce error variance by controlling for the influence of covariate factors that are thought to affect analysis outcomes. Statistical covariance analysis can equalize groups based on the influence of variables other than the treatment variable (Kadir, 2019). The one-way ANCOVA test was performed using SPSS 26 program in this research. Table 10 displays the outcomes of the one-way ANCOVA test.

Table 10. The result of one-way ANCOVA

| Tests of Between-Subjects Effects | | | | | |
|---|---|---|---|---|---|
| Source | Type III Sum of Squares | df | Mean Square | F | Sig. |
| Corrected Model | 1237,418[a] | 2 | 618,709 | 19,609 | ,000 |
| Intercept | 123,966 | 1 | 123,966 | 3,929 | ,052 |
| $X_2$ (covariate) | 432,278 | 1 | 432,278 | 13,700 | ,000 |
| $X_1$ (model) | 184,901 | 1 | 184,901 | 5,860 | ,018 |
| Error | 1924,691 | 61 | 31,552 | | |
| Total | 350525,000 | 64 | | | |
| Corrected Total | 3162,109 | 63 | | | |
| a. R Squared = ,391 (Adjusted R Squared = ,371) | | | | | |

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In Table 10, row X1, the value of $F_{observed}$ is 5.860, with a p-value of 0.018 at a significance level of 0.05. This result suggests that the p-value is lower than 0.05, indicating that $H_0$ is rejected and $H_1$ is accepted. In conclusion, the VARK-Fleming model affects students' mathematical concept understanding ability by influencing self-concept.

Table 10 shows that the value of $F_{observed}$ is 13,700 with a p-value of 0.000 at a significance level of 0.05. This finding demonstrates that the p-value is lower than 0.05. As a result, $H_0$ is rejected, and $H_1$ is accepted. The conclusion is that self-concept covariate variables affect students' mathematical concept understanding ability.

The corrected model findings in Table 10 indicate a $F_{observed}$ value of 19,609 with a p-value of 0.000 at a significance level of 0.05. This number demonstrates that the p-value is lower than 0.05. Therefore, $H_0$ is rejected, and $H_1$ is accepted. In conclusion, students' mathematical concept understanding ability is simultaneously influenced by the VARK-Fleming model and self-concept.

The results of the one-way ANCOVA test reveal that the VARK-Fleming model has a greater influence than the expository model on concept understanding ability. Students taught using the VARK-Fleming model had a higher posttest score of concept understanding ability than those taught with the expository model, particularly on presenting concepts in diverse forms of mathematical representation. This is because the Fleming VARK model involves actively engaging students in discovering and understanding concepts, allowing them to develop their individual potential to the fullest. The benefits of VARK-Fleming can make the learning environment energetic and interesting, causing students to appear eager during the learning process. According to its benefits, learning activities are more effective because it integrates the four learning styles and provides direct experience by integrating students as much as possible in understanding mathematical concepts. This model makes it easier for students to understand mathematical concepts (Monariska & Komala, 2020; Nurhidayah, 2021). However, some students are not yet accustomed to combining the four learning styles. This is consistent with previous research conducted by (Didit Chayono & Nuriyatin, 2019; Hidayati & Jahring, 2021; K et al., 2021), which found a positive and significant impact of the Fleming VARK learning model on students' mathematical reasoning and connections. Additionally, studies conducted by (Agusriandi, 2020; Monariska & Komala, 2020; Prihaswati & Purnomo, 2021) concluded that the Fleming VARK model is effective in improving students' mathematical connections and creativity.

Similarly, students' self-concept influences their ability to understand concepts. Students with positive self-concept answer mathematics problems better than students with negative self-concepts. This finding can be seen in the results of the posttest of concept understanding ability, where students with positive self-concept tend to solve concept understanding ability problems correctly, particularly on indicators of determining, using, and referring to certain operating procedures. This is because students with a positive self-concept have greater confidence in their abilities and put in more effort to complete their tasks, even when they find them challenging. As a result, they

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are less likely to give up easily. This research aligns with previous studies conducted by (Ayodele, 2011; Rofika Hasan et al., 2021; Sinta Lestari & Ettie Rukmigarsari, 2021), which concluded that there is a relationship between self-concept and students' conceptual understanding and mathematical achievement. Additionally, previous studies by (Musriandi, 2017; S. M. Sari & Pujiastuti, 2020) found that an individual's self-concept influences their mathematical abilities, whereby a more positive self-concept is associated with better mathematical skills in terms of formulating concepts and expressing ideas.

The Fleming VARK model and self-concept simultaneously influence students' conceptual understanding abilities, as indicated by a p-value < α, suggesting that H1 is accepted. Therefore, when the Fleming VARK model and self-concept are combined, they have an influence on students' mathematical conceptual understanding. Further analysis will be conducted using the t-statistic in Table 11.

Table 11. Post-hoc test results

| Parameter Estimates | | | | | | |
|---|---|---|---|---|---|---|
| **Parameter** | **B** | **Std. Error** | **t** | **Sig.** | **95% Confidence Interval Lower Bound** | **95% Confidence Interval Upper Bound** |
| Intercept | 23,734 | 12,573 | 1,888 | ,064 | -1,406 | 48,875 |
| X2 | ,582 | ,157 | 3,701 | ,000 | ,267 | ,896 |
| [X1=1,00] | 3,967 | 1,639 | 2,421 | ,018 | ,690 | 7,244 |
| [X1=2,00] | $0^a$ | . | . | . | . | . |

a. This parameter is set to zero because it is redundant.

Table 11 in the row [X1 = 1.00] shows that the value of t0 is 2.421 with a p-value of 0.018 at a significance level of 0.05. This number demonstrates that the p-value is lower than 0.05, indicating that $H_0$ is rejected and $H_1$ is accepted. In conclusion, after adjusting for student self-concept, the mathematical concept understanding ability taught to students using the VARK-Fleming model is superior to that taught using the expository model. Because the VARK-Fleming model combines the four learning styles of visual, auditory, read/write, and kinesthetic, it not only provides direct experience by involving students as much as possible in understanding mathematical concepts (Mulabbiyah, Ismiati, 2018), but it also makes the learning environment active and fun to get students excited so that they do not experience difficulties understanding mathematical concepts. According to this statement, other research (Almola, 2022; Jumrah et al., 2022) discovered that the VARK-Fleming model is more effective in boosting concept understanding and mathematics learning achievement because it integrates the four learning styles. Based on the previous description, it is possible to conclude that the VARK-Fleming model is superior to the expository model.

## CONCLUSION AND SUGGESTION

Based on the analysis and discussion of the research data, it can be concluded that: Firstly, there is an influence of the Fleming VARK learning model on students' mathematical conceptual understanding, while controlling for self-concept. Secondly, there is an influence of the covariate

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variable, self-concept, on students' mathematical conceptual understanding. Thirdly, there is a simultaneous influence of the Fleming VARK learning model and self-concept on students' mathematical conceptual understanding. This means that the Fleming VARK model and self-concept have an impact on students' mathematical conceptual understanding.

Based on the research findings and observations in the field, the following suggestions are proposed: The Fleming VARK learning model can be implemented in teaching and learning activities, especially in mathematics, to make students more active, independent, and creative, and to facilitate their understanding of the learning material. Educators should foster positive self-concepts towards mathematics in students to develop internal motivation to strive for excellence in mathematics. Therefore, it is recommended for educators to implement the Fleming VARK learning model as an alternative and varied learning environment that can enhance students' mathematical conceptual understanding. For future research, it is suggested to explore other abilities that can be applied through the Fleming VARK model. Hopefully, this research can provide benefits and contribute valuable insights for educators in general.

## REFERENCES

Achi Rinaldi, Novalia, M. S. (2020). *Statistika Inferensial untuk Ilmu Sosial dan Pendidikan* (1st ed.). PT Penerbit IPB Press.

Afri, L. D. (2019). Pengembangan Soal Tes Kemampuan Representasi dan Penalaran Matematis Serta Skala Sikap Self Concept Untuk Siswa SMP. *AXIOM : Jurnal Pendidikan Dan Matematika*, *8*(1). https://doi.org/10.30821/AXIOM.V8I1.5440

Agusriandi, A. (2020). Peningkatan Kreativitas Matematika Melalui Model Vark-Fleming pada Siswa Kelas VIII2 SMP Negeri 3 Mattiro Sompe. *Diferensial: Jurnal Pendidikan Matematika*, *2*(1), 39–50.

Almola, L. D. S. A. Y. (2022). Preferred learning styles according to the VARK model among students of the Department of Mathematics and its relationship to their mathematical achievement. *Nasaq*, *34*(3).

Andinny, Y. (2015). Pengaruh Konsep Diri dan Berpikir Positif terhadap Prestasi Belajar Matematika Siswa. *Formatif: Jurnal Ilmiah Pendidikan MIPA*, *3*(2). https://doi.org/10.30998/FORMATIF.V3I2.119

Anggraini, Y. P., & Kartini, K. (2020). Analisis Kesalahan Siswa dalam Menyelesaikan Soal Persamaan Kuadrat Pada Siswa Kelas IX SMPN 2 Bangkinang Kota. *AXIOM : Jurnal Pendidikan Dan Matematika*, *9*(2), 210–223. https://doi.org/10.30821/AXIOM.V9I2.7682

Astuti, T. P., Masykur, R., & Pratiwi, D. D. (2018). Pengaruh Model Pembelajaran Tandur Terhadap Peningkatan Kemampuan Pemahaman Konsep dan Penalaran Matematis Peserta Didik. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika*, *7*(2), 201–209.

Ayodele, O. J. (2011). Self-concept and Performance of Secondary School Students in Mathematics. *Journal of Educational and Developmental Psychology*, *1*(1),

DOI: https://doi.org/10.24127/ajpm.v12i2.7532

176–183. https://doi.org/10.5539/jedp.v1n1p176

Baiduri, Priono Utomo, D., & Wardani, C. (2021). *Monograf Pemahaman Konsep Geometri Ditinjau Dari Kecerdasan Intrapersonal Dan Interpersonal* (1st ed.). Universitas Muhammadiyah Malang.

Didit Chayono, A., & Nuriyatin. (2019). Kemampuan Penalaran Matematika Dengan Gaya Belajar VARK. *THETA: Jurnal Pendidikan Matematika*, *1*(2), 58–61.

Erawati, N. K., Purwati, N. K., & Rini. (2020). Kemampuan Pembuktian Matematika Berdasarkan Gender Dan Gaya Belajar. *Prima: Jurnal Pendidikan Matematika*, *4*(2), 109–120.

Fajar, A. P., Kodirun, K., Suhar, S., & Arapu, L. (2019). Analisis Kemampuan Pemahaman Konsep Matematis Siswa Kelas VIII SMP Negeri 17 Kendari. *Jurnal Pendidikan Matematika*, *9*(2), 229. https://doi.org/10.36709/jpm.v9i2.5872

Febriani, P., Widada, W., & Herawaty, D. (2019). Pengaruh Pembelajaran Matematika Realistik Berbasis Etnomatematika Terhadap Kemampuan Pemahaman Konsep Matematika Siswa SMA Kota Bengkulu. *Jurnal Pendidikan Matematika Raflesia*, *4*(2), 120–135. https://doi.org/10.33449/JPMR.V4I2.9761

Fleming, N. D. (2012). Facts, Fallacies and Myths: VARK and Learning Preferences. *Retrieved from Vark-Learn. Com/Introduction-to-Vark/the-Vark-Modalities.*

Gunur, B., Lalus, E., & Ali, F. A. (2019). Pemahaman Konsep Matematis Siswa Melalui Penerapan Model Pembelajaran Inkuiri Terbimbing. *Edumatica: Jurnal Pendidikan Matematika*, *9*(2).

Handayani, S. D. (2016). Pengaruh Konsep Diri dan Kecemasan Siswa Terhadap Pemahaman Konsep Matematika. *Formatif: Jurnal Ilmiah Pendidikan MIPA*, *6*(1). https://doi.org/10.30998/FORMATIF.V6I1.749

Hariyani, N., & Sejati, V. A. (2019). Pengembangan Rumah Baca di Pedesaan Dengan Fleming Model (VAK). *JURNAL SOSIAL Jurnal Penelitian Ilmu-Ilmu Sosial*, *20*(2), 85–90. https://doi.org/10.33319/SOS.V20I2.45

Hattie, J. (2014). *Self-Concept* . Psychology Press.

Hawk, T. F., & Shah, A. J. (2007). Using Learning Style Instruments to Enhance Student Learning. *Decision Sciences Journal of Innovative Education*, *5*(1), 1–19. https://doi.org/10.1111/J.1540-4609.2007.00125.X

Hendrayana, A. (2017). Pengaruh pembelajaran pendekatan rigorous mathematical thinking (RMT) terhadap pemahaman konseptual matematis siswa SMP. *Jurnal Riset Pendidikan Matematika*, *4*(2), 186. https://doi.org/10.21831/jrpm.v4i2.15385

Hidayati, U., & Jahring, J. (2021). Analisis Kemampuan Koneksi Matematis Siswa ditinjau dari Gaya Belajar. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika*, *10*(4), 2890–2900.

DOI: https://doi.org/10.24127/ajpm.v12i2.7532

https://doi.org/10.24127/AJPM.V10I4.4417

Hussain, I. (2017). Pedagogical Implications of VARK Model of Learning. *An International Peer-Reviewed Journal*, *38*.

Jumrah, Paturusi, M. A., & Maharida. (2022). Students Learning Style By Using Neil Fleming's Vark Model And Inventory. *Journal of Language Testing and Assessment*, *2*(1), 79–86. https://doi.org/10.56983/JLTA.V2I1.71

K, I., Jahring, J., & Subawo, M. (2021). Analisis Kemampuan Komunikasi Matematis Ditinjau Dari Gaya Belajar. *Square : Journal of Mathematics and Mathematics Education*, *3*(1), 56–65. https://doi.org/10.21580/SQUARE.2021.3.1.7704

Kadir. (2019). *STATISTIKA TERAPAN (Konsep, Contoh dan Analisis Data dengan Program SPSS/Lisrel dalam Penelitian)* (3rd ed.). Rajawali Pers.

Kartika, H. (2017). Meningkatkan Kemampuan Pemecahan Masalah Matematis dan Self-Concept Calon Guru Di Kabupaten Karawang Melalui Pendekatan Open-Ended. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika*, *6*(2), 198–204.

Kaushal Kumar Bhagat, C.-N. C. and C.-Y. C. (2016). The Impact of the Flipped Classroom on Mathematics Concept Learning in High School on JSTOR. *International Forum of Educationcietal Techy, Nanology & Sotional Taiwan Normal University, Taiwan*, *19*(3), 134–142.

Khairani, B. P., Maimunnah, & Roza, Y. (2021). Analisis Kemampuan Pemahaman Konsep Matematis Siswa Kelas XI SMA/MA pada Materi Barisan dan Deret. *Jurnal Cendekia : Jurnal Pendidikan Matematika*, *05*(02), 1578–1587.

Khofifah, L., Supriadi, N., & Syazali, M. (2021). Model Flipped Classroom dan Discovery Learning terhadap Kemampuan Pemahaman Konsep dan Pemecahan Masalah Matematis. *PRISMA*, *10*(1), 17–29. https://doi.org/10.35194/JP.V10I1.1098

Luritawaty, I. P. (2018). Pembelajaran Take and Give dalam Upaya Mengembangkan Kemampuan Pemahaman Konsep Matematis. *Mosharafa: Jurnal Pendidikan Matematika*, *7*(2).

Manik, R., & Radjah, C. L. (2017). Rendahnya Konsep Diri Akademik Siswa SMP. *Jurnal Pendidikan: Teori, Penelitian, Dan Pengembangan*, *2*(4), 494–502.

Markus, H., & Wurf, E. (1986). THE DYNAMIC SELF-CONCEPT: A Social Psychological Perspective. *Annual Review of Psychology*, *38*(1), 299–337.

Mayasari, D., Lina, N., & Habeahan, S. (2021). Analisis Kemampuan Pemahaman Konsep Siswa dalam Menyelesaikan Soal Cerita Matematika. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika*, *10*(1), 252–261. https://doi.org/10.24127/AJPM.V10I1.3265

Monariska, E., & Komala, E. (2020). Resiliensi dan Kemampuan Koneksi Matematik dengan Pembelajaran Berbasis Vark dalam Menyelesaikan Soal pada Mata Kuliah Analisis Vektor. *SJME (Supremum Journal of*

DOI: https://doi.org/10.24127/ajpm.v12i2.7532

*Mathematics Education)*, *4*(1), 101. https://doi.org/10.35706/sjme.v4i1.3149

Montgomery, D. C. (2013). *Design and Analysis of Experiments*. Permissions Department, John Wiley & Sons, Inc.

Mulabbiyah, Ismiati, A. S. (2018). Penerapan Model Pembelajaran Fleming-VAK (Visual, Auditory, Kinesthetic) untuk Meningkatkan Hasil Belajar Siswa Kelas IV MI Thohir Yasin pada Muatan Pelajaran IPA. *El Midad: Jurnal PGMI*, *10*(1), 56–74.

Musriandi, R. (2017). Hubungan Antara Self-Concept dengan Kemampuan Pemecahan Masalah Matematis Siswa. *Jurnal Dedikasi*, *1*(2), 150–160.

Ngalimun. (2012). *Strategi dan Model Pembelajaran*. Scripta Cendekia.

Ni Komang Riski Juniarti, I Gede Margunayasa, N. K. (2020). Hubungan Antara Pola Asuh Orang Tua dan Konsep Diri dengan Kompetensi Pengetahuan Matematika Siswa. *Jurnal Ilmiah Sekolah Dasar*, *4*(1), 17–25. https://doi.org/10.23887/JISD.V4I1.24273

Ningsih, S. Y. (2017). Peningkatan Kemampuan Pemahaman Konsep Siswa Melalui Pendekatan Matematika Realistik di SMP Swasta Tarbiyah Islamiyah. *MES: Journal of Mathematics Education and Science*, *3*(1), 82–90. https://doi.org/10.30743/MES.V3I1.223

Nur, A., Widodo, A., Ardani, A., & Firdaus, E. F. (2021). Pengaruh Kemandirian dan Model Problem Based Learning Berbantuan Google Classroom Terhadap Kemampuan Pemahaman Konsep Matematis. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika*, *10*(4), 2757–2764. https://doi.org/10.24127/AJPM.V10I4.4279

Nurani, M., Riyadi, R., & Subanti, S. (2021). Profil Pemahaman Konsep Matematika ditinjau dari Self Efficacy. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika*, *10*(1), 284–292. https://doi.org/10.24127/AJPM.V10I1.3388

Nurdin, E., Ma'aruf, A., Amir, Z., Risnawati, R., Noviarni, N., & Azmi, M. P. (2019). Pemanfaatan video pembelajaran berbasis Geogebra untuk meningkatkan kemampuan pemahaman konsep matematis siswa SMK. *Jurnal Riset Pendidikan Matematika*. https://doi.org/10.21831/jrpm.v6i1.18421

Nurhidayah, N. (2021). Implementasi Gaya Belajar VARK dengan Media Pembelajaran Berbasis Online Terhadap Pemahaman Konsep Dan Pemecahan Masalah Matematika Siswa. *Journal Peqguruang: Conference Series*, *3*(2), 484–489. https://doi.org/10.35329/JP.V3I2.2710

Othman, N., & Amiruddin, M. H. (2010). Different perspectives of learning styles from VARK model. *Procedia - Social and Behavioral Sciences*, *7*, 652–660. https://doi.org/10.1016/J.SBSPRO.2010.10.088

Pamungkas, A. S., Sultan, U., & Tirtayasa, A. (2015). Kontribusi Self Concept Matematis dan Mathematics Anxiety Terhadap Hasil Belajar Mahasiswa. *Jurnal Dinamika Pendidikan*, *8*(2), 55–

ISSN 2089-8703 (Print)
ISSN 2442-5419 (Online)

DOI: https://doi.org/10.24127/ajpm.v12i2.7532

60. https://doi.org/10.51212/JDP.V8I2.114

Pranata, E. (2016). Implementasi Model Pembelajaran Group Investigation (GI) Berbantuan Alat Peraga Untuk Meningkatkan Kemampuan Pemahaman Konsep Matematika. *JPMI (Jurnal Pendidikan Matematika Indonesia)*, *1*(1), 34. https://doi.org/10.26737/jpmi.v1i1.80

Prihaswati, M., & Purnomo, E. A. (2021). Profil Gaya Belajar Mahasiswa Prodi Pendidikan Matematika Berdasarkan Model VARK. *Teorema: Teori Dan Riset Matematika*, *6*(2), 242–249. https://doi.org/10.25157/TEOREMA.V6I2.6064

Putra, F. G. (2016). Pengaruh Model Pembelajaran Reflektif dengan Pendekatan Matematika Realistik Bernuansa Keislaman terhadap Kemampuan Komunikasi Matematis. *Al-Jabar : Jurnal Pendidikan Matematika*, *7*(2), 203–210. https://doi.org/10.24042/AJPM.V7I2.35

Rofika Hasan, U., Nur, F., Rahman, U., Eka Damayanti, dan, Pendidikan Matematika, P., & Alauddin Makassar, U. (2021). Self Regulation, Self Esteem, dan Self Concept Berpengaruh Terhadap Prestasi Belajar Matematika Peserta Didik. *ANARGYA: Jurnal Ilmiah Pendidikan Matematika*, *4*(1), 38–45. https://doi.org/10.24176/ANARGYA.V4I1.5715

Sari, D. Y., Rinaldi, A., & Andriani, S. (2021). Peningkatan Pemahaman Konsep.Matematis Dengan Penerapan Model Pembelajaran Elpsa Melalui Media Dart Board Math. *Jurnal Pembelajaran Matematika Inovatif*, *4*(6), 1433–1440. https://doi.org/10.22460/jpmi.v4i6.1433-1440

Sari, F. Y., Supriadi, N., & Putra, R. W. Y. (2022). Model Pembelajaran CUPs Berbantuan Media Handout: Dampak terhadap Kemampuan Pemahaman Konsep Matematis ditinjau dari Gaya Kognitif. *Mosharafa: Jurnal Pendidikan Matematika*, *11*(1), 95–106. https://doi.org/10.31980/MOSHARAFA.V11I1.1128

Sari, S. M., & Pujiastuti, H. (2020). Analisis Kemampuan Komunikasi Matematis Siswa ditinjau dari Self-Concept. *Kreano, Jurnal Matematika Kreatif-Inovatif*, *11*(1), 71–77. https://doi.org/10.15294/KREANO.V11I1.22717

Sarniah, S., Anwar, C., & Putra, R. W. Y. (2019). Pengaruh Model Pembelajaran Auditory Intellectually Repetition terhadap Kemampuan Pemahaman Konsep Matematis. *Journal of Medives : Journal of Mathematics Education IKIP Veteran Semarang*, *3*(1), 87–96. https://doi.org/10.31331/MEDIVESVETERAN.V3I1.709

Satriani, S., Fahinu, F., & Misu, L. M. La. (2021). Hubungan Self-Concept dengan Kemampuan Pemahaman Matematis Siswa Kelas VIII SMP Negeri 17 Kendari. *Jurnal Penelitian Pendidikan Matematika*, *9*(1), 29–42. https://doi.org/10.36709/JPPM.V9I1.16745

DOI: https://doi.org/10.24127/ajpm.v12i2.7532

Sinta Lestari, Ettie Rukmigarsari, S. E. W. (2021). Pengaruh Disposisi Matematis Dan Self Concept Terhadap Kemampuan Pemahaman Konsep Matematis Peserta Didik Pada Materi Aritmatika Sosial | Lestari | Jurnal Penelitian, Pendidikan, dan Pembelajaran. *Jurnal Penelitian, Pendidikan, Dan Pembelajaran*, *Vol.16*(19).

Sudjana. (2003). *Teknik Analisis Regresi dan Korelasi*. Tarsito.

Sumartini, T. S. (2015). Mengembangkan Self Concept Siswa Melalui Model Pembelajaran Concept Attainment. *Mosharafa: Jurnal Pendidikan Matematika*, *Vol. 4*(2), 48–57.

Tahir, T. (2021). The Effect of Learning Styles on Students' Mathematical Communication Ability. *Journal of Medives : Journal of Mathematics Education IKIP Veteran Semarang*, *5*(1), 13–21. https://doi.org/10.31331/MEDIVESVETERAN.V5I1.1378

Widyastuti, R., Sri Anggoro, B., Sastra Negara, H., Dwi Yuliani, M., & Nur Utami, T. (2020). *Understanding Mathematical Concept: The Effect Of Savi Learning Model With Probing-Prompting Techniques Viewed From Self-Concept*. 12060. https://doi.org/10.1088/1742-6596/1467/1/012060

Zunita, P. O. (2018). Efektifitas Model Discovery Learning Dan Guided Discovery Ditinjau Dari Ketrampilan Pemecahan Masalah Matematika Terhadap Hasil Belajar Kelas 4 Dabin 2 Dan 3 Kecamatan Godong-Grobogan. *Journal for Lesson and Learning Studies*, *1*(3), 268–278. https://doi.org/10.23887/jlls.v1i3.15013