

Students' mathematics self-concept and their learning style

N Delima^{1,2}, M A Rahmah¹ and A Amam³

¹ Department of Mathematics Education, Universitas Subang, West Java, Indonesia

² Universitas Pendidikan Indonesia, West Java, Indonesia

³ Universitas Galuh, Jln. R.E. Martadinata No. 150 Ciamis, West Java, Indonesia

nitadelima1985@gmail.com

Abstract. The success of mathematics learning can be supported by several aspects such as mathematics self-concept. Some studies suggest that mathematics self-concept is associated with performance in mathematics. This student performance can be supported by meaningful learning. A meaningful learning will be realized if in the learning process, teachers pay attention to the learning style of each student. Thus, mathematics self-concept and learning styles are two important aspects in supporting the success of learning processes. This study aims to describe how students' mathematics self-concept and their learning styles. This research was conducted in high school in Subang Jawa Barat Indonesia. The results of this study indicate that 67.86% of high school students in Subang have a negative mathematics self-concept and 57.89% of them have an assimilating style. Overall, the results of this study show that the majority of students who have negative mathematics self-concept have an assimilating learning style. Meanwhile, most of the students who have positive mathematics self-concept have an accommodating style. This research can be a reference for teachers in deciding a model of learning will be used in classroom.

1. Introduction

Learning mathematics can be seen as an active and constructive process, where students try to participate effectively to solve problems given by the teacher in the classroom. Therefore, mathematics learning should provide a challenge, which can stimulate students' curiosity through a given problem. In addition, learning should also be designed to help students complete by providing stimulants. In the process of giving this stimulant, each student must have a difference in understanding and processing the information given to him. This difference is called learning style..

The challenges given by the teacher at the time of learning take place will impact on students' attitudes towards learning itself. This is in line with Bandura [1] which says that the way a person thinks and assesses himself can shape a person's attitude, especially when facing challenging situations. The views and feelings of a person about him that includes psychological, physical, and social aspects by Rakhmat [2] are termed self-concept. Furthermore, Rakhmat [2] divides one's self-concept into two types, namely positive self-concept and negative self-concept. Positive self-concept is self-acceptance. A person with a positive self-concept will know who he is, can understand and accept positive and negative facts about him. Evaluation of him becomes positive and can accept the existence of others. According to Rini [3], a person is said to have a negative self-concept if he believes and views himself as weak, helpless, unable to do anything, incompetent, failed, unfortunate, unattractive, disliked, and loses appeal to life so His efforts in dealing with everything were relatively small and did nothing.

The characteristics of each student in learning should be the teacher's attention. This is done so that the teacher can determine an appropriate stimulant to obtain optimal learning. As stated by Pratiwi, et. al. [4], that if someone is forced to learn something with a method that is not his style, that person can feel depressed and frustrated. If students know their learning style, it will be easier for them to learn something. Likewise from the teacher's perspective, teachers who understand their students' learning styles will more likely present teaching styles that are appropriate to students' needs. The learning style studied in this research is the learning style carried by David A. Kolb which is then termed Kolb's learning style. Kolb, Boyatzis and Mainemelis [5] divides learning styles into four styles, namely: (1) Diverging or style of exploration, students with exploration styles like to see phenomena based on

multiple perspectives; (2) Assimilating, students with assimilation style always understand the problem widely then concluded; (3) Converging, students with this style like to look for practical sides of theory or ideas; (4) Accommodation, students with this style prioritize exploration of challenging experiences.

Adegoke [6] found that students' mathematical achievements had a positive and significant relationship with their mathematics self-concept (MSC). This is in line with the results of previous research conducted by Marsh and Hau, 2003; Marsh, 2005; Liu, Wang and Perkins, 2008 [6] who found that students' academic achievements had a positive and significant relationship with the academic self-concept they had. In the PISA report [7], it is stated that aspects related to mathematics self-belief are mathematics self-efficacy (MSE) i.e. a person's self-confidence in overcoming and solving a mathematical problem effectively, mathematics self-concept (MSC) i.e. a person's confidence in ability in doing their own mathematical activities, mathematics anxiety is a feeling of depression and anxiety when dealing with mathematics, and engagement, that is a sense of attachment between mathematical activities and other activities both inside and outside of school. Marsh [8] defines mathematics self-concept (MSC) as a person's perception of himself regarding his reasoning abilities and mathematical skills, pleasure and interest in performing mathematical activities.

Based on the description, it can be concluded that mathematics self-concept and learning style are two important aspects in supporting the success of a learning. Research on mathematics self-concept and learning styles has been carried out, but there have been no studies analyzing both together. In connection with this, a study is needed to analyze students' mathematics self-concept and their learning styles at once. In addition, so that this study provides wider benefits, each research variable is analyzed by gender.

2. Methodology

This research is a descriptive one conducted in Subang, Jawa Barat, Indonesia. The population for this research is all senior high school students in Subang. The sampling for this research is purposively performed based on the mean score of national examination for mathematics subject from all senior high school students in Subang. The instruments used in this study are mathematics self-concept questionnaire and learning style inventory (LSI) questionnaire adopted from Kolb and McCarthy [9].

Learning style inventory (LSI) consists of 36 items of statements with four alternative answers. The four kinds of alternative answers are scores that must be chosen by the students describing the proximity of each statement with their own personal condition, as follows, number 4 illustrates that the statement is very appropriate with the condition of students, number 3 illustrates that the statement appropriate with the conditions of students, number 2 illustrates that the statement somewhat appropriate with the conditions of students while the number 1 illustrates that the statement is less appropriate with the conditions of students. Each score is summed by the group of statements specified by LSI. This group of statements is accumulated in scores that reflect a person's preference when acquiring a new knowledge. Pratiwi, et. al. [4] explains that some people perceive new information through concrete things, relying on their own senses (concrete experience). Some others tend to make symbolic or abstract representations, perform analysis and make systematic planning (abstract conceptualization). Meanwhile, there are people who process their experiences by observing others involved in the experience, then reflecting on what happens (reflective observation). Others prefer to engage directly and take action (active experimentation). This combination of individual preferences creates a learning style dimension [10]. The illustration of the combination of these two preferences can be seen in Figure 1. The LSI scores obtained by each student will map out what preferences they have and belong to what learning style dimension.

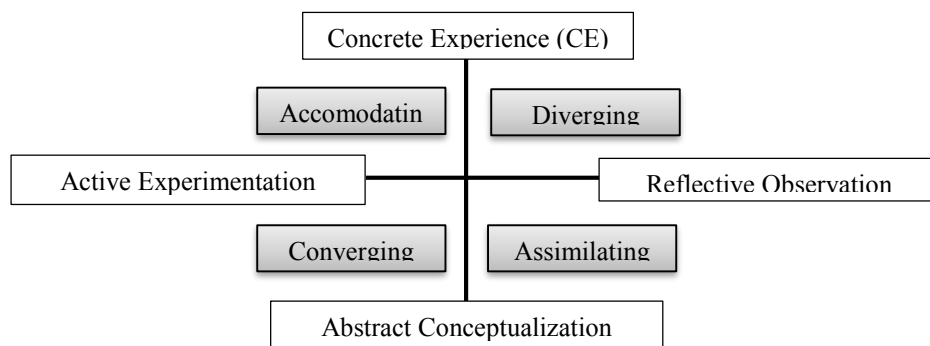


Figure 1. Kolb's learning style

In the meantime, mathematics self-concept (MSC) questionnaire is designed by modifying mathematics self-concept questionnaire used by PISA. The questionnaire used by PISA is a close-ended questionnaire with strongly agree, agree, disagree, and strongly disagree options consisting of five

statements: (1) I am not good enough in mathematics, (2) I get a good score in mathematics, (3) I learn mathematics very fast, (4) I always believe that mathematics is one of the coolest subjects, and (5) I understand every mathematics material, even the most difficult one. The modification is performed through inserting numerous new statements and completing statement sentences by making them suitable for learning materials. The number of statements in this questionnaire is thirty items and this instrument is also considered as valid through Spearman r test with 5% significant level and it has high reliability.

3. Findings and discussion

Data for this research consist of students' mathematics self-concept (MSC) questionnaire score and their LSI score. The mean score of each student's mathematics self-concept (MSC) is classified into two categories that are students with positive mathematics self-concept and students with negative mathematics self-concept. This classification is performed through creating two interval classes with the length of each class is 1.5. The following table displays frequency distribution of students' mathematics self-concept (MSC) score in each group.

Table 1. Classification of students' mathematics self-concept (MSC) and their gender

No	Group	MSC mean score	Numbers of student	Numbers of student	
				Male	Female
1	Positive	$1.00 \leq \overline{MSC} < 2.50$	9	8	1
2	Negative	$2.50 \leq \overline{MSC} \leq 4.00$	19	10	9

Based on Table 1, it is shown that the proportion of students who have negative MSC is more than students who have positive MSC. This data is in line with the results of the PISA assessment, which states that the majority of students have negative MSC [7]. The PISA results also mention that there are significant differences in MSC male and female students. The proportion of students with positive MSC is more owned by male students.

The fact that shows that the majority of female students have negative MSC, is reinforced by the theory put forward by Deutsch, Hoffman, Wilcox [11] that women face a number of constraints in full self-development, created by society, whose systems are built on gender differences. The system in the form of gender values is socialized and constructed to the community, women and men from birth and is accepted taken for granted as things that seem to be a nature that cannot be changed and contested. Various studies show that women tend to experience low self-esteem, are less independent. Honor effect is a fear of success syndrome when faced with competitive conditions with men, and the emergence of dependency and asking for protection. Women even seem to not recognize who they are, where they are going and what they can do [12].

Furthermore, to obtain an in-depth description of the characteristics of students, this study will discuss the types of learning styles that students have in each gender. Table 2 shows the composition of student learning styles based on the LSI scores obtained.

Table 2. Classification of students' learning style and their gender

		Kolb's learning style				Total
		Assimilating	Accommodating	Diverging	Converging	
Gender	Male	7	7	3	1	18
	Female	6	3	0	1	10
Total		13	10	3	2	28

Table 2 shows that the learning style that dominates students is assimilating styles. Students with this style, usually like theories that can be rationalized or logic rather than practical values. In activities, they like activities such as reading, exploring analytical models, and spending a lot of time thinking deeply [4]. When viewed from the psychology of the age of high school students, at that age, students begin to have independent learning that is developing [13]. Listiyowati, Andayani and Karyanta [14] suggested that high school students are generally in the late adolescent phase, where in this phase they are in a realistic phase. This is in line with the theory put forward by Kolb, Boyatzis and Mainemelis [4] which states that in students with assimilating learning styles, they have a rational and logical nature. This rational and logical nature directs them to think things deeper. This trait will certainly emerge if they

already have good learning independence. Therefore, it is reasonable if at this age, the majority of students have assimilating styles.

Diverging is an exploratory learning style, students with this style like seeing phenomena based on multiple perspectives. Usually they like working in groups, are more open to ideas and appreciate feedback even though they are personal. Students with this style are able to see concrete situations in various perspectives, so the process of finding a pattern for them is something that can be considered easy. The approach to solving problems used by students with this style is to observe carefully and not act. This is a bit contrary to the psychological characteristics of women. Nurhayati [15] suggested that women are often portrayed as expressive behavior but men behave instrumentally in relation to relationships in the social environment. Thus, it is clear that Table 2 shows that none of the women with diverging styles. This was also reinforced by research conducted by Murfi and Rosidah [16] which found that none of the high achieving female students had diverging styles.

Kolb, Boyatzis and Mainemelis [4] suggest that students with converging styles prefer to look for practical aspects of theory or ideas. They will feel satisfied when they can make the right decisions and solve problems thoroughly so that they are more interested in technical tasks than talking about theoretical issues. In this study, the proportion of male and female students with this style is the same. Meanwhile, Kolb, Boyatzis and Mainemelis [4], provide a description that students with accomodating styles place more emphasis on exploring challenging experiences, they like completing tasks together with others both in planning goals, completing field assignments and trying an unique and creative ways to complete tasks. This is in accordance with the characteristics of men, so it is quite reasonable if in this study, the proportion of male students with this style is more than female students.

A study of course requires drawing conclusions that can be generalized and can be accounted for statistically. Therefore, in this study, proportion testing was also carried out. The following is a data tabulation for each group.

Table 3. Contingency table

			Kolb' Learning Style				Total
			Assimilating	Accomodating	Diverging	Converging	
MSC	Negatif	Count	11	4	2	2	19
		Expected Count	8.8	6.8	2.0	1.4	19.0
	Positif	Count	2	6	1	0	9
		Expected Count	4.2	3.2	1.0	.6	9.0
Total		Count	21	13	10	3	2
		Expected Count	21.0	13.0	10.0	3.0	2.0

Based on Table 3, it is found that dominance occurs in students with negative MSC who have assimilating styles. Meanwhile, none of the students with positive MSC have converging styles. Table 3 also provides information that 67.86% of high school students in Subang have negative mathematics self-concept and 57.89% of them have assimilating styles. In addition, accommodating styles dominate students with positive mathematics self-concept.

In Table 3, there is an observation frequency that has zero value, therefore the test for independence between Kolb's learning styles and MSC are done using the Fisher Exact Test. This test is done to see whether the two variables are mutually independent or not. The following are the results of the test.

Table 4. Fisher exact tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)
Pearson Chi-Square	6.181 ^a	3	0.103	0.120
Fisher's Exact Test	5.619			0.094
N of Valid Cases	28			

a. 6 cells (75.0%) have expected count less than 5. The minimum expected count is 0.64.

b. The standardized statistic is 0.410.

Table 4 shows that the significance value at Fisher's Exact Test is 0.094. This value is greater than alpha 0.05, thus it can be concluded that the two variables are mutually independent. In other words, there is no significant relationship between learning styles and MSC. Although, this study provides results that learning styles do not affect students' MSC, however, this study can provide an overview of the learning styles of each high school student, so that the teacher can direct them in learning that fits their learning style. As stated by Pratiwi, et. al. [4], if a teacher understands student learning styles, it is very possible for teachers to present teaching styles that are appropriate to students' needs. In addition, it can also help students who have learning difficulties. Learning that accommodates student learning styles, will motivate students to be more active in learning. Meanwhile, Githua and Mwangi [8] and Delima [17] suggested that students' learning motivation affects their MSC. Thus, this learning will indirectly have a good impact on MSC students. Fuad [18] has conducted research related to several learning methods that are suitable for use in each student's learning style. The group of students with diverging styles is more appropriate if they learn by using the lecture method, the question and answer method, and the task method; students with accommodating styles will be better if the learning method uses real-world problems. Meanwhile, students with converging styles are more appropriate to use procedural learning and discussion methods.

Likewise with students, if a student understands his own learning style, it will be easier for them to learn something and increase motivation to display the best abilities. In Kolb and Kolb [10], it was argued that over the past three decades, researchers have found consistency between learning styles and a number of other variables, such as personality type, specialization in education, professional careers, roles in work, and adaptability. High school students are students at the final level, where after this, they have to make choices in their future development. According to Kolb and Kolb [10], students with converging styles, will be more interested in natural science and engineering. Meanwhile, students with diverging styles, they prefer to explore language, literature, history and other social sciences. In groups of students with assimilating styles generally, have an interest in the scientific field of science and mathematics. For students with accommodating styles, tend to show interest in the field of business field study and engineering while suitable work for students with this style include sales and marketing. These results provide an overview for students to start learning based on their learning style and focus their interests on their future careers.

4. Conclusion

Taking into account the result of data analysis elaborated the previous section, it can be concluded that 67.86% of high school students in Subang have a negative mathematics self-concept and 57.89% of them have an assimilating style. Overall, the results of this study show that the majority of students who have negative mathematics self-concept have an assimilating style. Meanwhile, most of students with positive mathematics self-concept have an accommodating style. It is highly recommended for further researchers to investigate the method to develop a learning model for the students with diverse learning style and mathematics self-concept.

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