Does Cognitive Style Affect Mathematics Creative Thinking Ability?

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Abstract. Many studies have tried to examine the cognitive style, but it is still relatively common because it tends to be associated with learning achievement in mathematics. Very few studies have tried to link cognitive style with mathematical creative thinking skills regarding gender. This comparative study compares students' mathematical creative thinking abilities based on cognitive style and gender. A total of 77 Class VII students of SMP Negeri II Langke Rembong were involved in this study. Data were collected using tests, namely tests of creative thinking skills and tests of cognitive style. The results of the analysis using Two Paths Anova show that there is no difference in students' mathematical creative thinking abilities based on cognitive style and gender. This study's results support various theories that cognitive style and gender do not determine a person's mathematical ability. Implications of results and strategies for improving mathematics creative thinking ability are discussed.

Keywords: cognitive style, creative thinking, mathematics

1 Introduction

Cognitive style is an individual's distinctive way of using cognitive abilities to receive and process information [1]. The typical way is permanent, reflected in attitudes, preferences, or strategies that become an individual habit in understanding, remembering, thinking, and solving problems [2]. Therefore, cognitive style can be viewed as a perceptual and intellectual activity that characterizes a person responding to various situations or information around him [3].

The study of cognitive style still leaves a big question. Various studies exploring the impact of cognitive style on learning have yet to show consistent results. Researches show that cognitive style generally affects memory performance [4] and learning achievement in mathematics [5], [6]. However, the answer to the question: of which cognitive style is more supportive of academic achievement is varied and inconsistent. Some studies show that external intervention, such as specific learning methods, only affects student achievement with a field-dependent cognitive style [7]. In contrast, other studies show the opposite [8]. In

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addition, research also finds that external intervention positively affects learning achievement in mathematics, both field-independent and field-dependent cognitive styles [9].

In addition to inconsistencies, studies on the impact of cognitive style still need to be more general. So far, studies on cognitive style have mostly looked at its impact on mathematics learning achievement [5]–[8], [10]. In contrast, mathematics learning achievement is a combination of various more specific mathematical abilities such as problem-solving abilities [11], reasoning and proof [12], communication [13], connections [14], representation [15], critical thinking [16], and creativity [17]. When studying mathematics, these abilities are interconnected, support each other, and form a person's mathematical performance. Therefore, their respective contributions need to be investigated further.

In particular, there are many studies on cognitive styles. However, very few studies have attempted to reveal the impact of cognitive styles on mathematical creative thinking abilities, especially when viewed by gender. In the last decade, for example, researchers have tried to examine: the influence of cognitive style and gender on conceptual understanding abilities of mathematics [18], the effect of cognitive style on mathematical critical thinking skills [19], [20], the effect of cognitive style and gender on mathematics learning achievement [21], and the effect of cognitive style on problem-solving ability [22]. Previous research that is quite relevant to this research is the effect of cognitive style on problem-solving abilities in the creative thinking process [23]. However, this study did not review creative thinking skills by gender. Another study tried to describe mathematical creative thinking skills based on cognitive style using the Knisley learning model [24]. However, the study also did not look at gender differences in them.

This study tries to reveal the impact of cognitive style on mathematical creative thinking ability. To explore these impacts, researchers reviewed them by gender. The aspect of gender also needs to be considered because various studies have shown that there is an effect of gender on math performance [25], [26], although other studies have shown otherwise [27].

The cognitive style itself consists of several kinds. Witkin divides cognitive styles into two types, namely Field Dependent (FI) and Field Independent (FI) [3]. In contrast to Witkin, Grimley classifies cognitive styles into two types, namely the Wholistic-Analytic cognitive style and the Verbal-Imagery cognitive style [28]. In this study, researchers used the classification made by Witkin, namely FI and FD. Students with FI cognitive style can observe small parts or details of general things. Students in this category are more independent and confident. They can succeed in learning through practice and individual activities without depending on others.

Meanwhile, students with FD cognitive style can observe the whole picture or general ideas. They are more social and sympathetic. They can succeed in learning through intensive communication with others [3].

2 Method and Materials

This quantitative research was conducted on 24-30 May 2022 involving 77 students of Class VII, SMP Negeri 2 Langke Rembong. The aspect measured is the ability to think creatively, which is reviewed based on cognitive style and gender. To determine the students' cognitive style, the researcher used the Group Embedded Figures Test (GEFT) instrument, which consisted of 16 items in the form of pictures. Referring to GEFT, students are categorized into two groups: Field Independent (FI) cognitive style and Field Dependent (FD) cognitive style. Furthermore, mathematical creative thinking ability was measured using the

Mathematical Creative Thinking Ability Test (TKBKM), compiled by the researcher, validated by two mathematicians, and tested before being used. TKBKM consists of three questions in the form of descriptions and measures four aspects of creative thinking skills: fluency, flexibility, originality, and elaboration. Data were analyzed using descriptive statistics and inferential statistics. The hypothesis was tested using two-way ANOVA.

3 Results and Discussion

3.1 Results

Based on the GEFT results, as many as 77 students were involved in the test. From 77 students, it is known that 36 students have FI cognitive style and 41 students have FD cognitive style. Of the 30 male students involved, 15 students with FI cognitive style and 15 with FD cognitive style. Meanwhile, from 47 female students, 21 students with FI cognitive style and 26 with FD cognitive style (see Table 1).

Furthermore, based on the results of the TKBKM, it is known that the average scores for men and women are 5.23 and 5.30, respectively. Meanwhile, the average score of students with FI and FD cognitive styles were 5.31 and 5.24, respectively.

Table 1. Descriptive statistics (Dependent variable: Creativity)

Cognitive Style	Gender	Mean	Std. Deviation	N
Field Dependent	Male	5.60	2.098	15
	Female	5.04	2.271	26
	Total	5.24	2.200	41
Field Independent	Male	4.87	2.356	15
	Female	5.62	1.596	21
	Total	5.31	1.954	36
Total	Male	5.23	2.223	30
	Female	5.30	1.999	47
	Total	5.27	2.075	77

The use of two-way ANOVA shows that there is no significant difference in students' creativity based on gender (Sig. value = 0.877 > 0.05) and cognitive style (Sig. value = 0.846 > 0.05). These results indicate no gender or cognitive style effect on the ability to think creatively mathematically. In addition, the results of this study also show that cognitive style and gender together do not affect mathematical creative thinking ability (Sig. value = 0.184 > 0.05).

3.2 Discussion

Cognitive style determines how the cognitive structure processes various external stimuli. The influence of cognitive style on various cognitive operations in human learning performance in the past few decades has shown relatively consistent results after the publication of Witkins [3]. However, recent developments have shown that certain environmental factors influence the relationship between cognitive style and human learning performance. The results of this study have shown another development that cognitive style does not always have a linear effect on various human learning performances in aspects of cognitive behaviour. This finding contradicts the findings of previous studies that examined differences in cognitive style on mathematics achievement in terms of gender [5], [6], [21],

which showed that cognitive style factors were one of the differentiating aspects in mathematics learning performance between men and women.

The absence of the influence of cognitive style on students' mathematical creative thinking abilities seen from the aspect of gender shows that the gender variable, which has been suspected to be one of the discriminatory aspects in various human cognitive operations [29], has been refuted. This idea means that various cognitive performances attributed to gender factors are irrelevant as differentiating aspects. This concept is understandable because long before, cultural factors were identified as barriers to access of specific sexes, especially women, to information or stimuli from the media [30]. The existence of equal opportunities for men and women to get the opportunity to obtain education [31] and the availability of wealthy learning resources that anyone can access regardless of gender/gender background became one of the factors that led to the hypothesis. This research is not proven.

On the other hand, these findings imply that variations in cognitive styles, especially field-dependent and field-independent views from the aspect of gender on various human cognitive performance and abilities, including creativity, need to be investigated from other factors. The existence of women's emancipation in various fields of public life has become an indication that cultural shifts and lifestyles have affected human cognitive development. In this case, it remains relevant to study the influence of culture on human cognitive development [32].

4 Conclusion

Cognitive style is not a cognitive ability, so it makes sense if it does not affect a person's success in learning mathematics. Cognitive style is how a person uses cognitive abilities to receive and process information from the surrounding environment. The results of this study show that, in terms of gender, cognitive style does not affect the ability to think creatively mathematically. This concept means that the gender factor is not a discriminatory aspect in studying the influence of cognitive style on students' mathematical creative thinking abilities. This finding also shows limitations in involving other aspects of this research. Some of the following variables can be suspected as extraneous variables that allow other researchers to study them so that they can add to the repertoire of new knowledge in this field. These variables include: 1) the level of exposure to information is powerful in today's digital era. 2) cultural factors, especially parenting patterns for children in the early stages of their development; 3) broader and more equitable access and educational services for male and female students, as well as education in urban and rural areas; 4) level of education Different parental education and occupations may also provide variations in cognitive style in its influence on mathematical creative thinking abilities.

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