Students of Mathematics Education of feminine female in Probability Problem-Solving on Binomial Distribution based Field-Independent Cognitive Styles

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ABSTRACT

This study aims to analyze the probabilistic thinking of a female undergraduate student in Mathematics Education who possesses feminine characteristics and a Field-Independent cognitive style. The subject, coded as MPI (Independent Female Student), was selected based on the needs of the study and met specific criteria: gender identity determined through a gender questionnaire, cognitive style identified using the Group Embedded Figures Test (GEFT), and mathematical ability assessed through UTBK SBMPTN questions. Among 20 students assessed, the majority demonstrated moderate mathematical ability, with MPI selected as a representative subject based on her profile. This research uses a descriptive qualitative method with a case study design. Data were collected through probability problem-solving tests and interviews and were analyzed through the processes of data reduction, data presentation, and conclusion drawing. The analysis was guided by Polya's four-stage problem-solving framework: understanding the problem, devising a plan, carrying out the plan, and looking back. The findings indicate that MPI exhibits generally good probabilistic thinking. She was able to understand the problems well, devise a plan, and execute her solution. However, some shortcomings were identified, particularly at the "devise a plan" stage, where she did not apply the combination formula appropriately, which led to errors in the use of the binomial distribution formula. Additionally, while the “looking back” stage was not evident in her written responses, reflective thinking was revealed during interviews. Overall, the study concludes that feminine female students with a Field-Independent cognitive style can demonstrate strong probabilistic thinking, though they may require further support in applying specific mathematical strategies. This research contributes to the understanding of how gender and cognitive style influence mathematical problem-solving in higher education, especially in the context of probability.

Keywords: Probabilistic thinking, Feminine female, Field-Independent cognitive style, problem-solving probability

INTRODUCTION

When someone thinks about a problem that has various possibilities or contains elements of uncertainty, then that person is thinking probabilistically. This is in accordance with several opinions including: 1) (Jolliffe, 2005) states that probabilistic thinking is thinking that involves understanding how models are used to simulate random phenomena, how data are generated to estimate probabilities, and how symmetry and other properties of the situation allow the determination of probabilities; 2) (Mooney et al., 2014) & (Groth et al., 2021), state that probabilistic thinking is used to describe a person's thinkng in response to various kinds of probability problems. Problems/situations that contain elements of uncertainty refer to a randomized experiment where there are several possible outcomes; that is, the actual outcome cannot be precisely determined in advance (Jones et al., 1997); 3) (Savard, 2014), states that thinking in response to situations involving uncertainty is called probabilistic thinking. Events that will happen are different from events that have already happened and events that are happening. If events that have already occurred and events that are happening involve certainty, while events that will occur involve uncertainty. Thus, in predicting events that will occur, it is necessary to pay attention to elements that are random; 4) (Jones et al., 1999) that "in this study the term probabilistic thinking will be used to describe children's thinking in response to any probability situation", this statement explains that the definition of probabilistic thinking is to describe a person's thinking in response to a probability situation, where a probability situation is a situation that contains an element of uncertainty.

Furthermore, (Sari et al., 2024) mentioned that there are four main constructions of probabilistic thinking, namely the construction of sample space, probability of an event, probability comparisons, and conditional probability.In solving a probability problem, a person can carry out thinking activities as stated by (Slavin, 2015) that the thought process in processing information, storing, and recalling information from within his probabilistic thinking through activities in random experiments, determining the sample space to determine the probability of an event ((Nilsson & Intellecta DocuSys, 2006); (Chernoff, 2009); (Khemlani et al., 2012); (Batanero, 2015); (Lavenant & Santambrogio, 2019); (Ingram, 2022)) so that everyone has different probabilistic thinking, this is in accordance with the statement of (Amir & Williams, 1999) and (Sharma, 2012), explaining that culture (which includes language, religion and experience) affects the probabilistic knowledge of each individual. Problem solving is an appropriate way in lectures to train students to think. (Pehkonen, 2008) states that "Problem solving has generally been accepted as a means for advancing thinking skills". In addition, Deal & Wismer (2010) stated that "problem solving plays an important role in mathematics and should have a prominent role in the mathematics education." Problem solving plays an important role in mathematics and should have a prominent role in mathematics education. Various preliminary data obtained show that students' ability to solve problems is a focus of learning at all levels of education. Especially at the undergraduate level.

(Polya, 1945) divides four stages in solving mathematical problems, namely: understanding the problem, devise a plan, carry out the plan, and look back. where students are able to understand the problem, students are able to determine the strategy or method to be used from the given problem, able to carry out the plan that has been determined and able to re-test the solution that has been determined or look for other alternative answers. (Witkin et al., 1977) states, field independent (FI) tend to have a clearer self-concept with clear boundaries between internal attributes, feelings, and needs and the external social environment. Subjects with cognitive style field independent (FI) more effectively they learn step by step or regular that begins with analyzing facts and processing to get so that subjects who have cognitive style field independent (FI) tend to be more independent in solving a problem by thinking analytically and systematically, motivation arises from within the students themselves, and not easily influenced by criticism. However, the subject had difficulty in learning the social sciences, while feminine are traits that are more often or commonly found in women than men. So feminine is a characteristic that is believed and shaped by culture as an ideal for women. For example, being compassionate and sensitive to the needs of others is considered a feminine trait (Hoyenga & Hoyenga, 1982) there is research that states that feminine women have an advantage over masculine men, this is in line with research from (Haroun et al., 2016) stated that examining gender differences in teachers on knowledge for teaching in Saudi Arabia which includes Content Knowledge and Knowledge content of Students on the topic of bilangar and its operations. The results showed that female teachers scored significantly better on Content Knowledge than male teachers In addition, female teachers also had better Knowledge content of Students than male teachers.

METHOD

Research design

The approach used is descriptive qualitative. (Fraenkel et al., 2011), because this study aims to determine the differences in probabilistic thinking undergraduate students of mathematics education cognitive style Field Independent based on gender. The gender in this study is feminine. This study uses a qualitative research model with a type of case study research. This case study research focuses on one particular object that is raised as a case to be studied in depth so as to reveal the reality behind the phenomenon of the ability to think probabilistically female undergraduate mathematics education students based on Field-Independent cognitive style in problem-solving probability.

Participants and data collection

Selected 1 feminine female undergraduate mathematics education student who has a Field-Independent cognitive style and has been tested using a math ability test obtained from UTBK SBMPTN questions. UTBK SBMPTN questions are questions used in the selection process to enter state universities and have the advantage of credible and standardized test results. The selection of high, medium, and low levels of mathematical ability refers to the assessment guidelines at the Universitas Sembilanbelas November Kolaka, namely A (high ability), B (medium ability), and C (low ability), but the research subjects in undergraduate students of the mathematics education study program at the Universitas Sembilanbelas November Kolaka (USN) Kolaka were selected using purposive sampling technique with the condition that they had taken Mathematical Statistics I course and the IPK value of undergraduate students of mathematics education semester 6 was also taken into consideration, especially those included in medium ability because based on interviews with lecturers teaching mathematical statistics I course. This is because one of the contents of the material in it, namely Probability, is included in the Mathematical Statistics I course. Furthermore, data collection is done by distributing probability problem-solving test questions (TPMP) to students the form of the question is as follows:

Figure 1:
Probability problem-solving task

2. A circular dart target board has a small circular center called the target center (Bullseye), the target center in area 1 consists of 2 parts, namely the red inner part (Double Bull) and the green outer part (Bull) while 20 circular areas numbered 1 to 20 are located around the board. Each circular area is further divided into 3 parts, namely in area 2 includes the target boundary line which is assumed to be inside the circle and gets a double value of 3, in area 3 includes the target boundary line which is assumed to be inside the circle and gets a double value of 2, while in area 4 is the outermost area of the target board, so that if someone throws the dart and hits a certain number, then he gets a value equal to the number, twice the number, or three times the number, depending on which part of the hit area is successively on the outside, the center, and the inside which is assumed that the boundary between 2 adjacent curves is given an iron plate, so that the arrow cannot stick in the boundary line. If the chance of someone hitting the center of the target is 0.04, the chance of hitting double value 3 is 0.45, the chance of hitting double value 2 is 0.20, and the chance of hitting the outermost region of the target board is 0.03 which is illustrated in the following figure

Then determine that the probability that 15 dart throws result in:

a. Hit the center of the target exactly 5 times
b. Getting a double score at most 2 times
c. Scored double three more than 7 times
d. Hits the outermost area of the target board 4 times

Research Tools

Research data obtained using probability problem solving tasks used to look more deeply probabilistic thinking subjects who have Field-Independent cognitive style. because probability problem solving tasks contain indicators of probabilistic thinking. Before the research is carried out, then the thing that is done is to see the instruments used to determine the ability of probabilistic thinking undergraduate students of mathematics education in solving mathematical problems in general and probability specifically selected based on mathematical ability test and GEFT test. Mathematical ability tests referred to in this study are general mathematics questions consisting of statistics, geometry, and algebra taken from UTBK SBMPTN, while GEFT is used in categorizing Field-Independent cognitive style in the subject.

Data analysis

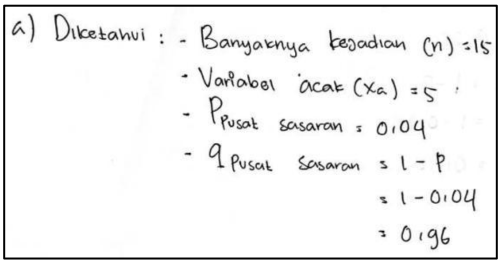
After categorizing the probabilistic thinking data, data analysis was carried out to find out the probability problem solving of feminine female students based on Field-Independent cognitive with the stages of data reduction, data presentation, and conclusion drawing.

FINDINGS AND DISCUSSION

Result

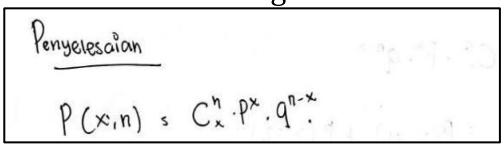
The initial process of giving the probability problem solving test instrument to prospective subjects was given to 15 undergraduate students of mathematics education class of 2020. From the results of the analysis of the mathematics ability test of the Class of 2020, it was obtained that 0% of students were in the high category, as many as 8 out of 15 students scored in the medium category with a percentage of 53.34%, while in the low category 7 out of 15 students were obtained with a percentage of 46.67%. Meanwhile, the results of the analysis of the mathematics ability test of the Class of 2021, obtained 0% of students who were in the high category, as many as 7 out of 12 students who scored in the medium category with a percentage of 58.34%, while in the low category obtained as many as 5 out of12 students with a percentage of 41.67%. Meanwhile, the GEFT test given to undergraduate students of mathematics education class of 2020 was 15 people. From the results of GEFT analysis of Class 2020 students obtained as many as 8 students who have FD cognitive style with 1 masculine male and 7 feminine females, and there are 7 students who have FI cognitive style including 1 masculine male and 6 feminine females. For the Class of 2021, obtained 5 students who have FD cognitive style with 1 masculine male and 4 feminine females, and there are 7 feminine female students who have FI cognitive style. Based on purposive sampling of the results of math ability tests and GEFT tests, this study focused on feminine female subjects. Selection of the subject of this study on the basis of the consideration of the lecturer Supervisor of Mathematical Statistics 1 course and the results of the math ability test which has the highest percentage level that is in the medium category. Field-Independent cognitive style was chosen based on the results of the Group Embedded Figure Test (GEFT), so that the subject initials FJA with the MPI code in the Class of 2020 was chosen. More details can be seen in the results of the subject's assessment in solving probability problems in part a below

Figure 2:
Understand the Problem



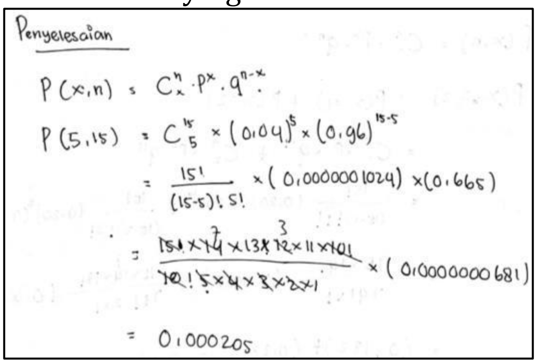
Based on the results of the MPI subject's Probability problem solving task, it can be seen that he can write down the known things from the problem given in the picture. However, in the aspect of writing down the things that are asked from the given problem has not been seen.

Figure 3:
Devising a Plan



Based on the results of MPI subject's Probabilistic problem-solving task, it can be seen that he has been able to develop a problem-solving plan based on known things using the binomial distribution formula.

Figure 4:
Carrying Out the Plan



Looking Back stage: Based on the results of the MPI subject's work, it has not been seen in the aspect of rewriting the final answer to the problem given, but using interviews obtained information that the MPI subject has re-examined the results of his work starting from the known things to determine the probability of an event of throwing an arrow hitting the target center point 5 times.

CONCLUSION

The conclusion section contains a summary of the research findings, which correlate with the research objectives written in the introduction. Then state the main points of the discussion. A conclusion generally concludes with a statement about how the research work contributes to the field of study as a whole (shows how progress from the latest knowledge). A common mistake in this section is to repeat the results of an experiment, abstract, or be presented with a very list. The concluding section must provide clear scientific truths. In addition, the conclusions can also provide suggestions for future experiments.

Discussion

Based on the results of the MPI subject probability problem-solving task, can be seen in:1) Understand the Problem stage, it can be seen that he can write down the known things from the problem given in the picture. However, in the aspect of writing down the things that are asked from the given problem has not been seen; 2) Devising a Plan stage, it can be seen that he has been able to develop a problem-solving plan based on known things using the binomial distribution formula; 3) Carrying Out the Plan stage, MPI subject can implement the Plan in solving the problem directly with the binomial distribution formula without using the combination formula based on the algorithm that has been compiled; 4)Looking Back stage, The results of the MPI subject's work, it has not been seen in the aspect of rewriting the final answer to the problem given, but using interviews obtained information that the MPI subject has re-examined the results of his work starting from the known things to determine the probability of an event of throwing an arrow hitting the target center point 5 times. This is in line with some research results (Lin & Davidson-Shivers, 1996) state that individuals who have a field-independent (FI) cognitive style tend to participate actively in learning activities so that they can analyze a situation and be able to reconstruct it, and are better able to solve aproblem without being guided. (Supratman, Budayasa & Rahaju, 2025) stated that quantitative testing of 20 feminine female students with a Field-Independent cognitive style showed significant results, with multiple regression analysis yielding F = 23.429 and a significance of 0.000 < 0.05. This confirms the important role of probabilistic thinking in solving probability problems. Qualitatively, in-depth interviews were conducted with one representative student, MPI, selected based on predefined criteria.

In the Polya-based problem-solving test, MPI understood the problem, devised a plan, and used the binomial distribution formula directly without applying the combination formula. While MPI did not rewrite the final answer, the interview revealed that she had accurately reviewed her work, from given data to the probability value obtained.

ACKNOWLEDGEMENT

The authors would like to thank the Ministry of Research and Technology's Beasiswa Pendidikan Indonesia (BPI), the Center for Higher Education Financing Services (BPPT PUSLAPDIK), and the Lembaga Pengelola Dana Pendidikan (LPDP) for supporting the publication of this article. The authors would like to thank Universitas Negeri Surabaya, and Universitas Sembilanbelas November Kolaka for providing the necessary resources and facilities for the completion of this research article.

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