Student’s Thinking Interference in Understanding Functions

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Abstract. This paper aims to describe students' thinking interference when studying function material. The study was conducted by analyzing the work results of 6 students of Mathematics Education Study Program FMIPA State University of Malang in the 6th semester about the function material. The results of the study show that students think interference when they understand the functions with verbally, symbolically, and diagrams.

1. Introduction
Function is one of the topics in mathematics. Based on the current curriculum in Indonesia, function material began to be introduced to students in class VIII. After that the material function is continued at the next level of higher education with various forms of representation. Understanding students about the function can be known through representations written or expressed verbally. This is consistent with what was stated by [1] that students' understanding of a mathematical concept can be seen from standards: problem solving, reasoning and evidence, communication, connection, and representation. Therefore, prospective teacher students, in this case students of Mathematics education study program are very necessary to know the meaning of the function correctly. Students are expected to be able to understand functions in various representations, such as words (verbal), tables, graphs, diagrams, or through equations. This is because the understanding of the concept of function will affect learning mathematics as a whole ([2], [3], [4], [5], & [6]). According to [7] the concept of this function is a unifying mathematics and has an important role in learning other mathematical topics, both in middle school and in college.

[8] examined thinking and function with the results of Jigsaw cooperative learning can make students more easily understand the concept of inverse functions. Research conducted by [9] shows that the construction of the teacher's knowledge of the concept of function is weak, both in defining functions verbally or symbolically. For example the use of words or phrases that are not appropriate in defining functions or using symbols that are not appropriate in defining functions. Furthermore [9] said that when teacher candidates represent functions with various forms, teacher candidates show weaknesses in changing one representation to another. When teacher candidates represent functions, there are overlapping construction processes. Based on the results of [9] research, the authors suspect that there is thinking interference in prospective teachers when representing functions. Interference of thinking is the event of recalling information stored in long-term memory mixed with other information or the information that is drawn is blocked by other information [10]. [11] states that obstacles or errors occur because the withdrawal of certain information is interrupted by the withdrawal of other information. While [12] states that thinking interference can inhibit students' thinking process if the construction of two concepts is still vague.

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[13] developed information processing theory. This theory is a cognitive theory of learning that describes processing, storing, and recalling knowledge from the brain [13]. In information processing theory, interference occurs when the process of recalling information in long-term memory is used to solve problems in working memory or short-term memory is interrupted or exchanged with other information. [10] distinguishes interference into two, namely global interference and local interference. Global interference occurs if the information retrieval process is hindered by other information. Whereas local interference occurs if the information retrieval process, the information is mixed with other information related to the information that was withdrawn.

2. Research methods
This research is a qualitative research with descriptive research type. The research was carried out by giving assignments to students to be done in an aloud way to know the students' thinking when working on the task as well as to find out the interference that occurred. The subject of this research was 6 students of 2015 B offering Mathematics Education study program totaling 6 students. The questions given are:

Write down the full function definition you know!

3. Results and Discussion
In this study qualitatively described the occurrence of interference thinking students when working on the task of defining the meaning of function. This description is viewed from information processing theory. By using information processing theory can be identified the characteristics of thinking interference experienced by students in defining the meaning of function. The following is presented the results and discussion of defining functions performed by 6 research subjects, namely S1, S2, S3, S4, S5 and S6. Figure 1 is the results of the S1 work on the function.

Figure 1. The results of the S1 work

From the results of the S1 work above, there appears to be thinking interference when S1 writes the meaning of the function. From work S1 can be seen at the end of S1 indicating that \((a, b)\) \(\in f\). From the writing S1, S1 does not state that \(f\) is a set at the beginning of the definition sentence. This shows that S1 does not state the genus of \(f\) in its definition so that the definition becomes unclear. Figure 2 is the results of the S2 work on functions.
Translation in English

Verbal function definition

function is the relation between set A which is said with the domain and set B which is said to be a codomain, where member set A has the right pair one at the set B. The set member that has a pair at set A is called the range.

Symbolic function definition

\[ f: A \rightarrow B, \forall x \in A, \exists! f(x) \in B \]

Function definition in a diagram

From the results of the S2 work above, there appears to be interference thinking when S2 writes the meaning of function. In defining functions in verbal form, S2 states that the function is the relation between set A which is said to be the domain and set B which is said to be a domain, where member set A has the right pair one on the set B. The word "member of set A" in the function definition proposed by S2 can mean that "there is member A" who has the right pair in set B. This shows that when S2 will express the function definition verbally, there is interference whether saying "there is a member " or every member ". In defining functions symbolically, S2 writes \( f: A \rightarrow B, \forall x \in A, \exists! f(x) \in B \). In this symbolic definition interference occurs, namely when S2 writes \( \exists! f(x) \in B \). The ambiguous S2 writes the symbol \( f(x) \), which is said to be in B. Because if it is written \( f(x) \) it means that it already shows a map of \( x \), which means it has function. Even though here it will still explain what functions are. While in defining functions in a diagram, interference occurs in the S2 between definitions or examples. From the picture it appears that it is just one example of a function that is represented in an arrow diagram, but S2 states that it is a function definition. This interference occurs because the information drawn is blocked by other information, namely between the definition and example. This is consistent with the opinion of [10] which states that the process of recalling information is hindered by other information called global interference. Figure 3 is the results of S3 work on functions.
Figure 3. The results of the S3 work

**Translation in English**

**Verbal**

*It is known that Mrs. Zuraidah gives pencils to each student in a different color. Each student only gets one pencil with a different color.*

From the results of the S3 work above, there appears to be interference thinking when S3 writes the meaning of function. When writing definitions, both verbally, symbolically, as well as diagrams, S3 has not been able to distinguish this definition of what an example of a function is. Interference that occurs in this S3 is global information and local interference. Figure 4 is the results of S4 work on the function.

Figure 4. The results of the S4 work

**Translation in English**

**Verbal**

*The function of set A to set B is the relation that maps each member of set A right to set B. The function f is the correspondence of x in the origin region (domain) to the value of f (x) in the area of the friend (codomain) exactly one (single).*  

Symbolically:

\[ f: A \rightarrow B, \forall a \in A, \exists b \in B \exists f(a) = f(b) \rightarrow a = b \]
From the first verbal definition, it means that the function is a set of ordered pairs that maps each member to set A with exactly one member set B. The second verbal function definition, S4 uses correspondence as genus and the value of x in the domain to \( f(x) \) is single at kodomain as differentia. By using this sentence in the function definition, it means that S4 states that the function is as an extract between a set of A (domain) and set B (codomain). In other words, the second verbal definition says that the function is on and 1-1. Because S4 says that the function can be defined by two programs, namely verbal and symbolic, meaning that these two sentences are verbally deemed to have the same meaning, which in reality is different. Furthermore, S4 says that functions can also be symbolically defined. Symbolic function definitions are as follows. \( f: A \rightarrow B, \forall a \in A \exists b \in B \exists f(a) = f(b) \rightarrow a = b \). By saying "symbolic definition", it means that S4 wants to show a different definition of definition with the same purpose between verbal and symbolic expressions. The symbolic expression of the function definition made by S4 says that the function from A to B is for every \( a \in A \) there is \( b \in B \), so that if \( f(a) = f(b) \) then \( a = b \). This statement refers to the function 1-1, which is different from the statement in the verbal definition of the first or the second. Figure 5 is the S5 work result about the function.

**Figure 5.** The results of the S5 work

**Translation in English**

The function \( f \) is a rule that maps exactly one member to the domain to a member of the codomain.

Function \( f \) is the set of ordered pairs

From the results of the S5 work above, there appears to be interference thinking when S5 writes the definition of function. There are 2 definitions written by S5. The first definition, S5 says that a function is a rule that maps exactly one member of the domain to a member of the domain. Inference of thinking occurs when S5 writes the word "exactly one". S5 writes "exactly one" member of the domain. This information is mixed with "exactly one" information on the domain. In the second definition, S5 experiences interference when writing a function is a set of sequential pairs. The information drawn by S5 is mixed with the understanding of the relation. Figure 6 is the results of the S6 work about the function.

**Figure 6.** The results of the S6 work

**Translation in English**

Function or mapping is a relation that pairs members of set A to set B by pairing exactly one member of set A to set B
From the results of the S6 work above, there appears to be thinking interference when S6 writes the meaning of function. S6 only states the function is a relation that maps a set to another set. Here S6 has not been able to differentiate whether a domain member function has been mapped to a set of codomains or not. The information taken by S6 about the function domain is mixed between "each" and "member" only. This is a local interference, because the information taken is mixed with other information related to the information that was withdrawn. This is consistent with the opinion of [10] stating that local interference occurs if during the information retrieval process, the information is mixed with other information related to the information that was withdrawn.

4. Conclusion
The results of the study show that students think interference when they understand the functions both verbally, symbolically, and diagrams. When students write a verbal definition there is interference about the membership of a set. When students write symbolic definitions there is interference in making membership symbols a set of whether all or not all. When students write definitions through diagrams occur in distinguishing whether it is an example or a definition of function. The cause of interference has not been investigated by researchers. Therefore, it is suggested that researchers interested in this matter can further examine the causes of students' thinking interference when understanding the meaning of function.

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