An onto-semiotic approach: Analyzing of field-independent and field dependent students' understanding in solving statistical problems

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Abstract. This article describes to analyzing of field-independent and field dependent students' understanding in solving statistical problems used to onto-semiotic approach. The subject matter of field dependent and field independent cognitive styles. Explorative descriptive research was undertaken involving 30 senior high school students. Data was obtained through task-based interviews. The result of this study indicates that there is a difference of students' understanding between field dependent and field independent students' in solving mathematical problems when using onto-semiotic approaches based on language, concepts and procedures, while based on computational aspect, proposition and argument. Field independent students in solving statistical problems tend to use mathematical terms and symbols consistently, more analytically and unaffected by the given problem, and using correct settlement measures. Field dependent students' tend to use maturing terms and symbols of math, tend not to be able to explain the related elements of concepts used in solving statistical problems and tend to have some correct steps of resolution. Thus the onto-semiotic approach is one of the innovations in learning mathematics to overcome student difficulties in solving statistical problems.

1. Introduction
The onto-semiotic approach is the ontology of mathematical objects. Ontology is a particular branch of philosophy that studies what objects are studied and the relationship between objects and human beings that produce knowledge. The main objects in the onto-semiotic approach include problems, languages, concepts, procedures, propositions, and arguments [1]. This approach considers three aspects of mathematics: problem-solving activities, symbolic language and logical and organized conceptual systems [2]. The onto-semiotic approach can be used to analyze students' understanding of math problems. Understanding and problem-solving abilities are a must to consider in order achieving the goals of mathematics learning [3]. This goal is a high demand that cannot be achieved only through memorization, routine exercise questions. After the mathematics learning takes place, students are expected to master and understand the concepts of mathematics and its relevance to solve related problems in everyday life.

By solving problems students can develop and build ideas, and can practice integrating the concepts, theorems and skills they learn. In addition to solving problems, students gain experience using the knowledge and skills they already have to apply to non-routine problem solving [4][5]. The problem solving steps used in this study include understand to problem, carry out the plan, carrying out the plan and looking back [6].
One that affects students' understanding differences in mathematical problems solving is the cognitive style [4]. Cognitive style is a typical way a person in processing, storing and using information to respond to a task. Cognitive style is divided into two: field dependent and field independent [7]. Field dependent is a cognitive style that students possess by accepting something more global and having difficulty separating themselves from their environment or being more influenced by their environment. Whereas field independent is the cognitive style that students have which tends to express a loose picture of the background of the image, and is able to distinguish objects from the surrounding context.

An onto-semiotic approach in this study is used to analyze field independent and field dependent student's understanding in statistical problems solving based on aspects of language, concepts, procedures, computing, propositions and argument. An aspects the onto-semiotic approach is used in accordance with the [2]. Understanding is the result of student construction in solving mathematical problems that conclude from oral and written communication. While the problem solving ability is the process of finding answers from non-routine problem using steps that are understanding the problem, planning the completion, implementing the completion plan and review the appropriate answer [6].

2. Method
Selection of research subjects using the GEFT test was adopted from [6]. Subjects are grouped into two: field dependent students and field independent students. The instrument used is a test of statistical problems. Data collect with tests and interviews. Data analysis includes data reduction, data presentation, conclusion drawing and report writing. Subjects used are high school students. Data from results of statistical problems test and interview results are described in the form of written words from the subject. Thus, this research includes explorative research with the qualitative approach according to [8]

3. Results and Discussions
Field Independent (FI) students' understanding is based on the onto-semiotic approach to solving statistical problems.

Understand to problem
Understanding of field independent students in understand to problem of statistics by explaining what is known and what is asked in the matter of using his own words. At the stage of understanding the problem, language-based comprehension involves explaining the purpose of the problem with his/her own words, defining all terms correctly based on aspects of the mean, median and mode concepts.

Carry out the plan
Understanding of Field Independent students in carry out the plan of statistical problems by explaining the strategies to be used in solving the problem accompanied by the reason. In the planning phase of solving statistical problems, the concept-based understandings include the mean, median and mode, based on the procedural aspects and the arguments include (1) writing the number 6 by 15 with the reason according to the mean formula, (2) determining the median location and the corresponding mode known in (3) write down the requested data with a trial strategy-try with the required conditions.

Carrying out the plan
Field independent understanding in carrying out the plan based on carry out the plan. In the planning phase of solving statistical problems, the concept-based understandings include the mean, median and mode, based on the procedural aspects and the arguments include (1) writing the number 6 by 15 with the reason according to the mean formula, (2) determining the median location and the corresponding mode known in (3) write down the requested data with a trial strategy with the required conditions.

Look back
Understanding of field independent students in look back of statistical problem solving by determining the mean, median and mode of data created along with the reason. At this stage, the concept-based comprehension includes the mean, median and mode, based on the aspects of the procedure and the argument of determining the mean, median and mode of data created on the grounds to assure its truth. As based on the proposition aspect, mention 4 statistical statements-related statements and procedures performed.

The understanding of Field dependent students is based on the onto-semiotic approach to solving statistical problems.

Understand to problem
Understanding of field dependent students in understand to problem of statistics by explaining what is known and what is asked in the matter of using sentences in accordance with the given problem. At the stage of understand to problem, language-based comprehension involves explaining the meaning of the problem equals the problem, defining some of the terms correctly and briefly and based on the mean, median and mode aspects of concepts.

Carry out the plan
Understanding of field dependent students in carry out the plan of statistical problems by explaining the strategies to be used in solving the problem accompanied by the reason. In the planning phase of solving statistical problems, the concept based comprehension includes mean, median and mode, based on procedural aspects and arguments including explaining the strategies used in solving problems with strategies by writing names and values and the steps used include (1) creating a name And values, (2) recalculate the mean, (3) calculate the median, and (4) determine the mode.

Carrying out the plan

![Figure 2. Result of field dependent student's test](image)

At the stage of implementing a statistical problem solving plan, concept-based understandings include mean, median and mode, based on procedural aspects and arguments including explaining the strategies used in solving problems with strategies by writing names and values and the steps used include (1) making name and value, (2) recalculate the mean, (3) calculate the median, and (4) determine the mode.
Look back
Understanding of field dependent students in look back of statistical problem solving occurs by determining the mean, median and mode of that data. At this stage, the concept-based comprehension includes the mean, median and mode, and based on the proposition aspect, mentioning 3 statistically related statements by concept definition.

Here is a comparison of field independent and field dependent students’ understanding based on the onto-semiotic approach to solving statistical problems presented in the following table.

**Table 1.** Comparison of field independent and field dependent students’ understanding based on the onto-semiotic approach to solving statistical problems.

| Poly'a's four step to problem solving | Subject | Field Independent students | Field Dependent students |
|--------------------------------------|---------|-----------------------------|--------------------------|
| Understand to problem | **Language:** interpreting the problem with its own sentence, defining all the terms correctly. | **Concept:** Mean median and mode. | **Language:** to interpret exactly the problem, defining some of the terms correctly and briefly. | **Concept:** Mean median and mode. |
| Carry out the plan | **Concept:** mean, median and mode | **Procedures and arguments:** write the number 6 by 15 with the reason according to the formula of the mean, determine the median location and the corresponding mode known in the matter with the known corresponding reason, write down the requested data by a trial strategy-try with the required conditions. | **Concept:** Mean median and mode. | **Procedures and arguments:** explains the strategy by writing the name and value and the steps used are making the name and value, recalculating the mean, calculating the median, and determining the mode. |
| Carrying out the plan | **Concept:** mean, median and mode. | **Procedures and arguments:** write numbers by reason according to the formula of the mean; determine the location of the median and the corresponding mode known in the problem with the known reason, and write down the requested data by a trial strategy-try with the required conditions. | **Concept:** Mean median and mode. | **Procedures and arguments:** use a strategy by writing the name and value and the steps used to create the name and value, recalculate the mean, calculate the median, and determine the mode. |
| Look back | **Concepts:** Mean median and mode. | **Procedures and arguments:** that defines the mean, median and mode of data created with reason to assure the truth. | **Concepts:** Mean median and mode. | **Proposition:** mention 3 statistical related statements performed. | **Proposition:** mention 4 statistical related statements by definition of concept. |

Based on table 1 above, understanding the understanding of field independent students and field dependent at the stage of understanding the object problems that arise in the onto semiotic approach to language and concepts, at carry out the plan of the strategy and carrying out the plan are concepts, procedures and arguments In the looking back stage, the understanding of the field independent Students is based on the onto semiotic approach of concepts, procedures, arguments and propositions and the understanding of the field dependent students based on the semiotic approach to the concept of propositions. From the results of the description, the onto-semiotic approach can be used to analyze the understanding of field independent and field dependent students in solving mathematical problems, in accordance with [7].
4. Conclusion
There is a difference in the understanding of field independent and field dependent students in solving mathematical problems using the onto semiotic approach on the basis of aspects of language, concepts and procedures. While the understanding of field independent and field dependent students is based on similar propositions and arguments. Field independent students in solving statistical problems tend to use mathematical terms and symbols consistently, more analytically and unaffected by the given problem, and using correct completion measures. Field dependent students tend to use maturing terminology and symbols, tend not to be able to explain the elements related to concepts used in solving statistical problems and tend to leave out some of the correct steps of completion. The differences are in line with the characteristics of field independent and field dependent students as proposed by [7].

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