

Students' statistical literacy on junior high school

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Abstract. Statistical literacy is a key ability expected of citizens in information-laden societies, and is often touted as an expected outcome of schooling and as a necessary component of students' numeracy and literacy. The facts show that the statistical literacy ability of Indonesian students is still in an alarming category and Indonesian students for junior high school have not been able to compete internationally in the statistical literacy. This qualitative descriptive research was conducted to describe junior high school students' ability and difficulties in basic skills of statistical literacy. Data were collected from 6 students of 8th grade in one of junior high school in Aceh, Indonesia through test and interviews. The results clearly show that students' statistical literacy are still in low category. Students are good in understanding the data but they have limited understanding of the data presentation concept. Students have difficulty in using the principle of presenting the data into the pie chart. Many steps of presenting the data are not complete. From this study can be concluded that students' basic skills of statistical literacy has not been satisfied. Therefore, mathematics learning process in data presentation concept should be improved.

1. Introduction

Statistics has been a key component of the mathematics curriculum over the past quarter century [1]. Statistics also has been emphasized as one of the elements that define scientific literature in the 21st century[2]. This means that students who have good statistical skills will have the ability to find and understand the usefulness and interpretation of data in a critical way and it becomes one of the important aspects that must be owned to become competent individuals in the 21st century.

In Indonesian, statistics becomes one of the most important material that must be learned and mastered from an early age. Statistics have been included in the elementary mathematics curriculum as part of arithmetic since 1975 and even today statistics becomes one of the core materials in the Curriculum 2017 revision for elementary school, junior and senior high school where the expected competences are the student be able to describe the various presentation of data in the form of tables or diagrams, appropriate to communicate information from a data set and be able to describe the data in the form of tables or specific diagrams that match the information conveyed.

Students who receive statistical education should have the ability to understand and overcome the uncertainty, variability, and statistical information in the world around them, and participate effectively in an informed society, then can contribute or participate in the production, interpretation, and communication of data relating to the problems they face [3]. The ability to interpret, critically evaluate, and communicate the various statistical information and messages obtained is called statistical literacy [4]. The term statistical literacy also can be understood as ability to demonstrate minimal knowledge of basic concepts and statistical procedures [5,6]

Based on the description above it means one of the important objectives of mathematics education in schools is statistical literacy where students' ability to understand, interpret and represent or communicate the data are the most important skills should be owned. Although the underlying concepts of statistical literacy are embedded in the mathematics curriculum, it is assumed that students encounter statistical messages in a wide variety of contexts both in and out of school. Consequently statistical literacy is more than a topic of the mathematics curriculum. Moreover Moore stated that statistics itself is regarded as a methodological discipline that is distinct from mathematics [7].

Nevertheless statistical literacy of Indonesian students is still in an alarming category and students in junior high school have not been able to compete internationally in the statistical literacy[8,9]. Based on PISA result in 2012, Indonesian students score was only 375 for mathematical literacy while in 2015 the score was 386. The increasing results showed, but the score was still below the average PISA score set by OECD that was 494 [10].

Francois, et al stated "PISA data has a greater proportion of mathematical items focusing on the domain of data and uncertainty. While 39% of PISA items are classified under the mathematical content domain 'data and uncertainty' [9]. Its means that junior high school students' statistical literacy to understand and analyze data, interpret data and communicate data should be improved. Regarding to explanation above, it is important to conduct investigation of junior high school students' ability and difficulties in basic skill of statistical literacy.

Baecause In statistical literacy requires basic skills that include the ability to organize data, compile and display tables, and work with different data representations[11], so that peoples' statistical literacy involves both a knowledge component (comprised of five cognitive elements: literacy skills, statistical knowledge, mathematical knowledge, context knowledge, and critical questions) and a dispositional component (comprised of two elements: critical stance, and beliefs and attitudes) [12].

In this research focus only in four students knowledge component as shown in Tabel 1.

Tabel 1. Knowledge somponent of statistical literacy

Knowladge Component of Statistical Literacy	Description
Literacy skill	The basis of capability required. Understanding statistical information requires a variety of text processing skills so that students can derive meaning from the information presented.
Statistical knowledge	Students must have statistical knowledge. Where statistical literacy requires students to be able to present a data in various forms (tables, graphs or diagrams). Not only presents data but also must understand how to collect and process data
Mathematical knowledge	Students need to have numeracy skills in order to interpret the exact numbers used in statistical information
Context knowladge	Data is viewed as context-related numbers, where the context is the source of meaning and basis for interpreting the results to be obtained. Context knowledge is the main determinant of interpretation. If students are not familiar with the context of the data collected, students will more difficult to interpret.

2. Method

The method used in this research was descriptive qualitative research method. The research was conducted by taking samples from junior high school students of grade 8 with the age of 13-15. Instrument used in this research ware test and interview guidance. The test was given to 27 students in

one class. From the results of the tests conducted selected six students as subjects to be interviewed. The subjects were selected based on the variation of scores obtained by students and students who make unique solution steps. The deep interview and analysis were held to know students ability and difficulties based on test given.

3. Result and Discussion

The question given was PISA question in data and uncertainty content which using personal context category. On the question given, students are required to be able to understand the relationship between verbal language and symbolic language given from the data, be able to interpret the data provided and be able to calculate correctly and be able to represent data into tables and pie chart. Based on answers from six students interviewed, it is known that there are three different answers done by the students.

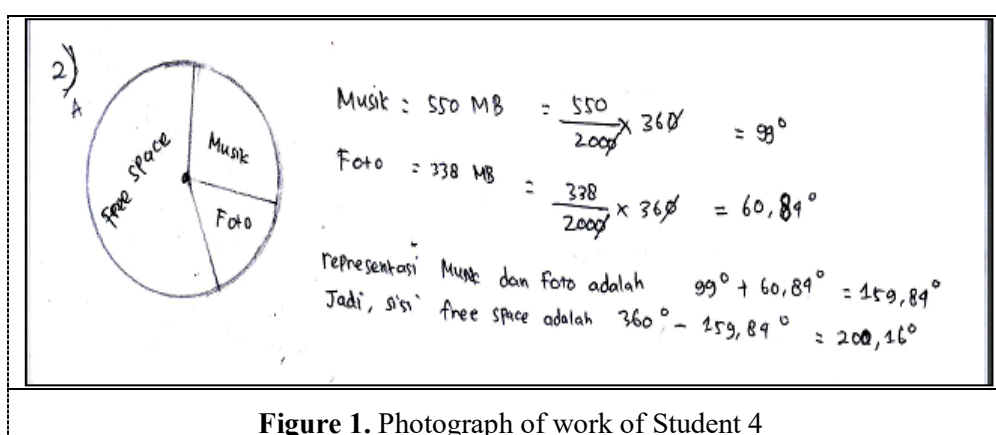


Figure 1. Photograph of work of Student 4

From six students interviewed, the response of Student 4 in Figure 1 is the correct answer for the question. From the solution made and from the interview results are known student first identifies the capacity of each album to be inserted into a new flash, then student complete the step to illustrate the diagram by calculating the percentage or the angle size that formed from each album correctly. Subject can also represent the current state of the requested flash disk into the pie chart correctly.

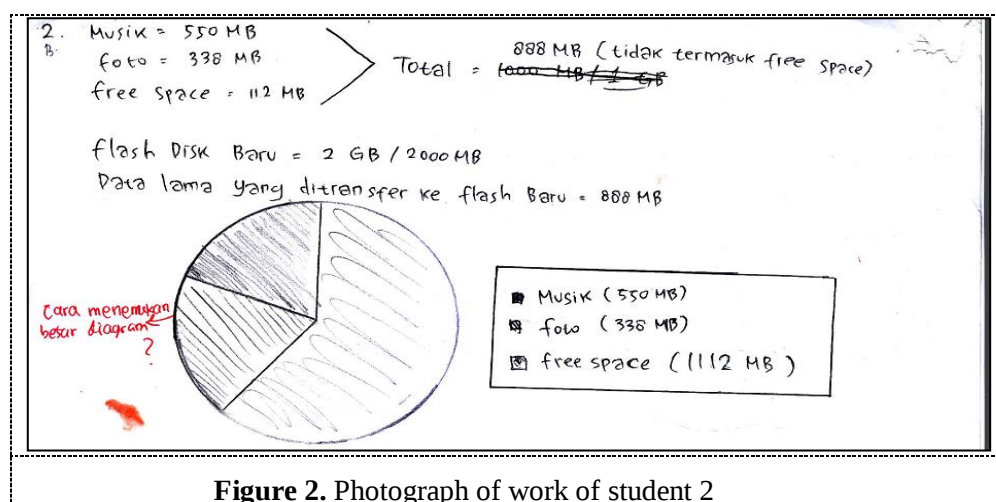


Figure 2. Photograph of work of student 2

The answer shown in Figure 2 indicates that Student 2 is able to identify the capacity of each album through the calculation correctly, but Student 2 does not complete the process of calculating the percentage or angle size of each album as a step to draw a pie chart, thus showed Student 2 paints pie

chart by estimating only. From the interview result is known that Student 2 has not been able to make representations into the pie chart with complete and appropriate steps. Student understands the context, but does not know how to representing the data into a pie chart because lack understanding of data display concept.

Students 1, 3 and 6 also solved the problem as Student 2 did in Figure 2. Based on the figure is known that the students are able to identify the problem with the correct step of reference in the early stages, but in the stage of completing the required representation, students do not complete the process to calculate the percentage or the degree of each album. It is mean that students have difficulty in representing data into the pie chart.

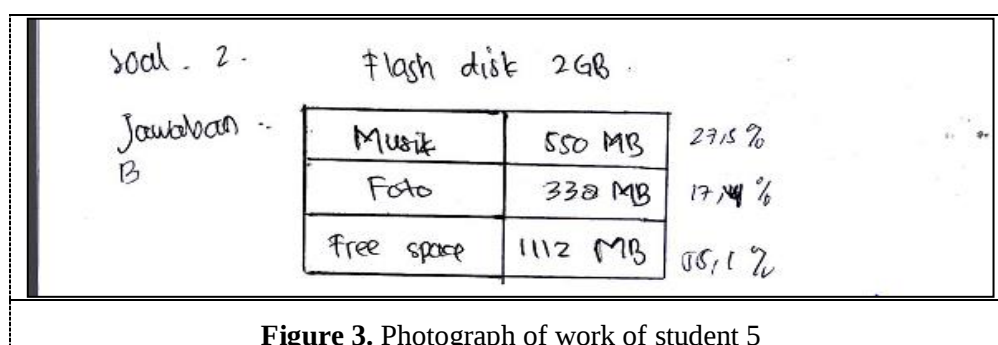


Figure 3. Photograph of work of student 5

Student 5 solved the problem as shown in Figure 3. Student 5 is correct in identifying and calculating the capacity and percentage of data provided, but does not draw a pie chart as a representation of the new flash disk required. Through interview conducted, it is known that Student 5 understands the purpose of the given problem, the calculation steps are correct, but Student 5 has difficulty in representing data into the pie chart. Student 5 is only able to represent data into the table, in addition Student 5 has limited understanding of the regarding the concept used. Student said that the concepts used to answer this question are only addition and subtraction operations. Student is rarely face contextual problems so difficult in understanding the problem so that student can not answer the problem perfectly.

From above description it can be concluded that from six students interviewed only Student 4 is able to identify problems and perform calculations correctly and Student 4 is able to write the steps to paint the pie chart completely. Based on the guidance of the assessment of mathematical communication, Student 4 gets score 4. For Student 1 Student 2, Student 3 and Student 6 they get score 2 because the steps to calculate the percentage or large degree for drawing the phi chart are not complete. One person that is Student 5 who get score 1, it indicates that Student 5 has limited understanding the purpose of the question.

Tabel 2. Percentage students' reached knowledge component of statistical literacy

Knowledge Component of Statistical Literacy	Percentage
Literacy skill	16%
Statistical knowledge	16%
Mathematical knowledge	33%
Context knowledge	83%

Based on the Tabel 2 it indicates that only one student has a good understanding in literacy skill and statistical knowledge. It is mean student has sufficient text processing skills so that the student can

obtain the meaning of the information presented and student can communicate clearly verbal or written opinion, in which the opinion contains information that has the correct truth or evidence. Only two students have sufficient mathematical knowledge which show only two students understand some mathematical knowledge and procedures that used to produce statistical information such as calculate percentage or degree size to paint a pie chart. Five students understand the context of the question clearly that promoted easy to interpret the information of the question.

Furthermore, based on the analysis result of students' task and interview, some students difficulties found: (1) student has limited understanding of the data display concept; (2) students has difficulty in using the principle of presenting the data into the pie chart; (3) students are difficult to understand the context because of rarely faced contextual problems.

4. Conclusion

From this study, it can be known that the junior high school students' statistical literacy is still unsatisfied. The results clearly show that students' ability were in low category. Students are good in understanding the context of the question, but fewer students are good in literacy skill, statistical knowledge and mathematical knowledge. Some students have difficulties because they has limited understanding of the data display concept. Students has difficulty in using the principle of presenting the data into the pie chart and students difficult to understand the context because of rarely face contextual problems.

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6. References

- [1] American Statistical Association 2005 Guidelines for assessment and instruction in statistics education: College report *Report* pp 1–61
- [2] OCDE 2000 *Measuring student knowledge and skills. The PISA 2000 assessment of reading, mathematical and scientific literacy* (Paris: OECD Publisher)
- [3] Gal, I., & Garfield J B 1997 *The Assessment Challenge in Statistics Education*. Amsterdam: IOS Press and The International Statistical Institute. ed J B G I. Gal, Joan B Garfield (Amsterdam, The Netherlands: IOS Press and The International Statistical Institute.)
- [4] Garfield, J., & Ben-Zvi D 2004 *The Challenge of Developing Statistical Literacy, Reasoning and Thinking* (Dordrecht: Kluwer Academic Publishers.)
- [5] Schagen I 1998 Statistical literacy is the essential skill for educational managers *Educ. J. I*
- [6] Watson J M and Ben A. Kelly 2008 Sample, Random and Variation: The Vocabulary of Statistical Literacy *Int. J. Sci. Math. Educ.* **6** pp 741–67
- [7] Carmichael C, Callingham R, Hay I and Watson J 2010 Statistical literacy in the middle school: The relationship between interest, self-efficacy and prior mathematics achievement *Aust. J. Educ. Dev. Psychol.* **10** pp 83–93
- [8] Dasari D 2006 Kemampuan Literasi Statistis dan Implikasinya dalam Pembelajaran *Semin. Nas. Mat. dan Pendidik. Mat.* pp 1–9
- [9] Stacey K 2011 The PISA view of mathematical literacy in Indonesia *Indones. Math. Soc. J. Math. Educ.* **2** pp 95–126
- [10] PISA 2016 *PISA 2015 Results in Focus*
- [11] Joan Garfield 2003 Assessing Statistical Reasoning *Stat. Educ. Res. J.* **2** pp 22–38
- [12] Gal I 2002 Adults' statistical literacy: Meanings, components, responsibilities *Int. Stat. Rev.* **70** pp 1–51