Exploration of table and graph literacy of statistics student at Universitas Negeri Makassar

M A Tiro, M K Aidid and A S Ahmar
Department of Statistics, Universitas Negeri Makassar, Makassar, Indonesia
E-mail: arif_tiro@unm.ac.id

Abstract. This study aim to explore and review the literacy of tables and graphs for statistics students at Universitas Negeri Makassar. To obtain this aim, descriptive analysis conducted on the students results of table and graph literacy test. This study is importance for leading statistical learning tendency which emphasis on technical procedures with much mathematical formula. From this exploration, we can identify weaknesses that must be looked for solutions, particularly would improve learning of tables and graphs literacy to improve student’s visualization and communication skills. Indicators of tables and graphs literacy have four domains, namely: (1) understanding tables and graphs concepts, (2) the ability of tables and graphs application, (3) skills of making table and graph, and (4) the accuracy of tables and graphs interpretations. The four domains are mapped according to grade of student. Mapping of table and graph literacy will be the basis of statistical learning strategies. Conclusion of the data analysis that the level of achievement scores of students in understanding the concept of the tables and graphs is still low (≤43%), the ability of tables application is still too low (41%), but for the ability of graphics applications is slightly higher (58%). Furthermore, the skills to make the table is still very low (25%), but for the skills to make the graph is slightly higher (59%). The general conclusion that the achievement score of statistics students of students batches 2013, 2014 and 2015 was still below the expectations. Thus, learning strategies need to be formulated to improve every aspect of learning in statistics courses.

1. Introduction
As described Schield that the core curriculum should be based on a theory about discipline of statistics [1]. In statistical theory, data are not just numerical figures as studied by mathematicians, but data are numbers in context. Some changes can pervasive and important happening in the form and type of data which available to the general public. Data from large-scale studies are increasingly available. For larger sample sizes, small differences will be statistically significant. For example, an outcome of the National Longitudinal Survey of Youth (NLSY), involving 12,000 subjects, found a 0.4 point difference in IQ test scores between men and women that statistically significant at the significance level of 5% [2]. Someone who has a statistical literacy is equipped to recognize the effect of sample size on the statistical significance. Thus, in the large-sized data, assign people who have statistical literacy should anticipate that the statistical significance of almost meaningless because the relationship between the two variables are expected to be statistically significant. We can anticipate that understanding the context and the influence of confounding variables is much more relevant than understanding the statistical random variation and its statistical significance. The knowledge and skills
are becoming increasingly important if the data population (ie, studies based on large samples), giving the effect became more common in decision-making, both for government and for business.

The results of the study are generally presented in the form of tables and graphs. A good table is an integral part of a publication, both for analytical articles as well as for research papers. Using tables effectively reduces the amount of data in text. The table also eliminate the purposes of discussion variables are less significant, are not important in the story line. Two important things to note in the presentation of the data in the table: (1) create table so that easy for the reader to understand the numbers in the table; (2) layout design and titles (label) of table in the form of direct and simple, so that the reader's attention focusing on the substance delivered by the data, rather than the structure of the table. Presentation is striking and disturbing contents from the observed important to avoid. Remember that technology is only waitress. We should not add useless notes and obscure elements on the tables. Keep the message simple for the reader. Thus, the purpose of the presentation of data can to be retained in mind when designing and creating of graph. Based on this description, the statistical literacy needs to be an emphasis on the learning process [3]. Education is a conscious and deliberate effort to create an atmosphere of learning and the learning process [4] and in the process of learning, a person have specific characteristics in learning. The characteristics of each person is different [5]. The primary basis for explaining the data and results of statistical analysis are the table and graph. Thus, literacy of table and graph as a strong foundation for the application of statistical literacy [6–8]. From this reasons, the researchers designed a study with the aim to: (1) obtain map of the quality of students’ understanding of the concept and application of table and graph for explaining the data and results of statistical analysis; (2) obtain map of the quality of the students’ ability using table and graph in real-life contexts; (3) obtain map of the quality of students’ ability to create table and graph of the data and results of given statistical analysis; (4) obtain map of the quality of students’ for interpreting the data and results of data analysis presented in tables and graphs.

2. Research Method

This study is a descriptive analysis conducted on students of Statistics Department of Universitas Negeri Makassar about literacy of table and graph. The instrument of this study was developed referring to Tiro & Ahsan [8] and Tiro & Sukarna [9]. Students were given the test and the results are analyzed, explored and described. Students are seen in the category of batch levels, namely the batches 2013, 2014, and 2015. Two research variables are defined as (1) table literacy is the ability to communicate statistical information’s by tables and (2) graph literacy is the ability to visualize statistical information’s by graphs.

Collecting Data using instrument (1) test of basic table literacy and (2) test of basic graph literacy both are in the form of multiple choice questions. Both of these tests are developed to test that simultaneously collecting data to perform analysis: (1) the level of difficulty of each test item; and (2) discrimination index for each item test.

The approach used to analyze the survey data is quantitative descriptive and classification. Classification analysis is used to determine the classification of the problems faced by students in literacy of tables and graphs. Furthermore, factor analysis was conducted to see the conformation of construct validity of operational definition variables. Thus, construct validity of the test, and the relationship between the two variables were analyzed with path analysis.

3. Result and Discussion

3.1. Result

In the descriptive analysis are shown in the median, mean, standard deviation, coefficient of kurtosis and skewers of the literacy of table and graph. Furthermore, the boxplot diagram of each indicator is presented to see the distribution of score of basic literacy of table and graph. Boxplot is selected because it showed a mean value, to describe the size of the central tendency; interquartile range (3rd quartile - 1st quartile) to describe the variability of 50% of the data in the middle, outliers that
describes the data is extremely different from most other data. The boxplots can be seen in the Figure 1 and Figure 2. The are same outliers for application, skills of making and interpreting tables (Figure 1), but only one outlier for understanding concept of graph (Figure 2).

![Figure 1. Boxplot four indicators literacy table](image1)

![Figure 2. Boxplot four indicators literacy graph](image2)

3.2. Discussion
Basic literacy test of tables and graph were done to determine the level of difficulty of the questions. From this test shows that the number of items that are difficult on table literacy is 4 questions (25%) as much on graph literacy. The highest of difficult level in table literacy is an understanding concept (question number 9) \((p = 0.12)\), it means that only 12% of the students were correct for this question. This questions measure knowledge of student about the type of tables, namely demonstration table of the smaller ones are eligible to be placed in the text and the greater of reference tables should be placed in the appendix of a paper.

Furthermore, difficult question of graph literacy is also on indicators of understanding the concept (question number 9) \((p = 0.06)\), it means that only 6% of the students are correct in this question. This question measure respondents' understanding of the use of relevant graph to understand the characteristics of the data distribution. In this case, boxplot show the model of the data distribution, symmetrical, with a long tail at the bottom or the up. So, the topic of types of graphs are relevant with specific types of data still need attention in learning statistics. Then, the highest achievement of students in table literacy is an understanding concept with a score: 1.68 of 4.00 (42%). In addition, the lowest achievement of students in table literacy is create a table with score: 1.01 of 4.00 (25%). Similarly, the highest achievement in graph literacy is the accuracy of interpretation with score: 2.39 of 4.00 (56%). On the other hand, the lowest achievement in graph literacy is the understanding of the concept with score: 1.70 of 4.00 (42%). Thus, the main of information presented by tables and graphs need to be well understood by the students, in addition to the types of tables and graphs that are relevant for specific types of data.

From the discussion above, the strategy needs to be applied in teaching tables and graphs literacy are numerical. The table use to see the real of value in a comparative approach, and the graphs use to see trend of the data in the correlative approach.

The achievement of students in tables and graphs literacy can be seen in Table 1. This table shows that the ranges of level of achievement in table literacy range from 25% (skills to create a table) to 42% (understanding of the concept and application capabilities of table). Next, the range of achievement level of graph literacy from 43% (understanding the concept of the graph) to 60% (the precision of graph interpretation). So, student achievement in table literacy is still very low, but for graph literacy is slightly higher (though still needs to be improved).
Table 1. Level of achieved in table and graph literacy of students

| Indicator                              | Table Literacy | Graph Literacy |
|----------------------------------------|----------------|----------------|
|                                        | average  %     | average %      |
| Understanding of concept               | 1.68 42%       | 1.70 43%       |
| Ability of application                 | 1.66 42%       | 2.32 58%       |
| Skills of making table and graph       | 1.01 25%       | 2.35 59%       |
| accuracy of interpretation             | 1.61 40%       | 2.39 60%       |

Association between two variables (literacy of table and graph) were analyzed with path analysis. This relationship is presented in Figure 3, this image shows confirmatory factor analysis for each variable, literacy of table and graph, and correlation analysis of both.

From the path analysis, we have result:

Chi-square = 21,860
Degrees of freedom = 21
Probability level = 0.408

| Model                   | GFI | AGFI |
|-------------------------|-----|------|
| default models          | 0.946 | 0.907 |
| Independent models      | 0.895 | 0.866 |

From the results above, the value chi-square: 21.86 with p = 0.408 and GFI, AGFI exceed 0.85 or the default model is better than the independent models. This results show that the model supported by empirical facts. However, the correlation coefficient between literacy of table and graph is 0.003 with p = 0.691. Results of inferential analysis show that there is no significant correlation between scores of table and graph literacies. This might be due to differences in the orientation of the information.
presented in the table and graph. The table present information with the real scale and comparative, but the graph present information about scale approach and associative or tendencies.

This results of this study almost the same with the results of previous results by Tiro, Nusrang and Ahsan [10] about descriptive and inferential statistics where the level students achievement of an understanding of concepts (60%), the ability to apply the concept (60%), and the ability to interpret the results (60%). Another previous Sudarmin, Tiro and Irwan [11] about probability and random events where the level students achievement on understanding of concepts (46%), the ability to apply the concept (56%), and the ability to interpret the results (66%).

4. Conclusions

Based on the results of the discussion can be concluded that: (1) the level of student achievement on understanding the concept of the table is still relatively low (41%), as well as understanding of the concept of graph is still low (43%); (2) the level of student achievement on ability application of table is still too low (41%), but the ability application of graph is slightly higher (58%); (3) the level of students achievement in the skills to create a table is still very low (25%), but creativity to make the graph is slightly higher (59%) and (4) the level of student achievement in the accuracy of interpretation of table is still very low (25%), however accuracy of interpretation of graph is already higher (59%). The general conclusion that the student achievement based on batches 2013, 2014 and 2015 was still below expectations. Thus, learning strategy needs to be improved on any subject of learning statistics. The results of this study

Acknowledgments

The authors would like to express their thanks to Faculty of Mathematics and Natural Sciences, Universitas Negeri Makassar for the opportunity provided to carry out this research and supported fund, to the management of the Research Institute of Universitas Negeri Makassar for facilitation of this research, and the committee of IConMNS-2017 for giving opportunity to present the results of the research.

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