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THE EFFECTIVENESS OF CONCEPT MAP APPLICATION ON IDENTIFYING PRESERVICE MATHEMATICS TEACHERS' MISCONCEPTIONS OF GRAPHIC LITERACY

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Abstract. The concept map becomes meaningful with the connection between the new concepts and the existing concepts in the cognitive structure. Using the concept map, the learners combine the contents and realize the internal connection between the concepts. In this sense, statistics is important as they help people interpret important information. The purpose of the effectiveness of the concept map is to identify misconceptions in the field of mathematics education from graphic literacy. The current research method is an interpretation of two quantitative and qualitative methods. The statistical population was all preservice mathematics teachers (PMT), 18 undergraduate PMTs and 15 master's PMTs were selected as the purposive sample. The PMTs of each level were divided into three groups. The PMTs of the first group completed the concept map and then answer the questions of the written exam and the second group first answer the questions of the written exam and then completed the concept map and the third group only answer the questions of the written exam. The PMTs of group 1 and 2 did not have the opportunity to return to the exam questions they did first and correct their answers. In order to evaluate the effect of using concept maps on PMTs' learning, all PMTs of the three groups answered one question called the total exam. To analyze the data, the one-way analysis of variance test was used for each group and as an average for all groups, as well as comparing the difference of the average scores of the groups in the written exam with Tukey's post-test method. In the end, with the help of the concept map tool, PMTs' misconceptions were identified and classified into 4 categories, failure to correctly recognize the names of graphs, incorrect drawing of statistical graphs, failure to correctly recognize the type of variable and recognition of the appropriate graph for a data set. The research findings showed that the concept map identified the misconceptions of preservice teachers with better results than the results of the written exam. PMTs can use this method to teach different subjects, especially statistics in school, and improve the teaching-learning process and strengthen meaningful learning.

Keywords: Concept map, meaningful learning, graphic literacy, statistics education, misconceptions, preservice teachers.

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1. Introduction

Statistical graphics are important because they help people interpret a lot of important information. View statistical graphics as a powerful tool, giving people a summary of quantitative data and even categorical data. Humans interpret various findings about sports games, medical reports, health statistics, etc [3]. with the help of Statistical graphics; Therefore, Statistical graphics play a very important role in our human lives. In this research, concept map is used as a valuable tool to evaluate PMTs' understanding of statistical literacy and to identify PMTs' misconceptionss of this concept. A concept map leads to meaningful learning by making connections between new concepts and existing concepts in the cognitive structure. By using the concept map, the learners combine many contents and realize the internal connection between the concepts. The purpose of the research is the effectiveness of the use of concept maps on identifying the misconceptions of PMTs about graphic literacy [19]. The present research method is a combination of quantitative and qualitative methods. The statistical population was all PMTs, 18 undergraduate PMTs and 15 master's PMTs in secondary school were selected as a purposive sample. The PMTs of each level were divided into three groups. The PMTs of the first group completed the concept map and then answer the questions of the written exam and the second group first answer the questions of the written exam and then completed the concept map and the third group only answer the questions of the written exam. The PMTs of group 1 and 2 did not have the opportunity to return to the exam questions they did first and correct their answers. In order to evaluate the effect of using concept maps on PMTs' learning, all PMTs of the three groups answered one question called the total exam. In the second stage, all PMTs in all three groups answered one question called the total exam. In the third stage, regarding the total exam, deeper investigations were conducted using the results of the interviews conducted with PMTs and qualitative analysis methods. To analyze the data, the one-way analysis of variance test was used for each group and as an average for all groups, as well as comparing the difference of the average scores of the groups in the written exam with Tukey's post-test method. In the end, with the help of the concept map tool, PMTs' misconceptions were identified and classified into 4 categories: Failure to correctly recognize the names of graphs, incorrect drawing of statistical graphs, failure to correctly identify the type of variable and recognition of the appropriate graph for a data set.

2. Main Resalts

The results indicate that using concept maps as an evaluation tool improves PMTs' learning and identifies their misconceptions. The use of concept maps in evaluation is supported by the idea of changing approaches in evaluation in order to use different tools in addition to written exams. The research findings showed that the concept map identified the misconceptions of PMTs with better results than the results of the written exam. The first misconception identified in the research was about the lack of recognition of different charts such as curve graph, histogram and bar graph. The PMTs did not know the characteristics of these charts correctly and were confused in distinguishing between charts and their drawing. Some PMTs used a bar graph instead of a histogram. Most of the PMTs had problems in drawing the histogram and did

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not use the right and left limits of the graph for drawing. But this misconception was not clearly visible in the concept map and it was revealed in the exam. Therefore, it cannot be said that concept maps show us comprehensive evidence of people's knowledge. Therefore, it seems that the concept map cannot completely replace the written exam. Some PMTs had confusion and misconception in identifying the variable type of each of the statistical charts. A number of PMTs considered bar graphs to be related to discrete variables or did not correctly identify the type of histogram graph variable. These misconceptions could be recognized and evaluated with the help of concept map. The results of the present study are in line with the findings of Reyhani [32] and Novak's [19] studies in the science course. It is also in line with the results of Barwells [44], Williams [40] and Smita's [45] research in mathematics course, in the sense that concept maps are used in the assessment of mathematics course, it helps PMTs in the field of graphic literacy in recognizing the misconceptions.

3. Conclusion

The results of this study show that teaching through a concept map can make the learning process more meaningful. Therefore, evaluation through concept map gives us a better possibility to identify misconceptions and the level of understanding of the audience, so that PMTs can improve the teaching-learning process and strengthen meaningful learning. PMTs can use this method to teach different subjects, especially statistics in school. We need more research in this field. Issues such as how to use concept maps in teaching other concepts of mathematics and statistics in secondary and even higher education can be considered in future researches. It can also be suggested that PMTs can use different methods of presenting pre-prepared concept maps as an educational strategy in their future teaching in schools at different stages of education. In this context, PMTs can also be encouraged to use it as a teaching-learning strategy by preparing concept maps of the subject matter.

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