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Logical Reasoning Abilities of Junior High School Students in the Province of Cotabato, Philippines

Paul John B. Ongcoy (MST)
University of Southern Mindanao, Kabacan, Cotabato, Philippines
pauljohnongcoy@yahoo.com.ph

Abstract - *Reasoning abilities of the learners and its development was well-discussed in the world of education. The higher the ability of the person to reason abstractly, the higher the probability that a person will effectively function in the society. Thus, it is the main goal of the K-12 Curriculum of the Department of Education to improve the reasoning abilities and formal reasoning among students in the country. The higher the reasoning ability of a person, the more productive he is. The ability of logical reasoning has an essential function in the academic performance of students and their construction of the concepts. This study aimed to determine the logical reasoning abilities of 150 randomly selected junior high school students. Specifically, this study aimed to determine the logical reasoning abilities namely combinatorial reasoning, controlling variables, correlation reasoning, probabilistic reasoning and proportional reasoning among the grade 10 junior high school students and determine whether there is a significant difference in students' logical reasoning abilities according to their gender. The respondents answered the Test of Logical Thinking (TOLT). Thirty respondents were interviewed to verify their answers. The findings of the study led to the following conclusions: most students correctly answered problems in probabilistic reasoning and least number of students correctly answered problems in proportional reasoning and combinatorial reasoning and, male and female respondents have equal performances in problems pertaining to combinatorial reasoning, controlling variables, correlational reasoning and probabilistic reasoning but female respondents are better in proportional reasoning than the male respondents.*

Keywords: *logical reasoning abilities, junior high school students, K to 12 curriculum, Test of logical Thinking*

INTRODUCTION

In the world of education, reasoning abilities of the learners and its development was well-discussed. The higher the ability of the person to reason abstractly, the higher the chance that a person will effectively function in the society. Thus, it is the goal of the Enhanced Basic Education Curriculum or the K-12 Curriculum of the Department of Education to improve the reasoning abilities and of formal reasoning among students at all levels of the basic education in the country. The higher the reasoning ability of a person, the more productive he is. According to Atay [1] and Lawson [2], the ability of logical reasoning has an essential function in the academic performance of students and their construction of concepts and knowledge.

Demirel [3], Lawson [4] and Linn [5] have distinguished five different modes of formal operational reasoning: proportional reasoning - realizing equal proportions of two quantity and logic to understand and solve quantitative relations; controlling variables - realize all the variables in given condition, suppose hypothesis for the role of variables and systematically control variables to verify the hypothesis to derive conclusion; probabilistic reasoning - ratio of expected probability for all the possible probability; correctional reasoning - ability to realize relationship between variables even the changes of object and phenomena are irregular; and combinatorial reasoning - count all the possible cases for solving problem without duplication which are the determinants of the success of students in science and

mathematics advanced courses at secondary level [6]. Demirel [3] emphasized that logical reasoning abilities includes effective use of concepts, giving scientific solutions to problems, detecting differences between concepts, generalizing, classifying, representing a problem with a mathematical formula, computing, simulating and providing a hypothesis testing. Meehan [7] and Shemesh [8] have identified that there was no significant difference in the logical reasoning abilities between male and female.

OBJECTIVES OF THE STUDY

With the introduction of the Enhanced Basic Education Curriculum in the Philippine Basic Education System which promotes the improvement of logical reasoning abilities among Filipino learners, this study generally aimed to determine the logical reasoning abilities of junior high school students. Specifically, this study aimed to determine the logical reasoning abilities namely proportional reasoning, controlling variables, combinatorial reasoning, probabilistic reasoning and correlation reasoning among the grade 10 junior high school students and determine whether there is a significant difference in students' logical reasoning abilities according to their gender.

METHODS

The samples of this study were 150 grade 10 students randomly selected from 10 public junior high schools in the Second Congressional District of the Province of Cotabato, Philippines. This study was conducted from October 2015 – February 2016. The respondents answered the Test of Logical Thinking (TOLT). Thirty respondents were interviewed to verify their answers.

This study used two-stage random sampling. The sample schools were selected through simple random sampling. The respondents who came from the randomly selected school and the respondents selected for bottom-up interview were selected using simple random sampling.

Before questionnaires were administered, formal permissions from the Schools Division Superintendents of the Department of Education's Schools Divisions of Cotabato Province and of Kidapawan City were sought and obtained. The researcher himself administered the instrument used in this study including the bottom-up interview. Respondents (15 respondents from each school) were gathered to fill-up the questionnaire. The students were told about the nature of the instrument and how this should be answered. They were given an enough time (approximately 1 hours) to answer the questionnaire. After the testing, 30 respondents (3 respondents per school) were selected for a bottom-up interview in verification of the answers.

The instrument used in this study was the "Test of Logical Thinking (TOLT) developed by Tobin and Capie [9]. This instrument was developed to measure the modes of cognitive reasoning abilities of students according to Piaget: proportional reasoning, controlling variables, probabilistic reasoning, correlational reasoning and combinatorial reasoning. The problems were distributed into the following: problems 1 and 2 were proportional reasoning; problems 3 and 4 were controlling variable; problems 5 and 6 were probabilistic reasoning; problems 7 and 8 were correlational reasoning; and problems 9 and 10 were combinatorial reasoning.

Descriptive statistics which includes measures of variability (standard deviation) and measures of central tendency (mean,) were used to determine logical reasoning abilities of junior high school students. The t-Test of independent samples and F-test were used to test the hypothesis.

RESULTS AND DISCUSSION

Table 1. Logical Reasoning Abilities of Junior High School Students according to the Hierarchy of Piagetian Mode of Logical Reasoning Abilities

Logical Reasoning Abilities	Mean	%	SD
Probabilistic Reasoning	0.53	26.50	0.77
Proportional Reasoning	1.23	61.50	0.85
Controlling Variable	0.9	45.00	0.83
Combinatorial Reasoning	0.53	26.50	0.73
Correlational Reasoning	0.84	42.00	0.62

Majority of the respondents (61.50%) answered the problems in proportional reasoning. This was followed by controlling variable reasoning (45.00%) and correlational reasoning (42.00%). Least number of students (26.50%) answered problems in probabilistic reasoning and combinatorial reasoning.

According to the respondents during the interview, most of the students said that they got correct answers in problems pertaining to proportional reasoning because they had discussed the topics in their Mathematics and in some Sciences subjects.

Meanwhile, they got low scores in problems about combinatorial reasoning because of the time constraints (maximum of 1 hour). They had the difficulty in answering the problems in combinatorial reasoning because there was no other technique they knew other than the use of tree diagram.

Table 2. Logical Reasoning Abilities of Junior High School Students and their Gender

Logical Reasoning Abilities	Sex	Mean	SD	F-value	p-value
Proportional Reasoning	Male	1.12	0.80	2.60^{*}	0.004
	Female	1.51	0.84		
Controlling Variable Reasoning	Male	0.79	0.83	1.02^{ns}	0.31
	Female	0.94	0.83		
Probabilistic Reasoning	Male	0.70	0.89	1.51^{ns}	0.13
	Female	0.47	0.72		
Correlational Reasoning	Male	0.88	0.62	0.54^{ns}	0.59
	Female	0.82	0.62		
Combinational reasoning	Male	0.63	0.75	1.08^{ns}	0.28
	Female	0.49	0.72		

[ns]*not significant at 5% level of significance*
significant at 5% level of significance

There was no significant difference between the logical reasoning abilities and their gender with the exemption of the proportional reasoning where in there was a significant difference between the proportional reasoning and their gender. Male and female respondents have equal performances in problems pertaining to controlling variables, correlational reasoning, probabilistic reasoning and combinatorial reasoning.

Female respondents are better in proportional reasoning than the male respondents. According to the female respondents during the bottom-up interview, they were able to answer problems pertaining with proportional reasoning because they were more exposed in daily life situations like budgeting their weekly allowance, allocating their study time and doing proportions in the ingredients of the menu they cooked.

CONCLUSION AND RECOMMENDATION

The findings of the study led to the following conclusions in the logical reasoning abilities of grade 10 junior high school students: most students correctly answered problems in probabilistic reasoning and least number of students correctly answered problems in proportional reasoning and combinatorial reasoning and male and female respondents have equal performances in problems pertaining to controlling variables, correlational reasoning, probabilistic reasoning and combinatorial reasoning but female respondents are better in proportional reasoning than the male respondents.

In view of the results and in consideration of the limitations of this study, the following recommendations are hereby presented: teachers should determine the logical reasoning abilities of the students at the beginning of the instruction so that proper use of teaching strategies, instructional materials, remediation and other factors needed in the delivery of the lessons be used properly and appropriately; it is also recommended that teachers must expose students with higher order thinking skills mathematics problems so that their reasoning skills will be enhanced. Further, teachers must have to be creative as well in coming with relevant tasks to enhance students' logical reasoning abilities and a research of this kind with different logical reasoning test is recommended; curriculum developers must consider the levels of cognitive development and logical reasoning abilities of students in making new curriculum and in reviewing and revising the existing one; and students must engage to activities that will enhance their logical reasoning abilities.

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