An Analysis Of Higher Secondary Students Logical Thinking Ability In Mathematics

Abstract
Logical thinking includes the abilities of using numbers effectively, providing scientific solutions to problems, detecting the separations between the concepts, classifying, generalizing, representing with a mathematical formula, computing, providing a hypothesis, testing and stimulating. The aim of this study is to investigate whether the logical thinking level of higher secondary students were being affected by the variables of gender and school type in Chennai city. The study was conducted using survey method and the sample included 200 students who have chosen mathematics as one of the subject at the higher secondary level. The data were collected through a questionnaire consisted of 45 questions which was developed by the investigator for measuring logical thinking level. The students were required to choose the best possible answer among the given alternatives. Pearson Correlation, Multiple Regression and t-test were used for analysis of data. The results of the study indicated that the logical thinking ability of higher secondary students was significantly affected by both the variables gender and school type.

1. Introduction
The development of logical thinking abilities had considerate interest in the world of education. Cohen (1980) stated that the ability of logical thinking is positively correlated with the ability of performing the rules in the society. Hence, being responsible for preparing individuals for their future positions in the social life, schools aim to improve the logical thinking skills of their students. The ability of logical thinking has a fundamental role in students’ academic performance in
mathematics. From the related literature, it has been pointed that among the priorities of the mathematics and science education was developing students’ logical thinking abilities (Lawson, 1982).

2. Significance of The Study
Logical thinking ability in mathematics is an indispensable skill needed for each and every student at the higher secondary level. As the students are in the gateway to enter into higher education, they should excel in logical thinking skill so as to achieve better in whatever course they are going to take in their higher education. Hence, the investigator felt the importance of this study and chosen the sample as students at the higher secondary level. Nonetheless, not many studies have been conducted to gauge the higher secondary school students’ logical thinking abilities in the Indian context.

3. Assumptions Of The Study
Researcher has assumed the relevant facts associated with the variables of the study. On the basis of developmental nature of psychological change of the higher secondary students, it has been assumed that girls have the more logical thinking ability in solving mathematical problems than their counterparts.

4. Research Questions
The following research questions were framed to guide this study.
1. Are there any relationship between gender, school type and logical thinking ability in mathematics?
2. What is the contribution of each of the two predictor variables: gender and school type to logical thinking ability?
3. Is there any difference in logical thinking ability of higher secondary students based on their gender and school type?

5. Research Procedure
This study adopted a normative survey method in collecting data from the proposed sample of this study. This research study involves the determination of the effect of variables namely gender and school type to logical thinking ability of higher secondary school students.

5.1 Problem of the Study
An Analysis of Higher Secondary Students’ Logical Thinking Ability in Mathematics is the problem of the study under investigation. Gender and Type of School has been given more emphasis in this study in order to improve the quality of education for those who are studying in backward areas.

5.2 Sample of the Study
Based on Cognitive Development Theory proposed by Jean Piaget, higher secondary students those who are at the formal operational stage (15-16 years) where they can think logically about abstract propositions and test hypotheses systematically were constituted as sample. Hence, a total of 200 first year higher secondary school students i.e. 100 students from Government schools and 100 from Government Aided schools were chosen using random sampling method for this study.
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5.3 Tool Description

The data were collected through a questionnaire which consists of 45 questions to test the logical thinking ability of higher secondary school students was developed by the investigator. The students were instructed to choose the best possible answer from the given alternatives. In scoring of the participants’ score on the instrument, for the multiple choice items, students received 1 point for providing the correct answer with the correct reasoning behind it and 0 point for the wrong answer.

5.3.1. Standardization of The Test

Using Cronbach Alpha Co-efficient method, the reliability of the tool was found to be 0.871 which was highly reliable for the targeted sample of this study. By obtaining the expert judgment, the content validity of the corresponding tool has been found.

5.4 Analytical Techniques Used

Statistical analyses techniques like Pearson Correlation test, t-test and Multiple Regression Analysis has been used to analyze the collected data.

6. Data Analyses and Interpretation

Data collected was analyzed by using SPSS 16.0. In order to determine individual and combined contribution of gender and school type to logical thinking ability of higher secondary students, multiple regression analysis was performed. To test the mean score differences between independent samples, the researcher utilized independent sample ‘t’ test.

Results are presented as given below.

Research Question 1

Are there any relationship between gender, school type and logical thinking ability in mathematics?

Table 2: Correlation between gender, school type and logical thinking

<table>
<thead>
<tr>
<th>Variable</th>
<th>Gender</th>
<th>School type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Logical Thinking</td>
<td>0.472*</td>
<td>-0.383**</td>
</tr>
</tbody>
</table>

**Significant at 0.01 level

Results from Table 2 revealed that gender correlated positively with logical thinking whereas school type correlated negatively with logical thinking and the correlation co-efficient were significant at 0.01 level.

Research Question 2

What is the combined contribution of each of the two predictor variables: gender and school type to logical thinking ability?
Table 3: Summary of the Multiple Regression Analysis

<table>
<thead>
<tr>
<th>Model</th>
<th>R</th>
<th>R Square</th>
<th>Adjusted R Square</th>
<th>Std. Error of the Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>.608(^a)</td>
<td>.369</td>
<td>.363</td>
<td>5.834</td>
</tr>
</tbody>
</table>

\(^a\) Predictors: (Constant), gender, school type

Table 3(a): ANOVA\(^b\)

<table>
<thead>
<tr>
<th>Model</th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regression</td>
<td>3923.540</td>
<td>2</td>
<td>1961.770</td>
<td>57.637</td>
<td>.000(^a)</td>
</tr>
<tr>
<td>Residual</td>
<td>6705.240</td>
<td>197</td>
<td>34.037</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>10628.780</td>
<td>199</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\(^a\) Predictors: (Constant), gender, school type
\(^b\) Dependent Variable: logical thinking

Results from table 3 shows that the predictor variables jointly account for 36.9% of the variance observed in students’ logical thinking ability and it is inferred that the result is significant at 0.01 level.

Research Question 3

Is there any difference in logical thinking ability of higher secondary students based on their gender and school type?

Table 4: Mean Difference in logical thinking ability based on gender and school type

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>t-value</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Boys</td>
<td>100</td>
<td>21.87</td>
<td>6.429</td>
<td>7.531</td>
<td>.000**</td>
</tr>
<tr>
<td>Girls</td>
<td>100</td>
<td>28.75</td>
<td>6.491</td>
<td></td>
<td></td>
</tr>
<tr>
<td>School Type</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Govt. Aided</td>
<td>100</td>
<td>28.10</td>
<td>7.231</td>
<td>5.829</td>
<td>.000**</td>
</tr>
<tr>
<td>Government</td>
<td>100</td>
<td>22.52</td>
<td>6.272</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\(^*\) Significant at 0.01 level

From the above values, it is inferred that there is significant difference between boys and girls in their logical thinking at 0.01 level. The mean scores revealed that girls were higher in logical thinking abilities when compared to boys. This result might be caused due to the fact that girls are more confident and hardworking than boys. This finding was contradictory with the previous researchers (Lay Yoon Fah, 2009; Tuna et al., 2013) who found that there was no significant difference in logical thinking abilities based on gender.

It is also found that there is significant difference between the students’ logical thinking ability studying in Government Aided and Government higher secondary schools at 0.01 level. Similar result was also evident from the study conducted by Tuna et al. (2013) where significant difference was found between the students based on their school type. From the mean scores, it was found that the students who are studying in Government Aided schools performed better in logical thinking test. A cause for this result could be the fact that students with higher scores might have chosen
mathematics as one of the subject in Higher Secondary level because of their own interest and were selected on merit basis than those who placed in Government schools.

7. Conclusion
As research indicates that teaching methodologies significantly contributes on one’s ability of logical thinking, use of special teaching techniques and activities requiring critical skills such as problem solving, creative, critical and reflective thinking would improve students’ logical thinking abilities. Hence, teachers should strive to improve upon these skills among students so as to ensure better future for them.

8. References
[7] http://www.efdergi.hacettepe.edu.tr/200528AY%C5%9EE%20YEN%C4%B0LMIEZ.pdf

About the Authors
Dr. S. Vasanthi is the Principal of N.K.Thirumalachariar National College of Education for Women, Chennai. She has a very rich experience in research and produced many Ph.D.’s under her guidance. She is dynamic, enthusiastic and encouraging. She is also an active Committee Member in framing curriculum for the two year B.Ed. and M.Ed. Programmes of our Parent University namely, Tamil Nadu Teachers Education University, Chennai. Her research interests include Economics of Education, Educational Evaluation and Teacher Education.

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