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INTERACTIVE EFFECT OF CONSTRUCTIVIST APPROACH TO INSTRUCTION IN MATHEMATICS AND IQ OF STUDENTS ON THEIR SPATIAL ABILITY

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ABSTRACT

This paper attempts to ascertain the interactive effect of constructivist approach to instruction in mathematics and intelligence quotient of students on their spatial ability. For this purpose, an intervention programme based on constructivist strategies of about 38 hours was developed for students of standard eighth spreading over nine weeks. The aim of the research was to ascertain whether constructivist strategies-based instruction facilitates the spatial ability of students, and if so, for which level of intelligence quotient of students. Structured tools were used in study. The participants of the study included 48 and 52 students in the experimental and control groups respectively. Students were found to be significantly influenced by the intervention programme. Thus, it may be said that the intervention programme based on constructivist approach to instruction is found to be effective in enhancing spatial ability of students. The effect size of the intervention programme on spatial ability of students was found to be 0.427 which is small in magnitude. There was no significant effect of IQ as well as the interaction effect of treatment and IQ on students' spatial ability.

KEYWORDS :*Constructivist Approach (CA), Spatial Ability (SA), Intelligence Quotient (IQ)*

INTRODUCTION :

According to the Roberts (1993), IQ tests measure ability to understand ideas and not the quantity of your knowledge. IQ tests measure general intellectual ability in a number of different ways. One of the spatial ability- the ability to visualize manipulation of shapes and the second is mathematical ability- the ability to solve problems and use logic. Students IQ scores don't significantly increase over time. There is evidence that maintaining an intellectually stimulating atmosphere (for example, by learning new skills, to interpret and make drawings, form mental images or solving puzzles) boosts some cognitive ability, similar to the way maintaining an exercise regimen boosts physical ability, but these changes aren't permanent and do not have much effect on IQ scores.

Spatial ability is of great importance for success in solving many tasks in everyday life. This ability can be viewed as a unique type of intelligence distinguishable from other forms of intelligence, such as verbal ability, reasoning ability, and memory skills. Spatial ability is not a monolithic and static trait, but made up of numerous sub-skills, which are interrelated among each other and develop throughout your life.

RATIONALE OF THE STUDY

Constructivist strategies-based instructional programme could be used for enhancing spatial ability of the students. Constructivist strategies i.e., concept mapping, BBL, KNWS, co-operative learning and project based learning could include different activities wherein students can share their difficulties with teacher or with peers and resolve their problems. It is expected that IQ of a student will interact with the intervention programme and influence on spatial ability of students.

REVIEW OF RELATED LITERATURE

Cheng and Mix (2010) studied to investigate a potential causal relationship between spatial ability and math ability. To do so, they used a pre-test-training-post-test experimental design in which children received short-term spatial training and were tested on problem solving in math. They focused on first and second graders because earlier studies suggested significant relations between mental rotation ability and early math ability in this age group. Pitta (2010) studied spatial versus object visualisation: the case of mathematical understanding in three-dimensional arrays of cubes and nets: in this investigates the relations of students' spatial and objects visualisation with their analytic, creative and practical abilities in three-dimensional geometry. (Motes, 2006) studied two mathematics tests, one on three-dimensional arrays of cubes and one on nets. The results suggest that spatial visualisation was related to students' practical abilities in three-dimensional arrays of cubes, whereas object visualisation was related to students' creative abilities in nets. Furthermore, high and low spatial visualisers differed in their practical abilities in three-dimensional arrays of cubes and in their analytic abilities in nets, whereas, high and low object visualizes differed in their creative abilities in nets. Turgut (2003) studied to investigate relationships among pre-service primary mathematics teachers' gender, academic success and spatial ability. The study was conducted in Izmir with 193 pre-service primary mathematics teachers of Dokuz Eylul University. In the work, spatial ability test, which consists of two main sub-tests measuring spatial orientation and spatial visualization abilities, is used. In order to analyze the obtained data, descriptive statistics, Pearson product moment correlation coefficient and Mann-Whitney U test are used. The results indicated that pre-service primary mathematics teachers' spatial ability level is low; there is a positive relationship between spatial ability and academic success; there is no significant difference between spatial ability and gender and the abilities of spatial orientation and spatial visualization are positively correlated. Newcombe (2013) studied seeing relationships using spatial thinking to teach science, mathematics, and social studies, the author discusses four specific strategies for enhancing and supporting the spatial aspects of the science, mathematics, and social studies curricula. However, these four strategies are examples of what can be done, not an exhaustive list. The overarching concept is to embrace the spatial visualizations used for discovery and communication in these subject areas, helping students learn to read, discuss, and even create these visualizations. Doing so will aid the transmission of content and the future learning of new content, and the meta-analysis indicates it will probably act as a spatial skills training of its own. Spatial ability can be improved inside and outside the classroom, as well as by instruction in other subject areas, notably the visual arts. Spatializing the curriculum by including and explicitly teaching the spatial symbol systems that lie at the heart of science, mathematics, and social studies is an achievable and worthwhile goal.

OPERATIONAL DEFINITIONS OF THE TERMS

Constructivist Approach: Constructivism is a philosophy about learning that proposes learners need to build their own understanding of new ideas.

Intelligence Quotient: The ability to solve problems and to adapt to and learn from life's everyday experiences. The ability to solve problems, the mental abilities that enable one to adapt to, shape, or select one's environment and the ability to understand and deal with people, objects, and symbols.

Spatial Ability: The ability to interpret and make drawings, form mental images, and visualizes movement or change in those images. Spatial ability tests measure the ability to manipulate shapes in two dimensions or to visualize three dimensional objects presented as two dimensional pictures.

Statement of the Problem: Interactive Effect of Constructivist Approach to Instruction in Mathematics and Intelligence Quotient of Students on their Spatial Ability.

Scope and Delimitations of the Study: In the present study, English medium schools from Greater Mumbai affiliated to the SSC board have been included. It excludes schools with other media of instruction such as Marathi, Hindi, Urdu, Gujarati etc. The present study includes VIII std. students from English medium schools situated in Greater Mumbai. Students from other primary and secondary classes have been excluded. It also excludes schools affiliated to ICSE or CBSE boards. The present research studied the effect of constructivist approach to instruction mathematics and IQ on spatial ability of students. It has excluded other student-background variables from its purview. The study has adopted the quantitative approach rather than the qualitative approach.

Aim of the Study: To ascertain the interactive effect of the intervention programme and IQ of students on their spatial ability.

OBJECTIVES OF THE STUDY

1.To compare the pre-test scores of spatial ability of students from the experimental and control groups.

2.To ascertain the interactive effect of the intervention programme and intelligence quotient on spatial ability of students.

3.To compute the effect size of the intervention programme and intelligence quotient on spatial ability of students.

Null Hypotheses of the Study

1.There is no significance difference in the pre-test scores of spatial ability of students from the experimental and control groups.

2.There is no significant the interactive effect of the intervention programme and intelligence quotient on spatial ability of students.

Methodology of the Present Study: The study has adopted the quasi-experimental method. In the present research, the quasi-experimental design of the pre-test post-test, non-equivalent groups' type was used. It can be described as follows:

$O_1 X O_2$ $O_3 C O_4$

Where, O_1 and O_3: Pre-test Scores
O_2 and O_4: Post-test Scores
X : Experimental Group
C : Control Group

Factorial Design: The researcher was used the factorial design to study the interactive effect of the treatment and IQ of the students on the spatial ability towards mathematics. The researcher was first administered the pre-test to both, the experimental and control groups. After the pre-test, the experimental group was taught using the interactive effect of the treatment of constructivist approach and control group was taught using traditional method. The duration of the intervention programme was 38 hours in the experimental group. At the end of the programme post-test was administered on the students of both the groups.

Sample of the Study: In the present study, the sample has been selected consisting of one intact class each of std. VIII from two different schools situated in the Greater Mumbai. The experimental and the control groups included 48 and 52 students respectively.

Tools of the Study: In the present stud, the following tools were used by the researcher to collect data:

1. Spatial Ability-Differential Aptitude Test Battery adopted by Bennett (n.d.)
2. IQ – N.V.T.I by Nafde (n.d.)

Intervention Programme: The duration of the intervention programme is 38 hours. The control group was taught using the traditional method. And experimental group was taught by using intervention programme, which was using different strategies such as concept mapping, BBL, KNWS, co-operative learning and project based learning.

Techniques of Data Analysis: The present research has used statistical techniques of t-test, ANOVA and Wolf's formula.

Null Hypothesis 1: There is no significance difference in the pre-test scores of spatial ability of students from the experimental and control groups.

Table 1: PRE-TEST SCORE OF SA OF EG AND CG

Group	Sample Size	Mean	SD	t	P (two tailed)
EG	48	19.18	4.29	1.02	0.310
CG	52	18.40	3.34		

The preceding table shows that, there is a not significant difference between the pre-test scores of spatial ability of the experimental and control groups. Hence the null hypothesis is accepted. The mean pre-test spatial ability of students from EG is significantly greater than that of the CG.

Since the experimental and control groups were not selected randomly and since the two groups were not found equivalent on the pre test, the residual spatial ability were computed using Dyer's Regression Residuals Method through regression equation of post-test spatial ability scores on pre-test equation scores of students. The residual scores thus obtained represent scores from which the effect of pre-test scores of spatial ability has been removed statistically. This residual spatial ability is used for the testing of the next hypothesis.

Null Hypothesis 2: There is no significant the interactive effect of the intervention programme and IQ on the residual spatial ability scores of students.

This hypothesis was tested using two-way ANOVA in which the pre-test scores of students on residual spatial ability are controlled. The following table shows the relevant statistics of residual spatial ability of students by treatment and IQ.

Table 1: Relevant statistics for ANOVA

Levels of IQ / Group	Low IQ	Average IQ	High IQ	Total
	N	N	N	N
CG	18	29	5	52
EG	10	23	15	48
	28	52	20	100
	Mean	Mean	Mean	Mean
CG	-1.5824	-0.8779	0.4747	-0.9917
EG	0.9579	0.4381	2.1276	1.0744
Total	-0.6752	-0.2958	1.7144	0

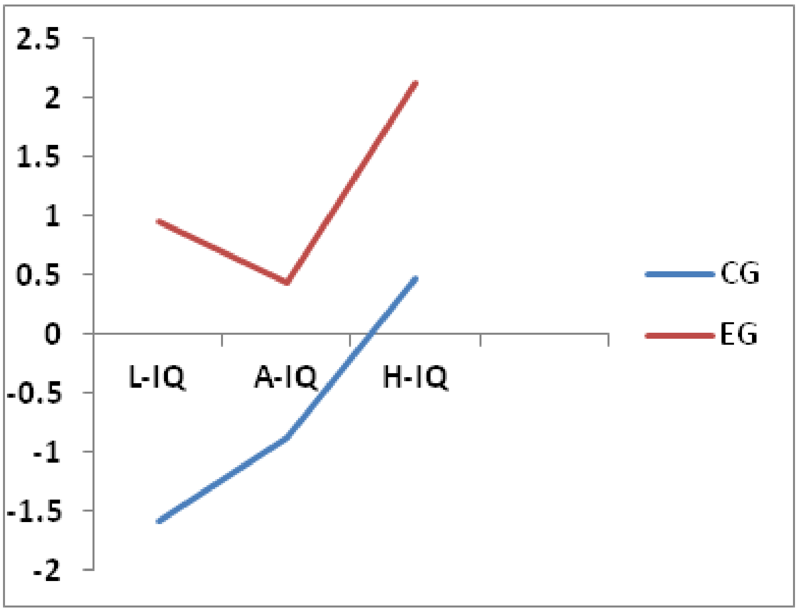
The following table shows the ANOVA of residuals scores of spatial ability of students by intervention programme and IQ after partial ling out the effect of the pre-test spatial ability of students.

Table 2: ANOVA for SA of students by treatment (T) and IQ

Source	SS	df	MS	F	P
Rows	106.55	1	106.55	4.63	0.034
Column	76.1	2	38.05	1.65	0.1976
Interaction	0	2	0	0	1
Error	2163.81	94	23.02		
Total	2313.85	99			

The preceding table shows that (a) the F-ratio for rows i.e. intervention programme is significant at 0.034. Hence it may be concluded that the Mean residual spatial ability of the experimental group is significantly greater than that of the control group. (b) The F-ratio for columns i.e. IQ is not significant at 0.05 level. Hence it may be concluded that the Mean residual spatial ability does not differ significantly on the basis of IQ of students. (c) The F-ratio for interaction effect of intervention programme and IQ is not significant at 0.05 level. Hence it may be concluded that the mean residual spatial ability of students do not differ on the basis of the interaction between intervention programme and IQ of students.

The following figure shows the differences in the mean residual spatial ability of students on the basis of treatment and IQ of students.



The effect size of the independent variables was computed using Wolf's formula and was found to be 0.427 (small) for the intervention programme.

CONCLUSION:

It may be concluded that the mean residual spatial ability of students of the EG is significantly greater than that of the CG. Thus, the constructivist strategies-based instructional programme was found to be effective in enhancing spatial ability of students with high, average and low IQ. However, its effect size is found to be low in magnitude. The IQ of the students was not found to influence the spatial ability of students.

DISCUSSION:

The treatment i.e. the intervention programme developed by the researcher is found to be effective for enhancing spatial ability of students. The literature review indicated that the skills that make up spatial ability are the results of long learning and training processes. The level of spatial performance someone is capable of may change over time. You are likely to gain in performance through practice, training, and learning, but you may also lose in standing relative to others if they acquire more experience that supports their performance or make more progress in their intellectual development. So that teachers play in the enhancing spatial ability are paramount in student success in terms of pupils taking more interest in mathematics with right decisions and the ability to interpret and make drawings, form mental images, and visualizes movement or change in those images. This study could serve as a contribution to educational research that will help to enrich the teaching and learning practices with the help of constructivist strategies based instruction that may increase the spatial ability of students with different levels of IQ backgrounds.

Moreover, with concerns among educational practitioners in general about the gaps in spatial ability among control groups, this study has shed light on different constructivist strategies for participating students that can be utilized readily in an effort to increase the spatial ability of students for different IQ groups and ultimately contribute to teaching practices that could facilitate spatial ability of students. In sum, the results of this study could provide a framework for educators to implement best practices that will lead to increasing spatial ability of students and help to close the education gap that persists.

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