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INTERACTIVE INSTRUCTION AS A POTENTIAL TOOL TO IMPROVE SPATIAL ABILITY OF LEARNERS

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ABSTRACT*--Instruction is an amalgamation of teaching as well as learning activities. The study aimed to find the effect of Interactivity with dynamic visualisation (IDV) of teaching chemistry; on Spatial Ability of Undergraduate (UG) boys & girls of Jabalpur, India. Random sampling was used with a total sample size of 315 UG students of Jabalpur. To measure the spatial ability of the UG students, Spatial ability test of DBDA Revised (David Battery of Differential Abilities) was used. The study was conducted by Experimental method. The researcher used Non-Equivalent Pre-test Post-test Control Group Design. Treatment was given for a period of one month to both the groups. The data was analyzed by Two way Analysis of Variance (ANOVA). A significant main effect was found for group as well as interactional effect between gender and group at 0.01 level of significance. Thus there is a need to bring focus on such innovative practices of teaching in chemistry education which can improve the spatial ability of the learners.*

Keywords*--Interactivity, Chemistry, Spatial Ability, Dynamic visualizations*

I. INTRODUCTION

In learning chemistry students often face problems in understanding many concepts specially the abstract ones. As a researcher it becomes crucial to find out various effective teaching strategies that can help learners in understanding the complex concepts or maybe the concepts which are not complex but appear to be complex to the students.

Spatial ability is the ability of an individual to visualize the rotation of objects in three or two dimensional space. Lohman defined spatial ability as “The ability to generate, retain, and manipulate abstract visual images. At the most basic level, spatial thinking requires the ability to encode, remember, transform, and match spatial stimuli” (as cited in Harle Marissa and Towns Marcy, 2011,p. B). BARKE, H.D. and ENGIDA, T. (2001) have pointed out that for effective chemistry learning, it is important that the learners possess a considerable level of spatial ability. The students generally find it difficult to observe and analyse the rotation of molecules in space. Copolo Cynthia F. & Hounshell Paul,B. (1995) have suggested that students tend to encounter with “spatially-related chemistry problems” that require a substantial level of thinking in the three dimensional space.(Rochford, 1987; Rozzelle and Rosenfeld, 1985; Small and Morton, 1983; and Tuckey et al. 1991). Hence there is a need to bring forth such

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teaching practices that help students in attaining knowledge that is deep-seated; especially those involving at the abstract level.

Instruction is an amalgamation of teaching as well as learning activities. "Strategies determine the approach a teacher may take to achieve learning objectives. Teaching is a natural part of instruction process" (Saskatchewan Education 1991, as cited in Akdeniz Celal, 2016, pp.61). Instructional strategies are the approaches adopted by teachers, to achieve the primary and essential aims of instruction. Interactivity is the crucial component of teaching learning process. Research has shown that if interactivity is imbibed in the classroom sessions, it may result in better learning outcomes.

Kline Keith A. (2012) showed that the individuals with higher spatial ability were able to create better mental models from static instructions than those with lower spatial ability. They also found that there was no interaction between spatial ability and instructional condition. They further suggested that the individuals with lower spatial ability might require further assistance in terms of generation of mental models which could be probably provided by animated instructions. Similarly various dynamic visualisations like animations, simulations have shown to improve students' learning or performance. Eun-mi Yang , Thomas Andre , Thomas J. Greenbowe & Lena Tibell (2003) have shown that animations improve overall performance in electrochemistry of the high spatial ability learners. They did not find any interaction between the spatial ability and treatment. However they have suggested that the relationship between narration, spatial ability and use of animations should be further investigated. Kosa Temel (2016) confirmed that spatial visualisation skills of the students improved by using dynamic geometry software and also that they were a predictor of success in analytic geometry. Maeda Yukiko and Yoon Yoon So (2013) who had done a meta-analysis on "Gender difference on mental rotation ability" found that the males performed much better than females on the Purdue Spatial visualization tests; which were attributed to the time limits.

If interactivity is used along with dynamic visualizations; then would it improve the spatial ability of the learners? Does interactivity with dynamic visualizations (IDV) have an effect on the spatial ability of the learners? Does spatial ability have any interaction with gender? The researcher intended to find out the answers to these questions in this study.

II. OBJECTIVE AND HYPOTHESIS

The objective of this study was to find out the effect of IDV of teaching chemistry on Spatial Ability of UG students.

The hypothesis formulated was

H_0: There is no significant effect of IDV of teaching chemistry on Spatial Ability of UG students.

III. DELIMITATIONS

The study was delimited to Jabalpur region. The topics selected as per the syllabus by the state university. The UG students were considered for the study of the age group 17years -20years. The students selected were those who had chemistry as one of the subjects.

IV. METHOD

Experimental method was used by the researcher for this study. The researcher used Non-Equivalent Control Group Design.

The undergraduate students of colleges of Jabalpur, having chemistry as one of the subjects were considered as the population.

Random sampling was used. The total sample size was 315 Undergraduate students of Jabalpur; where Experimental group had 165 participants (87 females and 78 males) and Control Group had 150 (64 females and 86 males) participants. To measure the spatial ability of the UG students, a standardised Spatial ability test of DBDA Revised was used.

The sample selected was divided into experimental and control group. The topic chosen to be taught was chemical bonding. The Control group was taught chemistry by traditional teaching method and the Experimental group was taught by interactivity with dynamic visualizations (IDV) i.e. dynamic visualisation was used along with interactive teaching method. The lesson plans were prepared in such a manner that there was extensive level of interaction in between the dynamic visualizations. Peer Instruction and Think pair share were some of techniques that were used in the experimental group. Both the groups were taught for duration of one month. The experimental group was taught with interactive instructional methods along with simulations and interactive videos as dynamic visualizations. As a part of treatment, few lessons of the experimental group were delivered in the State Institute of Science Education, Jabalpur. The simulations and 3D videos that were used as aids were on VSEPR Theory, concept of hybridisation, shapes of covalent molecules and Molecular orbital theory.

V. RESULT AND DISCUSSION

The data was analyzed by Two Way Analysis of Variance (ANOVA) in SPSS. The tables so obtained are shown below in Table 1 and Table 2. The mean, standard deviation values are given in Table 1.

Table 1: Gender and Group Wise Mean, SD and N of Spatial ability scores of males and female UG students

	GROUP	**MEAN**	**Std. DEV**	**N**
Female	Experimental	16.3333	10.12442	87
	Control	3.7969	3.01941	64
	Total	11.0199	10.06146	151
Male	Experimental	13.6667	8.95105	78
	Control	5.6512	5.62299	86
	Total	9.4634	8.39397	164
Total	Experimental	15.0727	9.65159	165
	Control	4.8600	4.76851	150
	Total	10.2095	9.24889	315

Table 2: Summary of 2X2 ANOVA of Spatial ability scores

Source	Type III Sum of Squares	Df	Mean Square	F
Gender	12.798	1	12.798	.218
Group	8190.852	1	8190.852	139.607**
gender * group	396.354	1	396.354	6.756**
Error	18246.561	311	58.671	
Total	59694.000	315		
Corrected Total	26860.171	314		

**significant at 0.01Level of significance

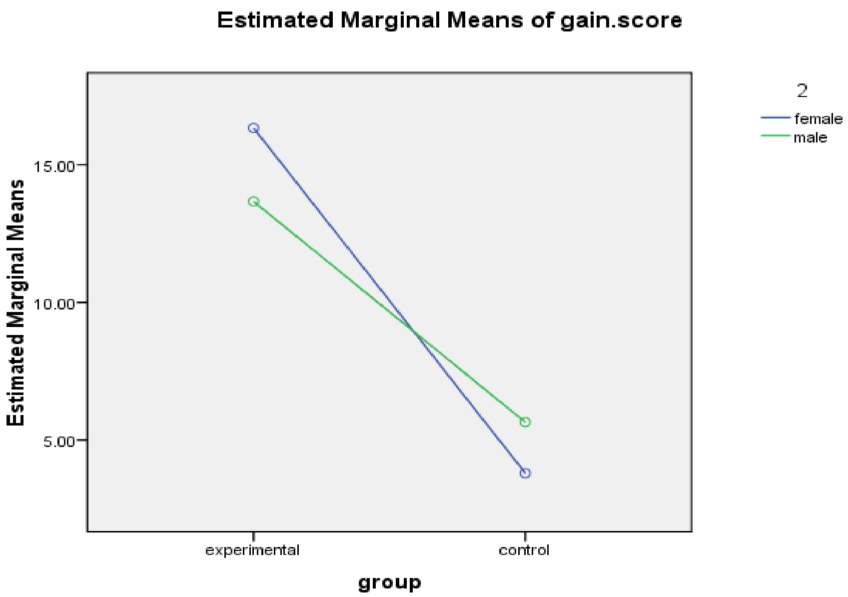

Figure 1: Gender and group-wise Interactional effect

From table 2 it can be seen that the F-value for gender is 0.218 with d.f= 1/314, which is not significant at 0.05 L.O.S. It means that there was no significant effect of IDV on spatial ability of undergraduate boys and girls. Therefore sub-Null Hypothesis I (i) "there is no significant gender-wise effect of IDV of teaching chemistry on spatial ability of Undergraduate students' is not rejected.

From table 2 it is observed that F-value for group is 139.607 with d.f= 1/314, which is significant at 0.01 L.O.S. It means that there was a significant effect of group on spatial ability of learners. Therefore the sub- Null

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Hypothesis I (ii) 'there is no significant group-wise effect of IDV of teaching chemistry on spatial ability of Undergraduate students' is rejected. Further it is clearly exhibited from the table 1 that the mean score of the experimental group (15.0727) was significantly better than the mean score of control group (4.8600). It means that IDV had a better effect in improving the spatial ability.

The F-value for interaction between gender and group is 6.756 with d.f= 1/314, which is significant at 0.01 L.O.S. It means that spatial ability of undergraduate boys and girls belonging to experimental and control group differ significantly. Therefore the sub-Null Hypothesis I (iii) 'there is no significant gender and group-wise interactional effect of IDV of teaching chemistry on spatial ability of Undergraduate students' is rejected. Further it is clear that the mean score of spatial ability of females in the experimental group (M=16.3333) was significantly higher than the mean score of spatial ability of females in control group (M=3.7969). Similarly the mean score of spatial ability of males in the experimental group (M=13.6667) was significantly greater than the mean scores of spatial ability of males in control group (M=5.6512) (vide graph no.1). This reflects that both males and females of experimental group; taught by IDV were benefitted more in terms of spatial ability than the control group who were taught by traditional teaching. It shows that the experimental group students performed significantly better than the control group in terms of spatial ability.

Three main findings of the study were:

a) There was no significant effect of IDV on spatial ability of undergraduate boys and girls.

b) IDV had a better effect in improving the spatial ability of learners.

c) Both males and females of experimental group; taught by IDV were benefitted more than the control group who were taught by traditional teaching in terms of spatial ability.

The first finding regarding effect of gender on spatial ability differs from previous studies. The study conducted by Maeda Yukiko and Yoon Yoon So (2013) showed that males performed better than females in mental rotation ability. Kosa Temel (2016) confirmed that spatial visualisation skills of the students improved by using dynamic geometry software. This is similar to the second finding of this study, that using IDV can improve the spatial ability of learners. Hornbuckle Susan F., T. Gobin Latanya and Thurman Stephanie N. (2014) have pointed out that spatial reasoning skills can be improved by teaching organic chemistry to learners and specifically it improves this skill for below average learners. The third finding of this study is in sync with the findings of Tzuriel David and Egozi Gila (2010), who revealed that gender differences in spatial ability were removed after treatment. During data collection, the investigator found that the students of experimental group were more interactive and actively participated in the discussions as compared to the students of the control group. This could possibly be one of the reasons for improved spatial ability of the learners taught by IDV.

VI. CONCLUSION

Based on the results obtained, it may be concluded that significantly at par difference was found between experimental and control groups. The spatial ability of the undergraduate students of experimental group was found to increase significantly by using IDV. The spatial ability of learners cannot be simply developed by traditional teaching method; but rather there needs to be an intervention in terms of usage of interactive teaching methods which are combined with dynamic visualizations which would prompt the learners to visualize and comprehend the complex concepts easily.

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