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Understanding of Three Dimensional Diagrams

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Abstract
As a policy matter a child should be admitted in class – I after attaining the age of year 5, but in our social setup that is rarely followed. That is why, the students of year – 8 were traced from class II, III and IV of 121 Government Primary /Primary Sections of Government Middle Schools of 15 Tehsils of Five Districts from Southern Punjab. In all, 7212 students were involved in the study. Major objective of the study was to find out the age category at which the students of year 8 understand three dimensional diagrams to minimum and maximum extent. Present age was calculated by subtracting physical age of each student as recorded in the admission register from the date of test administration. It was found that only 1240 (17.18%) of the total students were of year-8, sorted out 1.0% (24) students from class II, 20% (485) of class III, and 30.18% (731) of class IV. A standardized non-verbal test and a perception test were administered to achieve the objectives. After piloting the tool, there were 42 items comprising upon 15 rectangular, 20 hexagonal, and seven diagrams from real daily life. The results highlighted that maximum average scores were found for the age category of 8 year, 2 months and 15 days and minimum average scores in the first category of age for the sampled students.
Keywords: 3-D Diagrams, Perception, Primary Education, Understanding

INTRODUCTION

This is a common phrase now-a-days that a diagram can be worth a thousand words and the same is accepted by the educationists in common that diagrams supports in meaningful learning. The use of diagrams in text books has a long – standing tradition in education. Diagrams have become indispensable tool for teaching, specifically at primary level. Not limited to this, diagrams facilitate understanding and used extensively in educational contexts throughout the curriculum. This was confirmed by Ainsworth & Loizou (2003) through their study in which they concluded that diagrams could develop deeper understanding of the content whilst learning. In the same context Irani and Ware (2000) expressed that diagrams play important role in communication, planning and problem solving. They further experimented and concluded that 3-D diagrams facilitate in object recognition and because of this quality they are easier to interpret and remember. That is why, high quality books for pre-school children convey the concepts through pictures instead of words.

Under the same approach, diagrams are included purposefully in the textbooks of the students at primary level to enhance their understanding and facilitate them in identifying and memorizing the objects. Not only this, these colorful diagrams are helpful to maintain their interest in learning and promote to think and perceive new ideas. Moreover, diagrams help in building students' understanding in various ways, for example; reducing the amount of cognitive effort to solve scientific problems and limiting the ambiguity of textual information.

Understanding the use of diagrams is an important educational issue and part of the growing interest internationally. Importance, role, and understanding of diagrams are not new ideas of research in developed countries but still ignored by the researchers in Pakistan. Therefore, the present research focused to examine the understanding of three – dimensional (3-D) diagrams by 8 year old students studying in the primary schools of Pakistan.

Following to this is a brief literature review which may facilitate the readers of this piece of research to understand the role of diagrams in learning process.

LITERATURE REVIEW

Diezmann (2006) conducted a study in which he focused on primary students' ability to select an appropriate diagram to represent any given information. According to the author, selecting an appropriate diagram is one of the three key skills for effective diagram use and fundamental to problem solving skill. Total 37 students were selected from one of the two cohorts in the larger study (n=137). These were the students which correctly identified the matrix as the correct diagram for three consecutive years on global structure or link type property tasks. They commenced in the 3-year study as Grade 3 students (8 or 9 year old) and did not engage in any specific instruction about diagram use over this period. Primarily, students' knowledge of the properties of diagrams was investigated in the larger study through a series of 15 scenario-based tasks, which focused on a

range of properties of the matrix, network and hierarchy. The tasks were designed in accordance with the principles used by Novick and Hurley (2001) and set within the context of an Amusement Park. The first sentence or two of the task sets up a cover story. The next sentence or two focuses on a particular property of a diagram. The final sentence indicates that someone wants a diagram for a purpose relevant to the cover. These tasks required students to (1) select the diagram that best suits the given information and to (2) justify their selection and (3) non-selection of particular diagrams. At the end they concluded that many students were either not developing appropriate knowledge of the properties of diagrams or are unable to communicate their knowledge adequately. Thus, there is a need for explicit instruction about the properties of diagrams, which essentially constitute the "building blocks" of diagram literacy. The results also served as a caution that over time changes in students' reasoning about diagrams or their communication of specified reasoning are not necessarily positive. Therefore, it is necessary to change the complexity of the nature and number of diagrams with the age and experiences of the learners.

It has been demonstrated in many studies that learning benefits when instruction includes both diagrams and verbal descriptions, specifically when measured by tests of problem-solving skill (Davenport, Yaron and Koedinger, 2008). Davenport, et al. explained in their research paper that they carried out a series of randomized-design studies in chemistry classrooms to test whether molecular-level diagrams would enhance conceptual understanding of chemical equilibrium. Molecular-level diagrams were considered to be highly relevant to the course instructor and similar diagrams had led to better performance in other classroom studies. Two versions of a tutorial on equilibrium and acid base chemistry were constructed. The tutorials had identical text and differed only in the presence of molecular-level diagrams. Learning was measured by multiple choice questions, interactive problem solving and open-ended transfer assessments. Although students made significant pre-to-posttest learning gains, students that received instruction, including diagrams performed not better than students in the text-only condition. They expressed the reason of failure was due to the deliberately extraneous information or seductive details given by the instructors. Therefore, they suggested that other factors must be considered to determine whether and when particular representation of diagrams will enhance learning. Later, they concluded by proposing three factors that influence the effectiveness of instructional diagrams: (1) diagrams should be chosen to achieve specific instructional goal; (2) diagrams should be designed to make target knowledge explicit and (3) diagrams should consider the cognitive processing of the learner and provide a bridge from prior knowledge to the targeted knowledge.

During literature review, no or very few research papers were found discussing the role of diagrams at primary level teaching and learning. Therefore, this was considered that this study will contribute in adding the knowledge for understanding the students' cognitive and/or problem solving skills whilst teaching at primary level.

PURPOSE

Major objective of the study was to find at which age categories the children were able to pick up the three dimensional diagrams to minimum and maximum extent. So that, the authors, teachers, and publishers should take a lot of pain to select appropriate 3-D diagram to convey a complex concept in a simple and easy way for a relatively permanent change in the behavior of the learner.

METHODOLOGY

Tools of the Study: A survey was conducted to find 'A Perception Test' regarding understanding of three dimensional (3-D) diagrams' by children of age 8 years in Pakistan. The answer of all departments of Education and Psychology in all different universities of Pakistan was 'No'. Later, The Directorate, Center of Excellence, Quaid-i-Azam University Islamabad assured the 'Non Availability' of such test. Researcher was encouraged to step in the development of such Non-verbal test initially at Punjab level. For this purpose, it was directed to contact The Australian Council for Educational Research Ltd. Victoria, who provided a standardized non-verbal test constructed by Raven (1989) for Primary level students. The said test was comprising upon geometrical drawings with respect to the length or breadth of different designs, arranged in psychological order. The primary objective of using this test was to force the students to concentrate and pick up the relevant concept of different dimensions of a diagram, which raised the interest level of respondents. Another objective of administering the said test was to develop intimacy between researcher and students to attempt the perception test more interestingly and carefully.

On the basis of published model of a perception test given by Nicholson and Seddon (1977), a Perception Test comprising 75 geometrical diagrams was constructed. In these diagrams, it was emphasized to check the understanding of the students with respect to the relationship between distance, size, length, breadth from different angles of 3-D Diagrams.

Face Validity of the Tool: After developing the perception test, experts available in Multan and Islamabad were consulted to enhance the face validity of the tool. In the light of the guidance of the experts, necessary changes

were made in the test, and then 67 items were administered for pilot study. For this purpose, the researcher contacted the heads of the institutions for administering the tests on a small sample of relevant classes both for Boys and Girls in four urban, and four rural Government Primary Schools in Multan District only. On the basis of the responses of the students, the difficulties faced by the researcher during test administration, especially in the rural areas and the item analysis, following necessary changes were made to finalize tests:

1. Fifteen most difficult items were dropped.
2. Statements of all items were translated into Urdu (Native Language).
3. Sequence of the items was rearranged from easy to difficult.
4. Father's Qualifications and profession was added in the personal bio-data section.
5. Minor changes in the sequence of the options / distracters were also brought into.

After that, the test was dispatched to nine experts available in the relevant field in Pakistan, who suggested:

1. to add real pictures related to three dimension from daily life in the test.
2. to drop two more confusing items.
3. to add at least five more items related to double vision aspect.
4. no intermixing of rectangular and hexagonal diagrams.
5. to re-administer the test for the sake of second pilot study.

The opinions of all experts were incorporated in the test. Necessary amendments, additions and deletions were made. Eight items related to the double vision aspect were added after deleting two confusing items. Twenty two real pictures from daily life were selected. These pictures were selected from recommended textbooks of class II, III, IV, and the books related to the field of Psychology, different websites providing real pictures from daily life. A test comprising 80 items was re-administered for second Pilot Study in District Khanewal.

In the light of the results of second Pilot Study, the perception test comprising 42 items was finalized as under:

1. 15 items related to rectangular geometrical figures.
2. 20 items related to hexagonal geometrical figures.
3. 07 real pictures from daily life.

Population and Sample: To develop a perception test for the students of year 8, it was suggested by the experts to include all students enrolled in class II, III, and IV in Government Primary / Primary Sections of Government Middle Schools of Pakistan as the population of the study. The study was delimited to the Punjab province only. As the population was much more scattered in remote areas of the district, therefore, it was decided to select the sample on the basis of 'cluster sampling technique'. Eight government primary schools per Tehsil were selected, four each from rural and urban blocks comprising upon two schools for each sex from each cluster. From single sectioned schools, all students were selected as sample, otherwise, one section was selected randomly and from overcrowded classes 20 students were selected on the basis of systematic random sampling technique. In all, 1441 students of class II, III and IV were involved in the study from District Multan only, comprising upon 51.77% boys and 48.23% girls.

After determining the age factor of the students, the age-year was subdivided on monthly basis into twelve age categories and boundary of the year was fixed. The Perception Test was administered after the preparatory test. Almost all students participated in both tests confidently, which were administered personally by the researchers with the help of the concerned class teachers after due permission of the authorities under a scheduled program. On the basis of the results of District Multan, necessary sequential and other minor changes in the distracters were brought into the perception test and administered in four more randomly selected districts of Southern Punjab on the same criterion as opted for Multan. District-wise involvement of the students was 1947 (26.997%) from Khanewal, 1424 (19.745%) from Lodhran, 962 (13.399%) from Sahiwal, and 1438 (19.939%) from Vehari. Overall, 7212 students of class II, III and IV were involved in the study from all the five districts, comprising upon 50.46% boys and 49.54% girls.

Criteria for determining the students of Year 8 only: Only 1240 (62.12%) of the students of year 8 were included in the analysis, out of which 49.27% were boys and 50.73% girls.

Data Analysis: For analytical purposes, data were classified into twelve categories on monthly basis with respect to the age of the students and thirteen categories with respect to sex, residential area, parental education and income wise, etc. Average scores and Standard Deviation of each category were computed on month-wise and overall basis. Best average score out of twelve month-wise age categories was interpreted as the maximum understanding of the students of a particular age group about 3 – D diagrams and vice versa. Z- Test was applied to compute the significant or insignificant differences between overall average scores of different categories. All items of the perception test were analyzed by determining the values of 'p', 'D' (Wiersma and Jurs, 1990 p. 144), 'Phi' (Wright, 1968), and 'Effectiveness of each distracter'.

RESULTS AND CONCLUSIONS

On the basis of tabulation of data, following major results emerged:

1. Perception Test was administered to 7212 students in all. Only 1240 (17.19%) students were found

within the prescribed age of year – 8. Rest of the 82.81% students were either under-age or over-age.

2. Data of 1240 students of year 8 only were analyzed, out of which 49.27% were boys and 50.73% girls.
3. Internal consistency between odd and even test items was recorded 0.4141, but total test reliability was 0.5857.
4. Maximum numbers of 'best average scores' (69.23%) of different categories of the students were found in 9th category of age, 15.38% in 6th, and one each (7.69%) in 4th and 7th category of age (Table 3). Which indicated that majority of the students from different categories attained maximum understanding about 3-D diagrams up-to the age of 08 Y-02 M- 15 D (Table 1). The students included in the last three categories of age could not retain the status of maximum average scores due to wrong entries of physical age as recorded in the admission registers.
5. Minimum average scores of 53.85% of different categories of the students were recorded in 1st category of age (Table 3), 15.38% each in 2nd, and 10th; and one each 7.69% in 7th and 8th categories of age. Such shift of minimum averages in later age categories than that of the maximum averages as recorded among total girls, rural girls and urban boys reflected that either these three categories of the students did not attempt the test seriously or there might be a lot of intermixing of different age categories in the actual and factual entries of date of birth as recorded in the admission registers.
6. When average scores of all different categories of students were compared (Table 2), it was found that 9th age category of rural boys secured average scores (15.15) which was the top most and best average than all other categories. There were 333 students in that category with 12.11 overall average score, which was again the best one among all thirteen overall average scores. The average scores like 15.15 and 12.11 reflected that the test was difficult. But the difficulty index of the test reflected that only item No 30 and 41 were carrying negative values.
7. Overall average score of the sampled students (1240) was 10.89. Out of other 12 overall average scores of different categories of students, 5 (41.67%) were more than 10.89 and 7 (58.33%) were less than overall average score of the sampled students. There was a variation of one category otherwise there would have been normal distribution of different categories. That variation might be due to wrong entries of date of birth.
8. Sex-wise, best average 13.63 and overall average scores 11.38 of total boys (611) were better than 12.30 and 10.42 respective average scores of total girls (629), which reflected that boys were having slightly better grip over understanding 3-D diagrams than the girls.
9. Residential area-wise, total rural students (640) were having much better 'best average scores' and slightly better 'overall average scores' than total urban students (600). Rural boys (333) were much ahead with respect to their 'best average' and 'overall average' scores than rural girls (307). In case of urban boys (278) and urban girls (322), the results were opposing the results of rural boys and girls in both 'best' and 'overall' averages. Such opposing results might be due to the participation of comparatively more elder rural boys than urban boys. Because in urban areas, the parents might be more careful and particular in maintain birth records of their children as compared to the rural parents.
10. With respect to the education of the parents, the sampled students were divided into educated and uneducated families only. The orphans, adapted and dependents other than the parents were not included in the analysis. The results indicated that 'best average scores' of the sampled students from uneducated families were slightly better, while 'overall average scores' were comparatively better than the students from educated families. Such differences in the average scores might be due to the professional involvements of the educated parents resulted in comparatively less time for the children for continuous push to achieve the targeted objectives as per desired plan.
11. With respect to the income of the parents, the sampled students were divided into above average income and below average income families only. The orphans, adapted and dependents other than the parents were not included in the analysis. The results indicated that 'best average' and 'overall average' scores of the students from above average income families were slightly better than the students from below average income families. Because the parents, from 'above average income' category could facilitate their children to provide suitable environment for mental development and conceptual learning just from day – 1. On the other hand, parents from 'below average income' category might not nourish and nurture their children properly. How could the parents from 'below average income' group provide such games and instruments which help in developing problem solving ability and understanding 3-D diagrams among their children? But this argument was rejected by the application of Z test, because the difference between the two overall average scores was to the minimum extent.
12. Comparison between overall average scores of different groups of sampled students reflected significant difference between boys vs. girls, rural boys vs. rural girls and sampled rural students vs. sampled urban students. It means understanding about 3-D diagrams by boys was different than girls. This difference further increased in case of rural boys (12.11) and rural girls (10.22).

13. Insignificant differences were observed between overall average scores of urban boys vs. urban girls and income-wise distributed sampled students. It means understanding about 3-D diagrams was almost similar between urban boys and urban girls; and parental income was playing no effective role to understand 3-D diagrams by their children.
14. Out of 1240 students, 17.3% only dropped different items (Table 4). Item No. 5 was dropped by maximum 13 (1.05%) students. That reflected, item 5 was either most difficult or least attractive for the students. Eleven (26.19%) different items were dropped by two students each.
15. There were 168 distracters in all in the perception test. Not a single distracter was selected by less than 7.6% of the students. Option IV of item No. 27 was the least attractive (7.6%) distracter. Option III of item No. 17 was the most attractive distracter, which was selected by 808 (65.16%) of the students. Each of the almost one fourth of the distracters were selected by more than one third of the students, which proves that test was constructed very carefully and after thorough consultation.
16. With respect to high achievers, the range of the values of Difficulty Index (p) was in between 0.1373 to 0.7015. In case of low achievers, the range was 0.0242 to 0.5706, which indicated that the test was difficult to some extent.
17. The Discriminatory Index (D) pointed out that item 30 and 41 were unable to differentiate between high and low achievers therefore, those items should be dropped or incorrect responses of high and low achievers should be critically analyzed to revise the items (Table 4). Item No. 9, 16, 18, and 24 were very good discriminating items, 17% were good, 40. 47% need minor revision and 21.43% of the items demand major revision. Rest of the 24% items were least differentiating. The range of the values of 'D' was from – 0.0064 to 0.4687.
18. The values of phi verified that item No. 30 and 41 were carrying negative values. The range of the values of 'Phi' was from – 0.0065 to 0.4966. The computed values of Phi helped to identify more discriminating items than the values of 'D'. There were more than 14% very good, about 36 % good discriminating items. About 19% need minor and 21% of the items demanded major revision. Very few items like 8, 30, 32, and 41 were clearly pointed out to replace with easy items.

RECOMMENDATIONS

On the basis of above mentioned results and discussions, following recommendations could be proposed:

1. To overcome the problem of exact date of birth of the children, it is suggested that all those babies which are born in the hospitals or registered maternity homes the records of such births should be entered in the national data base directly by the hospitals or maternity homes.
2. Overall impression of the test is 'a difficult test' therefore a few easy items should also be included in the test by replacing the difficult or least differentiating items. For example, item 5 should either be dropped or re-constructed due to being the least attractive item to the students. Under such circumstances a third pilot study should be administered.
3. All those items carrying negative 'p' values along with four other difficult items be dropped from the test. Rest of the 36 items should be re-arranged with respect to the descending order of the difficulty index. Last twelve items should be administered to year – 8 students only.
4. There may be so many extraneous or aesthetic factors, which affect the scores of the students but such factors are supposed to be least effective in such studies. For example the presence of a female examiner in boys' sections and vice versa in Pakistani cultural setup. Though that was minimized through 'Preparatory Test' as advised by the experts, yet that factor might be playing a definite role, due to which averages of the boys of year – 8 were usually disturbing. It is suggested that in future studies male teachers should administer the tests in boys' sections and females in girls' sections (where admissible).

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Appendix

Table No. 1: Month-wise Distribution of Total Sample of Year – 8 –

Group No	Age Group		n	Mean	Standard Deviation	SEM.	Remarks
	From	To					
1.	07-05-16	07-06-15	115	09.62	2.71	0.25	
2.	07-06-16	07-07-15	92	10.17	4.76	0.50	
3.	07-07-16	07-08-15	97	10.09	3.46	0.35	
4.	07-08-16	07-09-15	101	10.94	4.13	0.41	
5.	07-09-16	07-10-15	79	10.66	4.59	0.52	
6.	07-10-16	07-11-15	89	11.89	5.21	0.55	
7.	07-11-16	08-00-15	104	11.66	5.77	0.57	
8.	08-00-16	08-01-15	95	10.92	5.23	0.54	
9.	08-01-16	08-02-15	87	13.13	6.88	0.74	
10.	08-02-16	08-03-15	142	10.35	5.64	0.47	
11.	08-03-16	08-04-15	114	10.75	4.28	0.40	
12.	08-04-16	08-05-15	125	10.98	3.70	0.33	
	Year 8 Only		**1240**	**10.89**	**4.87**	**0.14**	

Table No. 2: Comparisons of Means Scores Obtained by the Students of Year-8

S. #	Description of Students	N	Overall Ave Scores	Standard Deviation	Calculated Value of 'Z'	Rem.
1.	Boys	611	11.38	5.19	3.475	
	Girls	629	10.42	4.50		
2.	Rural Boys	333	12.11	6.18	4.504	
	Rural Girls	307	10.22	4.34		
3.	Urban Boys	278	10.50	3.46	0.331	
	Urban Girls	322	10.61	4.64		
4.	Rural	640	11.20	5.46	2.334	
	Urban	600	10.56	4.14		
5.	Below Ave Inc.	788	10.73	4.61	1.568	
	Above Ave Inc.	449	11.19	5.31		

Table No. 3: DATA ANALYSIS – YEAR – 8

S.#	Category		ANALYSIS OF THE SAMPLED STUDENTS ON THE BASIS OF MONTH-WISE DISTRIBUTION OF DATA												All
			A. 1	A.2	A. 3	A. 4	A. 5	A. 6	A. 7	A. 8	A. 9	A. 10	A. 11	A. 12	
1.	**Total Sample**	**N**	**115**	**92**	**97**	**101**	**79**	**89**	**104**	**95**	**87**	**142**	**114**	**125**	**1240**
		$\bar{x}$	9.62	10.17	10.09	10.94	10.66	11.89	11.66	10.92	13.13	10.35	10.75	10.98	10.89
		S	2.71	4.76	3.46	4.13	4.59	5.21	5.77	5.23	6.88	5.64	4.28	3.70	4.87
		se	0.25	0.50	0.35	0.41	0.52	0.55	0.57	0.54	0.74	0.47	0.40	0.33	0.14
2.	**Total Boys**	**N**	**53**	**30**	**42**	**43**	**37**	**31**	**43**	**55**	**54**	**86**	**69**	**68**	**611**
		$\bar{x}$	9.53	10.67	10.36	12.86	11.68	11.13	11.02	11.38	13.63	11.03	11.46	11.56	11.38
		S	2.51	4.40	4.39	4.97	5.69	3.72	4.58	5.36	6.27	6.65	5.58	4.05	5.19
		se	0.34	0.80	0.68	0.76	0.94	0.67	0.70	0.72	0.85	0.72	0.67	0.49	0.21
3.	**Total Girls**	**N**	**62**	**62**	**55**	**58**	**42**	**58**	**61**	**40**	**33**	**56**	**45**	**57**	**629**
		$\bar{x}$	9.69	9.94	9.89	9.52	9.76	12.29	12.11	10.27	12.30	9.23	10.00	10.44	10.42
		S	2.89	4.49	2.57	2.62	3.13	5.84	6.54	5.05	7.80	2.87	2.82	3.26	4.50
		se	0.37	0.63	0.35	0.34	0.48	0.77	0.84	0.80	1.36	0.38	0.42	0.43	0.18
4.	**Total Rural**	**N**	**49**	**37**	**28**	**45**	**26**	**53**	**63**	**48**	**52**	**106**	**76**	**57**	**640**
		$\bar{x}$	10.43	10.22	11.43	12.11	10.73	12.58	10.84	10.42	13.96	10.31	10.89	11.25	11.20
		S	2.71	4.58	3.84	5.25	6.00	6.38	4.10	5.74	7.60	6.10	5.28	4.31	5.46
		se	0.39	0.75	0.73	0.78	1.18	0.88	0.52	0.83	1.05	0.59	0.61	0.57	0.22
5.	**Total Rural Boys**	**N**	**22**	**08**	**16**	**27**	**15**	**16**	**34**	**23**	**34**	**61**	**44**	**33**	**333**
		$\bar{x}$	10.14	11.00	10.38	13.67	13.00	11.13	11.71	11.91	15.15	11.33	12.11	12.24	12.11
		S	2.44	6.59	4.16	5.56	6.65	4.66	4.81	7.48	7.27	7.52	6.51	4.70	6.18
		se	0.52	2.33	1.04	1.07	1.72	1.17	0..83	1.56	1.25	0.96	0.98	0.82	0.34
6.	**Total Rural Girls**	**N**	**27**	**29**	**12**	**18**	**11**	**37**	**29**	**25**	**18**	**45**	**32**	**24**	**307**
		$\bar{x}$	10.67	10.00	12.83	9.78	7.64	13.22	9.83	9.04	11.72	8.93	9.22	9.88	10.22
		S	2.94	3.99	2.98	3.81	3.14	6.96	2.80	3.02	7.89	2.88	1.91	3.33	4.34
		se	0.56	0.74	0.86	0.90	0.95	1.14	0.52	0.60	1.86	0.43	0.34	0.68	0.25
7.	**Total Urban**	**N**	**66**	**55**	**69**	**56**	**53**	**36**	**41**	**47**	**35**	**36**	**38**	**68**	**600**
		$\bar{x}$	9.02	10.15	9.55	10.00	10.62	10.86	12.93	11.43	11.89	10.36	10.87	10.88	10.56
		S	2.57	4.92	3.16	2.62	3.77	2.44	7.64	4.66	5.51	3.43	3.43	3.21	4.14
		se	0.32	0.66	0.38	0.35	0.52	0.41	1.19	0.68	0.93	0.56	0.56	0.39	0.17
8.	**Total Urban Boys**	**N**	**31**	**22**	**26**	**16**	**22**	**15**	**09**	**32**	**20**	**25**	**25**	**35**	**278**
		$\bar{x}$	9.10	10.55	10.35	11.50	10.77	11.13	8.44	11.00	11.05	10.32	10.32	10.91	10.50
		S	2.51	3.50	4.60	3.52	4.89	2.53	2.24	3.14	2.56	3.78	3.20	3.28	3.46
		se	0.45	0.75	0.90	0.88	1.04	0.65	0.75	0.56	0.57	0.76	0.64	0.88	0.21
9.	**Total Urban Girls**	**N**	**35**	**33**	**43**	**40**	**31**	**21**	**32**	**15**	**15**	**11**	**13**	**33**	**322**
		$\bar{x}$	8.94	9.88	9.07	9.40	10.52	10.67	14.19	12.33	13.00	10.45	11.92	10.85	10.61
		S	2.66	5.71	1.72	1.91	2.80	2.24	8.15	6.91	7.91	2.62	3.75	3.19	4.64
		se	0.45	0.99	0.26	0.30	0.50	0.53	1.44	1.79	2.04	0.79	1.04	0.56	0.26
10	**From Educated Families**	**N**	**57**	**43**	**42**	**53**	**45**	**47**	**40**	**54**	**34**	**66**	**50**	**73**	**604**
		$\bar{x}$	9.14	9.72	10.07	11.17	10.93	11.60	10.65	11.87	13.00	9.95	9.74	10.82	10.40
		S	2.77	3.96	3.69	3.64	5.54	5.32	4.98	6.20	7.33	5.09	2.65	3.33	4.39
11	**Un-Educated Families**	**N**	**51**	**27**	**25**	**36**	**13**	**26**	**43**	**17**	**43**	**65**	**59**	**44**	**449**
		$\bar{x}$	10.02	8.41	11.24	10.11	9.00	13.08	12.98	10.06	12.95	11.32	12.17	11.50	11.33
		S	2.58	3.18	4.17	2.53	2.77	6.13	7.13	2.86	6.51	6.13	5.80	4.47	5.10
12	**Below Average Income**	**N**	**71**	**57**	**74**	**76**	**34**	**39**	**42**	**54**	**57**	**109**	**82**	**93**	**788**
		$\bar{x}$	9.85	9.46	10.01	11.29	10.56	11.36	10.74	9.39	12.77	10.62	11.46	11.08	10.73
		S	2.90	3.02	3.72	4.38	5.14	3.76	4.66	3.10	6.68	6.14	5.28	3.14	4.61
13	**Above Average Income**	**N**	**44**	**35**	**23**	**25**	**45**	**50**	**59**	**41**	**30**	**33**	**32**	**32**	**449**
		$\bar{x}$	9.25	11.34	10.35	9.88	10.73	12.30	12.41	12.93	13.80	9.33	9.41	10.97	11.19
		S	2.35	6.59	2.52	3.10	4.17	6.12	6.58	6.65	7.30	2.59	2.31	5.17	5.31

Table No. 4. Effectiveness of the Distracters in Perception Test for Year – 8 (Total = 1240)

Item No.	Distracter Number				Not Att.	Value of 'p'
	I	II	III	IV		
1.	225	136	720	157	2	0.1268
2.	153	195	330	552	10	0.4488
3.	495	174	196	370	5	0.4008
4.	327	159	206	546	2	0.2641
5.	110	744	233	140	13	0.1899
6.	221	158	762	94	5	0.1789
7.	356	179	269	436	0	0.2169
8.	125	590	389	134	2	0.4766
9.	304	493	338	101	4	0.2735
10.	134	469	343	292	2(Q1=45)	0.2771
11.	490	278	320	151	1	0.2244
12.	429	257	336	214	4	0.1731
13.	122	219	289	606	4	0.0987
14.	481	247	254	256	2	0.1995
15.	408	258	219	349	6	0.2091
16.	127	654	306	150	3	0.2474
17.	129	186	808	109	8	0.1510
18.	555	178	201	296	10	0.2407
19.	143	158	666	265	8	0.2151
20.	105	202	780	153	0(Q2=46)	0.1629
21.	202	200	641	195	2	0.1632
22.	550	204	242	238	6	0.1929
23.	176	222	665	167	10	0.1431
24.	171	541	318	208	2	0.2569
25.	228	344	210	453	5	0.2785
26.	143	192	482	419	4	0.3900
27.	223	255	666	94	2	0.2060
28.	152	239	715	128	6	0.1037
29.	121	196	700	219	4	0.5663
30.	113	185	199	735	8(Q3=49)	0.5966
31.	156	364	334	384	2	0.2940
32.	128	269	265	570	8	0.4627
33.	272	243	349	370	6	0.2828
34.	653	214	210	157	6	0.1734
35.	300	196	230	505	9	0.1868
36.	526	157	307	242	8	0.1964
37.	459	216	347	209	9	0.1698
38.	383	308	279	259	11	0.2107
39.	465	327	179	262	7	02125
40.	661	215	203	156	5(Q4=71)	0.1263
41.	595	232	232	179	2	0.4806
42.	238	181	555	264	2	0.2132