# EFFECTIVENESS OF COMPUTER ASSISTED INSTRUCTION IN THE ACQUISITION OF MATHEMATICAL CONCEPTS IN RELATION TO INTELLIGENCE AT SECONDARY STAGE

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## ABSTRACT

*The present investigation was conducted to find out the Effectiveness of Computer Assisted Instruction in the Acquisition of Mathematical Concepts in relation to intelligence at Secondary Stage. Sample of 120 students of 9th class was taken randomly from that school which has computer lab. This group was divided into two parts one would be taught by computer Assisted Instruction and other was with traditional teaching method. Computer software package from 9th class syllabus was developed and used as treatment variable by the investigator and Achievement test of mathematics was constructed by the investigator itself. Significant difference had been found between achievement of students taught through CAI and traditional method and significant difference in mean scores of acquisition of mathematical concepts of students at different levels of intelligence irrespective of strategy of teaching.*

**Keywords:** Computer Assisted Instruction, Mathematical Concepts, Educational instructional packages.

## INTRODUCTION

Success in mathematics is central to a quality education. The better educated a society, the more flourishing the society. Proponents of computer technology in education argue that it makes learning easier, more efficient and more motivating (Schacter and Fagnano, 1999). Computer assisted instruction is an educational medium in which instructional content or activities are delivered through the computer and projector. Great emphasis is given to the Computer assisted instruction in the curriculum of education of the developed countries. The main purpose of using computer technology is to train individuals to cope with the fast developing and changing science world and also helps them to utilize the recent technologies in every field. With the rapid development of information and communication technology, the use of computers in education has become a necessity. The use of computers in education provides the students with a more satisfactory learning environment, serves to create and sustain interest and helps in increasing the students' motivation level. Hence, the use of computer technology plays a very important role in the teaching and learning process (Isman, Baytekin, Balkan, Horzum and Kiyici, 2002).

With the furtherance in technology, computers start to be used in educational environments to develop audio and visual materials such as simulation and animation. The use of computers in teaching and learning activities to unite science and technology is defined as Computer-assisted instruction. The computer assisted teaching has an impact on the development of the educational technology to a large amount and this has resulted in the formation of the instructional packages for the Computer assisted instruction. The primary purpose of the educational instructional packages is to solve the learning problems in the mathematics courses encountered by the students, to increase their motivation, achievements and to protect them against the negative effects of the cramming in the educational system. The teachers used computer instructional packages as complementary materials for taking notes about their students and observations, making tables, developing materials, doing calculations and preparing simple educational software. These are used as teaching material in the teaching as a part of a subject or the whole subject (Alkan, Deryakulu and Simsek, 1995, Isman, 2005).

## COMPUTER ASSISTED INSTRUCTION (CAI)

There are two basic features of computer assisted instruction. The first is that the computer can evaluate students' responses instantly and indicates whether the response is right or wrong on the basis of pre-established keywords identified within it. When the student's answers correspond to the anticipated incorrect answers, then the computer gives corrective clue or offers general hints when the answer does not relate to any of the anticipated in right answers. It would also call for a modified or new answer. In this way, every student is involved in the learning process as different from a conventional classroom where only a small percentage of the students respond to the teacher's questions. Each student responding and receiving necessary feedback through computer assisted instruction is led towards the goal of effective learning. Secondly, the computer can individualize instruction in a number of specified ways. Instruction can be individualized according to differential aptitude, achievement, and interest. The computer makes note of the learner's performance and progress and on the basis of the evaluation of his ongoing achievement and as per his needs, it can modify his programme for further learning. The great asset of the computer is its instant response and its flexibility to suit the learners' needs and requirements through tutorial interaction and dialogue (Sharma, 2006).

Computer assisted instruction has the potential to dramatically extend education around the world. Not only do these computers provide a means for disseminating scholarly articles and electronic books, but they can also be used to deliver quality instruction. Computer assisted instruction offers several advantages over traditional education programs. Reduced delivery cost is the single greatest advantage of Computer assisted instruction. Internet-based or standalone learning modules can be distributed to the user at little or no cost. The two major costs associated with Computer assisted instruction are the development of instructional media and the capital costs of the computers. Both of these costs can be minimal when considering the cost per user.

According to Senemoglu (2003), "Computer assisted instruction enables the children to progress at their own pace and provides them with appropriate alternative ways of learning by individualizing the learning process".

## INTELLIGENCE

The word intelligence came from the Latin word coined by Cicero to translate the Greek intelligence, in general, is the ability to learn from experience and to deal with new situations and also the ability to deal effectively with the task involving abstractions. Intelligence is the ability to think, analyze, solve problems, and recognize. There are two primary forms of intelligence, verbal and nonverbal. Verbal intelligence revolves around language problems and the skills needed to comprehend, assess and solve them. Nonverbal intelligence revolves around visual and spatial problems and the propensity to understand and explain those types of problems. Intelligence is known by various different names; among them are intelligence quotient, intellectual ability, cognitive functioning, and general ability.

It is acknowledged by all teachers that one of the most important single variables which affect schooling is the quality of behavior called intelligence. The term intelligence is hazy and ambiguous in its sense. In our day-to-day conversation, we often mention that a particular child or individual is very intelligent or is not intelligent. All such comments are based on our observation of the performance or behavior of the individual concerned in comparison to others of his group. Intelligence is a component of successful living. One indicator of the difficulty involved in understanding intelligence is the variety of the definitions used in its measurement.

Stern (1914), "Intelligence is a general capacity of an individual consciously to adjust his thinking to new requirements. It is the general mental adaptability to new problems and conditions of life".

Thorndike (1920) defined intelligence as "the power of good responses from the point of view of truth or fact".

Wagnon (1937), "Intelligence is the capacity to learn and adjust to relatively new and changing conditions."

## SIGNIFICANCE OF STUDY

Mathematics is one of the most important subjects of the academics in secondary level education, because mathematics at secondary level education is the basic mathematics which is the laying stone for the higher education in mathematics. Some students who want to peruse career in mathematics or want to study mathematics at higher level of education, sometime due to complexity of the subjects, students find it difficult to understand the basic concepts of mathematics, which is perhaps due to fault lecture method so some other unfair seen causes. As it is evident from the previous studies like Gasiorowaski, Jeanne Heindel (1998) in his study 'The relationship between students characteristics and math achievement when using computer spread sheets found that following a computer software technology –rich supplement to regular math instruction,

suggest that spread sheets can serve as a valuable cognitive tool for all seventh grade math students in general and for those who have an active learning strength and those will lower socio economic status in particular. Another author, Carter, F.I (1999) in his study found that computer assisted instruction training programs were superior to traditional programs on vocational education among high school students. Thus we can say that computer assisted instruction can help to understand the complexity of the subjects at each step in very interactive way. One can't go to the next step of the complexity unless the previous one is understand and applied clearly and correctively So computer software package provide the better access to understand the complexities of the topic / subjects and create interest among students. Thus will help the students to learn more in sort time and will save the precious time of students. So keeping in view, the importance mathematics concepts especially at secondary stage when students are at threshold of conception of their future stream, the investigator selected the study which aimed not only teach IX class through computer assisted instruction but also determining the efficiency of computer assisted instruction in acquisition of mathematical concepts.

**OBJECTIVE OF THE STUDY**

To study the effect of strategies of teaching and level of intelligence and their various interactions on the acquisition of mathematical concepts.

**HYPOTHESES OF THE STUDY**

- There will be a significant difference in mean scores of acquisition of mathematical concepts of students taught through traditional strategy and computer assisted instructional strategy.
- There will be positive and significant difference in mean scores of acquisition of mathematical concepts of students at different levels of intelligence irrespective of strategy of teaching.

**SAMPLE OF THE STUDY**

The population for the study was students of 9th class enrolled in different secondary school in Abohar Tehsil. Random sampling technique was employed to raise the sample. For conducting the experiment, sample size was 120 students of 9th class.

**RESEARCH TOOLS**

1. Computer software package from 9th class syllabus was developed and used as treatment variable by the investigator.

2. Achievement test of mathematics was constructed by the investigator itself.

## STATISTICAL TECHNIQUES

Statistical techniques i.e ANOVA, Mean, SD and t-ratio were employed to analyze the raw data.

### RESULTS AND INTERPRETATION OF HYPOTHESES
### TABLE (i)
### Summary of Analysis of Variance (2x3x2) factorial design

| Source of Variation | DF | Sum of Square | Mean sum of Squares | F-ratio | Level of Significance |
|---|---|---|---|---|---|
| Teaching Strategies (A) | 1 | 1484.18 | 1484.18 | 25.25 | Significant |
| Intelligence (B) | 2 | 8257.004 | 4128.50 | 70.239 | Significant |
| Interaction A x B | 2 | 17.120 | 8.560 | 0.146 | Insignificant |

## MAIN EFFECT OF TEACHING STRATEGIES

It is observed from the table (i) that F- ratio for difference in gain achievement scores of computer assisted instruction and traditional method of teaching is 25.25 which in comparison to the table value is found significant at 0.01 level of significance. It shows that the difference in means of two groups could not be attributed to mere sampling error or chance difference. Hence the research hypothesis: There will be significant difference in mean scores of acquisition of mathematical concepts of students taught through traditional strategy and computer assisted instructional strategy, is accepted. The result indicates that achievement of group taught through computer assisted instruction is much higher than that of traditional method of teaching.

In order to probe deeper, F-ratio is followed by t-test. The values of the t- ratio for instructional strategies have been given in the table (ii)

**Table (ii)**

**Showing t-ratio for mean gain achievement scores of
Control and experimental group**

| Group | Mean | SD | N | S.E$_D$ | C.R. | Interpretation at different level |
|-------|------|-----|----|------|------|----------------------------------|
| G$_1$ Control Group | 26.00 | 10.49 | 60 | 1.06 | 4.257 | Significant at 0.01 Level |
| G$_2$ Experimental Group | 35.50 | 12.44 | 60 | | | |

A bar diagram has been drawn to depict the mean gain scores on achievement in mathematics and has been presented in fig 1.1

**Bar diagram showing comparison of mean gain achievement scores of experimental and control group**
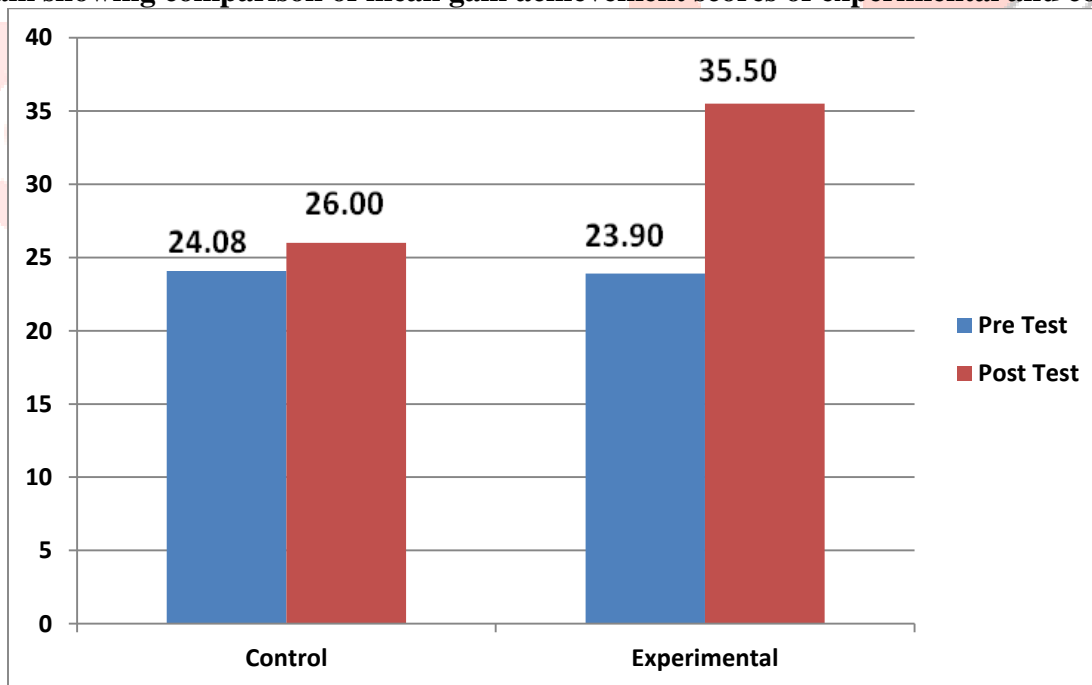


**Fig.1.1**

It is observed from the table ii and fig 1.1 that the mean gain achievement scores of experimental group i.e. group taught through computer assisted instruction is 35.50, which is higher than the corresponding mean gain scores of 26.00 for the control group i.e. group taught through traditional method of teaching. The t-value

testing the significance of mean gain difference on achievement in mathematics of experimental and control group is 4.25 which in comparison to the table value is found significant at 0.01 level of significance. Hence, the hypothesis of significant difference is accepted in case of computer assisted instruction and traditional method of teaching irrespective of grouping across other variables. The result indicates that the students taught through computer assisted instruction perform significantly better than that of students who taught through traditional method of teaching.

Several studies also observed computer assisted instruction a superior strategy of teaching as compared to the traditional method the following results are supported by Narang,(2004), Bump (2004), Vaidyanathan, Rengarajan & Devi (2002),Gupta &Garg(2010),Singh(2010), Iyekekpolar(2011).

## MAIN EFFECT OF INTELLIGENCE

It has been seen from the table i that the F- ratio for difference of mean gain scores of the different groups for intelligence is 70.23 which in comparison to the table value has been found significant at 0.01 level of significance. This shows that levels of intelligence affect the achievement in mathematical concepts differently. The difference in the means of above average, average and below average intelligence group cannot be due to sampling error or experimental error; it may be due to their ability levels. The mean of the group above average students was higher than the mean of average and below average students group. Hence the hypothesis $H_2$: There will be positive and significant difference in mean scores of acquisition of mathematical concepts of students at different levels of intelligence irrespective of strategy of teaching, stand accepted. The result implies that students at above average, average and below average levels of intelligence differ on achievement in mathematics. This result is supported by Panda (2005).

To investigate further, F-ratio is followed by t-test. The values of the t-ratio for different combination have been given in the following table (iii)

### TABLE (iii)
### Showing t-ratio for above average, average and below average
### Groups on mean gain achievement scores

| Group | Mean | SD | N | $SE_M$ | CR | Interpretation at different level |
|-------|------|----|----|--------|----|-----------------------------------|
| $I_1$ A.AVG* | 42.81 | 10.088 | 32 | 1.7833 | 5.47 | Significant at 0.01 Level |
| $I_2$ AVG** | 31.59 | 8.78 | 57 | 1.1635 | | |
| $I_1$ A.AVG* | 42.81 | 10.0881 | 32 | 1.7833 | 12.14 | Significant at 0.01 Level |
| $I_3$ B.AVG*** | 18.00 | 5.3291 | 31 | 0.957 | | |
| $I_2$ AVG** | 31.59 | 8.78 | 57 | 1.163 | 7.85 | Significant at 0.01 Level |
| $I_3$ B.AVG*** | 18.00 | 5.329 | 31 | 0.957 | | |

A bar diagram has been drawn to depict the mean gain scores of above average, average and below average groups on achievement in mathematics and has been presented in figure 1.2

**Bar diagram showing comparison of mean gain achievement scores**

**of different levels of intelligence**
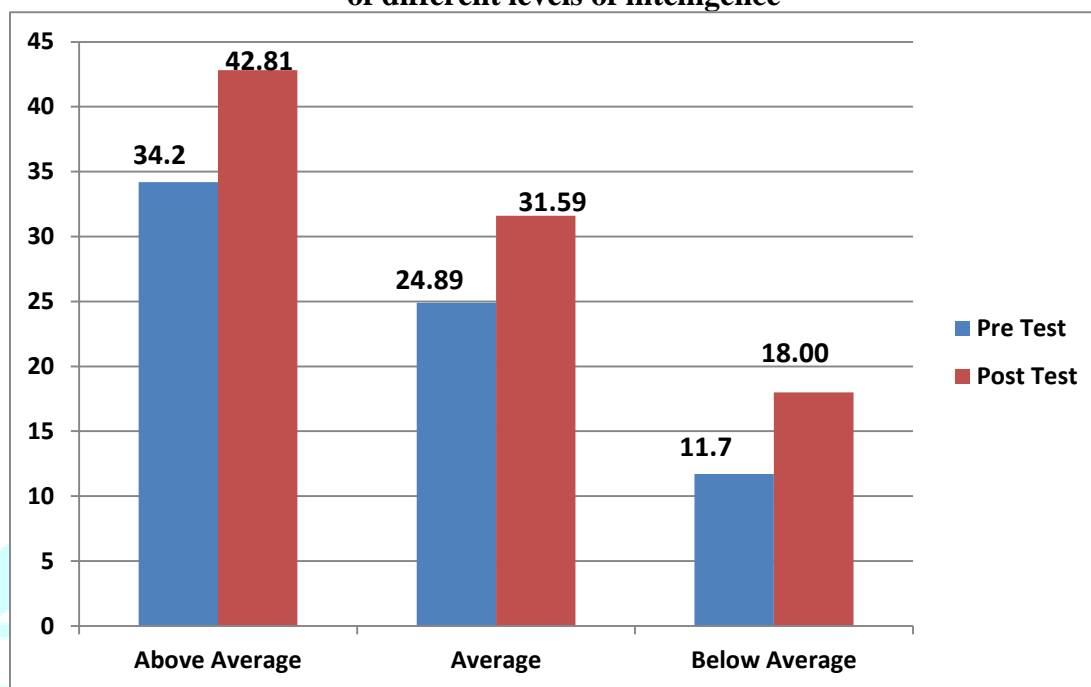


**Fig.1.2**

It is observed from the table (iii) and figure 1.2 that the mean gain score of above average intelligence group is 42.81 which is higher than the corresponding mean gain score of 31.59 for average intelligence group. The t- ratio for difference in gain scores of above average and average intelligence group is 5.47, which in comparison to the table value (2.66) has been found significant at 0.01 level of significance. The result indicates that above average intelligence group of students perform significantly better than that of average intelligence group of students.

The mean gain score of above average intelligence group is 42.81which is higher than the corresponding mean gain score of 18.00 for below average intelligence group. The t- ratio for difference in gain scores of above average and below average intelligence group is 12.14, which in comparison to the table value (2.66) has been found significant at 0.01 level of significance.

The mean gain score of average intelligence group is 31.59 which is higher than the corresponding mean gain score of 18.00 for below average intelligence group. The t- ratio for difference in gain scores of average and below average intelligence group is 7.85, which in comparison to the table value (2.66) has been found significant at 0.01 level of significance.

This inferred that there was a statistically significant difference in the achievement of average intelligence and above intelligence group. These results concluded that above intelligence group will scores more marks than average intelligence group in the subject of mathematics at IX class level.

From the figure1.2 it can be concluded that the computer teaching strategy show better performance over the traditional teaching strategy.

## CONCLUSION

- There exist significant difference in mean scores of acquisition of mathematical concepts of students taught through traditional strategy and computer assisted instructional strategy.
- There exist significant difference in mean scores of acquisition of mathematical concepts of students at different levels of intelligence irrespective of strategy of teaching.

## EDUCATIONAL IMPLICATIONS

- ➢ CAI proved to be a better mode of instruction than the traditional method in all the content areas i.e. Geography, History, Mathematics, Physics etc.
- ➢ The teacher should use this kind of package for slow learner, low achievers and wanders as per the need.
- ➢ CAI proved to be reducing the burden of the student as well as the teacher.
- ➢ To prepare a multimedia package in the form of CAI, contemplate training should be given to the teacher.
- ➢ To aware, the teachers with such kind of package demonstration should be made and motivation should be provided to use packages in the classrooms.

## REFERENCES

Afzal, M .T. & Gondal, B. S. Fatima, N. (2014). The effect of computer based instructional technique for the learning of elementary level mathematics among high, average, and low achievers, International journal of education and development using information and communication technology ,10 (4), 47-59.

Alkan, C., Deryakulu, D. & Simsek, N. (1995). *Introduction to educational technology* (2 ed.). Ankara: Onder Printing House.

Basturk, R. (2005). The Effectiveness of Computer Assisted instruction in Teaching Introductory statistics. Educational Technology and Society, 8(2), 170-178.

Bhatt, B.D. & Parkash,R. (1994). Modern Encyclopedia of Educational Technology. Kanishka publisher distributors,New Delhi.

Bump, D. E. (2004). The effect of a computer multimedia interactive mathematics program on the mathematics achievement of developmental mathematics college students. Retrieved from http://dl.acm.org/citation.cfmid=1023202

Carter, F.l. (1999). The effects of computer-assisted-instruction on vocational education high school students. Fullertion : California State University in MAI *36*(06),  1602.

Dhevakrishnan, R, Devi, S. & Chinnaiyan, K. (2012). computer assisted instruction (CAI) in Teaching of Mathematics secondary level, International Journal of Advancement in research and technology, 1(4),1-3.

Gupta, A. & Garg, S.K. (2010). A study of effectiveness of computer- assisted teaching in linguistic comprehension of the students. Asian journal of Psychology and Education, 43(3-4), 19-23.

Isman, A. (2005). *Instructional technology and material development*. Ankara: Pegem A Publishing.

Isman, A., Baytekin, C., Balkan, F., Horzum, M. B., & Kiyici, M. (2002). Science education and constructivism. *The Turkish Online Journal of Educational Technology, 7*(1), 41-47.

Iyekekpolar, A. (2011). Effect of computer-assisted instruction on students' achievement in mathematics. Retrieved from http://driyekekpolor.blogspot.com/2011/01 /effect-of-computer-assistedinstruction.htm

Makkar, N. (2012). Relative superiority of computer assisted instruction over traditional methods in learning concept of mathematics. International Journal of Research in Education Methodology Council for Innovative Research, 1(3), 60-62.

Naseema,C. (2007).From Black Board to the Web Integrating Technology and Education. Knaishka publisher distributors,New Delhi.

Romani,P. & Patadia,H. (2012).Effectiveness of computer assisted instruction in teaching Arithmetic. International Journal of Scientific and Research Publication,2(11),1` 2550-3

Schacter, J. & Fagnano, C. (1999). Does computer technology improve student learning and achievement? How, when, and under what conditions? *Journal of Educational Computing Research, 20*(4), 329-343.

Singh, A. (2010). Effectiveness of computer assisted instruction in acquisition of mathematical concepts in relation to achievement motivation and study habits. Unpublished Ph. D. Thesis, Chandigarh: Panjab University.

Smith, R.R. (1996). Effects of textbook. static CAI, and animated CAI, and learning styles on the achievement of college students in symbolic matrix algebra (Doctoral Dissertation), University of South Florida. *Dissertation Abstracts International*, 57-07A.

Soe, K., Koki, S., Chang, J. M. (2000*). Effect of computerassisted instruction (CAI) on reading achievement: A metaanalysis.* https://eric.ed.gov/?id=ED443079

Soylu, M.Y. & Akkoyunlu, B. (2002). The effect of learning styles on achievement in different learning environments**.** *Turkish Online Journal of Educational Technology* 8*(*4) ·43-50.

Spearman, C. (1904) "General Intelligence", objectively determined and measured. *American Journal of Psychology,* 15, 201-293. reterived from inhttp:// psychclassics.yorku.ca/Spearman/

Srivastava A.K & Misra G (2007). *Rethinking Intelligence: Conceptualizing Human Competence in a Cultural Context*. New Delhi : Concept Publishing Company:.

Stern, W. (1914). *Psychological Method of Testing Intelligence.* Baltimore: Warwick and York, 145-152.

Sumari, Z.H.S.S. (2010). Factors Contributing to Academic Achievement and Moral Development: A Qualitative study. *International Journal of Research and Review*. 15, 18.

Sunder, S. (2006). *Effect of computer based multimedia instructional strategy on achievement in English language in relation to anxiety and parent child relationship.* Dissertation Ph.D. Edu. P.U. Chandigarh.

Suppes, L. & Binford, F. (1965). Experimental teaching of mathematical logic in the elementary school. *The Arithmetic Teacher*, 12, 187-195.

Swan, K., Mitrani, M., Guerrero, F., Cheung, M., & Schoener, J. (1990). *Perceived locus of control and computer based instruction.* Retrieved from http://www.hungyeh.com.tw/FI5620.pdf

Tanner, K, Allen,D.(2004). Learning styles and problem of instructional selection- engaging all students in science courses cell Biol. *Educ*, *3*(4),197-201.

Tanveer,A.M. & Gondal, M. B. (2010). Effect of Mathematics Software Facilitated    Teaching on Students Learning. *International Journal of Technology, Knowledge & Society*, *6*(3).

Thomas, P. Y. & Emereole, H. U. (2002). *Effect of computer-based instruction on performance in physics. Sabinet Online,* 6, 97-112. Retrieved from http:// www.sabinet.co.za/ abstracts /saarmste/saarmste v6 a9.xml.

Thomson, G.H. (1939). *The Factorial Analysis of Human Ability*. London: University of London Press.

Thorndike, E.L (1920). *Intelligence and Its Uses*: Harpers Magzine,  227-235

Thurstone, L. L. (1938). *Primary mental abilities*. Chicago: University of Chicago Press.

Tobin, K. & Capie, W. (1984). The test of logical thinking. *Journal of Science and Mathematics Education of the Child, 7*(1), 5-9.

Torres, C.R. (1993). *The cognitive ability and learning styles of students enrolled in the college of agriculture at the Ohio state university*. Doctoral Dissertation, The Ohio State University, Columbus.

Vaidyanathan, N., Rengarajan, V. & Devi, T. K. (2002). Effectiveness of multimedia approach on the achievement of primary children in mathematics. *Indian Psychological Abstracts and Reviews*, *9*(1), 166.

Vaishanv, R.S. (2013). Learning style and academic achievement of secondary school students. *Voice of Research*, *1* (4), 1-4.

Vyas (2002). A study of learning style, mental ability, academic performance and other ecological correlates of under graduate adolescent girls. *Journal of Psychological Researches*, *41*(5), 44-48.

Wagh, S. K. (1991). Development of a multimedia instructional system for remedial measures in fractional numbers. Ph.D. Edu. Shivaji University. *Fifth Survey of Educational Research*, II, 1299-1300.

Wagnon, M.J. (1937). *Reading in Educational Psychology*. New York : Houghton Mifflin,  401.

Walia, J. S. (2003). *Foundations of Education Psychology*. Ahim Paul Publishers, Jalandhar.

Wang, K., Wang, T., Wang, W. L. & Huang, S.C. (2006). Learning styles and formative assessment strategy: Enhancing student achievement in web based learning. *Journal of Computer Assisted Learning*, *22* (3), 201-217.

Woodworth & Marquis (1948). *Psychology* (5th ed,). New York: Henry Holt & Co.

Woodworth,R.S.(1972). Quoted H.S. Bajwa in " *A Study Of Academic Achievement In Physics In Relation To Intelligence, Creativity And Aptitude For Physics At Sr Sec Stage*", Ph.D. Thesis, Panjab University,1998.

Yadav, P. (2018). Construction and Standardization of Achievement in Hindi(SRJI) Scholarly Research. *Journal for International Studies,* 5(44).

Yusuf, M. O. & Afolabi, A.O. (2010). Effect of computer Assisted Instruction (CAI) on secondary school student performance in biology. *TOJET: The Turkish Online Journal of Educational Technology*, *9*(1),62-69. reterived from http://files.eric.ed.gov/fulltext/EJ875764.pdf

Zukerman, Siberman & Hall (2013).The Relation Between Intelligence and Religiosity: A Meta-Analysis and Some Proposed Explanations. *Personality and Social Psychology Review*, Reterived from https://journals.sagepub.com/doi/abs/10.1177/1088868313497266?journalCode=psra