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EXPLORING THE EFFECTS OF INTERACTIVE HYPERMEDIA INSTRUCTIONAL PROGRAM ON MATHEMATICS ATTITUDE AND ACHIEVEMENT IN RELATION TO LOCUS OF CONTROL

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Abstract

The paper presents the results of an empirical study investigating the impact of interactive hypermedia instructional program on student's Mathematics attitude and achievement in Mathematics in relation to their locus of control. The study relied on a pre test- post test control group experimental research design. The study covered a period of approximately four months and comprised students of 8th class from four different schools of Chandigarh. Results indicate a significant interaction effect of interactive hypermedia instructional program and locus of control on Mathematics attitude and achievement of students. Students having internal locus of control outperformed the students having external locus of control on Mathematics attitude and achievement. The usage of interactive hypermedia instructional program had improved students' Mathematics attitude and achievement.

Keywords: Interactive Hypermedia Instructional Program (IHP), Mathematics Attitude, Achievement in Mathematics and Locus of Control.

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1.0. Introduction

A number of important changes have occurred within the field of Mathematics education throughout the world. Mathematics is considered most difficult, hard, useless and boring subject as it involves complex learning activities which require lot of hard work from learners (Adhikary, 2012). Students need to get motivated time to time, so that they enjoy learning of Mathematics. As educators, we can create an ideal classroom environment that is conducive to learning and research suggests that it can be effectively achieved through instructional strategies (Callahan, 2010). Educators are now introducing various forms of software and multimedia presentation driven media into their classroom activities for enhancing learning of students (Tolhurst, 1995). Many new instructional interventions like computer assisted instructions, computer based instructions, hypermedia based instructions, on-line learning, mobile learning etc. have created a great deal of enthusiasm among instructors.

Hypermedia is learner-centered software, where learner is incharge and can use variety of media (Turner and Handler, 1997). Educational hypermedia applications could offer our schools, colleges and universities a powerful means of enriching the educational experience of their students when its proper place in the formal educational process can be established (Saxena, Kothari, Jain and Khurana, 2004). Various researches in this field had shown that learners found hypermedia classes more stimulating and motivating than traditional classrooms. Trotter (1989) indicated that hypermedia employs a strategy that is advantageous to students, since the learner is incharge and can use a variety of media to approach the subject.

Gayeski (1993) defined hypermedia as a classification of software programs which consists of networks of related texts, graphics, audio files, and/or video clips through which users navigate using icons or search strategies. Moore (1994) pointed out that hypermedia has become the hottest thing to happen to education since the arrival of the microcomputer and the advantages of using hypermedia includes the addition of combining sound and picture, the interactive opportunities for the learner, the ability to structure one's learning approach, the ability of the system to remember, the ability to pursue cross-reference and the increase of the learner's control over the subject matter.

Hypermedia, a term derived from hypertext, extends the notion of the hypertext link to include links among any set of multimedia objects, including sound, motion, video and virtual reality (Fairchild, 2004). Hypermedia reflects the characteristics of multimedia (text, graphics, drawings, still and moving images, etc.) and hypertext (text which contains links to other texts). It has always been an activity based name, rather than a box based name (Kothari and Saxena, 2004). Hypermedia consists of a system of control and presentation of information organized in a network of interlinked multimedia points.

Hypermedia is an instructional program which includes a variety of integrated sources in the instruction and the program is intentionally designed in segments and viewer responses to structured opportunities influence the sequence, size, content, and shape of the program (Schwier and Misanchuk, 1993). Educational hypermedia applications could offer our schools, colleges and universities a powerful means of enriching the educational experience of students, only when its proper place in the formal educational process can be established.

Hypermedia based instruction supports the construction of knowledge on a particular subject matter by improving the learner's ability to use the content domain to carry out authentic tasks and by providing these tasks with the tools needed to develop the skills of constructing an informed response and for evaluating alternative responses. Hypermedia applications are one such tool available to instructional designer which can be used to support constructivist, collaborative and experimental learning (Nunes and Fowell, 1996).

Review of research literature revealed that hypermedia based instructional strategy is effective than the traditional method of teaching (Babbitt and Miller, 1996; Zywno, 2001; Lancaster, Schumaker and Deshler, 2002; Mustafa and Sharif, 2011). The learner enjoyed the hypermedia units created by them and were actively involved in it (Mandell, 1999).

Hartshrone (2008) found that integration of hypermedia had a positive influence on elementary teachers' attitudes toward Science and it's found to be an integral component to increase their attitude towards Science. Rokni and Hamidi (2014) concluded that participants in the experimental group perceived hypermedia as an effective way for language learning, especially

for listening comprehension. Further, Falode, Ojoye, Ilobeneke and Falode (2016) recommended that hypermedia instructions should be used to supplement conventional lecture method of teaching to improve students' achievement and interest towards physics.

The introduction of multimedia computer applications in everyday life and activities has given the students, a possibility to approach information and scaffold their ideas in a variety of ways with the assistance of a familiar medium closely related to their interests and playtime activities like computer games. Sounds and images make the content of the programs more accessible to learners who sometimes find it difficult to decode and interpret solely on text-based information (Dimitriadi, 2001).

Hypermedia proved to be a valuable tool as hypermedia based material helped in learning, generating autonomy, interactivity in the moment of studying and aroused the interest and curiosity of students. The present study is an endeavour to explore the effectiveness of interactive hypermedia instructional program on student's Mathematics attitude and achievement in relation to their locus of control.

2.0. Research Questions:

The purpose of this study was to investigate the following research questions:

- RQ_{h1}: Does interactive hypermedia instructional program and locus of control have a significant interaction effect on student's Mathematics attitude?
- RQ_{h2}: Does interactive hypermedia instructional program and locus of control have a significant interaction effect on student's achievement in Mathematics?

3.0. Research Methodology:

3.1. Design of the study: The study relied on a pre test- post test control group experimental research design. In this study, instructional treatment i.e. interactive hypermedia instructional program was the independent variable; Mathematics attitude and achievement in Mathematics were the dependent variables; and locus of control was classifying variable which is studied at two levels viz. internal locus of control and external locus of control. The scores of dependent variables i.e. Mathematics attitude and achievement in Mathematics were calculated as mean

gain scores (difference in post test scores and pre test scores). In order to analyze the data, 2x2 factorial analysis of variance was used.

3.2. Sample of the study: The data was collected from the 200 students of 8th class of randomly selected four private secondary schools of Chandigarh in the academic session 2012-2013. From the four selected schools, 200 students were identified by administering Locus of Control scale. The researcher continued the administration of Locus of Control scale until 100 students each having internal locus of control and external locus of control was found. Further, these students were divided into two groups randomly i.e. one experimental group and one control group having 100 students each. Each experimental group and control group had 50 students having internal locus of control and 50 students having external locus of control. In all the four schools, one experimental group and one control group is formed having approximately equal number of students with internal locus of control and external locus of control.

The students of experimental group were taught through the interactive hypermedia instructional program and control group students were taught through the traditional teaching method in their respective Mathematics periods. There were six periods of 40 minutes each, allocated to Mathematics teaching per week for both the groups. The intervention lasted for about 60 days.

3.3. Data Collection Instruments: Following data collection instruments were used in the study:

- Instructional material for Mathematics based on the Interactive Hypermedia Instructional Program developed by the investigator for giving treatment to the experimental group students.
- Mathematics Attitude Scale developed and standardized by the investigator to collect scores on attitude towards Mathematics.
- Summative Mathematics Achievement test developed and standardized by the investigator to collect scores on achievement in Mathematics.
- Locus of Control Scale by Pal (1980) adapted by the investigator to collect data on locus of control.

4.0. Findings and Results:

In order to analyze and interpret the quantitative data, analysis of variance (2X2) on mean gain scores was employed and t-test was computed wherever F- value came out to be significant.

4.1. Analysis of variance on mean gain scores on Mathematics Attitude: The analysis of variance (2X2) was employed to compute the difference in mean gain scores of experimental and control group students on Mathematics attitude and results are presented as follows:

Table 1: **Summary of 2X2 Analysis of Variance**

Dependent Variable	Source of variation	Degrees of Freedom (df)	Sum of Squares (SS)	Mean Sum of Squares	F - value
Mathematics Attitude	Instructional Strategy (A)	1	9234.40	9234.40	57.58**
	Locus of Control (B)	1	703.12	703.12	4.38*
	A X B	1	748.84	748.84	4.67*
	Error within treatment	196	31429.38	160.35	
	Total	200	82529.00		
	Corrected Total	199	42115.75		

* Significant at 0.05 level of significance **Significant at 0.01 level of significance

For the main effects of instructional strategy on Mathematics attitude, from the table 1, it is clear that Mathematics attitude of students taught through interactive hypermedia instructional program and traditional teaching method was found to be significantly different at 0.01 level of significance.

For the main effects of locus of control on Mathematics attitude, it is evident that Mathematics attitude of students' having internal locus of control and external locus of control was found to be significantly different at 0.05 level of significance.

The interactional effect of instructional strategies and locus of control (AXB) on Mathematics attitude was found to be significant at 0.05 level of significance. A significant F-value indicated that two variables i.e. teaching strategies and locus of control interacted to produce significant effect on Mathematics attitude of students.

Further, to ascertain the significance of difference between means of various combination groups, t-ratios were computed and results are presented as follows:

Table 2. Showing t-ratio of various combination groups on mean gain scores on Mathematics Attitude for difference in Instructional Strategies and Locus of Control

Combination Groups	**A_1B_1** Mean= 24.82 S.D.= 18.34 N= 50	**A_1B_2** Mean= 17.20 S.D.= 12.02 N=50	**A_2B_1** Mean=7.36 S.D.=10.43 N=50	**A_2B_2** Mean=7.48 S.D.=7.16 N=50
A_1B_1	---	2.45*	5.85**	6.22**
A_1B_2		---	4.36**	4.90**
A_2B_1			---	0.06
A_2B_2				---

*Significant at 0.05 level of significance ** Significant at 0.01 level of significance

A_1- stands for Interactive Hypermedia Instructional Program;

A_2- stands for Traditional Teaching Method;

B_1-stands for Internal Locus of Control; and

B_2- stands for External Locus of Control

From table 2, the results for various combination groups on the basis of t-ratio are summarized as follows:

- Students having internal locus of control and taught through interactive hypermedia instructional program outperformed their counterparts on mean gain scores on Mathematics attitude who were having external locus of control and taught through interactive hypermedia instructional program.
- Students having internal locus of control and taught through interactive hypermedia instructional program outperformed their counterparts on mean gain scores on Mathematics attitude who were having internal locus of control and taught through traditional teaching method.

- Students having internal locus of control and taught through interactive hypermedia instructional program outperformed their counterparts on mean gain scores on Mathematics attitude who were having external locus of control and taught through traditional teaching method.
- Students having external locus of control and taught through interactive hypermedia program outperformed their counterparts on mean gain scores on Mathematics attitude who were having internal locus of control and taught through traditional teaching method.
- Students having external locus of control and taught through interactive hypermedia program outperformed their counterparts on mean gain scores on Mathematics attitude who are having external locus of control and taught through traditional teaching method.
- No significant difference is found in mean gain scores on Mathematics attitude of students having internal and external locus of control and who are taught through traditional teaching method.

4.2. Analysis of variance on mean gain scores on Achievement in Mathematics: The analysis of variance (2X2) was employed to compute the difference in mean gain scores of experimental and control group students on achievement in Mathematics and results are presented as follows:

Table 3: **Summary of 2X2 Analysis of Variance**

Dependent Variable	Source of variation	Degrees of Freedom (df)	Sum of Squares (SS)	Mean Sum of Squares	F - value
Achievement in Mathematics	Instructional Strategy (A)	1	630.12	630.12	6.93**
	Locus of Control (B)	1	315.00	315.00	3.92*
	A X B	1	435.12	435.12	4.41*
	Error within treatment	196	19324.90	98.59	
	Total	200	121371.00		
	Corrected Total	199	20705.15		

* Significant at 0.05 level of significance **Significant at 0.01 level of significance

For main effects of instructional strategy on achievement in Mathematics, from the table 3, it is evident that achievement in Mathematics of students taught through interactive hypermedia instructional program and traditional teaching method was found to be significantly different at 0.01 level of significance.

For main effects of locus of control on achievement in Mathematics, it is clear that achievement in Mathematics of students' having internal locus of control and external locus of control was found to be significantly different at 0.05 level of significance.

The interactional effect of instructional strategies and locus of control (AXB) on achievement in Mathematics was found to be significant at 0.05 level of significance. A significant F-value indicated that two variables i.e. teaching strategies and locus of control interacted to produce significant effect on achievement in Mathematics of students.

Further, to ascertain the significance of difference between means of various combination groups, t-ratios were computed and results are presented as follows:

Table 4. Showing t-ratio of various combination groups on mean gain scores on Achievement in Mathematics for difference in Instructional Strategies and Locus of Control

Combination Groups	**A_1B_1** Mean=26.94 S.D.=13.89 N=50	**A_1B_2** Mean=21.48 S.D.=8.06 N=50	**A_2B_1** Mean=20.44 S.D.=8.97 N=50	**A_2B_2** Mean=20.88 S.D.=7.46 N=50
A_1B_1	---	2.40*	2.77**	2.71**
A_1B_2		---	0.61	0.44
A_2B_1			---	0.26
A_2B_2				---

*Significant at 0.05 level of significance ** Significant at 0.01 level of significance

A_1- stands for Interactive Hypermedia Instructional Program;

A_2- stands for Traditional Teaching Method;

B_1-stands for Internal Locus of Control; and

B_2- stands for External Locus of Control

From table 4, the results for various combination groups on the basis of t-ratio are summarized as follows:

- Students having internal locus of control and taught through interactive hypermedia instructional program outperformed their counterparts on mean gain scores on achievement in Mathematics who were having external locus of control and taught through interactive hypermedia instructional program.
- Students having internal locus of control and taught through interactive hypermedia instructional program outperformed their counterparts on mean gain scores on achievement in Mathematics who were having internal locus of control and taught through traditional teaching method.
- Students having internal locus of control and taught through interactive hypermedia instructional program outperformed their counterparts on mean gain scores on achievement in Mathematics who were having external locus of control and taught through traditional teaching method.
- No significant difference is found in mean gain scores on achievement in Mathematics of students having external locus of control and taught through interactive hypermedia and students having internal locus of control who are taught through traditional teaching method.
- No significant difference is found in mean gain scores on achievement in Mathematics of students having external locus of control and taught through interactive hypermedia program and students having external locus of control and taught through traditional teaching method.
- No significant difference is found in mean gain scores on achievement in Mathematics of students having internal and external locus of control and who are taught through traditional teaching method.

5.0. Discussion and Conclusions:

The purpose of this study was to explore the effect of interactive hypermedia instructional program on student's Mathematics attitude and achievement in Mathematics in relation to their locus of control. The study covered a period of approximately four months and comprised a

sample of 200 students from four different schools in Chandigarh. The study relied on a pre test-post test control group experimental research design.

Statistically significant interaction effect of instructional strategy and locus of control was found on Mathematics attitude of students. This provides an answer for the research question (RQ_{h1}) indicating that interactive hypermedia instructional program and locus of control has a significant positive interaction effect on Mathematics attitude of students. The students having internal locus of control and taught through interactive hypermedia instructional program outperformed the students having external locus of control and taught through traditional teaching method.

Results of the study revealed that students taught through interactive hypermedia instructional program had significantly high mean gain scores on Mathematics attitude and Mathematics achievement than students taught through traditional teaching method. Students having internal locus of control outperformed the students having external locus of control on Mathematics attitude.

From the results, it may be concluded that interactive hypermedia program was more effective than the traditional teaching method. The above results are supported by the findings of Hartshrone (2008); Pilli and Aksu (2013); and Ciftci and Karadag (2014) who concluded that hypermedia based educational software had a positive effect on attitude of student's. However, Bayturan and Kesan (2012) revealed that hypermedia based instructions had no effect at students' attitude towards Mathematics.

The results of the present study indicated that students having internal locus of control and external locus of control have yielded significantly different mean gain scores on Mathematics attitude. Further, it is found that students having internal locus of control has developed significantly better Mathematics attitude than students having external locus of control group when exposed to interactive hypermedia program.

The present study revealed that the students taught through interactive hypermedia program were higher on achievement in Mathematics than students taught through traditional teaching method. The findings of the study provide an answer for the research question (RQ_{h2}) indicating interactive hypermedia instructional program and locus of control has a significant positive interaction effect on achievement in Mathematics of students. Results suggested that interactive hypermedia instructional program should be applied in classrooms for enhancement of learning of students.

Well-designed hypermedia helps learner to build more accurate and effective mental models which they cannot do from text alone (Dimitriadi, 2001). Interactive hypermedia program involves understanding of basic mathematical skills which is important for success in school and everyday life. The results were consistent with the findings of Babbitt and Miller (1996); Zywno (2001); Mustafa and Sharif (2011); Rokni, Montazeri, and Karimi (2014). and Ayob (2014) revealed that the learner's, whose previous scores were less, benefitted with the hypermedia instruction. Rokni and Hamidi (2014) and Amin, Alimuddin and Muris (2016) perceived hypermedia as an effective way for learning and improving the problem solving skill of students'. However, Chen (2002) indicated that not all learners can benefit from hypermedia learning.

The discussion of results has clearly indicated that interactive hypermedia program have proved superior because it is completely learner oriented. Student, depending upon their need, can consult the items in any order. Learner can very easily move from one topic to the other without having to close or open files. Interactive hypermedia program in the present study included various modes of learning such as video, audio, exercises and test items on topics relevant to the Mathematics syllabus. Through these activities learners were involved in direct experiences and were challenged to use higher order thinking skills. The program included wide array of instructional strategies which were student centered. These options transformed the user from a passive observer into an active participant.

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