Effectiveness of Web-based Instruction in Terms of Achievement of Class IX Mathematics Students of Jawahar Navodaya Vidyalaya

Balram Prasad Jhariya*, Laxman Shinde**

Abstract

The present study was done on Class IX students of Jawahar Navodaya Vidyalayas of Madhya Pradesh and Chhattisgarh. About 316 students were selected as sample by using random sampling technique. Using Self-developed Achievement Test in Mathematics and Advanced Progressive Matrices of J.C. Raven (1953) it is found that the (i) Adjusted mean scores of achievement in mathematics of Web-based Instruction (WbI) group is significantly higher than that of traditional method group when the groups were matched with respect to pre-achievement in Mathematics. (ii) Achievement in mathematics is independent of economic status when the groups were matched with respect to pre-achievement in mathematics. (iii) There is no significant effect of the interaction between treatment and economic status when the groups were matched with respect to pre-achievement in mathematics.

Introduction

Education is the most powerful instrument in the progress of any nation. Hence, the quality of education should be improved for the all-round development of a child and quality of instruction. At present, no one is satisfied with whatever happens in classrooms.

**Principal,* Shambhavi School of Education, Dhusera, Raipur, Chhattisgarh-493661.
***Reader,* School of Education, Devi Ahilya Vishwavidyalaya, Indore- 452001.

Web-based Instruction (WbI), which is an emerging field in education, is nevertheless, a part of rapid growth caused by the internet. Reasons for the growth of WbI include growth of distance education (reliable and inexpensive source) as compared to computer-based training, live broadcasts, video tapes, and so on, that enable learners, who prefer or are required to learn outside traditional classrooms, to attend classes in their homes or offices and provide delivery medium content provider and subject matter in one package unlike other mediums such as computer-based training that require a separate delivery mechanism.

Web-based Instruction is a vital area of research. Researchers are making efforts to design and develop different types and forms of Web-based Instruction material, which can improve the teaching-learning process. Some of the researchers are Manickam and Devonathan (2011), Karthikeyan and Jayraman (2011). These researchers have compared the achievement of Web-based Instruction/e-content group with traditional method group and have found the achievement of Web-based Instruction/e-content group to be significantly superior to the traditional method group. Unal (2005) has compared achievement of Web-based Instruction/e-content group with traditional method group and has found that there is no significant difference in the achievement of Web-based Instruction/e-content group and traditional method group.

Beta-Jones and Avery (2004), Cooper (2001), Thrasher et al., and Chahino (2011) have compared Web-based Instruction / e-content materials with traditional method (face-to-face learning) and have found that e-content materials that developed in different subjects at different levels were found to be significantly superior to traditional methods in terms of learning outcomes.

Beck (2010) has also compared online and face-to-face teaching and learning and has found that student learning occurred in all sections and that method of delivery was unimportant. Anstine and Skidmore (2005) compared online and face-to-face teaching and learning and found that the online learning environment was substantially less effective than the traditional learning environment. Snell et. al. (1999) has compared online/offline of the same course. For two academic years, the course had the same instructor, textbook, time period (1994–96) and they were related. The difference is that offline had lectures and online had videos. A significant difference was noted between online and offline education and that online appears to be more rigorous. Schmidt (2012) has compared students' learning outcomes in online and face-to-face accounting courses information and found that (i) Students taking the ACCT 211 and ACCT 311 online perform as well as face-to-face students in quizzes, chapter tests,

and final exam; (ii) In ACCT 211 and ACCT 311, there were some learning objectives, of which students learning face-to-face had a better understanding, while online students had a better understanding of other learning objectives; (iii) A student's prior knowledge has a strong relationship with his/her average quiz grades in ACCT 311 and a moderate relationship in ACCT 211. Lee (2005), Erdogan (2008), Chen and Jones (2007) have studied attitude towards Web-based Instruction / online and face-to-face learning and have found that users have been more satisfied in Web-based Instruction / online learning compared to face-to-face learning developed in different subjects at different levels.

Cooper (2001) studied and examined contrasts between online and traditional delivery methods in terms of the impact on student learning and satisfaction for similar course material. He found that traditional courses were characterised as being perceived as more satisfying than online classes, but that may have been as much a preconceived notion of expectations as much as the experience of taking classes. Yatrakis and Simon (2002) studied 'The Effect of Self-selection on Student Satisfaction and Performance in Online Classes' and found that (i) Students who chose to enrol in courses in an online format achieved higher rates of satisfaction and perceived retention of information, than those who enrolled in online courses when no such choice is provided, (ii) Student grades did not seem to correlate with students' perceptions. It might reasonably be assumed that students reporting higher levels of satisfaction and perceived retention of information should also perform better as measured by course grades.

Benson and Angela (2007) have investigated online post-secondary education for low-income clients of education support organisations (ESOs). A multi-stage case study approach was taken. The results showed that (i) ESO directors hold different perspectives on whether online learning is a good option for their clients; (ii) ESO programmes that are successful in serving online clients have expectations for student success, provide sufficient training and support, understand the learning needs of their clients, and are associated with colleges and universities that are supportive of online learning.

Brallier (2007) studied predictors of exam performance in web and lecture courses and found that (i) web-based courses had a significantly lower percentage of racial minorities than lecture-based courses; (ii) Race was a significant predictor of exam performance in web-based courses but not in lecture-based courses.

Rakap (2010) studied the impacts of learning styles and computer skills on adult students' learning online and found that (i) Learning styles or preferences had significant effects on adult students' knowledge

acquisition, (ii) There is a moderate positive correlation between computer skills and students' success, and (iii) There is no relationship between prior experiences with online courses and success in a web-based course.

Cobb (2011) studied social presence, satisfaction, and perceived learning of RN-to-BSN students in web-based nursing courses and found (i) A strong relationship among satisfaction, social presence, and instructor performance, (ii) All sub-domains of social presence correlated highly with the satisfaction sub-domains, except the communication factor, (iii) A strong relationship was found between perceived learning and social presence and comfort with the online course, (iv) Overall social presence, instructor performance, and the sub-domains of social presence predicted a significant amount of total variance in the overall satisfaction and perceived learning, (v) No significant relationship was found between the demographic factors and the overall social presence or perceived learning.

Nagalakshmi and Manikam (2011) have studied the effectiveness of online education technology for people with special needs. They have found that in all online educational tools respondents commented about presentation problems with essential features such as assessments and assignment. The most commonly reported problems were access to real-time, chat, e-mail, documents, assessments and discussion board included in online educational tools.

These materials i.e., Web-based Instructional material/ e-content/ online instructional material have not been able to enter the classroom due to various reasons such as cost of preparing the material and comprehension level. The difficulty in preparing the special type of instructional material included lack of trained personnel, equipment, problem of electricity, etc.

It is evident from previous research that little work has been done on Web-based Instruction and there is no consistency in the findings. These points lead to the selection of Web-based Instruction for the present study to fill this gap. It was decided to work in this area and compare Web-based Instruction with traditional method for teaching mathematics to Class IX students.

Key Words

In this study, the major key words used are as follows:

Web-based Instruction

Web-based Instruction refers to providing a learning environment that is mediated and supported via the internet/intranet and connected to a computer with hyperlinks to resources outside the instructional domain. The instruction is designed so that the computer displays lessons in response to learner/user interactions.

Jawahar Navodaya Vidyalaya

Jawahar Navodaya Vidyalayas (JNV) are schools for talented children and are a part of the system to provide quality education. The objectives of the scheme are to provide quality modern education to children predominantly from rural areas, without regard to their family's socio-economic condition.

Economic Status

The economic status of students means the economic condition of parents, which depends on their monthly or annual income. On the basis of monthly or annual income of their parents, the students were classified into three groups. The first one was low economic status group (up to ₹10,000 per month), the second was middle economic status group (monthly income between ₹10,000 and ₹25,000) and the third group was high economic status group (monthly incomes above ₹25,000).

Objectives

1. To design and develop the Web-based Instructional material in mathematics at Class IX level of Navodaya Vidyalaya.
2. To compare the adjusted mean scores of achievement in mathematics of Experimental and Control groups by considering pre-achievement in mathematics as co-variate.
3. To study the effect of treatment, economic status and their interaction on achievement in mathematics by considering pre-achievement in the subject as co-variate.

Hypotheses

1. There is no significant difference between adjusted mean scores of achievement in mathematics of Experimental and Control group by considering pre-achievement in mathematics as co-variate.
2. There is no significant effect of treatment, economic status and their interaction on achievement in mathematics by considering pre-achievement in mathematics as co-variate.

Methodology

Sample

The population of the study was Class IX students studying in Jawahar Navodaya Vidyalayas in India. The study, which is Experimental in nature, was conducted in eight Jawahar Navodaya Vidyalayas namely, Jawahar Navodaya Vidyalaya, Mana, Raipur (Chhattisgarh); Jawahar Navodaya Vidyalaya, Padmi, Mandla, (M.P.); Jawahar Navodaya Vidyalaya Kurud, Dhamtari (Chhattisgarh); Jawahar Navodaya Vidyalaya, Kanhiwada, Seoni (M.P.); Jawahar Navodaya Vidyalaya, Shahpur, Dindori (M.P.); Jawahar Navodaya Vidyalaya, Borai, Durg (Chhattisgarh), and Jawahar Navodaya Vidyalaya, Dongargarh, Rajnandgaon (Chhattisgarh). About 316 students of Class IX of the above-mentioned JNVs of

Madhya Pradesh and Chhattisgarh were selected for random sampling. Forty students were selected from each school but four students of two schools dropped out during the course. Finally, 159 students from four schools formed the Experimental group and 157 from the other four schools formed the Control group. School-wise, gender-wise and group-wise distribution of subjects is given in Table 1.

From Table 1, it is evident that the 159 subjects from four Schools namely, Jawahar Navodaya Vidyalaya, Mana, Raipur (Chhattisgarh); Jawahar Navodaya Vidyalaya, Padmi, Mandla (M.P), Jawahar Navodaya Vidyalaya, Kurud, Dhamtari (Chhattisgarh) and Jawahar Navodaya Vidyalaya, Kanhiwada, Seoni (M.P) formed the Experimental group, while 157 from other four schools namely, Jawahar Navodaya Vidyalaya, Shahpur, Dindori (M.P); Jawahar Navodaya Vidyalaya, Borai, Durg (Chhattisgarh); Jawahar Navodaya Vidyalaya, Dongargarh, Rajnandgaon (Chhattisgarh) formed the Control group.

Further, out of 316 students, there were 180 boys and 136 girls. Students were from both urban and rural areas and belonged to different castes and economic status. The medium of instruction in all eight schools was

Table 1
School-wise, Gender-wise Sample

S. No.	Name of the School	Boys	Girls	Total
1.	Jawahar Navodaya Vidyalaya Mana, Raipur, Chhattisgarh	23	16	39
2.	Jawahar Navodaya Vidyalaya, Padmi, Mandla, Madhya Pradesh	25	15	40
3.	Jawahar Navodaya Vidyalaya, Kurud, Dhamtari, Chhattisgarh	20	20	40
4.	Jawahar Navodaya Vidyalaya, Kanhiwada, Seoni, Madhya Pradesh	20	20	40
5.	Jawahar Navodaya Vidyalaya, Shahpur, Dindori, Madhya Pradesh	23	14	37
6.	Jawahar Navodaya Vidyalaya, Borai, Durg, Chhattisgarh	21	19	40
7.	Jawahar Navodaya Vidyalaya, Dongargarh, Rajnandgaon, Chhattisgarh	26	14	40
8.	Jawahar Navodaya Vidyalaya, Bargi, Jabalpur, Madhya Pradesh	22	18	40
Total		180	136	316

English. The mathematics syllabus was similar in all schools.

Experimental Design

The present study was experimental in nature. The study was designed on the basis of pre-test and post-test Control group design. As per Campbell and Stenley (1963), the layout of this design is given below:

R O X O
R O O

R = Random selection of sample
O = Observation
X = Treatment

As mentioned, under sample from each selected school 40 students of Class IX were selected randomly. From four schools, 160 students were assigned the treatment. The group receiving the treatment was called Experimental. From four other schools, 160 students were selected randomly for Control group, but four students of two schools dropped out during the course of treatment. Finally, 159 students from four schools formed the Experimental group and the other 157 from four other schools formed the Control group. Before starting the experiment, the achievement test developed by the investigator was administered to the students of both Experimental and Control groups. This constituted the pre-achievement scores. The Experimental group was taught some chapters of mathematics through Web-based Instruction. When the students of the Experimental group were undergoing the treatment, those in the Control group were engaged in regular activities in class. The treatment lasted four months. At the end of the treatment, the same achievement test, which was to be administered before the treatment, was administered separately to the students of both Experimental and Control groups.

Tools

The researcher validates the achievement test in mathematics based on Web-based Instructional material. For the establishment of validity of the achievement test, content validity method was used. This achievement test consisted of

Table 2
Action Plan

S. No.	Process	Duration
1.	Pre-test	60 Minutes
2.	Treatment	4 Months
3.	Assessment of Intelligence	60 Minutes
4.	Post-test	60 Minutes
5.	Assessment of Reaction Towards Web–Based Instructional Material	40 Minutes

short answer and objective-type questions. This test comprised 30 questions related to a few topics of mathematics. Each objective-type question had four alternatives, in which one option was true and others were flase. For each correct answer of a short answer type question, 4 marks were given, while 1 mark was given for correct answer of each objective-type question. Thus, the total marks were 60. The maximum time limit for this achievement test was one hour.

Content validity involves essentially the systematic examination of contents of the achievement test to determine whether it covers a representative content of the achievement to be measured. The content validity of the achievement test was established by having a discussion with five experts from the field of mathematics and three from the field of methods of teaching mathematics. On the basis of expert's opinion, the achievement test was found to be valid.

Data Analysis

The objective-wise data analysis techniques used are given below:-

1. One-way-ANCOVA was used for comparing the adjusted mean score of achievement in mathematics of Experimental and Control groups by considering pre-achievement in mathematics as co-variate.
2. Two-way ANCOVA was used for studying the effect of treatment, economic status and their interaction on achievement in mathematics by considering pre-achievement in mathematics as co-variate.

Result and Discussion

(a) Comparison of the adjusted mean scores of achievement in mathematics of Experimental and Control groups by considering pre-achievement in Mathematics as co-variate.

The third objective was 'Comparison of the adjusted mean scores of achievement in mathematics of Experimental and Control group by considering pre-achievement in mathematics as co-variate. Experimental group and Control group compared the adjusted mean scores of achievement in mathematics, so data were analysed with the help of one-way ANCOVA. The results are given in Table 3.

Table 3
Summary of One-Way-ANCOVA of Achievement in Mathematics of Class IX Students

Source of Variance	df	SSy.x	MSSy.x	Fy.x	Remark
Group	1	428.207	428.207	9.871	p< 0.01
Error	313	13578.321	43.381		
Total	315				

Table 4
Group-Wise Mean, Standard Error and Number of Students

Group	Mean	Standard Error	Number
Experimental	46.66	0.597	159
Control	44.065	0.556	157

Table 3 shows the adjusted F-value for treatment with df = 1/313 is 9.871, which is significant at 0.01 level of significance. It indicates that the adjusted mean score of achievement in mathematics of Experimental and Control groups by considering pre-achievement in mathematics as co-variate differ significantly. Hence, the null hypothesis that there is no significant difference between adjusted mean scores of achievement in mathematics of Experimental and Control groups by considering pre-achievement in mathematics as 'co-variate' is rejected. Further, as shown in Table 4, the adjusted mean score of achievement in mathematics of Experimental group is 46.66, which is significantly higher than that of traditional method group, whose adjusted mean score of achievement is 44.065. It may, therefore, be concluded that the adjusted mean score of achievement in mathematics of WbI group is significantly higher than that of traditional method group when the groups were matched with respect to pre-achievement in mathematics.

(b) Study of the effect of treatment, economic status and their interaction on achievement in mathematics by considering pre-achievement in mathematics as co-variate.

The seventh objective was to study the effect of treatment, economic status and their interaction on achievement in mathematics by considering pre-achievement in the subject as co-variate. The data were analysed with the help of 2×3 factoral design ANCOVA. The results are given in Table 5.

Table 5
Summary of 2×3 Factoral Design ANCOVA of Treatment, Economic Status and their interaction on Achievement in Mathematics by considering Pre-achievement in Mathematics as co-variate

Source of Variance	df	SSy.x	MSSy..x	Fy.x	Remark
Treatment	1	397.824	397.824	9.08	p< 0.01
Economic Status	2	11.835	5.92	0.135	p>0.05
Treatment Economic Status	2	26.006	13.003	0.297	P>0.05
Error	309	13.540	43.822		
Total	315				

Table 6
Group-wise Mean, Standard Error and Number of Students

	Levels	Number	Mean	Standard Error
Group	Experimental	159	46.548	0.600
	Control	157	43.953	0.617
Economic Status	High	48	45.518	0.491
	Middle	86	45.195	0.722
	Low	182	45.038	0.960

The result with respect to the effect of treatment on achievement in mathematics by considering pre-achievement in mathematics as co-variate is same.

Further, from Table 5 it is evident that the adjusted F-value for economic status is 0.135 with df= 2,309, which is not significant at 0.05 level of significance. It means that the adjusted mean score of achievement in mathematics of low, middle and high economic status group students did not differ significantly when pre-achievement in mathematics was taken as co-variate. So, there was no significant effect of economic status on achievement in mathematics by considering pre-achievement in mathematics as co-variate. Therefore, the null hypothesis that there is no significant effect of economic status on achievement in mathematics by considering pre-achievement in mathematics as a co-variate is not rejected. It may, therefore, be concluded that achievement in mathematics is independent of economic status when the groups were matched with respect to pre-achievement in mathematics.

The adjusted F-value for the interaction between treatment and economic status as obtained from Table 5 is 0.297 with df = 2/309 which is not significant at 0.05 level of significance. Therefore, the null hypothesis that there is no significant effect of interaction between treatment and economic status on achievement in mathematics by considering pre-achievement in mathematics as co-variate is not rejected. It can thus be concluded that there is no significant effect of interaction between treatment and economic status when the groups were matched with respect to pre-achievement in mathematics.

Findings

1. The adjusted mean score of achieve-ment in mathematics of WBI group is significantly higher than that of traditional method group when the groups were matched with respect to pre-achievement in mathematics.
2. Achievement in mathematics is independent of economic status when the groups are matched with respect to pre-achievement in mathematics.

3. There is no significant effect of interaction between treatment and economic status when the groups were matched with respect to pre-achievement in mathematics.

Educational Implications

The present study is related to Web-based Instruction. The study revealed that the Web-based Instruction was found effective in terms of achievement and reaction. The findings of the study have implications on students, teachers, administrators and society. The implication in case of each one of them is given under separate headings here under.

1. Students

In the formal education system, the topics have to be studied by students on that specific day, in that specific classroom and term. The topics and subjects cannot be studied on a different day or place. The students have to be in the specified classroom in that term and time (Arslan, 2002, p.34). On the other hand, Web-based Instruction frees students from space and time. In such a setting, students are to follow the instructional content at their own learning pace and needs (Thrasher et al., 2012). A finding of the present study shows that the achievement of WBI group is significantly higher than that of traditional method group. The results also show that students enjoy reading and learning through WBI method. Other results of the study show that the effects of other factors (i.e., gender, caste, residential background, economic status, etc.) on achievement were not significant. Therefore, we can say that the WBI method is more beneficial for all students.

2. Teachers

The present study will help teachers to understand the characteristics of WbI and its development. It will also help teachers to use WbI in the teaching-learning process and research.

3. Administrators

Students Gross Enrollment Ratio (GER) in secondary school in 2012 is 68.51 per cent (World Bank, 2011) and India's GER in higher education is 17.87 per cent, which is the lowest in the world (UGC, 17 September 2012). The aim of the Ministry of Higher Education, Government of India, is to expand the higher education sector in all modes of delivery to increase the GER in higher education to 15 per cent by 2011–12, 21 per cent by 2016–17 and 30 per cent by 2020 (Ministry of Human Resource Development, Government of India, 2012). The right to education, one of the basic rights as stated in national and international agreements, cannot be sufficiently provided to all students. There is a huge demand, though the supply is relatively insufficient.

In India, only 17.51 per cent of the students whose age is suitable for higher education are able to receive a university degree (UGC, 2012). This

forces universities to find additional resources and generate alternative solutions. It is widely accepted by almost all that traditional educational institutions are insufficient in offering education to the increasing population. As a consequence, this has initiated search for ways of providing quality education in an economic way, on a variety of topics, and to a wider audience. The solution to meet this demand is Web-based Instruction (Erdogan, 2005) because Web-based Instruction can reach a large number of students, which cannot be imagined in traditional approaches (Karasar, 1999, p.135, Thrasher et al., 2012).

4. Society

Further, some of the costs of classical instruction are reduced in web-based method. When there is a sufficient number of students, Web-based Instruction is estimated to cost 40 to 60 per cent less than classical instruction (Hall, 1999). Two-thirds of the cost in classical education are spent against transportation and facility rents (Horton, 2000, p.20). Likewise, the students' time spent on transportation and their being away from production can also be considered as economic cost. When the above points are taken into consideration, it could be claimed that it would cost less to deliver web-based instruction (Thrasher et al., 2012).

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