Effectiveness of Electronic Classroom For Teaching General Science at Secondary School Level

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This paper is based on a research to understand the effectiveness of a new teaching methodology i.e. an 'Electronic Classroom' adopted by the teachers in a school for teaching General Science. In this study, a Students Questionnaire on Effectiveness of Electronic Classroom (SQEEC) was developed and validated on a selected sample of students from a secondary school where this technology has been introduced and implemented for teaching and learning. The paper provides the background information related to the setup of an electronic classroom and its importance in the teaching of General Science. SQEEC was found to be a reliable and valid tool for assessing the effectiveness of the electronic classroom. Results of the study show that the electronic classroom as a methodology was found to be effective for teaching General Science in terms of improved achievement levels of the students and on the basis of their grade and age levels. However, no significant differences were found to exist between different groups of students on the basis of their gender.

Keywords: Effectiveness of Electronic Classroom, Technology in Teaching General Science.

Introduction

Technology has been aptly described as a tool for the extension and enhancement of sensory organs of human beings (McLuhan, nd). Historically, humans have used a wide range of technologies over time to communicate between themselves. Technologies such as writing, printing, telegraphy, radio, film, television and computers have enabled improved communications and have become a normal component of daily educational situations in most of the institutions of the developed as well as developing nations. In the late 20th century, the rapid development of computers and their use in schools provided an opportunity to implement computer-mediated education. The 21st century has seen the growth of a range of such applications of modern information technologies in schools, including presentations, simulation games, materials delivered over Internet etc. In addition, a number of companies and educational content developers have launched various forms of software and hardware solutions, which can be used both inside and outside

of a classroom. For example, classrooms equipped with computers, televisions, multimedia players provide support to today's teachers to easily explain complex concepts in all subjects including science. Today, virtual or online schools have come up in which some or all of the educational content is delivered by computer to more geographically distant learners. Now content matter can be accessed from all classrooms from a central location inside a school premises through networking. To illustrate, in a science class it is now possible for a teacher to even demonstrate the dissection through a large screen display system. In some cases, where students are unable to attend school, a student may work on a virtual frog at home without any face-to-face contact with a teacher or peers.

In India, technology has been identified as a useful tool in the hands of a teacher to teach complex concepts as in the case of science teaching by National Council for Educational Research (NCERT, 2006) and National Knowledge Commission (NKC, 2007). It can potentially help in overhauling of science teaching in Indian schools (Padma, 2005).

At present, several terms are being used for describing the technology inside a classroom. Terms like: Technology Integrated Classrooms; Technology Supported Classrooms; ICT Enabled Classroom; Technology Enriched Classrooms; Wired Classroom and Moodle (Riordan, 2008). All convey similar meaning. For the purpose of this study such classrooms are being referred to as 'Electronic Classrooms'.

Theoretical Background

Over years, teaching and learning have occurred in a variety of environments, ranging from home tutoring, to outdoor education, to the "traditional" classroom with blackboard and chalk, to the computerized classroom, also known as the electronic classroom. Each of these environments offers a unique perspective on learning and each has been found to be a valid forum for education. However, as we move into the 21st century, we find ourselves equipped with an abundance of computerized tools including electronic classroom, which are available for education, and these are found to be very useful under the present conditions.

The term “electronic classroom” carries with it a variety of meanings. It has been used to indicate a separate room, which is equipped with electronic devices for instructional purposes. In other words, it is a room with computers and multimedia devices. In a broad sense an electronic classroom environment is capable of supporting the process of teaching and learning in a classroom. But to provide such an environment the electronic classroom must have some combination of the following elements: a computer workstation for the instructor; a multimedia system capable of presenting a variety of

information (e.g., text, graphics, animation, audio, and video); a database of educational materials within the classroom, a computer workstation for each student; a local area network that allows communication among all of the workstations, and an arrangement for viewing and sharing of screen images; a system that provides storage, sharing, and transfer of documents; a telecommunications system to link the classroom to external educational resources (Hiltz, 1994 as cited in Suanpang et al, 2004). The multimedia configuration in the electronic classroom is a collection of computers and audio-visual equipment, often coordinated by one or two control panels. This setup allows the instructor an opportunity to use various devices to present information to the students. It also provides the students with many different ways to learn. By using different modalities (audio/visual) to process information, students are likely to better retain and recall that information. Shneiderman (1992, as cited in Alonso, 1996) offers that the term multimedia "suggests the use of a more than text-only applications, especially sound and video".

In developing countries like ours, major stakeholders in education need to take more decisions and steps towards the development of advance level electronic classrooms. As, one way of taking many of the advantages of the "traditional" classroom and adding the benefit of the computer technology, is to create a classroom environment that allows instructors to use computers to enhance their delivery of content, therefore, in the present study a feasible and cost effective system was created and established by upgrading the traditional system of teaching inside a classroom. Electronic classrooms, which provide students and instructors with this great opportunity, are currently operating and have been met with generally favourable reviews (Norman & Carter, 1992; Slatin, 1992).

Review of Literature

Siemens and Tittenberger (2009) in the Handbook of Emerging Technologies mentioned that to measure the effectiveness of technology use in teaching and learning process one has to answer questions like; "How do we measure effectiveness? Is it time spent in a classroom? Is it a function of test scores? Is it about learning or understanding?" A lot of research has been conducted on how modalities, distance, and models of education influence the quality of learning.

Bialo and Sivin (1995) reported about the effectiveness of science education; Bayrakter (2002) reported the effectiveness of Computer Assisted Instruction (CAI); Butler and Wiebe (2003) reported about technology based science lessons.

Enigo (1997) undertook a study relating to the effectiveness of instructor controlled interactive video (ICIV) and conventional non-interactive video. The researcher found that instructor controlled interactive video was more effective than the lecture method and conventional non-interactive video.

Livingston (2008) differentiated between three types of Wired Classrooms with reference to technology-enhanced classrooms; a) the hands-on electronic classroom (with a computer at every seat); b) the electronic lecture hall (with one instructor's machine plus projection); c) the networked classroom (with a network drop for the instructor's laptop or personal computer).

Riordan (2008) has given the concept of 'Moodle: An electronic classroom'. 'Moodle' is the name of a program that allows the classroom to extend onto the web. This program allows a common place for students to go for many classroom resources. Using 'Moodle', one can post news items, assign and collect assignments, post electronic journals and resources, and more.

It is quite clear from these research studies that electronic classroom can be conceived as a classroom equipped with latest technologies used both inside and outside a classroom though network. It can be an Italian Electronic Classroom (1981): a project aimed at providing free online useful information technology or an Integrated Classroom, or an Electronic Classroom of Tomorrow (ECOT, 2000) which is an online public community school sponsored by Lucas County (Ohio) Educational Service Centre or Blackstock School (2009), a classroom with an interactive learning environment, or an electronic library, or Technology Supported Classroom, ICT Enabled Classroom, Technology Enriched Classroom, Wired Classroom. All these are actually the advancements of the classroom equipped with audio visual aids in earlier times.

It can also be seen that current and emerging educational technologies have the potential to provide a platform for experimentation in teaching learning. Studies have shown that there are mostly favourable results for our teachers/learners while they teach/learn in the classroom.

For increasing the technology utilization in India, several initiatives have been taken by authorities for the introduction of technologies to make the teaching learning process more effective at different levels. These include CLASS Project (1984-85), Digitising the Black Board project (2000), Virtual Classroom Technology on EDUSAT for Rural Schools (ViCTERS, 2001), starting "EKLAVYA" channel (2003), "Vidya Vahini - "Intra-net and internet

for schools" Pilot Project (2003), an exclusive educational channel for Kerala, provision of Technology intrusion through National Curriculum Framework (NCF, 2005), Launch of Sakshat: National Mission on Education through Information and Communication Technology (NMEICT, 2009) and so on.

Therefore, in the present study the author would study the effectiveness of electronic classroom in a school where technology is integrated as a tool of teaching General Science. In this study, the effectiveness was defined as the impact of different media combined for delivery of content by the teachers through the electronic classroom technique as perceived by the students for learning General Science at the secondary school level.

OBJECTIVES OF THE STUDY

Following are the objectives of the study :

i. To integrate electronic classroom as a technology in science classrooms.
ii. To develop and statistically validate a tool to measure effectiveness of electronic classroom for teaching General Science at secondary school level.
iii. To study the effectiveness of electronic classroom in terms of achievement, age, gender and grade of the students while learning General Science.
iv. To study the effectiveness of electronic classroom in terms of technological background of the students.

METHODOLOGY

This study was conducted through survey (questionnaire) methodology. The entire group of students studying in the 7th, 8th and 9th grades in an English medium urban secondary school were involved in the survey. The sample for the present study consisted of 250 students (143 boys and 107 girls) in the age group of 11 to 14 years respectively. This study was accomplished in four major steps viz. a) establishment and implementation of electronic classroom, b) training of teachers, c) developing a tool to measure the effectiveness and d) administering the tool for the purpose of data collection and analysis of data.

Establishment and Implementation of Electronic Classroom as a Tool of Teaching

Before the final form of the electronic classroom was set up and made functional for teaching/ learning General Science in the experimental school, a number of settings/modes were tested and various trials were carried out. Out of all modes (Closed circuit television, cable television mode, computer

assisted instructions-CAI, computer connected with large screen television), the most workable and feasible mode that was achieved during this study was a type of integrated system. This integrated system was a combination of all the technologies, which were present in the institution. After conducting a number of field trials and implementation of digital content matter, the ultimate design of the electronic classroom that was finalized consisted of mainly two outputs in form of coaxial and digital signals were generated and transmitted from the control room known as the knowledge centre. This control room was facilitated with a server, two computers and four channels for video lectures and programmes. The signals generated from the control room were transmitted through a local area network, which had been created in all the classrooms of the school. In every classroom, the display systems were made available to receive both types of signals. This display system consisted of mainly the large screen television, a computer, projector, backup power supply and other network devices etc.

Along with the development, teachers were also trained according to a schedule and these trainings were conducted inside and outside of the campus of the school selected for the study. Most of the staff involved in the project received training from the companies, which were providing the hardware or software. For content, the experts from the subjects and languages were asked for conducting the training of the teachers and the staff involved in the content development.

Main reason for the success and acceptability of this system was the availability of most of the ICT tools for teaching inside a classroom. These software and hardware tools equipped and supported the teachers to teach with full confidence and made their teaching much easy than the conventional methods. They were flexible to use any technology according to their timetable and topic to be taught. Therefore, it was decided to implement this system in the actual teaching learning classroom environment. First, it was tested by all the experts and then by teachers. Some trial sessions were also carried out separately in absence of students, so that teacher may feel comfortable in the classroom teaching. This was followed by working out a plan and schedule for the electronic classroom sessions. Teachers were asked to map the content to be taught in a particular class according to the syllabus and prepare a modified time table showing the period to be taken through electronic classroom. All the teachers submitted the electronic classroom timetable to the concerned incharge and a final timetable was prepared for the conduct of the classes to be taken by teachers during this research study. Hence, this timetable was followed by the teachers throughout the period of this study. Overall, the

functioning of electronic classroom was found to be satisfactory.

Measuring the Effectiveness of Electronic Classroom

Keeping in view the main purpose of the study, an in depth review was done and it was found that a majority of tools developed have either been used in studying effect/impact of the type of technology utilized or for the effectiveness of learning material/ content and methodology of delivery of the content. Therefore, majority of the statements drafted in the tool belong to direct opinions of the students regarding the use of technology by the teacher and other factor related to technology inside a classroom.

A 22 items questionnaire entitled 'Students Questionnaire on Effectiveness of Electronic Classroom' (SQEEC) was prepared to evaluate the impact of electronic classroom. This questionnaire consisted of four scales namely Interest (five items), Comprehension (six items), Freedom to Learn (five items) and Enthusiasm (six items). This questionnaire was mainly developed on the model of TROFLEI (Technology Rich Outcome Focused Learning Environment Inventory); which was earlier designed and standardized by Fraser, Dorman and Aldridge in 2004. The subjects were asked to respond using a five-point scale (almost never, seldom, sometimes, often and almost always). A score of 1 represented the option "almost never" while a score of 5 on the scale represented the category "almost always".

First, a rough draft was developed by the investigator which was subjected to reading and approval of the experts in the field of technology in education at different levels. The instrument was improved in the light of the feedback from these experts including the experts in language and psychological testing.

The final draft of the instrument consisted of three parts. The first part comprised of 22 statements related to electronic classroom and the instructions for filling up the modified Likert-type response options. The second part focused on the demographic information about students including class, section, roll number, gender, age, subject, school name etc. The last part consisted of 10 questions related to technology integration in the day to day activities of the students which were considered as back ground variables for the study.

Data Analysis

Following the administration of the questionnaire, the items were scored by the researcher. Students' demographics were tabulated and analysed to determine whether there was a difference in the mean scores of the students belonging to different groups on the basis of their age, gender and grade. Data collected from the students were subjected to correlation, independent sample

t-test and one-way analysis of variance (ANOVA) using the SPSS software.

RESULTS

Results obtained from data analysis have been categorized and presented here according to the reliability and validity of the tool, achievement level, gender, class, age and other background variables respectively.

RELIABILITY AND VALIDITY OF THE TOOL

After administering the 'Students' Questionnaire on Effectiveness of Electronic Classroom' to the students, data were subjected to analysis for its reliability and validity. Prior to the reliability, to know the relationship of various items with in this scale, inter- scale correlations were calculated for all the scales of the questionnaire. These coefficients showed a satisfactory value of convergent validity among all the scales and these values were found to be significant beyond 0.01 level.

Table 1

Inter Scale Correlations for Students' Questionnaire on Effectiveness of Electronic Classroom (SQEEC)

Scales	Interest	Comprehension	Enthusiasm	Freedom to Learn
Interest	1	0.53(**)	0.45(**)	0.42(**)
Comprehension			0.51(**)	0.53(**)
Enthusiasm				0.42(**)

***Significant at 0.01 level*

To establish the internal consistency of the questionnaire its reliability was determined. Results obtained are presented in Table 2.

Table 2

Internal Consistency (Cronbach Alpha) Coefficient for Students' Questionnaire on Effectiveness of Electronic Classroom (SQEEC)

Scale Name	No. of Items	Alpha Reliability
Interest	5	0.65
Comprehension	6	0.68
Freedom to Learn	5	0.58
Enthusiasm	6	0.61
Overall	22	0.84

n=250

The results in Table 2 show that reliability for the scale 'Interest' is 0.65, for 'Comprehension' is 0.78, for 'Freedom to Learn' is 0.58 and for 'Enthusiasm' is

0.61. The reliability results of the all scales of the questionnaire were above 0.50. Also, the overall reliability value for Cronbach Alpha Coefficient is 0.84. This suggested that Students Questionnaire on Effectiveness of Electronic Classroom (SQEEC) could be used as a reliable tool (De Vellis, 1991) in the classroom situation to study the effectiveness of electronic classroom as a technology in teaching General Science.

The data obtained from the students through SQEEC were further analysed to determine whether there was a significance differences between the mean scores of the students in their achievement in General Science and on the basis of their age, gender and grade. Data collected from the students were subjected to independent sample t-test and one-way analysis of variance (ANOVA).

Effectiveness by Achievement

In order to examine the achievement levels of the students in General Science, a teacher made test was administered on the different units of General Science, which were taught through the conventional classroom methodology and electronic classroom technique. The t-test for independent samples was used to investigate if significant differences exist in the achievement levels of the students being taught using the two methodologies. The results obtained have been presented in Table 3.

Table 3

Significance of Difference between the Mean Achievement Scores in General Science Obtained by Students of Different Classes Before and After Studying through Electronic Classroom

Class	Variable	Mean	N	SD	*t*
7th	Before	58.47	90	10.29	4.44**
	After	62.85	90	5.09	
8th	Before	49.45	70	14.78	8.92**
	After	62.60	70	4.72	
9th	Before	61.44	90	24.58	14.92**
	After	97.01	90	6.34	
All	Before	57.02	250	18.39	13.59**
	After	75.08	250	17.37	

***Significant at 0.01 level*

The results in Table 3 show that at the 7th , 8th and the 9th grade level the achievement of the students was found to be significantly higher when General Science was taught to them through electronic classroom technique.

All the values of t i.e. 4.44, 8.92 and 14.92 were found to be significant at 0.01 level of significance. The results also reveal that the mean achievement in General Science of the combined group was also significantly higher in the post-test as compared to pre-test. The t-value (13.59) was found to be significant at 0.01 level of significance.

The obtained results clearly show that the achievement level of secondary school students learning General Science through electronic classroom technique are significantly higher as compared to when they were learning General Science through conventional classroom teaching methodology. The obtained results yield clear evidence that using electronic classroom technique to teach General Science at the secondary level in Indian schools enhances the achievement level of the students studying in 7th, 8th and 9th grades respectively.

Effectiveness by Age

One-way analysis of variance (ANOVA) technique was employed to know the significance of difference between scores obtained on effectiveness between groups formed on the basis of their age. The results are shown in the Table 3.

Table 4

Summary of Analysis of Variance Showing Group Differences Among Students of Different Age Levels on Students Questionnaire on Effectiveness of Electronic Classroom (SQEEC)

Effectiveness	Age	N	Mean	S D	F
Interest	11	40	22.78	2.19	4.87**
	12	65	21.58	3.24	
	13	84	21.30	2.82	
	14	61	20.57	2.90	
Comprehension	11	40	26.08	3.33	3.55*
	12	65	24.97	3.29	
	13	84	24.43	4.10	
	14	61	24.66	3.71	
Enthusiasm	11	40	27.13	3.37	2.12
	12	65	26.03	3.35	
	13	84	25.93	2.92	
	14	61	25.66	2.32	
Freedom to Learn	11	40	22.35	2.40	4.36**
	12	65	22.11	2.88	
	13	84	20.64	3.50	

Table 4 contd.....

Effectiveness	Age	N	Mean	S D	F
Overall Effectiveness	11	40	98.33	9.31	4.91**
	12	65	94.69	9.76	
	13	84	92.31	11.39	
	14	61	90.98	9.35	

** Significant at 0.05 level **Significant at 0.01 level*

Table 4 shows the significant differences among students belonging to 11, 12, 13 and 14 years of age on different scales of SQEEC as well as on overall effectiveness. Results reveal that three out of four scales of the SQEEC are significantly different i.e. Interest, Comprehension and Freedom to Learn. However, no significant differences were observed among the students of age 11, 12, 13, and 14 years of age on the Enthusiasm scale. This means that significant differences do exist among students belonging to different age levels with respect to effectiveness. In order to explain as to which subgroup significantly excel the other subgroups, the significance of differences were computed by determining multiple comparisons by Least Significance Difference (LSD) t-test as presented in Table 5.

Table 5

Multiple Comparisons Showing Group Differences Among Students of Different Age Levels on Students' Questionnaire on Effectiveness of Electronic Classroom, SQEEC (LSD)

Dependent Variable	(I) Age	(J) Age	Mean Difference (I-J)	Std. Error
Interest	11	12	1.19*	0.58
		13	1.47*	0.55
		14	2.20**	0.58
	12	13	0.28	0.47
		14	1.01	0.51
	13	14	0.74	0.48
Comprehension	11	12	1.11	0.74
		13	1.65*	0.70
		14	2.34**	0.74
	12	13	0.54	0.60
		14	1.23	0.65
	13	14	0.69	0.62
Enthusiasm	11	12	1.09	0.60
		13	1.20*	0.57
		14	1.47*	0.61
	12	13	0.10	0.49
		14	0.38	0.53
	13	14	0.27	0.50

Table 5 contd.....

Dependent Variable	(I) Age	(J) Age	Mean Difference (I-J)	Std. Error
Freedom to Learn	11	12	0.24	0.62
		13	1.71*	0.60
		14	1.33*	0.63
	12	13	1.46*	0.51
		14	1.09	0.55
	14	13	0.37	0.52
Overall Effectiveness	11	12	3.63	2.05
		13	6.02**	1.96
		14	7.34**	2.07
	12	13	2.38	1.68
		14	3.71*	1.81
	13	14	1.33	1.71

** Significant at 0 .05 level.*

***Significant at 0 .01 level.*

The analysis of results as shown in Table 5 reveal that:

i. Students aged 11 years have been found to exhibit significantly higher scores on the scale of 'Interest' as compared to their counterparts aged 14, 13 and 12 years respectively.

ii. Students aged 11 years have been found to exhibit significantly higher scores on scale 'Comprehension' as compared to their counterparts aged 14, 13 and 12 years respectively.

iii. Students aged 11 years have been found to exhibit significantly higher scores on scale 'Enthusiasm' as compared to their counterparts aged 14, 13 and 12 years respectively.

iv. Students aged 11 years have been found to exhibit significantly higher scores on scale 'Freedom to learn' as compared to their counterparts aged 14, 13 and 12 years respectively.

v. Students aged 11 years have been found to exhibit significantly higher scores on overall effectiveness scores as compared to their counterparts aged 14, 13 and 12 years respectively.

Thus, mean scores obtained by students of age 11 years were found to be significantly higher than the students of age 14, 13 and 12 years respectively when General Science was taught to them through electronic classroom technique. Therefore, it may be concluded that significant differences do exist among the students of different age groups with respect to perceived effectiveness of electronic classroom as the younger group have shown more interest, comprehension, enthusiasm and freedom to learn and an overall

willingness in studying General Science through electronic classroom as compared to students of other age groups.

Effectiveness by Gender

An independent samples t-test was applied to know the significance of differences between the mean scores obtained on the effectiveness with respect to the gender. The results are shown in Table 6.

Table 6
Means, SD's and t-Value for Gender Differences as Measured by the Students' Questionnaire on Effectiveness of Electronic Classroom (SQEEC)

Effectiveness	Gender	N	Mean	SD	*t*
Interest	Male	143	21.43	2.94	0.05
	Female	107	21.45	2.93	
Comprehension	Male	143	24.76	3.44	0.48
	Female	107	24.53	4.06	
Enthusiasm	Male	143	25.99	2.72	0.57
	Female	107	26.21	3.36	
Freedom to Learn	Male	143	21.38	2.97	0.06
	Female	107	21.40	3.36	
Overall Effectiveness	Male	143	93.55	9.16	0.02
	Female	107	93.58	11.93	

Results of Table 6 reveal that no significant differences exist in the mean scores of boys and girls on all the scales of SQEEC and on overall Effectiveness of using electronic classroom for teaching General Science. It may be indicated that both boys and girls have equally perceived the learning through electronic classroom technique as highly interesting because of high mean scores.

Effectiveness by Class

One-way analysis of variance technique (ANOVA) was applied to know the significance of difference between means on the effectiveness of Electronic Classroom technique for teaching General Science. The ANOVA test results have been given in Table 7.

Table 7

Summary of Analysis of Variance Showing Group Differences Between the 7th, 8th and 9th Class Students on Students' Questionnaire on Effectiveness of Electronic Classroom (SQEEC)

Effectiveness	Class	N	Mean	SD	F
Interest	7	90	21.79	2.98	9.10**
	8	70	22.25	2.44	
	9	90	20.44	2.97	
Comprehension	7	90	25.30	2.91	9.39**
	8	70	25.53	4.09	
	9	90	23.35	3.79	
Enthusiasm	7	90	26.50	3.18	3.14*
	8	70	26.34	3.16	
	9	90	25.46	2.61	
Freedom to Learn	7	90	21.84	2.86	8.08**
	8	70	22.13	2.92	
	9	90	20.36	3.39	
Overall Effectiveness	7	90	95.43	9.09	11.10**
	8	70	96.26	10.37	
	9	90	89.61	10.61	

**Significant at 0.05 level*

***Significant at 0.01 level*

Table 7 shows the significance of difference between scores obtained on different scales of effectiveness as well as on overall effectiveness by the students of classes 7th, 8th and 9th. An analysis of results revealed that 'F' ratios calculated for all scales and for overall effectiveness were found to be significant beyond 0.05 level. This means that significant differences do exist among students belonging to classes 7th, 8th and 9th with respect to effectiveness of Electronic Classroom technique for teaching General Science.

In order to explain as to which subgroup significantly excels the other subgroups, the significance of differences were computed by determining multiple comparisons by Least Significance Difference (LSD) t-test. The results have been presented in Table 8.

Table 8

Multiple Comparisons Showing Group Differences Between the 7th, 8th and 9th Class Students on Students' Questionnaire on Effectiveness of Electronic Classroom, SQEEC (LSD)

Dependent Variable	(I) Class	(J) Class	Mean Difference (I-J)	Std. Error
Interest	7	9	1.34**	0.42
	8	7	0.47	0.45
		9	1.81**	0.45
Comprehension	7	9	1.94**	0.54
	8	7	0.23	0.57
		9	2.17**	0.57
Enthusiasm	7	8	0.16	0.48
		9	1.04*	0.44
	8	9	0.89	0.48
Freedom to Learn	7	9	1.49**	0.46
	8	7	0.28	0.49
		9	1.77**	0.49
Overall Effectiveness	7	9	5.82**	1.49
	8	7	0.82	1.60
		9	6.65**	1.60

** Significant at 0.05 level.*

*** Significant at 0.01 level.*

The analysis of results as shown in Table 8 reveal that:

i. Students studying in class 8th have been found to exhibit significantly higher scores on scales 'Interest', 'Comprehension', and 'Freedom to Learn' and on overall effectiveness as compared to students of class 9th. However, no significance of difference between means has been found to exist between 8th and 9th class students on scores obtained on scale 'Enthusiasm'.

ii. Students studying in class 7th have been found to exhibit significantly higher scores on every scale viz. 'Interest', 'Comprehension', 'Enthusiasm' and 'Freedom to learn' and on overall effectiveness as compared to students of class 9th.

iii. No significant differences have been found to exist between the scores obtained by the students of class 7th and 8th on all scales of SQEEC.

Thus, mean scores obtained by students of class 8th were found to be significantly higher than the students of classes 7th and 9th when the General Science was taught to them through electronic classroom technique. Therefore, it may be implied that significant differences do exist among the students of different classes with respect to perceived effectiveness of

electronic classroom as the class 8th students have shown more interest, comprehension, freedom to learn and an overall willingness in studying through electronic classroom as compared to students of other classes.

The statistical analysis and findings of the quantitative analysis of results may lead to the conclusion that electronic classroom methodology for teaching General Science (as used in this study) is effective in the case of secondary school students, who have shown their willingness to study through this method in future also.

Effectiveness by Technological Background of the Students

In addition to the age, gender and grade, a possibility of the other influencing factors was also worked out by asking some questions as given in Table 9. Eight of the ten questions were designed to know the technological background of the students, one was related to coaching and last one attempted to know the impact of electronic classroom.

Table 9

Responses on Technological Background of the Students Obtained on Students' Questionnaire on Effectiveness of Electronic Classroom (SQEEC)

Q.No.	Statement	Yes (%)	No (%)
1	Does your family have computer/laptop at home?	149 (60%)	101 (40%)
2	Do you use your computer for school related work?	163 (65%)	87 (35%)
3	Do you have access to internet at home?	77 (28%)	173 (72%)
4	Do you watch programmes from Discovery, National Geographic and Animal Planet channels?	227 (91%)	23 (9%)
5	Do you use your mobile for consulting your teacher?	119 (48%)	131 (52%)
6	Do you watch the recorded lectures of your teacher in computer or television?	86 (34%)	164 (66%)
7	Does your family support you in studying through computer, television etc.?	218 (87%)	32 (13%)
8	Do you take Tuitions / attend extra tutorials?	164 (66%)	86 (34%)
9	Do you have educational / multimedia CD's for learning science at home?	175 (70%)	75 (30%)
10	Are you interested for studying through more electronic classes in future?	243 (97%)	7 (3%)

The results in the Table 9 show that more than 60% of the students use computers for school related work, use technological gadgets and watch educational programmes/CD's. Therefore, it is evident that the students are well verse with the technology in their day-to-day activities. However, very few of them have been found to have Internet facility and access to recorded

lectures etc. Table 9 also illustrates that in question no. 10 students have shown their will to study through this methodology inside a classroom.

Further, analysis of the data was carried out to know the effect of technology background of the students on effectiveness of electronic classroom technique for teaching General Science. The results from Independent samples t-Test between these two groups (Yes and No) are given in Table 10.

Table 10

Means, SD's and t-Value for Scores Obtained on SQEEC by Students on the Basis of their Technology Background

Total Effectiveness	Ans.	N	Mean	SD	Std. Error	*t*
Q1	Yes	149	93.73	10.90	0.89	1.10
	No	101	93.31	9.70	0.96	
Q2	Yes	163	94.26	10.72	0.84	0.36
	No	87	92.26	9.73	1.04	
Q3	Yes	77	94.58	10.71	1.22	0.81
	No	173	93.11	10.28	0.78	
Q4	Yes	227	93.71	10.25	0.68	1.35
	No	23	92.13	12.03	2.50	
Q5	Yes	119	95.54	9.42	0.86	2.67**
	No	131	91.77	10.97	0.95	
Q6	Yes	86	95.50	10.22	1.10	1.34
	No	164	92.55	10.40	0.81	
Q7	Yes	218	94.11	10.16	0.68	0.33
	No	32	89.81	11.49	2.03	
Q8	Yes	164	93.68	10.02	0.78	0.84
	No	86	93.33	11.18	1.20	
Q9	Yes	175	93.97	10.54	0.79	0.95
	No	75	92.62	10.11	1.16	
Q10	Yes	243	93.83	10.09	0.64	0.66
	No	7	84.42	17.05	6.44	

***Significant at 0.01 Level*

The results, as shown in Table 10, reveal that no significant differences exist between the two groups (Yes and No) formed on the basis of their answers to these questions except question no. 5, where, a significant difference exists in terms of using mobiles for consulting teacher.

Therefore, it was found that technological background has generally no

significant effect on the scores obtained on students' questionnaire on effectiveness of electronic classroom for teaching General Science.

Conclusion

It can be concluded that the present study has yielded valuable information regarding the effectiveness of the electronic classroom technique for teaching General Science to students studying in 7th, 8th and 9th classes. The effectiveness of electronic classroom technique was equally perceived to be (highly) effective by both male and female students who were involved in the study. The statistical analysis and findings lead to the conclusions that the tool Students Questionnaire on Effectiveness of Electronic Classroom (SQEEC) is a reliable tool under theses settings. Also, younger group of children especially the 11 year olds have shown more Interest, Comprehension, Enthusiasm and Freedom to learn and an overall willingness in studying through electronic classroom as compared to students of other age groups. Thus, the results show that electronic classroom as a teaching technology can improve teaching of General Science and bring about an increase in achievements levels of students under the above-mentioned conditions.

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