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Assessment of interest level towards Information and Communication Technology (ICT) integrated science teaching among secondary level school students

Dipti Mohanta[1*], Sudarshan Baral[2], Pradipta Ranjan Rauta[3]

[1]District Institute of Education & Training, Puri, Govt. of Odisha, College Road, Puri, Odisha 752001, India
[2]Department of Education, S.C.S. Autonomous College, Puri, Odisha, 752001, India
[3]Department of Biology, SIIR, New Delhi, India

[*]**Corresponding author** Email:**dipti.moon@gmail.com**

ABSTRACT

Information and Communication Technology (ICT) holds greater promise in enhancing science learning as well as in improving the quality of science education. So, the current research was sought to access the interest of secondary level school students towards ICT based science teaching based on the response toa self-designed questionnaire. The data analysis appeared to show high acceptability of attitudinal level of students towards ICT adoption for learning process and general usage. Descriptive statistical analysis indicated an overall positive response to the constructs as all means were above the midpoint. There was a significant and positive correlation between Exhilaration (EX) and Cognitive Support (CS) (r = 0.63); Cognitive Support (CS) and Detriment (DT) (r = 0.88); Exhilaration (EX) and Detriment (DT) (r = 0.57). The qualitative and quantitative analysis revealed that the level of students' attitude towards ICT in science teaching and learning was positive despite the challenges in its integration in public secondary schools.

Key words: ICT, science teaching, interest, secondary school, students

INTRODUCTION

The current generation students are being raised in a rapidly changing society due to continuous influx of new computer-based technologies that offer faster worldwide links to communication, commerce, and culture. There are many technological advances that have changed the world of education in the 21st century. Now a days, Information and communications technology (ICT) has become a popular component in everyone's life by playing a central role in education. The computers are being used in school since 1980s and now become an integral part of teaching and learning process. This is so because modern technology offers many means of improving teaching and learning in the classroom [1].The potential that ICTs have in supporting the school curriculum and education through the provision of effective communication opportunities for students and teachers have been reported [2].

ICT is a tool and a way to improve the pedagogy of teaching, building a more effective organizational structure in schools, stronger links between schools and the community, and empower students [3]. Both the teachers and students get numerous opportunities to efficiently work due to use of ICT in teaching and learning [4]. Most of the countries use ICT in education by doing routine tasks like retrieval of information from the internet. There are a lot of improvements on education system, school management, and construction of smart schools. In teaching science, ICT can be extremely useful. ICT tools like video demonstration and experimental simulations can replace in large part, expensive laboratory equipment and reagents. Again Virtual Reality (VR) Science labs eliminate the need for many safety restrictions and easily facilitate simulation experience of real world. Video clips can also provide a lively environment for many scientific process, concept and applications. The use of ICT is responsible for better understanding of practical events. So, it can inspire the students to learn science by keeping them engaged in (visual capture and stimulation) and participating in (researching, designing and presenting) classroom activities.

Science teachers are encouraged to plan learning activities that can provide opportunities to students for searching and analyzing information from multimedia resources and then solve the problems using simulations [5]. By realizing the

importance of ICTs in education, the educationists always focus on to detect the challenges in ICT integration into teaching in order to improve the quality of teaching. The integration of ICT does not essentially make science lessons fun, exciting and enjoyable as only 50% of the students preferred to use ICT in learning process and other 50% of the students preferred traditional classroom discussion [5].The definitive purpose of science teaching is to teach students by making science a part of their life activities. However, there is an ongoing trend to motivate the students to learn authentically and independently. This trend needs ICTs as infrastructure and cognitive support tools. The use of ICT forces the teachers to modify their usual traditional practices and even philosophies [6]. Depending on all of these factors involved in learning activities and expected learning outcomes, ICT can play various transformative and mediating roles in the learning atmosphere. It is increasingly accepted by researchers, educators and governments around the world that ICT presents many opportunities for teaching and learning in secondary education. In India, ICT can play a significant role in school education as highlighted in the national curriculum framework 2005 [7].

Hypothesis

ICT integrated science teaching among secondary level school students have positive impact on the learning process with high acceptability of interest level of students towards ICT adoption for learning process and general usage.

Objective

The current research was focused to access the interest level of secondary level school students (9^{th} class, 25 no.) towards ICT based science teaching based on the response to a self-designed questionnaire.

METHOD

Participants

A total of 25 students of class 9^{th} of from Govt. Girls High School, Puri, Odisha participated in this study.

Procedure

During science teaching, all the students were provided traditional instruction with a set of interspersed ICT-based lessons (video, PPT, digital photographs, use of internet, online mock test). Then, a survey was performed after ICT based science teaching to access the student's perception with existing teaching (status of ICT in quality science teaching-learning).

Tools

A self-designed attitude scale for students was used for the present study. The scale consisted of 26 statements (items), out of which 12 nos. were negative and 14 nos. were positive with a five point Likert type scale (1 to 5). The 26 statements were categorized into three dimensions (Sub- scale) such as cognitive support (9), detriment (12) and exhilaration (5). All the statements were mentioned in Table 1. This method was relevant to the study because it involved frequency of answers to the same questions by different respondents. The students (25 students available in the class) were asked to respond the questionnaire by putting tick mark against 5 options (strongly agree, agree, neutral, disagree and strongly disagree). Then, the collected responses were scored in 5 point scale (strongly agree: 5, agree: 4, neutral: 3, disagree: 2 and strongly disagree: 1 for positive statement; strongly disagree: 5, disagree: 4, neutral: 3, agree: 2 and strongly agree: 1 for negative statement).

Data analysis

Addressing the complexity of the various factors that impact students' intention to use ICT necessitates analysis of both quantitative and qualitative data to gain a more in-depth and comprehensive understanding of the data collected. The research design adopted in this study was descriptive survey. The data were drawn from both the quantitative and qualitative components of the questionnaire. The present questionnaire was developed to understand the student's perception about ICT based science teaching.

The data were analyzed qualitatively and quantitatively. After coding the student's response, the data were aggregated, arranged by common themes and the clustering of related themes (presented in plotted graphs) to be compared and contrasted in order to gain an insight into interest towards the use of ICT. The data were analyzed quantitatively by performing several statistical tests (i.e., mean, standard deviation, Cronbach's alpha and Pearson correlation coefficient).The coefficient of reliability of each construct was assessed using Cronbach's alpha. The coefficients of correlation were calculated to examine the correlation between different constructs.

Table 1. The questionnaire and rating scale to study the attitude of student's towards ICT integration in science class.

Sl No.	Statement	Dimension of Attitude scale	Rating score				
			Strongly agree	Agree	Neutral	Disagree	Strongly Disagree
1	ICT helps to create pleasant environment in science classes	Exhilaration	5	4	3	2	1
2	I like those teachers who use ICT in their classes	Exhilaration	5	4	3	2	1
3	I feel motivated and attentive in science classes	Exhilaration	5	4	3	2	1
4	I feel confident and less burdened while learning concepts through mobile apps/ learning apps	Exhilaration	5	4	3	2	1
5	ICT is a tool to understand 21st century science	Exhilaration	5	4	3	2	1
6	ICT helps to ask more questions	Cognitive Support	5	4	3	2	1
7	ICT very much helps to search information related to scientific facts and concepts	Cognitive Support	5	4	3	2	1
8	I like ICT as it is very useful to understand practical concept of science	Cognitive Support	5	4	3	2	1
9	I like to refer several e- resources to solve problems in science	Cognitive Support	5	4	3	2	1
10	I like ICT integrated science classes when complex concepts are to be indulged	Cognitive Support	5	4	3	2	1
11	ICT helps to prepare science projects	Cognitive Support	5	4	3	2	1
12	I feel bored in classes when teachers use lecture-method for teaching science	Cognitive Support	5	4	3	2	1
13	ICT helps me to complete my home-work faster	Cognitive Support	5	4	3	2	1
14	ICT helps to know hard spots in science content	Cognitive Support	5	4	3	2	1
15	ICT fosters ill- competition among students	Detriment	1	2	3	4	5
16	ICT has limited scope in teaching science	Detriment	1	2	3	4	5
17	I dislike my friends who uses to learn science through learning - apps	Detriment	1	2	3	4	5
18	I feel confused when lesson are taught within a simulated environment	Detriment	1	2	3	4	5
19	ICT reduces scope for hands - on activities in science	Detriment	1	2	3	4	5
20	ICT spreads fear among students	Detriment	1	2	3	4	5
21	ICT doesn't help students for examination	Detriment	1	2	3	4	5
22	ICT puts immense pressure on students	Detriment	1	2	3	4	5
23	ICT never enhances science achievement of students	Detriment	1	2	3	4	5
24	ICT resists teachers to explain contents within a stipulated time period	Detriment	1	2	3	4	5
25	ICT reduces the importance of books in learning.	Detriment	1	2	3	4	5
26	ICT should not be entertained in school because of having potential to make student mobile - addicted	Detriment	1	2	3	4	5

RESULTS AND DISCUSSIONS

ICT is a diverse set of technological tools and resources used to communicate, and manage information [8,9]. The implementation and use of ICT in schools can stimulate active, collaborative, and lifelong learning, increase students' motivation, offer better access to information and shared working resources, deepen understanding, help student think

and communicate creatively [10]. Learning through ICT is an active and engaged process, store, retrieves and transmits audio, video, graphics and textual information. These kinds of systems can have a powerful impact on the learner's problem solving abilities and can generate a positive effect. Previous studies have revealed that proper use of ICT can increase the educational quality in educational institutes and have positive impact on student's classroom performance [11–13]. ICT holds greater promise in enhancing science learning as well as in improving the quality of science education. ICT enables students get a live vision of life's aspect and scientific factors. This study was intended to identify the relationship between the Information and Communication Technology (ICT) use in science teaching and learning towards the interest of secondary school students in science subject.

Quantitative data analysis

Table 2 and Table 3 shows the level of interests towards the adoption of ICT in science teaching learning processes by displayed on personal responses based on mean, frequency and percentages. Table 2 above displays the secondary student's interest towards ICT during teaching science. From the general observation of the table above, it can be deduced that over 80% of the sample response are within the range of agree and strongly agreed. Similarly, above 60% student's response are within the range of strongly disagree and disagree in case of detriment category (negative statement). This appeared to show high acceptability of interest level of students towards ICT adoption for learning process and general usage. 0-32% (response range for different statements) of the respondents were totally clueless as to the impact of ICT tool and therefore, gave a neutral view on ICT impact towards their learning processes. 0-8% of the respondents in Table 2 above fall in the range of strongly disagreed and disagreed on the positive attitude and impact of ICT towards their entire learning process. This was proven as a result of low percentage and scores realized from the general evaluation of the student's interest towards ICT based science classes.

The descriptive statistics of the measurement items were shown in Table 2, Table 3 and Table 4. All participants available in the class (25 no.) answered the questions in the questionnaire. All means were above the midpoint of 3, ranging from 2.96±0.29 to 4.92±0.06.This indicates an overall positive response to the constructs that are measured in this study. The small standard deviation values ranged from 0.28 to 1.49, indicating a narrow spread of item scores around the mean. The skewness (from -3.298to 0.163) and kurtosis (from -1.512to 19.658) were all within the suggested cut-offs of absolute values less than 3 and 10 respectively[14], indicating univariate normality.

A closer examination revealed that 4 statements from the questionnaire have the highest rating (n= 30, Mean= 4.92, SD= 0.28) i.e. ICT helps to create pleasant environment in science classes (EX), I like those teachers who use ICT in their classes (EX), ICT helps to prepare science projects (CS) and ICT helps to know hard spots in science content (CS). Again, there was one statement with lowest rating (n=30, Mean= 2.96, SD= 1.46) i.e. ICT resists teachers to explain contents within a stipulated time period (DT).

The coefficient of reliability of each construct was assessed using Cronbach's alpha [15]. Cronbach's alpha is a measure of internal consistency (coefficient of reliability), that is, how closely related a set of items are as a group. It is considered to be a measure of scale reliability. It was recommended that a reliability coefficient (Cronbach's alpha value) of 0.70 or higher (less than 0.90) is regarded "acceptable" in social science research analysis. As mentioned in Table 4, Cronbach's alpha values of 3 dimensions i.e. EX (alpha= 0.69), CS (alpha= 0.73), DT (alpha= 0.72) are either nearly equal or above 0.7.

As shown in Table 4, there was a significant and positive correlation between Exhilaration (EX) and Cognitive Support (CS) ($r = 0.63$, $p < 0.05$). There was also a moderate positive correlation between Exhilaration (EX) and Detriment (DT) ($r = 0.57$, $p < .05$); strong and positive correlation between Cognitive Support (CS)and Detriment (DT)($r = 0.88$, $p < 0.05$). Similar correlation studies were also performed in other studies [16,17]. Again, The strengths of these correlations are considered large based on Cohen's (2013) suggestion of $r > 0.50$[18].

Table 2.Level of secondary students' attitude on the use of ICT tool.

Questionnaire		Strongly Disagree		Disagree		Neutral		Agree		Strongly Agree		Mean ± SD
		n	%	n	%	n	%	n	%	n	%	
1	ICT helps to create pleasant environment in science classes	0	0	0	0	0	0	2	8%	23	92%	4.92± 0.28
2	I like those teachers who use ICT in their classes	0	0	0	0	0	0	2	8%	23	92%	4.92± 0.28

3	I feel motivated and attentive in science classes	0	0	0	0	0	0	3	12%	22	88%	4.88± 0.33
4	I feel confident and less burdened while learning concepts through mobile apps/ learning apps	0	0	0	0	1	4%	6	24%	18	72%	4.68± 0.56
5	ICT is a tool to understand 21st century science	0	0	0	0	0	0	3	12%	22	88%	4.88± 0.33
6	ICT helps to ask more questions	0	0	0	0	1	4%	7	28%	17	68%	4.64± 0.57
7	ICT very much helps to search information related to scientific facts and concepts	0	0	0	0	0	0	3	12%	22	88%	4.88± 0.33
8	I like ICT as it is very useful to understand practical concept of science	0	0	0	0	1	4%	4	16%	20	80%	4.76± 0.52
9	I like to refer several e- resources to solve problems in science	0	0	0	0	0	0	3	12%	22	88%	4.88± 0.33
10	I like ICT integrated science classes when complex concepts are to be indulged	0	0	0	0	0	0	3	12%	22	88%	4.88± 0.33
11	ICT helps to prepare science projects	0	0	0	0	0	0	1	4%	24	96%	4.92± 0.28
12	I feel bored in classes when teachers use lecture- method for teaching science	0	0	2	8%	0	0	2	8%	21	84%	4.68± 0.85
13	ICT helps me to complete my home-work faster	0	0	0	0	0	00	8	32%	17	68%	4.64± 0.86
14	ICT helps to know hard spots in science content	0	0	0	0	0	0	0	0	25	100%	4.92± 0.28
15	ICT fosters ill- competition among students	18	72%	7	28%	0	0	0	0	0	0	4.72± 0.46
16	ICT has limited scope in teaching science	21	84%	2	8%	1	4%	1	4%	0	0	4.72± 0.74
17	I dislike my friends who uses to learn science through learning - apps	15	60%	6	24%	1	4%	2	8%	1	4%	4.28± 1.14
18	I feel confused when lesson are taught within a simulated environment	15	60%	6	24%	2	8%	1	4%	1	4%	4.32± 1.07
19	ICT reduces scope for hands - on activities in science	12	48%	4	16%	8	32%	1	4%	0	0	4.08± 1.00
20	ICT spreads fear among students	23	92%	1	4%	0	0	1	4%	0	0	4.84± 0.62
21	ICT doesn't help students for examination	22	88%	2	8%	1	4%	0	0	0	0	4.84± 0.47
22	ICT puts immense pressure on students	17	68%	8	32%	0	0	0	0	0	0	4.68± 0.48
23	ICT never enhances science achievement of students	21	84%	1	4%	1	4%	1	4%	1	4%	4.60± 1.04
24	ICT resists teachers to explain contents within a stipulated time period	5	20%	6	24%	1	4%	9	36%	4	16%	2.96± 1.46
25	ICT reduces the importance of books in learning.	11	44%	6	24%	2	8%	2	8%	4	16%	3.84± 1.49
26	ICT should not be entertained in school because of having potential to make student mobile -addicted	6	24%	11	44%	5	20%	3	12%	0	0	3.80± 0.96

Table 3.Descriptive statistics of questionnaire items.

Sl No.	Questionnaire	Mean	SD	SE	Skewness	Kurtosis
1	ICT helps to create pleasant environment in science classes	4.92	0.28	0.06	-3.298	9.641
2	I like those teachers who use ICT in their classes	4.92	0.28	0.06	-3.298	9.641
3	I feel motivated and attentive in science classes	4.88	0.33	0.07	-2.491	4.563
4	I feel confident and less burdened while learning concepts through mobile apps/ learning apps	4.68	0.56	0.11	-1.584	1.841
5	ICT is a tool to understand 21st century science	4.88	0.33	0.07	-2.491	4.563
6	ICT helps to ask more questions	4.64	0.57	0.11	-1.343	1.036
7	ICT very much helps to search information related to scientific facts and concepts	4.88	0.33	0.07	-2.491	4.563
8	I like ICT as it is very useful to understand practical concept of science	4.76	0.52	0.10	-2.197	4.463
9	I like to refer several e- resources to solve problems in science	4.88	0.33	0.07	-2.491	4.563
10	I like ICT integrated science classes when complex concepts are to be indulged	4.88	0.33	0.07	-2.491	4.563
11	ICT helps to prepare science projects	4.92	0.28	0.06	-3.298	9.641
12	I feel bored in classes when teachers use lecture- method for teaching science	4.68	0.85	0.17	-2.810	7.109
13	ICT helps me to complete my home-work faster	4.64	0.86	0.17	-2.608	6.163
14	ICT helps to know hard spots in science content	4.92	0.28	0.06	-3.298	9.641
15	ICT fosters ill- competition among students	4.72	0.46	0.09	-1.044	-0.998
16	ICT has limited scope in teaching science	4.72	0.74	0.15	-2.883	8.217
17	I dislike my friends who uses to learn science through learning - apps	4.28	1.14	0.23	-1.713	2.234
18	I feel confused when lesson are taught within a simulated environment	4.32	1.07	0.21	-1.821	3.128
19	ICT reduces scope for hands - on activities in science	4.08	1.00	0.20	-0.445	-1.343
20	ICT spreads fear among students	4.84	0.62	0.12	-4.352	19.658
21	ICT doesn't help students for examination	4.84	0.47	0.09	-3.143	9.969
22	ICT puts immense pressure on students	4.68	0.48	0.10	-0.822	-1.447
23	ICT never enhances science achievement of students	4.60	1.04	0.21	-2.699	6.659
24	ICT resists teachers to explain contents within a stipulated time period	2.96	1.46	0.29	0.163	-1.512
25	ICT reduces the importance of books in learning.	3.84	1.49	0.30	-1.097	-0.227
26	ICT should not be entertained in school because of having potential to make student mobile -addicted	3.80	0.96	0.19	-0.495	-0.485

Table 4.Mean, standard deviation (SD), Cronbach's alpha and bivariate correlations among the constructs.

Construct	Mean	SD	Cronbach's alpha	Correlation			
				EX	CS	SS	DT
Exhilaration (EX)	4.86	0.22	0.69	1.00	0.63	0.13	0.57
Cognitive Support (CS)	4.80	0.12	0.73	0.63	1.00	0.02	0.88
Detriment (DT)	4.31	0.42	0.72	0.57	0.88	-0.07	1.00

Qualitative data analysis

26 selective questions in the questionnaire provided qualitative information on students' interest to use ICT in science teaching. All the questions were made compulsory to respond. Then after student's response, all qualitative comments

were categorized, conceptualized and coded in five point Likert type scale (1 to 5). The collected responses were scored in 5 point scale (strongly agree: 5, agree: 4, neutral: 3, disagree: 2 and strongly disagree: 1 for positive statement; strongly disagree: 5, disagree: 4, neutral: 3, agree: 2 and strongly agree: 1 for negative statement).

Exhilaration (EX)

In the Exhilaration (EX) category, there are 5 questions in the questionnaire. All means were above the midpoint of 3, ranging from 4.68±0.11(SE) to 4.92±0.06(SE) (Table 3).The average mean value was 4.86±0.22(SD) (Table 4). This indicates an overall positive response to the constructs that were measured in this study (Figure 1). In fact, one question in this category has highest rating among all group (n= 25, Mean= 4.92, SD= 0.28), "ICT helps to create pleasant environment in science classes. The students responded all 5 statements by choosing either strongly agree or agree option. This indicates an overall strong positive response to the constructs that are measured in this study.

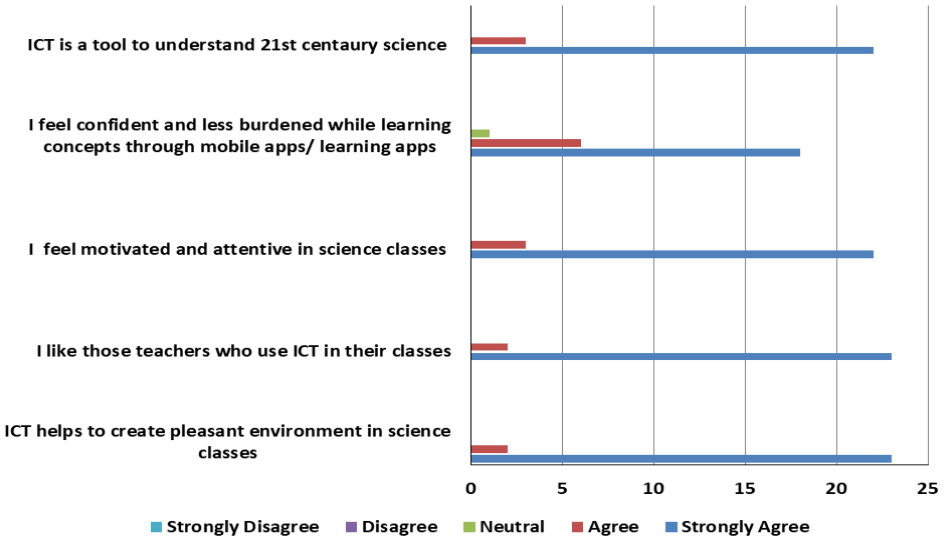

Figure 1: Perception of ICT uses in science teaching (Exhilaration).

Cognitive Support (CS)

A cognitive strategy helps to support the learner as he or she develops internal procedures that enable him/her to perform tasks that are complex. In this category, there are 9 questions in the questionnaire. All means were above the midpoint of 3, ranging from 4.64±0.17 (SE) to 4.92±0.06 (SE) (Table 3).The average mean value was 4.80±0.12 (SD) (Table 4). This indicates an overall positive response to the constructs that are measured in this study (Figure 2). The statement "ICT helps to prepare science projects" has the highest rating (n= 25, Mean= 4.92, SD= 0.28) in the group. This is due to wide use of ICT (e.g. power point presentation, online browsing tools, printed materials, other software) by the students in preparing science project. This indicates an overall strong positive response to the constructs that are measured in this study.

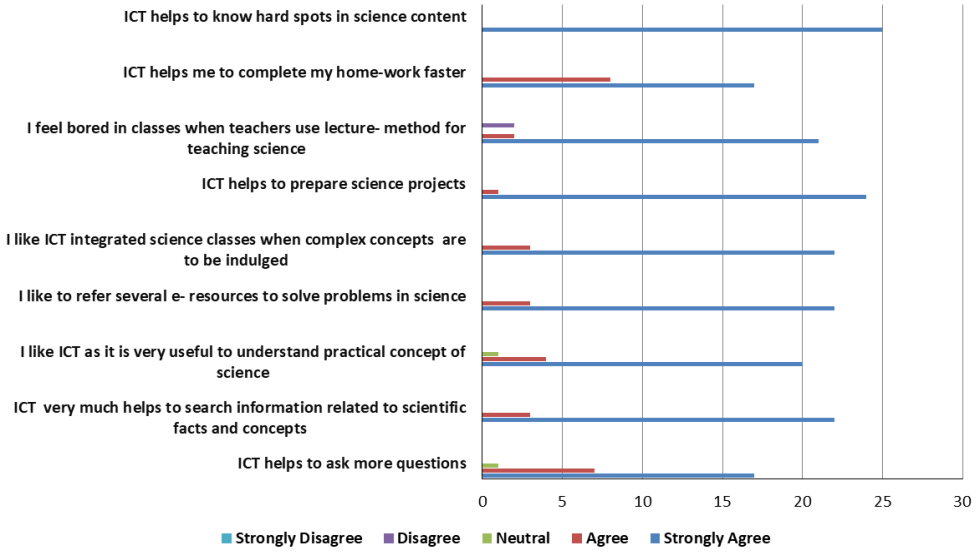

Figure 2: Perception of ICT uses in science teaching (Cognitive Support).

Detriment (DT)

Negatively worded statements are included in questionnaires to disrupt a response set where subjects respond favorably or unfavorably to all items [19,20]. This approach provides us with not only more reliability in terms of measurement but also ability to somehow assess the sincerity of our participant. So, 12 negative worded statements were placed in the questionnaires in scattered manners (in between 2 positive statements at different interval). After student's response, all the responses were coded in reverse order (strongly disagree: 5, disagree: 4, neutral: 3, agree: 2 and strongly agree: 1).Several studies recommends combining regular and reversed items for controlling for response style bias, but these results caution researchers in using them during analysis [21]. Therefore, all the responses in this category were coded in a reverse order to maintain the data uniformity by avoiding low correlation. Then the data were analyzed. All means were near or above the midpoint of 3, ranging from 2.96±0.29 (SE) to 4.84±0.12 (SE) (Table 3). The average mean value was 4.31±0.42 (SD) (Table 4). This indicates an overall positive response to the constructs that are measured in this study (Figure 3). The statement with highest rating in this group was "ICT spreads fear among students" (n= 25, Mean= 4.84, SD= 0.42). In response to this statement, 92% students were strongly disagreed and 4% students were disagreed (scored in reverse order as discussed above), that signifies increased popularity of ICT among students. Again, the statement with lowest rating was "ICT resists teachers to explain contents within a stipulated time period" (n= 25, Mean= 2.96, SD= 1.46). The high value of SD (standard deviation) indicated wide view of students on this statement. Some students may be not acquainted with ICT (prefers conventional teaching) or they require both ICT based teaching as conventional teaching (for which time is a limiting factor).

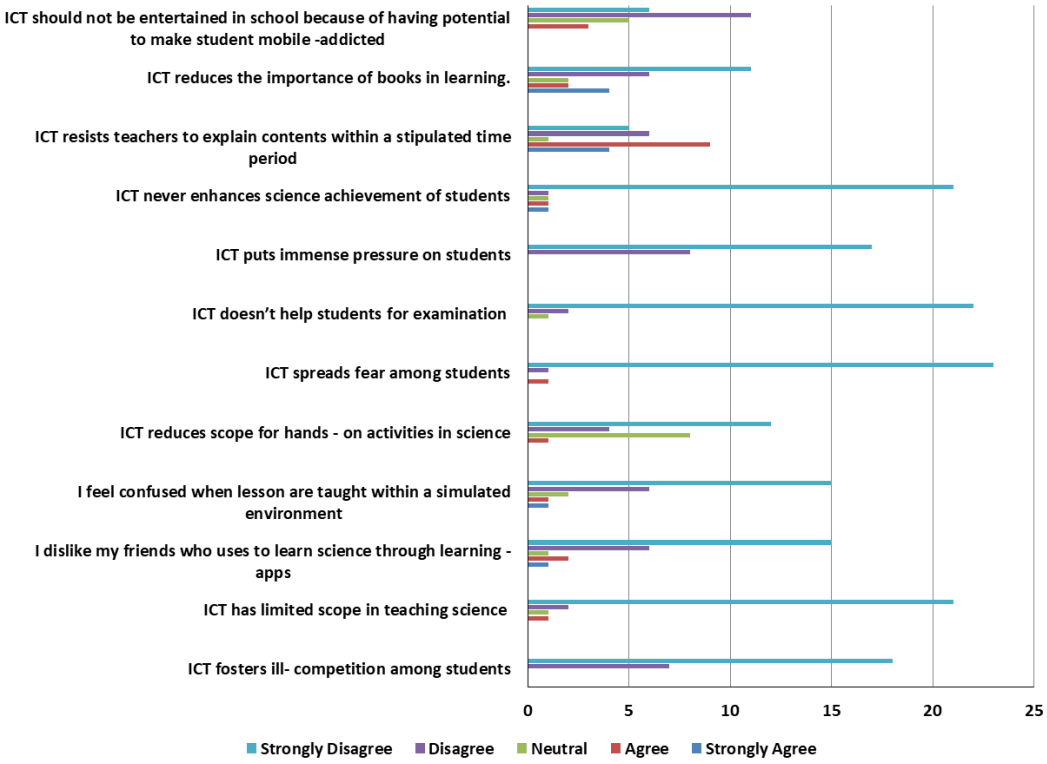

Figure 3: Perception of ICT uses in science teaching (Detriment).

From above analysis, it was observed that all means (student's response rating) were near or above the midpoint. Hence, it proved that secondary level students were highly and positively motivated and displayed great reception behavioral wise to integration of ICT in their science classes and its benefit towards their entire learning processes. The above results can be compared to several other studies that have been carried out to access the student's interest towards the integration of ICT in science teaching. A study on both students and teachers of 7 schools in Ajmer City, India concluded that ICT is beneficial for both teachers and students as it increases the quality of science teaching learning [22].In a another study on both primary and secondary school students revealed that 76% of the students increased their interest in obtaining knowledge through using ICT that was reflected as improvement in their performance [23]. Similarly, other studies also proved the popularity of ICT use in school (science teaching) among students as ICT improved student's intellectual qualities through higher order thinking, improved communication skills, problem solving and in depth understanding of concept [24,25]. Hence, Students' attitudes towards using ICT are generally favorable, and might be regulated by multiple factors as observed by Yang and Kwok [13]. Especially, in social constructive view, there are factors such as collaborating learning, student-teacher relationship; brain storming session should be taken care of along with ICT use. Again, ICT competency, internet connectivity, technical issues and usability are some factors that need to be focused for effective ICT integration in science teaching for secondary school level students.

CONCLUSION

The current study could be considered as a pilot study to investigate the use of ICT in science education in secondary school level (class 9th) students and their interest towards ICT based learning. The qualitative and quantitative analysis revealed that the level of students' interest towards ICT in science teaching and learning was positive despite the challenges in its integration in public secondary schools. However, large scale studies are required to access the impact of ICT use in science teaching in secondary school level and to address the issues in implementing ICT integrated science education based on views of both students and teachers.

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