



## EFFECT OF WEB BASED INSTRUCTIONAL STRATEGY ON ACHIEVEMENT IN COMPUTER SCIENCE IN RELATION TO SELF-REGULATED LEARNING

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### Abstract

The present study investigates the effect of web based instruction on achievement in Computer Science in relation to self-regulated learning. The data was collected from 300 XI class students of four private schools of Amritsar City affiliated to Central Board of Secondary Education, New Delhi. The Achievement Test in Computer Science consisting of 60 items and self-regulated learning Scale was developed and standardized by investigator to categorise students into high, average and low self-regulated learning students were used to collect the data. Experimental group was taught using web based instructional strategy and the control group was taught by conventional mode of instruction. Statistical techniques such as Mean and S.D were used in the analysis of data. F-ratio and t-test were employed to find significance of difference between means related to different groups and variables. The data was analysed using Analysis of Variance (2×3) and following conclusions were drawn: (i) The achievement of group taught through web based instructional strategy was significantly higher than that of conventional method of teaching. (ii) The performance of high self-regulated learning group was significantly higher than that of average and low self-regulated learning group on achievement in computer science. (iii) There was no significant interaction effect of instructional strategies and self-regulated learning on achievement in computer science.

**Keywords:** Web-Based Instructions, Achievement in Computer Science, Self-Regulated Learning.



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### Introduction

The advancements in technology have created a possibility for new ways of teaching and learning. The contributions of web in the teaching-learning process are the best among other computer innovations. The great potential of web can be fully utilized and taken advantage of, if teachers think about teaching and learning in new ways and master the use of new technology skills along with their students. The students of 21<sup>st</sup> century need to be fully engaged which requires the use of new constructive methods of teaching and learning with the help of technology tools and resources and providing them appropriate learning environment. The technology based instructional programmes help students continue learning

outside the classroom by providing study questions, activities, and even tests and quizzes for a class. The use of World Wide Web (www) as an instructional tool is gaining importance as many teachers and trainers have started incorporating it into their daily instructions. In mid of 1990s, the use of web for educational purposes was explored. Today, the web is on the way of being an important learning environment which provides students with a new and rich style of learning. The introduction of technology into the classroom is changing the nature of imparting education to students by allowing them to explore new areas of learning and thinking by using their all sense organs. It has changed the iconic tools of the trade. Students discover knowledge through inquiry and experimentation rather than by merely memorizing facts in a teacher dominated classroom setting where the teacher uses words and at the most charts and models. Overlays and handouts are stationary visuals, while technology based materials are interactive and fully animated that offer teachers an opportunity to move away from instructional strategies that focus on presentation of abstract information to the passive learner to an active process in which meaning is developed on the basis of experience (Kaur, 2012). In the constructivist view, the learner is building an internal representation of knowledge and a personal interpretation of experience (Ranade, 2001).

Education delivered with the help of internet is referred to by many names such as web based instruction, web based learning, web-based teaching, e-learning and online-learning. Web based instruction is the application of a repertoire of cognitively oriented instructional strategies within a constructivist and collaborative learning environment, utilizing the attributes and resources of the World Wide Web (Relan & Gillani, 1997). Khan (1997) defines web based instruction as a hypermedia-based instructional program which utilizes the attributes and resources of the World Wide Web to create a meaningful learning environment where learning is fostered and supported. Just as traditional instruction (whether teacher-centered or student-centered) is executed within the structural patterns which are in place, web-based instruction is situated within different contextual assumptions. First, it is assumed that the learner has access to the world wide web at all times, and is allowed to explore it in a self-determined or guided sequence. Second, web-based instruction would function best in a constructivist environment, indeed; the use of the medium in any other way would defeat its purpose in the instructional process. Third, the teacher "dethrones" him/herself as the disseminator of Information, and becomes a facilitator for finding, assessing, and making meanings from the information discovered from a variety of media.

Fourth, learning occurs in an interdisciplinary fashion without regard to the attainment of learning objectives within a fixed time (Relan & Gillani, 1997).

Web-based instruction is facilitated by network-based technologies that afford collaborative learning experiences and can provide learners with flexible access to materials at various times and/or locations. Although web-based instruction is primarily associated with a traditional view of distance education depicting only situations when learners are geographically dispersed, this form of instructional delivery may also be effectively used as a supplement to traditional, face-to-face, classroom, based activities. Specific features of web-based instruction provide multiple opportunities for student-to-content, student-to-student, and student-to-instructor interaction (Moore & Kearsley, 1996).

Web-based instruction offers multiple dimensions of use in education and training environments. As with computer-based instruction, it is capable of providing direct instruction to meet individual learning objectives. Due to its networking capability, the web can play additional roles. These include promoting and facilitating enrolment into courses, availing the syllabus or program of instruction, posting and submitting assignments, interacting with instructors and fellow students, collaboration on assignments, and building learning communities. The web has become a powerful tool for learning and teaching at a distance. Its inherent flexibility allows application in a variety of ways within an educational context, ranging from simple course administration and student management to teaching entire courses online. Each of these types of use works towards a different goal. These goals should be recognized when evaluating the use of the web. For example, an instructor may hold face-to-face lectures in a classroom but post the class syllabus, assignments, and grades on the web. In this case, it may not be appropriate to evaluate the use of the web with respect to learning outcomes since the web was not used in a direct instructional role (Olson & Wisner, 2002).

Achievement contributes to the educational growth and development. It is measured and assessed by achievement test and compared to the set norms to evaluate an individual's performance. Achievement refers to the amount of knowledge gained by the student in different subjects of study. It motivates the students to work hard and learn more. It also helps the teachers to diagnose and provide remedy to student's weaknesses after evaluation and helps the teacher to know whether their teaching methods are effective or not and bring improvements accordingly. In academic context, achievement concerns the development of

knowledge, understanding and acquisition of skills. Therefore, achievement may be defined as a measure of cognitive learning outcomes of Bloom's taxonomy at knowledge, understanding and higher order levels in a specific subject or a group of subjects.

Achievement is an end product of learning and its level and performance are affected by many factors. Learners' achievement at a particular point of time is a function of cumulative input of the variables which interact with the innate abilities or "The Learning potential of the students" (Hanushek, 1979). These interactions create an environment that affects the achievements of student. A plethora of research studies are available which have concluded that superior intellectual endowment is considered as an input variable that plays decisive role in setting up limits to achievement. Garg and Chaturvedi (1992), Noor-Jahan (1994) and Vaghela (2000) have shown significant relationship between intelligence and achievement. Achievement in computer science is influenced by various factors such as technology savviness, interest in hardware and software of a computer, practical usage of a computer, self regulatory practices on the part of student etc. The present study was limited to the instructional strategy and self regulation as two variables or factors that tend to influence achievement in computer science.

Self-regulated learning is a process that assists students in managing their thoughts, behaviours and emotions in order to successfully navigate their learning experiences. This process occurs when a student's purposeful actions and processes are directed towards the acquisition of information or skills (Zumbrunn, Tadlock & Roberts, 2011). Generally, models of self-regulated learning are separated into phases. A popular cyclical model discusses three distinct phases: Forethought and planning, performance monitoring, and reflections on performance (Pintrich & Zusho, 2002; Zimmerman, 2000).

During the *forethought and planning phase*, students analyze the learning task and set specific goals toward completing that task. When students learn unfamiliar topics, however, they may not know the best ways to approach the task or what goals might be the most appropriate. Teachers and/or more experienced peers often can instruct students on effective approaches in cases like these. Next, in the *performance monitoring phase*, students employ strategies to make progress on the learning task and monitor the effectiveness of those strategies as well as their motivation for continuing progress toward the goals of the task. Unfortunately, when strategies are new, students sometimes revert to using more familiar and perhaps ineffective strategies. For example, students may lapse into using the familiar

strategy of flash cards to study new vocabulary words because it might seem easier than the new, effective strategy presented by the teacher. Whereas taking the time necessary to practice and learn the new strategy could lead to meaningful learning, students' use of their fall-back strategy will likely leave them with a considerably less effective means to their learning. Close teacher monitoring and specific feedback can help students learn to use new strategies with fluency, especially if students face frustration. In the final *reflection on performance phase*, students evaluate their performance on the learning task with respect to the effectiveness of the strategies that they chose. During this stage, students also must manage their emotions about the outcomes of the learning experience. These self-reflections then influence students future planning and goals, initiating the cycle to begin again (Zumbrunn, Tadlock & Roberts, 2011).

In the last ten years, several educational psychologists (Dabbagh & Kitsantas, 2004; Hartley & Bendixen, 2001; Schunk & Zimmerman, 1998) have suggested that students require considerable motivation and self-regulation to stay engaged, guide their cognition, and regulate their effort in online situations. The highly independent nature of online learning is thought to be due, in part, to the lack of structure and guidance that normally comes from face-to-face, social interactions with an instructor and other students (Moore & Kearsley, 2005).

### **Need and Significance**

India is a country of large and diverse population. People belong to varied social differences like cultures, socio-economic status, live at varied geographical locations and many more. When we think of educating such a diverse population and achieving the best results in education, we cannot simply rely upon old and traditional methods of teaching and learning. Also, in India we have many such students who are unable to attend schools regularly on health grounds or due to certain family or financial problems. Web based instructional strategy can be used either for students who prefer online courses, distance education or for assisting classroom instruction. This strategy requires ability of using computers and assessing internet resources. The rising popularity and importance of web-based instruction in the field of education requires checking the effectiveness of web-based instruction by comparing it to other classroom instructional techniques and find out what factors influence the use of it for making the teaching and learning process effective. In the present study the effectiveness of web based instructional strategy is studied on achievement

in computer science relation to self-regulated learning, as the investigator felt that there is a need that web based instruction as an instructional strategy should be incorporated in schools because it has the potential to develop the various skills and abilities among students and make them better informed and high achievers.

### **Objectives**

The study was conducted to achieve the following objectives:

1. To compare the achievement of groups of students taught through web based instructional strategy and conventional teaching strategy in computer science.
2. To compare the achievement of high, average and low groups of students on self-regulated learning.
3. To examine the interaction effects between instructional strategies and self-regulated learning on achievement in computer science.

### **Hypotheses**

The study was designed to test the following hypotheses:

1. There will be no significant difference in the achievement of group taught through web based instructional strategy and conventional teaching strategy in computer science.
2. There will be no significant difference in the achievement of group having high self-regulated learning than that of average and low high self-regulated group of students in computer science.
3. There will be no significant interaction effect of instructional strategies and high self-regulated on achievement in computer science.

### **Sample**

In the present study, purposive sampling was initially employed to select those schools which have LAN facility and had opted for computer science subject in XI class and then random sampling technique was used to select five schools from amongst them. The sample in the present study was drawn at the school and student level. After selecting the schools, the intact sections of each school were randomly taken for experimental and control groups from the four schools. The present study was conducted on initial sample of 300 students of class XI who had opted for computer science subject from English medium schools of Amritsar, affiliated to Central Board of Secondary Education, New Delhi. The school-wise distribution of the sample is as shown the table-1.

**Table-1: The school wise distribution of the sample**

S. No.	Name of the Schools	Experimental Group	Control Group	Total
1	Shri Guru Harkrishan International School, Amritsar	25	25	50
2	The Millenium School, Amritsar	25	25	50
3	Khalsa Public School, G.T. Road, Amritsar	50	50	100
4	The Senior Study II, Amritsar	50	50	100
	<b>Total</b>	<b>150</b>	<b>150</b>	<b>300</b>

### **Design**

For the purpose of present investigation a pre and post-test factorial design was employed. In order to analyze the data a analysis of variance (2×3) was used for the two independent variables viz. instructional strategy and self-regulated learning. The impact of instructional strategy was examined at two levels, namely web based instructional strategy and conventional teaching strategy. The classification of self-regulated group was done at three levels viz. high, average and low self-regulated learning. The main dependent variable was the achievement in computer science, which was calculated as the difference in post- test and pre-test scores for computer science subject.

### **Tools Used**

The following tools were used for data collection:

- 1 General Mental Ability Test by Jalota (1972) was used to access the intelligence of the students for matching the group.
- 2 Self-Regulated Learning Scale developed by the investigators.
- 3 An Achievement Test in Computer Science developed by the investigators.
- 4 Instructional Material for Web Based Instructional Strategy and Conventional Teaching Strategy on five topics such as introduction to database concepts, data types, keys and their types, classification of SQL commands and creating and using a database using MYSQL of XI<sup>th</sup> class computer science subject were developed by investigators.

### **Procedure**

After the selection of the sample and allocation of students to the two instructional strategies, the experiment was conducted in six phases. Firstly, the investigator made necessary arrangements with the Principal of the school selected for the experiment. Secondly, General Mental Ability Test to assess intelligence was administered for matching of the students. Thirdly, the self-regulated learning scale was administered in each school in

order to identify the self-regulated learning levels of the students. Fourthly, an achievement test in computer science as pre-test was administered to the students of experimental and control groups. The answer-sheets were scored to obtain information regarding the previous knowledge of the students. Fifthly, the experimental group was taught through web based instructional strategy and control group was taught through conventional teaching strategy by the investigators. Sixthly, after the completion of the course, the achievement test in computer science as post-test was administered to the students of both the groups. The answer-sheets were scored with the help of scoring key.

## ANALYSIS AND INTERPRETATION OF THE RESULTS

### 1. Analysis of Descriptive Statistics

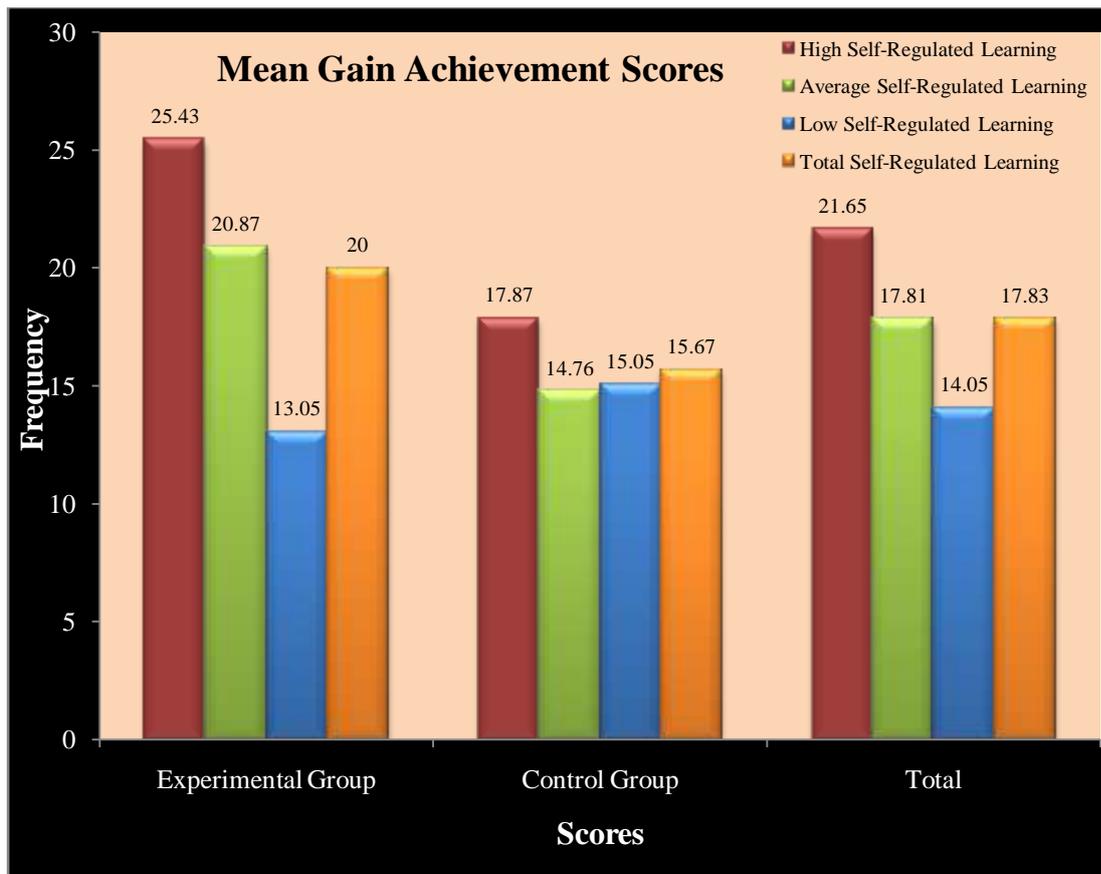
The data were analyzed to determine the nature of the distribution of scores by employing mean and standard deviation. The Analysis of Variance (2×3) was used to test the hypotheses related to web based instructional strategy, conventional teaching strategy and self-regulated learning levels. The mean and standard deviation of different sub groups have been presented in table- 2, 3, 4, 5 & 6. The obtained mean gain scores on achievement in computer science for experimental and control group has been given in table-2.

**Table-2: A summary of descriptive statistics of mean gain achievement scores of experimental and control group**

Variables	Experimental Group			Control Group			Total		
	N	Mean	SD	N	Mean	SD	N	Mean	SD
<b>High Self-Regulated Learning</b>				40	17.87				
<b>Average Self-Regulated Learning</b>	40	25.43	6.86	70	14.76		80	21.65	6.16
<b>Low Self-Regulated Learning</b>	70	20.87	6.75		5.54		140	17.82	6.15
<b>Total Self-Regulated Learning</b>	40	13.05	4.96	40	15.05		80	14.05	5.76
	150	20.00	7.82		6.55		300	17.84	6.88
				150	15.67				
					5.92				

*Source: Field Study, 2016*

To substantiate the data presented in table-2, a bar diagram was drawn to depict mean gain achievement scores for high, average, low and total self-regulated learning groups of experimental and control group has been given in fig-1.



**Fig-1: Bar diagram showing comparison of mean gain achievement scores of experimental and control group.**

The table-2 and fig-1 shows that the means gain achievement score of total self-regulated learning of experimental group is 20 and of control group is 15.67. This shows that the mean gain achievement score in computer science is high for the experimental group than that of control group with respect to self-regulated learning. Further the above table reveals that the mean gain achievement score of high self-regulated learning group of experimental group is 25.43 and of control group is 17.87. This shows that the mean gain achievement scores of high self-regulated learning is high for the experimental group than that of control group. And for average self-regulated learning, it is observed that mean gain of experimental group is 20.87 and of control group is 14.76. This shows that the mean gain achievement scores of average self-regulated learning is high for the experimental group than the control group. Further for low self-regulated learning, it is observed that mean gain of experimental group is 13.05 and of control group is 15.05. This shows that the mean gain achievement score in computer science of low self-regulated learning group is low for experimental group than that of the control group.

### Analysis of Variance on Gain Achievement Scores

The mean of different sub-groups, sum of squares, degree of freedom, mean sum of squares and the F - ratio have been presented in table-3.

**Table-3: Summary of Analysis of Variance (2×3) factorial design**

Source of Variation	Sum of Squares	df	Mean of Sum of Squares	F-ratio
Instructional Strategy (A)	958.99	1	958.99	28.47**
Self-Regulated Learning (B)	309.41	2	154.70	4.59*
Interaction (A× B)	29.95	2	14.97	0.45
Error Terms	9901.11	294	33.68	

*\*\*Significant at 0.01 level*

*(Critical Value 3.87 at 0.05 and 6.72 at 0.01 level, df 1/294)*

*(Critical Value 3.03 at 0.05 and 4.68 at 0.01 level, df 2/294)*

#### Web Based Instructional Strategy (A)

It is observed from the table-3 that the F-ratio for difference in gain achievement scores of web based instructional strategy and conventional teaching strategy is 28.47, which in comparison to the table value was found significant at 0.01 levels of significance. It shows that the groups are different beyond the contribution of chance. Hence, the hypothesis  $H_1$ : There will be no significant difference in the achievement of group taught through web based instructional strategy and conventional teaching strategy in computer science, is rejected. The result indicates that achievement of group taught through web based instructional strategy is much higher than that of conventional teaching strategy.

In order to probe deeper, F-ratio is followed by t-test. The values of the t-ratio for different combinations have been given in the table-4.

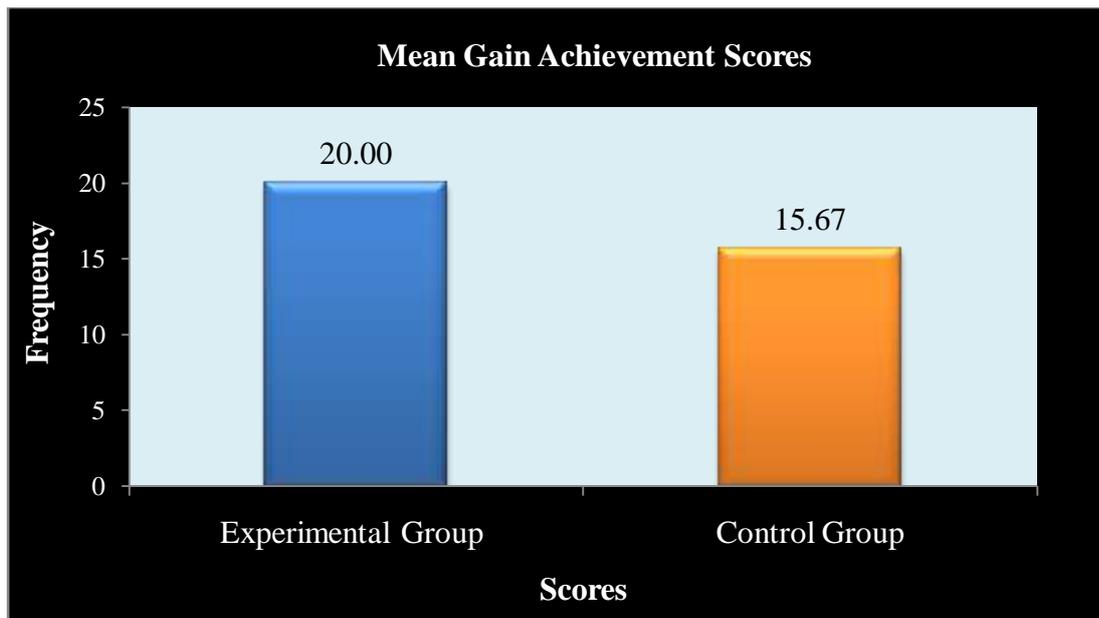
**Table-4: t-ratios for mean gain achievement scores of experimental and control group**

Variable	Experimental Group			Control Group			SE <sub>D</sub>	t-value
	N	Mean	SD	N	Mean	SD		
<b>Gain Achievement Scores</b>	150	20.00	7.82	150	15.67	5.92	0.80	5.41**

*\*\*Significant at 0.01 level*

*(Critical Value 1.97 at 0.05 and 2.59 at 0.01 level, df =298)*

A bar diagram has drawn to depict the mean gain achievement scores in computer science has been presented in fig- 2.



**Fig-2: Bar diagram showing comparison of mean gain achievement scores of experimental and control group**

It is observed from the table-4 and fig-2 that the mean gain achievement scores of experimental group taught through web based instructional strategy is 20.00, which is higher than the corresponding mean gain scores of 15.67 for the control group taught through conventional teaching strategy. The t-value testing the significance of mean gain difference on achievement in computer science of experimental and control group is 5.41, which in comparison to the table value was found significant at 0.01 levels of significance. Hence, the hypothesis  $H_1$  of significant difference is accepted in case of web based instructional strategy and conventional teaching strategy irrespective of grouping across other variables. The result indicates that the students taught through web based instructional strategy perform significantly better than that of students taught through conventional teaching strategy.

### **Self-Regulated Learning (B)**

It has been seen from the table-3 that the F-ratio for difference of mean gain achievement scores of the different self-regulated learning groups is 4.59, which in comparison to the table value was found significant at 0.05 levels of significance. Hence, the hypothesis  $H_2$ : The achievement of high self-regulated learning group is significantly higher than that of average and low self-regulated learning group of students in computer science, is accepted. The result indicates that the high, average and low self-regulated learning groups do not yield equal level of achievement.

To investigate further F-ratio is followed by t-test. The values of the t-ratio for different combination have been given in table- 5.

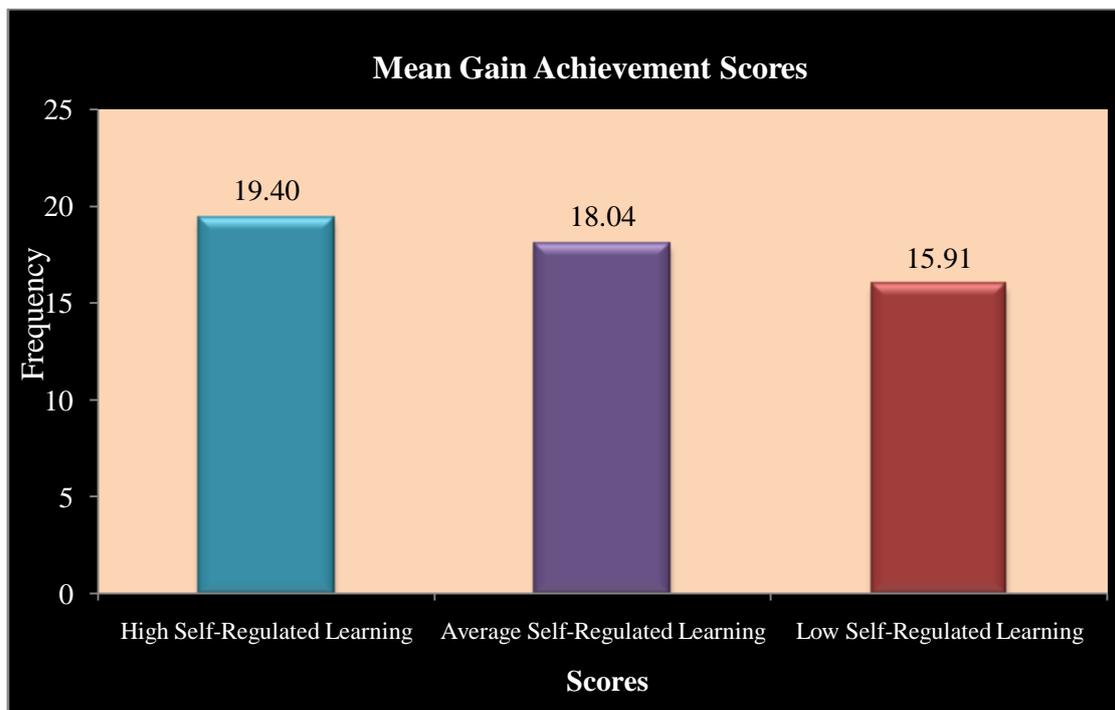
**Table-5: t-ratio for different combinations of different self-regulated learning groups**

Variables	High Self-Regulated Learning		Average Self-Regulated Learning		Low Self-Regulated Learning		
	N	Mean SD	N	Mean SD	N	Mean	SD
	82	19.40 7.10	136	18.04 7.40	82	15.91	6.80
<b>High Self-Regulated Learning</b>							
N	82						
Mean	19.40						
SD	7.10						
		--		1.35			3.20**
<b>Average Self-Regulated Learning</b>							
N	136						
Mean	18.04						
SD	7.40						
		--		--			2.17*
<b>Low Self-Regulated Learning</b>							
N	82						
Mean	15.91						
SD	6.80						
		--		--			--

\* Significant at 0.05 level

\*\* Significant at 0.01 level

A bar diagram has been drawn to depict the mean gain scores of high, average and low self-regulated learning groups on achievement in computer science and presented in Fig.-3.



**Fig-3: Bar diagram showing comparison of mean gain achievement scores of different levels of self-regulated learning**

It is observed from the table-5 and fig-3 that the mean gain achievement scores of high self-regulated learning group is 19.40, which is higher than the corresponding mean gain achievement score of 18.04 for average self-regulated learning group. The t-ratio for difference in gain scores of high and average self-regulated learning is 1.35, which in comparison to the table value ( $t_{0.05}=1.97$ , df 216) was not found significant even at 0.05 level of significance. Hence, the hypothesis of significant difference is rejected in case of high and average self-regulated learning irrespective of grouping across other variables. The result indicates that the high and average self-regulated learning groups of students do not differ significantly in respect of gain scores on achievement.

It is evident from the table-5 and fig-3 that the mean gain achievement scores of high self-regulated learning group is 19.40, which is higher than the mean gain achievement score of 15.91 for low self-regulated learning group. The t-ratio for difference in gain scores of high and low self-regulated learning group is 3.20, which in comparison to the table value ( $t_{0.01}=2.61$ , df 162) was found significant at 0.01 level of significance. Hence, the hypothesis of significant difference is accepted in case of high and low self-regulated learning irrespective of grouping across other variables. The result indicates that high self-regulated learning group of students perform significantly better than that of low self-regulated learning group of students.

It is clear from the table-5 and fig-3 that the means gain achievement score of average self-regulated learning group is 18.04, which is higher than the corresponding mean gain achievement score of 15.91 for low self-regulated learning group. The t-ratio for difference in gain scores of average and low self-regulated learning group is 2.17, which in comparison to the table value ( $t_{0.05}=1.97$ , df 216) was found significant at 0.05 level of significance. Hence, the hypothesis of significant difference is accepted in case of average and low self-regulated learning irrespective of grouping across other variables. The result indicates that average self-regulated learning group of students perform significantly better than that of low self-regulated learning group of students.

**Interaction between Instructional Strategies and Self-Regulated Learning (A × B)**

It is evident from the table-3 that the F-ratio for interaction between web based instructional strategy and self-regulated learning is 0.45, which in comparison to table value

was not found significant even at 0.05 levels of significance. It indicates that variable of instructional strategy does not interact with self-regulated learning to yield significant difference in respect of gain achievement scores. Hence, the hypothesis  $H_3$ : There exists significant interaction effect of instructional strategies and self-regulated learning, is rejected. The result indicates that there is no a significant difference in the gain achievement scores in computer science due to interaction effect of instructional strategies and self-regulated learning.

### **Discussion of the Results**

The finding of present study reveals that web based instructional strategy was more effective than that of conventional teaching strategy on achievement in computer science. Hence, the hypothesis  $H_1$ : There will be no significant difference in the achievement of group taught through web based instructional strategy and conventional teaching strategy in computer science, is rejected. The results are supported by the findings of Schutte (1997), who found that students taught through virtual class on World Wide Web scored an average of 20% higher than the traditional class on both examinations. Thiele, Allen and Stucky (1999) found that the web based format increased collaborative learning and improved computer skills. Owston and Wideman (1999) found that grades were significantly higher for the web-based classes than for the face-to-face classes, which were significantly higher than for the correspondence classes.

Daniel and Rohaida (2001) indicated that the students had a better understanding of the topics taught using web based instructions. Suwanbenjakul (2002) found that English learning achievement of students in the experimental group was higher than those of students in the control group. Kearns, Shoaf and Summey (2004) found that students in the web-based course scored significantly higher than those taught using traditional methods. Uzunboylu (2004) found that the English language grammar achievement of the experimental group's subjects was higher than the control group's subjects. Noisri (2005) found that the learning achievement of students with the web based instruction course was significantly higher than that of the students with normal teaching. Sengel (2005) found that there were significant differences between the pre-tests and post-tests of the science achievement test and attitude scale. Apichatibutarapong, Worrachittanon, Tenissara, Vongsirojgul and Petsuwan (2008) found that web-based instruction was effective in teaching Information Technology, Mathematics and Statistics, and Sciences. Mugan (2008) found that web intensive instruction

improved scores from pre-test to post-test on achievement in Biology. Kaur (2012) found that students achieved higher when taught through web based instruction as compared to conventional mode of instruction. Sudha and Amutha (2015) found that higher secondary learners of control group and experimental group differ significantly in the pre-test and post-test on achievement in Chemistry.

The results are contradicted by the findings of Davies and Mendenhall (1998), Rattanavijai and Sharma (2003) who reported no difference in the achievement of students taught through web based instruction and traditional method of instruction. Kearns, Shoaf and Summey (2004) found that the satisfaction level of students in traditional classrooms was still more than those of web based course. Khatony, Nayery, Ahmadi, Haghani and Vehvilainen-Julkunen (2009) found that there was no significant difference between the groups in either the pre-test or the post-test scores in the knowledge test. Kuo (2016) reported that synchronous web-based instruction affects thinking styles and creativity of teachers and students.

The finding of the present study indicates the performance of high self-regulated learning group was better in computer science than that of average and low self-regulated learning groups. The average self-regulated learning group performed better in computer science than the low self-regulated learning group. Hence, the hypothesis **H<sub>2</sub>**:The achievement of high self-regulated learning group is significantly higher than that of average and low self-regulated learning group of students in computer science, is accepted. The findings are supported by Pintrich and De-Groot (1990) who found that depending on the outcome measure, self-regulation, self-efficacy, and test anxiety emerged as the best predictors of performance. Staudt (1995) found that self-regulated learning strategies were positively correlated with achievement in English and Chemistry. Eom (1999) found that meta-cognitive and motivational strategies significantly influenced the overall model to predict achievement. Cobb (2003) found that time and study environment management and intrinsic goal orientation categories reported significant findings in their relationship to academic performance. Gagnon (2011) found that self-regulation capacity appears to be an important skill that may help both physicians and medical students to meet the demands of the medical profession and maintain an adequate level of well-being and performance in their work and daily life.

The results are contradicted by the findings of Lindsey-Randall (2008) who found that various motivational variables have no significant relationship with their achievement or persistence. McManus (2000) found that highly self-regulating learners learn poorly in mostly linear web-based hypermedia learning environments, where they have very few choices, while medium self-regulating learners learn poorly in highly nonlinear environments where they are given too many choices.

The finding of the present study further indicates that the interaction effect among instructional strategies and self-regulated learning did not yield significant difference in mean gain scores on achievement in computer science. Hence, the hypothesis **H<sub>3</sub>**: There exists significant interaction effect of instructional strategies and self-regulated learning on achievement in computer science, is rejected. The results are contradicted by the findings of Hargis (2000) who found that the ability to self-regulate one's learning appears to be an ideal characteristic for learning on-line via the internet. Yukselturk and Bulut (2005) in their study indicated that the effect of self-regulation variable on students' programming achievement was statistically significant. Bell (2006) through his study revealed that self-regulated learning was a significant predictor in the model of learning achievement in asynchronous online courses.

### **Findings**

1. The achievement of group taught through web based instructional strategy was found significantly higher than that of conventional method of teaching.
2. The performance of high self-regulated learning group was significantly higher than that of average and low self-regulated learning group on achievement in computer science. The further analysis revealed that:
  - (i) The mean gain score of high self-regulated learning groups was not significantly higher than that of average self-regulated learning group.
  - (ii) The mean gain score of high self-regulated learning group was significantly higher than that of low self-regulated learning group.
  - (iii) The mean gain score of average self-regulated learning group was significantly higher than that of low self-regulated learning group.
3. There was no significant interaction effect of instructional strategies and self-regulated learning on achievement in computer science.

## Conclusion

The present study reveals that web based instructional strategy gives better results than conventional teaching strategy for secondary school students. This could be because the students are able to access the web-based course from anywhere and at any time and at their own pace. Further, the self-regulated learning also slightly affects the achievement of computer science students in web based teaching-learning environment. The instructional strategies and self-regulated learning did not produce significant interactional effect on achievement scores. The study recommends the use of web based instructional strategy for better achievement of secondary school students in computer science. The self-regulated learning though did not seem to be a good predictor of achievement of students in computer science in web based learning environments. Hence, appropriate training to use computer and internet and self regulate must be given to achieve good results using web based instructional strategy.

## References

- Apichatibutarapong, S., Worrachittanon, W., Tenissara, R., Vongsirojgul, N., & Petsuwan, S. (2008, March). *Effects of web-based instruction on Thai students' achievement: A meta-analysis*. In *Proceedings of the seventh International Association of Science and Technology for Development (IASTED) International Conference on Web-Based Education*(pp. 105-107). Anaheim, CA, USA: ACTA Press. Retrieved May 5, 2014 from <http://www.actapress.com/Abstract.aspx?paperId=32839>
- Bell, P. D. (2006). *Can factors related to self-regulated learning and epistemological beliefs predict learning achievement in undergraduate asynchronous web-based courses? Perspectives in Health Information Management*, 3(7), 1-17.
- Cobb, R. (2003). *The relationship between self-regulated learning and academic performance in web-based courses*. Unpublished Ph.D. Thesis, Blacksburg, Virginia: Virginia Polytechnic Institute and State University. Retrieved July 26, 2014 from [http://scholar.lib.vt.edu/theses/available/etd03212003130332/unrestricted/srllonline\\_dissertation.pdf](http://scholar.lib.vt.edu/theses/available/etd03212003130332/unrestricted/srllonline_dissertation.pdf)
- Dabbagh, N., & Kitsantas, A. (2004). *Supporting self-regulation in student-centered web-based learning environments*. *International Journal on E-Learning*, 3(1), 40-47.
- Daniel, E. S. G., & Rohaida, M. S. (2001). *Elemental education*. *The Science Teacher*, 68(9), 50-53.
- Davies, R., & Mendenhall, R. (1998). *Evaluation comparison of online and classroom instruction for HEPE 129—Fitness and lifestyle management course*. Salt Lake City, UT: Brigham Young University.
- Eom, W. (1999). *The effects of self-regulated learning strategy on academic achievement in a computer-networked hypertext/hypermedia learning environment*. Unpublished Ph.D. Dissertation, Florida, United States: The Florida State University. Retrieved August 9, 2014 from <http://search.proquest.com/docview/304510504?accountid=28367>.
- Gagnon, M. (2011). *Exploring the self-regulation of physicians and medical students in relation to their well-being and performance*. Unpublished Ph.D. Dissertation, Ottawa, Canada: University of Ottawa. Retrieved July 14, 2014 from

- <http://search.proquest.com/docview/1364602363?accountid=28367>.
- Garg, V.P., & Chaturvedi, S. (1992). *Intelligence and socio-economics status as correlates of academic performance*. *Indian Educational Review*, 27(3), 107-109.
- Hanushek, E. A. (1979). *Conceptual and empirical issues in the estimation of educational production functions*. *Journal of Human Resources*, 14(3), 351-388.
- Hargis, J. (2000). *The self-regulated learner advantage: Learning science on the internet*. *Electronic Journal of Science Education*, 4(4), 1-8.
- Hartley, K., & Bendixen, L. D. (2001). *Educational research in the internet age: Examining the role of individual characteristics*. *Educational Researcher*, 30(9), 22-26.
- Jalota, S. S. (1972). *Manual for General Mental Ability Test*. Agra: Psychological Corporation.
- Kaur, M. (2012). *Effect of web based instruction on achievement in biology in relation to learning style*. Unpublished Ph.D. Thesis, Chandigarh: Panjab University.
- Kearns, L. E., Shoaf, J. R., & Summey, M. B. (2004). *Performance and satisfaction of second-degree Bachelor of Science in nursing students in web-based and traditional course delivery environments*. *The Journal of Nursing Education*, 43(6), 280-284.
- Khan, B. H. (1997). *Web-based instruction (ed.)*. Englewood Cliffs, NJ: Educational Technology Publications.
- Khatony, A., Nayery, N. D., Ahmadi, F., Haghani, H., & Vehvilainen-Julkunen, K. (2009). *The effectiveness of web-based and face-to-face continuing education methods on nurses' knowledge about aids: A comparative study*. *Biomedcentral Medical Education*, 9(1), 41. Retrieved November 26, 2013 from <http://www.biomedcentral.com/1472-6920/9/41/>
- Kuo, P. H. (2016). *Effects of synchronous web-based instruction on students' thinking styles and creativity*. *Eurasia Journal of Mathematics, Science & Technology Education*, 12(3), 609-619.
- Lindsey-Randall, A. K. (2008). *The effect of reading self-efficacy, expectancy-value, and metacognitive self-regulation on the achievement and persistence of community college students enrolled in basic skills reading courses*. Unpublished Ph.D. Dissertation, Los Angeles, CA, United States: University of Southern California. Retrieved July 17, 2014 from <http://search.proquest.com/docview/304461824?accountid=28367>.
- McManus, T. F. (2000). *Individualizing instruction in a web based hypermedia learning environment: Non-linearity, advance organizers, and self-regulated learners*. *Journal of Interactive Learning Research*, 11(3), 219-251.
- Moore, M. G., & Kearsley, G. (1996). *Distance education: A systems view*. Belmont, CA: Wadsworth Publishing.
- Moore, M. G., & Kearsley, G. (2005). *Distance education: A systems view*. (2<sup>nd</sup> ed.). Belmont, USA: Wadsworth Publishing Company.
- Mugan, P. R. (2008). *The effect of intensively using web-based resources on the performance and attitude of high school biology students*. Unpublished Master of Science Dissertation, Menomonie, Wisconsin, US: University of Wisconsin-Stout. Retrieved May 1, 2016 from <http://www2.uwstout.edu/content/lib/thesis/2008/2008muganp.pdf>
- Noisri, U. (2005). *A web based instruction for the information technology course of upper secondary level school: A case study Kanjanapisekwittayalai Nakornprathomschool*. Unpublished M.Sc. Thesis, Bangkok, Thailand: Mahidol University. Retrieved May 2, 2014 from <http://www.li.mahidol.ac.th/thesis/2548/cd382/4637197.pdf>
- Noor-Jahan, M. (1994). *Psycho-socio correlates of achievement of Muslim students*. *The Progress of Educations*, 68(10-11), 229-233.

- Olson, T. M., & Wisner, R. A. (2002). *The effectiveness of web-based instruction: An initial inquiry. The International Review of Research in Open and Distributed Learning*, 3(2), 1-17.
- Owston, R. D., & Wideman, H. H. (1999). *Internet-based courses at Atkinson College: An initial assessment. Toronto, ON: New York University. Retrieved July 14, 2014 from <http://www.yorku.ca/irlt/reports.html>*
- Pintrich, P. R., & De-Groot, E. V. (1990). *Motivational and self-regulated learning components of classroom academic performance. Journal of Educational Psychology*, 82(1), 33-40.
- Pintrich, P. R., & Zusho, A. (2002). *The development of academic self-regulation: The role of cognitive and motivational factors. In A. Wigfield, & J. Eccles (Eds.), Development of achievement motivation (pp. 249–284). San Diego, CA: Academic Press. Retrieved July 25, 2014 from [http://www.selfregulation.ca/download/pdf\\_documents/Self%20Regulated%20Learning.pdf](http://www.selfregulation.ca/download/pdf_documents/Self%20Regulated%20Learning.pdf)*
- Ranade, M. D. (2001). *Science teaching through computer assisted instruction: Research findings and insights. Unpublished Ph.D. Thesis, Pune: ShreematiNathibaiDamodarThakersey Women's University. Retrieved May 5, 2014 from [http://www.hbcse.tifr.res.in/episteme/episteme-1/allabs/mridula\\_abs.pdf](http://www.hbcse.tifr.res.in/episteme/episteme-1/allabs/mridula_abs.pdf)*
- Rattanavijai, C., & Sharma, S. K. (2003, May). *Learning outcomes in web based synchronous and asynchronous learning environments: A comparative analysis. Proceedings of 14<sup>th</sup> International Conference of the Information Resources Management Association on Information Technology and Organizations: Trends, Issues, Challenges and Solutions held at Philadelphia, USA (pp. 1070-1071). Retrieved April 7, 2014 from <http://www.irma-international.org/viewtitle/32248/>*
- Relan, A., & Gillani, B. J. (1997). *Web-based instruction and the traditional classroom: Similarities and differences. In B. H. Khan (Ed.), Web-based instruction (pp. 25–37). Englewood Cliffs, NJ: Educational Technology Publications.*
- Schunk, D. H., & Zimmerman, B. J. (1998). *Self-regulated learning: From teaching to self-reflective practice. New York: Guilford Press.*
- Schutte, J. G. (1997). *Virtual teaching in higher education. Northridge, CA: The California State University-Northridge.*
- Sengel, E. (2005). *Effect of web based learning tool on student learning in science education: A case study. Unpublished Ph.D. Dissertation, Ankara, Turkey: Middle East Technical University. Retrieved May 11, 2014 from <http://etd.lib.metu.edu.tr/upload/3/12606683/index.pdf>*
- Staudt, L. E. (1995). *Self-regulated learning strategies: Their relation to academic performance and self-efficacy in Chemistry and English. Unpublished Ph.D. Dissertation, Ontario, Canada: University of Windsor. Retrieved April 17, 2014 from <http://search.proquest.com/docview/89322384?accountid=28367>.*
- Sudha, A., & Amutha, S. (2015). *Higher secondary learners' effectiveness towards web based instruction on chemistry. Universal Journal of Educational Research*, 3(7), 463-466.
- Suwanbenjakul, B. (2002). *The development of web-based instruction on relative clauses for Mathayomsuksa V students at Kham-Sakaesaeng school, NakhonRatchasima. Unpublished M.A. Thesis, Thailand: Suranaree University of Technology. Retrieved May 05, 2013, from [http://sutir.sut.ac.th:8080/sutir/bitstream/123456789/1215/2/bongkot\\_fulltext.pdf](http://sutir.sut.ac.th:8080/sutir/bitstream/123456789/1215/2/bongkot_fulltext.pdf)*
- Thiele, J. E., Allen, C., & Stucky, M. (1999). *Effects of web-based instruction on learning behaviors of undergraduate and graduate students. Nursing and Health Care Perspectives*, 20(4), 199-203.

- Uzunboylu, H. (2004, June). *The effectiveness of web assisted English language instruction on the achievement and attitude of the students. Proceedings of World Conference on Educational Multimedia Hypermedia and Telecommunications held at Switzerland, Lugano* (pp. 727-733). Retrieved July 29, 2014 from <http://files.eric.ed.gov/fulltext/ED490528.pdf>
- Vaghela, I. V. (2000). *A study of academic achievement in relation to IQ and SES. The Progress of Education*, 74(7), 164-165.
- Yukselturk, E., & Bulut, S. (2005). *Relationships among self-regulated learning components, motivational beliefs and computer programming achievement in an online learning environment. Mediterranean Journal of Educational Studies*, 10(1), 91-112.
- Zimmerman, B. (2000). *Self-efficacy: An essential motive to learn. Contemporary Educational Psychology*, 25(1), 82-91.
- Zumbrunn, S., Tadlock, J., & Roberts, E. D. (2011). *Encouraging self-regulated learning in the classroom: A review of the literature. Metropolitan Educational Research Consortium: Virginia Commonwealth University*. Retrieved July 25, 2014 from [http://www.selfregulation.ca/download/pdf\\_documents/Self%20Regulated%20Learning.pdf](http://www.selfregulation.ca/download/pdf_documents/Self%20Regulated%20Learning.pdf)
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