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Effectiveness of computer based mastery learning strategy on learning outcomes of ninth graders' chemistry in relation to their academic stress and parental involvement

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Abstract
Till recently, various strategies have been tried in the field of education as far as mastering the study material by school children is concerned. In fact, it has been a topic of interest for many years. Today, Computer Based Mastery Learning is considered as one of the most effective means of attaining mastery learning. To explore the effectiveness of Computer based Mastery Learning Strategy on achievement in Chemistry of IX graders in relation to Academic Stress and Parental Involvement, a school sample of two hundred and forty 9th grade students of high and low Parental Involvement and Academic Stress was drawn from the representative Secondary Schools of Chandigarh. The major findings of the study were:

- The mean gain in Chemistry through Computer Based Mastery Learning was more than the mean gain through Conventional Group Learning.
- The gain means in Chemistry of the two Parental Involvement groups (High & Low) may not be treated as different beyond the contribution of chance factor and the observed mean difference may be ascribed to the chance factor alone.
- The gain means in Chemistry of the two groups (High and Low Academic Stress) may not be treated as different beyond the contribution of chance factor and the observed mean difference may be ascribed to the chance factor alone.
- The two variables Instructional Strategies (CBML&CGL) and Parental Involvement (High & Low) do not interact to yield difference in gain means in Chemistry and the two variables act independent of each other.
- The two variables Instructional Strategies (CBML&CGL) and Academic Stress (High & Low) do not interact to yield difference in gain means in Chemistry and two variables act independent of each other.
- The two variables parental Involvement (High & Low) and Academic Stress (High & Low) do not interact to yield difference in gain means in Chemistry and may be taken as independent of each other.
- The three variables Instructional Strategies, parental Involvement and Academic Stress interact with each other to yield differences in gain means in Chemistry for different combination groups:
- Students with High Parental Involvement and High Academic Stress attained higher gain means in chemistry through Computer Based Mastery Learning than through Conventional Group Learning.
- Students with High Parental Involvement and Low Academic Stress attained higher gain means through Computer based Mastery Learning than those with High Parental Involvement and Low Academic Stress studying through Conventional Group Learning.
- Students with Low Parental Involvement and High Academic Stress achieved higher gain means through Computer based Mastery Learning than those with Low Parental Involvement and High Academic Stress who were studying through Conventional Group Learning.
- Students with Low Parental Involvement and Low Academic Stress achieved higher gain means through Computer based Mastery Learning than those with Low Parental Involvement and Low Academic Stress who were studying through Conventional Group Learning.
- Students of Computer based Mastery Learning group with High Parental Involvement and with High Academic Stress achieved equal gain means in Chemistry as those with High Parental Involvement and Low Academic Stress studying through Computer based Mastery Learning.
- Conventional Group Learning students with High Parental Involvement having High Academic Stress attained equal gain means in Chemistry as those of Conventional Group Learning group having High Parental Involvement and Low Academic Stress.
- Computer based mastery learning group with Low Parental Involvement and High Academic Stress achieved equal gain means in Chemistry as Computer based mastery learning group with Low Parental Involvement and low Academic Stress group.
- Conventional Group Learning students with Low Parental Involvement and High Academic Stress are not different on their achievement gain means in Chemistry from their counterparts of Conventional Group Learning and Low Parental Involvement with Low Academic Stress.
- Students within Computer based mastery learning group with High Academic Stress; High Parental involvement group achieved equal gain means as those with Low Parental Involvement.
- Within Computer Based Mastery Learning group and Low Academic Stress, students with High Parental Involvement achieved equal gain means in Chemistry as those within similar group having low parental involvement.
- Students of Conventional Learning Group with High Parental Involvement and with High Academic Stress achieved equal gain means as those with Low Parental Involvement and High Academic Stress studying through Conventional Group Learning.
- Within Conventional Group Learning with Low Academic Stress; students with High Parental Involvement and those in Low Parental Involvement group achieved equal gain means in Chemistry.

Keywords: learning outcomes, computer based mastery learning (CBML), conventional group learning (CGL), academic stress (AS), parental involvement (PI)

Introduction: Computer Based Mastery Learning
Computer based learning is a method, which uses computers in a learning medium and strengthens students motivation and educational processes. It gives opportunities to both students and teachers to learn and teach more quickly and to combine active learning with computer technology. Collette and

Collette (1989) [5]. The studies show that computer based learning by way of simulation programs makes the concepts and processes more concrete and causes the students to understand more easily.Mastery learning as one of the important approaches to enhance student learning, was presented by Bloom (1966) and his associates based on Carroll's (1963) [3] model of school learning. It has been widely researched on and major projects have been carried out. MLS describe that the learning rate, LR, is a function of the time a learner has to learn to the time he actually needs to learn a given situation of instruction. Mastery Learning Strategy according to Bloom (1968a) [2] begins with the assumption that most students can attain a high level of learning capacity; if

- Instruction is approached systematically
- Students are helped when and where they have learning difficulty
- They are given sufficient time to achieve mastery, and
- There is some clear criterion of what constitutes mastery

The researches have authenticated that computer based instructions or the instructions which are delivered by computer plays a magic role in classes. Mastery of the subject matter is carried out with the help of a scientific computer based instructional plan. As mastery learning is highly planned instructional method to enhance learning based on the principle that learning rate is a function of the time a learner has to learn to the time he actually needs to learn. The students are not advanced to a subsequent learning objective until they demonstrate proficiency with the current one. Use of mastery principles with computers and with the help of parents seems to be an ideal situation for students to enjoy higher strides of success.

In Computer Based Mastery Learning, individualized remediation is the essential part that makes the teaching leaning process filled with fun for each student as it caters to the individual needs of every student and in this way leads to the mastery of the instructional.

Parental Involvement

Parental involvement has been seen as an important strategy for the advancement of the quality of education. The ultimate objective of this is to expand the social and cognitive capacities of pupils. Grolnick and Slowiaczek (1994) [7] denotes the extent to which as well as the way in which parents take a keen interest and actively participate in their child's education. Nurturing of children is directly related with home and parents. Parental Involvement implies how the parents involve themselves in developing the overall personality of the child. All parents have certain expectations, likes & dislikes and preferences regarding how children should be handled, brought up and educated.

Types of Parental Involvement

There can be two kinds of parent involvement, Hall & Sante (2000) [8].

A) Presence of Parents within the home ideally will include behaviours such as setting high expectations, monitoring homework, limiting television viewing or outside work, knowing a child's friends, discussing school events with children, valuing and talking about education, showing respect for teachers and all school staff.

B. The physical presence of parent's in the school, range from occasional attendance at a parent –teacher conference, regular participation in the school events, ongoing participation in school activities. Teachers and parents are all seen partners with their own but also shared tasks and responsibilities

Based on the factor analytic study of involvement indices by Grolnick and Slowiaczek (1994) [7], the investigator puts forth a multidimensional representation of Parental Involvement that focus on not one specific activity, but on various dimensions. According to this conceptualization, parents may show their involvement in the Childs schooling in three different ways viz:

1. **Behavior Involvement:** Parents may manifest their involvement through their *behaviors* i.e. their overt action may serve as indices of their involvement. They would include engaging in activities such as going to the child's school, meeting his teachers, attending parent-teacher meeting and the like. Parents are usually interested in knowing if their child is having any trouble in coping up with studies or not. Many research studies provide evidence for this form of involvement. One of the surveys (Chavkin and Williams, 1987) [4] found that the most frequent actions were:
   - Parent-teacher meeting.
   - Parents serving as chaperones.
   - Parents assisting with social activities.
   - Parents observing classrooms activities.
   - Open house or special programmes.
2. **Personal Involvement:** While parent's overt behavior is one way in which parents may exhibit their involvement in the child's schooling, the child may also have a more profound affective experience that his parents are providing resources to him and are concerned about him. The role of affective experiences and emotional climate at home has been worked upon by several researches. Studies have indicated the beneficial influence of emotionally supportive home situations on children's outcomes (e.g. Sauer and Gattringer,1985).
   This includes involvement in the academic and social life of the child. This would encompass activities such as: knowing about the child's day-to-day activities:
   - His whereabouts, friends, what he usually does at school.
   - How well he gets along with others.
   - How well is he doing in studies.
   - How regular and apt he is in his school work
   - How well he performs in examinations, and the like.
3. **Cognitive Stimulation and Cognitive Behaviors:** Exposing the child to cognitively stimulating activities and materials represents a historically new role for parents in fostering children's cognitive development (Lareau, 1987). Parental stimulation has been defined by Belsky, Goode, and Most (1980) as efforts to focus the infant's attention on objects and events within the environment. These attempts can be physical or verbal in nature. Parents should therefore ensure that their children are brought up in a

stimulating, thought provoking surrounding. School must organize such activities from time to time that could encourage parents to pursue at home, behaviors that encourage learning in their children and indicate a value for schooling. Such school activities must be conducted that support the teacher-parent relationship.

Learning Outcomes

'Learning' refers to the acquisition of behaviour being developed by the new Stimulus Response Connections. It is relatively permanent behaviour change tendency and is the result of reinforced practice **(**Kimble and Garmezy, 1963, Melvin, 1970) [9].

According to Encyclopedic Dictionary and Directory of Education (1971) learning outcome is *a* result of experience in or outside the school stated in terms of pupil behavior. The outcomes of learning resulting from learning activities may be skills and habits, social competence, abstract and creative thinking.

Achievement is one of the most important goals of education. The outcomes of education are usually characterized as the achievement of those who have been educated. These may be expressed in terms of whether or not the aims of education were fulfilled in relation to those individuals and to that degree. In order to find out what has been achievement, one requires some form of assessment.

Academic Stress

Academic Stress is mental distress with respect to some anticipated frustration associated with academic failure or even an awareness of the possibility of such failure, Gupta and Khan (1987). In the context of school, academic stress means a pervasive sense of urgency to learn all those things which are related or prescribed by the school, Shah (1988). Lazarus (1966) pointed out that stress is a threat, real or implied to the psychological or physiological integrity of an individual. Stress involves a stressor and stress response and stressors are generally psychological. Lazarus (1982) emphasized the role of perception and cognitive appraisal in the stress response process. He argued that unless we perceive a situation threatening, we will not experience stress. Stress has always been a concern of physiologists and psychologists who view the concept in different ways.

Relationship among all Variables i.e., Computer Based Mastery Learning, Learning Outcomes, Parental Involvement and Academic Stress.

The researches have authenticated that computer based instructions or the instructions which are delivered by computer plays a magic role in classes. Mastery of the subject matter is carried out with the help of a scientific computer based instructional plan. As mastery learning is highly planned instructional method to enhance learning based on the principle that learning rate is a function of the time a learner has to learn to the time he actually needs to learn. The students are not advanced to a subsequent learning objective until they demonstrate proficiency with the current one.

Stress makes a significant contribution to the prediction of subsequent school performance and acts as a negative predictor of academic performance in school children.

Learning habits to combat academic stress can bring benefits beyond the classroom. Results showed that there is a consistent positive effect of computer based mastery learning strategy on learning outcomes of students. In the present investigation, computer based mastery learning has resulted into higher achievement in gain scores of physics, chemistry and biology as against conventional group learning strategy. These results reveal that there is a consistent positive effect of computer based mastery learning strategy on learning outcomes of students.

Use of mastery principles with computers and with the help of parents seems to be an ideal situation for students to enjoy higher strides of success

The outcomes of the study, which are studied in relation to Academic stress and parental involvement, revealed the importance of quality of instruction, time allowed for learning, motive for learning a task and proper use of strategy for accomplishing a task that promotes quality of learning.

In Computer Based Mastery Learning, individualized remediation is the essential part that makes the teaching leaning process filled with fun for each student as it caters to the individual needs of every student and in this way leads to the mastery of the programmed material or the content by every one of them. In this way, the Mastery Learning being the best learning strategy, affects the learning greatly that every student attains much high scores as compared to the conventional method of teaching.

As far as the variable Parental Involvement is concerned, when parents take interest in the school as well as at home in the studies of their child, this variable,independently, positively affects the students' overall achievement in the academics. In this study, Computer Based Mastery Learning has been proved to be such a powerful Strategy that in the presence of it gain means (Gain mean Scores in Chemistry) even due to High and Low Parental Involvement may not be treated as different beyond the contribution of chance factor.

Similarly, individual effect of Academic Stress leads to various behavioural, physiological and psychological health hazards but when Computer Based Mastery Learning Strategy is applied for instruction in the classroom, The gain means (Mean Gain Scores in Chemistry) of the two groups due to academic stress (High & Low) may not be treated as different beyond the contribution of chance factor. There occurs no significant interaction effect of Academic Stress and Instructional Strategy. For Computer Based Mastery Learning individually engross students so much in the teaching – learning process that the effect of Academic Stress is almost nullified.

Again, there is no significant interaction effect of Instructional Strategy, Parental Involvement and Academic Stress, for, both Parental Involvement (High & Low) and Academic Stress (High & Low) almost loses their effect in the presence of highly effective Computer Based Mastery Learning Strategy.

Review of the related literature

The results of the present investigation were supported by research findings of Robert L. Bangert-Drowns Kulik, James A. Kulik (1990) [13] who showed that mastery learning programs have positive effects on the examination performance of students in colleges, high schools, and the

upper grades in elementary schools. *Laney, James D. et al. (1995)* [14] explored the effects of cooperative and Mastery Learning methods, alone and in combination, on first and second grade student's learning and retention of basic economic facts. The study suggests that the cooperative-Mastery Learning method is in line with current early childhood practices and has the capacity for simultaneously boosting the conceptual development and language development of young children. *Kuchler, (1999)* [11] suggested that CAI has only an overall small positive effect on mathematics achievement. The most effective CAI mode appears to be 'drill and practice" CAI appears to be equally effective across gender and grade level but has a greater positive impact on students from low socio-economic backgrounds. *Preciado, Christina (2005)* Conducted a study on CAI field test, the results of which were encouraging and suggest that the proposed methodology can be effective in performing its task. Piia Maria Björn[a*] & Paavo Leppänen (2013) [1] examined the results of Fast ForWord® training on English decoding-related skills. The students' English skills were examined in pre-test, post-test and follow-up measurements. The TRG (Training Group) students saw an acceleration in decoding-related skills. Lin, Chun-Hung; Liu, Eric Zhi-Feng; Chen, Yu-Liang; Liou, Pey-Yan; Chang, Maiga; Wu, Cheng-Hong; Yuan, Shyan-Ming(2013)in their study sought to compare the effectiveness of game-based and video-based remedial instruction incorporated with elements of mastery learning. The results demonstrate that (a) both instructional videos and the proposed Monopoly game enhance the learning of mathematical concepts; and (b) the Monopoly game is more effective than instructional videos at leveraging the benefits of mastery learning. The goal of the research was to integrate games and mastery learning into after-school remedial instruction and design a game to practice the steps of mastery learning. Cindy De Smet[ab*], Tammy Schellens[a], Bram De Wever[a], Pascale Brandt-Pomares[c] & Martin Valcke (2014) conducted a quasi-experimental study in the context of a biology course involving 360 secondary school students. A 2×2 factorial research design was adopted. The study provides empirical evidence that both the design and the group setting (collaborative versus individual) have an impact on learning outcomes. Although there was no main effect, several significant interaction effects with gender were found. The results are helpful to direct research about the design and implementation of learning paths in a secondary school setting and underpin the relevance of representation modes in science learning. Peter, *Ronoh*, Monicah Ndonga(2014) found that students taught using CBML(Computer Based Mastery Learning) approach had significantly higher scores in SMQ (Students' Motivation Questionnaire) than those taught using conventional approaches and found that there is no gender difference in motivation when CBML is used. They recommended that CBML teaching strategy be incorporated in teacher education programs. Marko; van de Schoot, Rens; Schober, Barbara; Finsterwald, Monika; Spiel, Christiane (2014) [17] examined that achievement and goal orientations are important for students' ongoing motivation. Students with a mastery goal orientation show the most advantageous achievement and motivational patterns. Much research has been conducted to identify classroom structures which promote students' mastery goal orientation. The TARGET framework is one example of these efforts and provides six instructional dimensions (task, authority, recognition, grouping, evaluation, time), which should form a classroom structure that fosters a mastery goal orientation. This study also provides the first empirical evidence, based on longitudinal data, that TARGET has a positive impact on student mastery goal orientation. Gladding, Gary; Gutmann, Brianne; Schroeder, Noah; Stelzer, Timothy (2015) [6] carried out a clinical study using first- and second-year university students where the mastery group attempted question sets in four levels, with animated solutions between each attempt, until mastery was achieved on each level. This combined elements of formative assessment, the worked example effect, and mastery learning. The homework group attempted questions with immediate feedback and unlimited tries. The two groups took a similar amount of time to complete the activity. The mastery group significantly outperformed the homework group on a free response post-test that required students to show their work in solving near and far transfer problems.

It is clear from the above review of literature that computers in education, computer assisted instruction and multimedia programme in teaching has an important present status in the present scenerio. From the findings of the recent researches on the students' performance, the need for effective teaching was felt. Hence it was understood that very few studies have been conducted to see the effect of multimedia programme on the students' performance. The very little studies have been concentrated on how students can be motivated through multimedia programme and also concentrated on the high and low achievers. Hence it was inferred that only a few researches have been attempted in multimedia programme in other subjects and Chemistry in particular at the school level. The summary of related studies helped the investigator in identifying the research gaps in the area of the study. Thus in the present study, an attempt has been made to study the effectiveness of multimedia programme in perceiving Chemistry among higher secondary students. The investigator has formulated the objectives, hypotheses and research design based on the findings of the previous studies.

Objectives

The study was conducted with following objectives

1. To develop and validate computer based mastery learning (CBML) instructional package in Chemistry for IX graders.
2. To study the impact of computer based mastery learning instructional packages on learning outcomes viz. achievement in Chemistry of IX graders.
3. To study the effect of academic stress on the learning outcomes viz. achievement in Chemistry of IX graders.
4. To study the effect of parental involvement on learning outcomes viz. achievement in Chemistry of IX graders.
5. To study the interaction effect of Instructional Strategies and academic stress on the learning outcome viz. achievement in Chemistry of IX graders.
6. To study the interaction effect of Instructional Strategies and parental involvement on learning outcomes viz.

achievement in Chemistry of IX graders.
7. To study the interaction effect of academic stress and parental involvement on learning outcomes viz. achievement in Chemistry of IX graders.
8. To study the interaction effect of Instructional Strategies, Academic stress and Parental involvement on learning outcomes viz. achievement in Chemistry of IX graders.

Hypotheses

The following hypotheses were formulated and tested:

Ho.1: There is no difference in the mean gain scores in Chemistry of IX graders when taught by Computer Based Mastery Learning and Conventional Group Learning.

Ho.2: There is no difference in the mean gain scores in Chemistry of IX graders with high and low Parental involvement.

Ho.3: There is no difference in the mean gain scores in Chemistry of IX graders with high and low Academic stress.

Ho.4: There is no interaction between Instructional Strategies and Parental involvement in respect of mean gain scores in Chemistry of IX graders.

Ho.5: There is no interaction between Instructional Strategies and Academic stress in respect of mean gain scores in Chemistry of IX graders.

Ho.6: There is no interaction between Academic stress and Parental involvement in respect of mean gain scores in Chemistry of IX graders.

Ho.7: There is no significant interaction among Instructional Strategies, Academic stress and Parental involvement in respect of mean gain scores in Chemistry of IX grader.

Sample

The research investigation was carried out on the students of IX th grade. The students ranged between 13 – 15 years of age. The sample was selected from the representative coeducational English medium senior secondary schools located in Chandigarh. The names of schools selected for the experiment have been listed below:

1. Shivalik Public School, 41-B, Chandigarh
2. DAV Senior Secondary School, Sec.8 Chandigarh

These two schools were assessed for matching of general background of the students and their entry behaviour knowledge (through Entry Behaviour Test). Both of these schools were found to be matched. Shivalik Public School, 41-B, Chandigarh was selected randomly for Experimental Group and DAV Senior Secondary School, Sec.8 Chandigarh was selected as control group. The control group was taught through Conventional method of teaching by their own teacher.Because of administrative constraints of the school, the experimental treatment was given to all the 150 students in three sections. During the process of experimentation that lasted for approximately 3 months, some students dropped out at one stage or the other. These students therefore were not considered at the time of analysis. The classification of students on the basis of Academic stress (high and Low) and parental involvement (high and Low) was done at the time of analysis. The final sample for analysis thus comprised of N= 92 Students.

Table 1: Final Sample according to Instructional Treatment

S. No.	Instructional Treatment	No. of Students Initial	
		ungrouped sample	final sample
1	Experimental Group	50+50+50	46
2	Conventional Group	30+36+34	46
	Total	240	92

Tools Used

The following tools were used for collecting data:

1. Parental involvement Scale: Developed and validated by Ahuja, M. and Sharma, Nidhi (2002)
2. Academic stress: Developed and validated by Abha Bisht (1987).
3. Entry Behaviour Test –Developed and validated by Ashu Malhan.
4. Formative Tests Developed and validated by the investigator separately for each unit.
5. Enrichment – material for early masters (Identified by the investigator from the related literature on the content).
6. Remedial instruction (provided with the help of Power Point Presentations used by the students according to their requirements including peer- tutoring developed and validated by the investigator).
7. Summative Tests for a group of 8 units of Chemistry (developed and validated by the investigator).

Computer based Mastery learning Instructional package: (developed and validated by investigators). The instructional package was based on Bloom's Mastery learning Strategy. The total package consisted of Content sequence, Enduring Understanding,Formulation of Objectives, orientation Session, Warm up session, Formative Test after every unit, Remediation (1 or 2 Rounds), Enrichment, Summative test.

The CBML package consisted of 8 units of Chemistry developed by investigators based on the cognitive skills, objectives and content matter taken from the syllabi of the IX class prescribed by National Council of Educational Research and Training, New Delhi. The topics selected were discussed with science teachers to scrutinize which content has to be taught. Instructional Objectives were written in behavioral terms and Sensitivity Indices were calculated for each item. Reliability coefficient for each Unit Formative Test was also calculated. Sensitivity indices & Reliability coefficient for all

the Summative Tests of Biology were also calculated. Unit Formative Test & Summative Tests were found reliable as well as valid.

Analysis and Interpretation of Data

Since the study was experimental in nature employing a 2x2x2 factorial design, an analysis of variance was proposed for analyzing data as the performance tests yielded the scores out of 75 for Chemistry. The subject scores were transferred on to the base of 100.

a) Descriptive Analyses on Gain Scores in Chemistry

The means, SD's of Experimental and Control groups across parental Involvement and Academic Stress have been recorded in table no.2.

Table 2: Table for Means and SD's of Chemistry Gain scores

	CBML		CGL	
	(Experimental group)		(Control group)	
	HPi	LPI	HPI	LPI
HAS	M =43.73	M =46.58	M =28.58	M =24.09
	N =11	N =12	N =12	N =11
	SD =8.84	SD =10.6	SD =8.58	SD =7.82
LAS	M =41.6	M =46.38	M =22.83	M =23.27
	N =10	N =13	N =12	N =11
	SD =8.76	SD =9.44	SD =7.02	SD =7.32
Total	M=42.72	M=46.48	M=25.71	M=23.68
	N=21	N=25	N=24	N=22
Total	M=44.76		M= 24.74	
	N=46		N=46	

CBML= Computer Based Mastery Learning and **CGL=**and Conventional Group Learning

HPI=High Parental Involvement and LPI= and Low parental involvement groups

HAS=High Academic Stress and LAS= Low Academic Stress

2x2x2 Analysis of Variance on Gain Scores in CHEMISTRY in relation to Instructional Strategies, Parental Involvement and Academic Stress.

The sample data as depicted in the table 2 showed variation in means on Chemistry Gain scores for selected two groups-experimental and conventional. To study whether the difference in means of the two groups was significant or not, a 2x2x2 analysis of Variance was applied on Chemistry Gain scores. Therefore sum of squares and F-ratios for main effects and two order and three order interaction effects were calculated and have been recorded in the following table no. 3. As it is shown in the table no. 2, the details of the Chemistry Gain scores for Experimental Group and Control Group across PI (high & low) and AS (high & low) levels have been given separately in two halves. The means and SD's have also been presented for each sub-group. Their means have been depicted on the bar diagrams given below:

b) Bar diagrams for Gain Scores in Chemistry

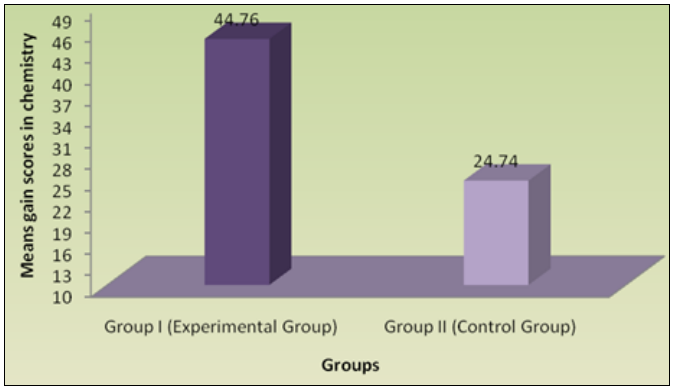

Fig 1: Bar Graph Showing the Means of Two Selected Groups on Gain Scores in Chemistry

The sample data as depicted in the table 1.1 and bar diagram, showed variation in means on Chemistry Gain scores. To study whether the difference in means was significant or not, 2x2x2 analysis of Variance was applied on Chemistry Gain scores.

2x2x2 Analyses of Variance on Gain Scores in Chemistry in relation to Instructional Strategies, Parental Involvement and Academic Stress.

A similar 2x2x2 ANOVA was employed to analyse Gain Scores in Chemistry.

This analysis has been done to test the following hypotheses:

Ho.1: There is no difference in the mean gain scores in Chemistry of IX graders when taught by Computer Based Mastery Learning and Conventional Group Learning.

Ho.2: There is no difference in the mean gain scores in Chemistry of IX graders with high and low Parental involvement.

Ho.3: There is no difference in the mean gain scores in Chemistry of IX graders with high and low Academic stress.

Ho.4: There is no interaction between Instructional Strategies and Parental involvement in respect of mean gain scores in Chemistry of IX graders.

Ho.5: There is no interaction between Instructional Strategies and Academic stress in respect of mean gain scores in Chemistry of IX graders.

Ho.6: There is no interaction between Academic stress and Parental involvement in respect of mean gain scores in Chemistry of IX graders.

Ho.7: There is no significant interaction among Instructional Strategies, Academic stress and Parental involvement in respect of mean gain scores in Chemistry of IX graders.

The sum of squares and F-ratios for main effects, interaction effects of instructional strategy, parental Involvement and Academic Stress have been recorded in the following table no. 1.2.

Table 3: summary of Analysis of Variance for the Gain Scores Chemistry.

Source of Variation	SS	df	MSS	F-Value
Main Effect A: Instructional Strategies; CBML vs. CGL	9220.01	1	9220.01	**28.6****
B: Parental Involvement	107.712	1	107.712	0.33
C:Academic Stress	106.532	1	106.532	0.33
Two Order Interactions: A x B Instructional Strategies x Parental Involvement	101.271	1	101.271	0.31
AxC Instructional Strategies x Academic Stress	35.316	1	35.316	0.11
B x C Parental Involvement x Academic Stress	117.349	1	117.349	0.36
Three Order Interaction: (A x B x C)	99966.758	1	99966.758	**309.90****
Within Group (Error)	27096.242	84	322.574	
Total	**136751.19**	**91**		

**Significant at 0.01 Level *Significant at 0.05 Level

It may be observed from the table no. 1.2 that the F-ratio for the difference between mean gains in Chemistry due to instructional strategies (Computer Based Mastery Learning and Conventional Group Learning) has been found 28.6 which is significant at the.01 level of confidence. It indicates that the null hypothesis for equality of the means *Ho.1:* There is no difference in the mean gain scores in Chemistry of IX graders when taught by Computer Based Mastery Learning and Conventional Group Learning, was rejected at the.01 level of confidence. The mean gains in Chemistry through the two strategies were found different. The observation of their respective means (table 1.1) may be observed that the mean gain in Chemistry through computer based mastery learning (M=44.76) was more than the mean gain through conventional group learning (M=24.74).

It may be observed from the table 1.2 that F-ratio for the difference in mean gains of the two parental Involvement groups (High & Low) was 0.33 which is less than the table value of F at the.05 level of confidence. Hence the null hypothesis; *Ho.2:* There is no difference in the mean gain scores in Chemistry of IX graders with high and low Parental involvement, could not be rejected even at the.05 level of confidence. It suggests that the gain means in Chemistry of the two Parental Involvement groups (High & Low) may not be treated as different beyond the contribution of chance factors and the observed mean difference may be ascribed to chance factor alone.

It may be observed that the table 1.2 that the F-ratio for the difference in mean gains in Chemistry of the two Academic Stress groups (High & Low) was 0.33 which is less than the table value of F at the.05 level of confidence. Hence the null hypothesis; *Ho.3:* There is no difference in the mean gain scores in Chemistry of IX graders with high and low Academic stress, could not be rejected even at the.05 level of confidence. It suggests that the gain means in Chemistry of the two groups (High and Low Academic Stress) may not be treated as different beyond the contribution of chance factor and the observed mean difference may be ascribed to the chance factor alone.

It may be observed from the table 1.2 that F-ratio for the interaction effect between Instructional Strategies and Parental Involvement in mean gains in Chemistry of the groups was 0.31 which is less than the table value of F even at the.05 level of confidence. Hence the null hypothesis; *Ho.4:* There is no interaction between Instructional Strategies and Parental involvement in respect of mean gain scores in Chemistry of IX graders, could not be rejected even at.05 level of confidence. It suggests that the two variables Instructional Strategies and Parental Involvement (High & Low) do not interact to yield difference in gain means in Chemistry and the two variables act independent of each other.

It may be observed from the table 1.2 that the F-ratio for the interaction between Instructional Strategy and Academic Stress was 0.11 which is less than the table value of F at the.05 level of confidence. Hence the null hypothesis; *Ho.5:*There is no interaction between Instructional Strategies and Academic stress in respect of mean gain scores in Chemistry of IX graders, could not be rejected even at the.05 level of confidence. It suggests that the two variables Instructional Strategies (CBML & CGL) and Academic Stress (High & Low) do not interact to yield difference in gain means in Chemistry and the two variables act independent of each other.

It can be observed from the table 1.2 that the F-ratio for the interaction between parental Involvement and Academic Stress was 0.36 which is less than the table value of F at the.05 level of confidence. Hence the null hypothesis of no interaction; *Ho.6:* There is no interaction between Academic stress and Parental involvement in respect of mean gain scores in Chemistry of IX graders, could not be rejected even at the.05 level of confidence. It suggests that the two variables parental Involvement (High & Low) and Academic Stress (High & Low) do not interact to yield difference in gain means in Chemistry and may be taken as independent of each other.

It may be observed from the table 1.2 that the F-ratio for the three order interaction among Instructional Strategies, parental Involvement and Academic Stress in respect of mean gains was found to be significant at the.01 level of confidence. Hence the null hypothesis; *Ho.7:* There is no significant interaction among Instructional Strategies, Academic stress and Parental involvement in respect of mean gain scores in Chemistry of IX grader, was rejected at the.01 level of confidence. It suggests that the three variables Instructional Strategies (CBML&CGL), parental Involvement (High & Low) and Academic Stress (High & Low) interact with each other to yield differences in gain means in Chemistry for different combination groups. The extent of their interaction has further been examined with the help of the t-ratios for the difference between different combination pairs of corresponding means. The means and the corresponding t-ratios have been calculated to test the following sub-

hypotheses and have been given in table 3 below:

Ho.7.1 For High Parental Involvement and High Academic Stress, mean gain scores in Chemistry through Computer based Mastery Learning and Conventional Group Learning are not different.

Ho7.2 For High Parental Involvement and Low Academic Stress, mean gain scores in Chemistry through Computer based Mastery Learning and Conventional Group Learning are not different.

Ho7.3 For Low Parental Involvement and High Academic Stress, achievement gain mean scores in Chemistry through Computer based Mastery Learning and Conventional Learning Groups are not different.

Ho7.4 For Low Parental Involvement and Low Academic Stress, achievement gain mean scores in Chemistry through Computer based Mastery Learning and through Conventional Group Learning are not different.

Ho7.5 For Computer based Mastery Learning group with High Parental Involvement gain mean scores in Chemistry for High Stress group are not different from Low Stress group studying through Computer based Mastery Learning.

Ho7.6 For High Parental Involvement, mean gain scores in Chemistry through conventional Group Learning having High Academic Stress are not different from those with conventional Group having Low Academic Stress.

Ho7.7 Within computer based mastery learning students with low parental involvement, the achievement gain means in Chemistry are not different for high academic stress & low academic stress.

Ho7.8 For Conventional Group Learning and Low Parental Involvement, High Academic Stress and Low Academic Stress groups are equal on achievement gain mean scores in Chemistry.

Ho7.9 Within computer based mastery learning and High Stress students, gain mean scores in Chemistry for High Parental Involvement are not different from those in Low Parental Involvement group.

Ho7.10 Within computer based mastery learning students with low academic stress the achievement gain means in Chemistry are not different for high Parental Involvement & low Parental Involvement.

Ho7.11 Within Conventional group learning and High Stress group gain mean scores in Chemistry for High Parental Involvement are not different from that of Low Parental Involvement.

Ho7.12 Within Conventional Group Learning students with low academic stress the achievement gain means in Chemistry are not different for high & low Parental Involvement group.

Table 3: t–ratios for difference between Means of Different combination pairs of Two Treatment Groups for Achievement Gain Mean Scores in Chemistry

Combination Group	CBML				CGL			
	HPI		LPI		HPI		LPI	
	HAS	LAS	HAS	LAS	HAS	LAS	HAS	LAS
	M=43.73 N =11	M=41.6 N=10	M=46.58 N =12	M=46.38 N =13	M=28.58 N =12	M=22.83 N =12	M=24.09 N =11	M=23.27 N =11
CBML/HPI/HAS	-	1.09	0.38	0.36	2.04*	2.81*	2.56*	2.67*
CBML/HPI/LAS		-	0.65	0.63	1.71	2.46*	2.23*	2.34*
CBML/LPI/HAS			-	0.03	2.51*	3.31**	3.03**	3.14**
CBML/LPI/LAS				-	2.5	3.31**	3.03**	3.14**
CGL/ HPI/ HAS					-	0.79	0.60	0.71
CGL / HPI/ LAS						-	0.17	0.06
CGL / LPI/ HAS							-	0.11
CGL / LPI/ LAS								-

- **With HPI and HAS**

CBML Vs CGL

It may be observed from the table 3 above that t-values for the difference between High Parental Involvement and High Academic Stress Group taught with Computer Based Mastery Learning and High Parental Involvement and High Academic Stress group taught with Conventional Group Learning was found to be significant at the.05 level of confidence. The difference in gain means was considered beyond the contribution of chance. Hence, the null hypothesis; *Ho.7.1:*For High Parental Involvement and High Academic Stress, mean gain scores in Chemistry through Computer based Mastery Learning and Conventional Group Learning are not different, was rejected at the 0.05 level of confidence. Hence the mean of both the groups may be taken as different. The observation of their mean indicates that students with High Parental Involvement and High Academic Stress attained higher gain means in chemistry through CBML (M = 43.73) than through CGL (M = 28.58).

- **With HPI and LAS**

CBML Vs CGL

It may be observed from the table 3 that t-value for the difference in gain mean scores for High Parental Involvement and Low Academic Stress Group taught with Computer based Mastery Learning and High Parental Involvement and Low Academic Stress Group taught with Conventional Group Learning was found to be significant at the.05 level of confidence. The means of both the groups were different. Hence, the null hypothesis; *Ho.7.2:* For High Parental Involvement and Low Academic Stress, mean gain scores in Chemistry through Computer based Mastery Learning and Conventional learning groups are not different, was rejected in favour of a finding that students with High Parental Involvement and Low Academic Stress attained higher gain means (M = 41.6) through Computer based Mastery Learning than those with High Parental Involvement and Low Academic Stress studying through Conventional group learning (M = 22.83).

- **With LPI and HAS**

CBML Vs CGL

It may be observed from the table that t-ratio for the difference between Low Parental Involvement and High Academic Stress Group, taught with Computer based Mastery Learning and Low Parental Involvement and High Academic Stress Group taught with Conventional Group Learning was found to be significant at the.01 level of confidence. Hence the means of both the groups were different. Hence, the null hypothesis; *Ho.7.3:*For Low Parental Involvement and High Academic Stress, achievement gain mean scores in Chemistry through Computer based Mastery Learning and Conventional Learning groups are not different, was rejected at 0.01 level of confidence. It leads to conclude that students with Low Parental Involvement and High Academic Stress achieved higher gain means (M=46.58) through Computer based Mastery Learning than those with Low Parental Involvement and High Academic Stress who were studying through Conventional Group Learning (M = 24.09).

- **With LPI and LAS**

CBML Vs CGL

It may be observed from the table that t- ratio for the difference between Low Parental Involvement and Low Academic Stress Group, taught with Computer based Mastery Learning and Low Parental Involvement and Low Academic Stress Group taught with Conventional Group Learning was found to be significant at the.01 level of confidence. The difference in gain means was considered beyond the contribution of chance. Hence, the null hypothesis; ***Ho.7.4:*** For Low Parental Involvement and Low Academic Stress, achievement gain mean scores in Chemistry through Computer based Mastery Learning and through Conventional group Learning are not different, was rejected at 0.01 level of confidence. The observation of their gain means leads to conclude that students with Low Parental Involvement and Low Academic Stress achieved higher gain means (M = 46.38) through Computer based Mastery Learning than those with Low Parental Involvement and Low Academic Stress who were studying through Conventional Group Learning (M = 23.27).

- **With CBML / HPI**

HAS Vs LAS

It may be observed from the table 3 that the t-value for the difference between High Parental Involvement and High Academic Stress Group, taught with Computer based Mastery Learning and the other group with High Parental Involvement and Low Academic Stress taught with Computer based Mastery Learning was not found to be significant even at the.05 level of confidence, suggesting that the two gain means were not different. Hence, the null hypothesis; *Ho.7.5:* For Computer based Mastery Learning group with High Parental Involvement gain mean scores in Chemistry for High Stress group are not different from Low Stress group studying through Computer based Mastery Learning, was not rejected even at 0.05 level of confidence. Hence the mean of both the groups may not be taken as different. It leads to conclude that students of Computer based Mastery Learning group with High Parental Involvement and with High Academic Stress achieved equal gain means in Chemistry as those with High Parental Involvement and Low Academic Stress studying through Computer based Mastery Learning.

- **With CGL / HPI**

HAS Vs LAS

It may be observed from the table that t-value for the difference between High Academic Stress Group taught with Conventional Group Learning having High Parental Involvement and Low Academic Stress Group taught with Conventional Group Learning having High Parental Involvement was not found to be significant even at the.05 level of significance. The observed difference in gain means was considered to be contribution of chance factor only. Hence, the null hypothesis; *Ho.7.6:* For High Parental Involvement, mean gain scores in Chemistry through conventional Group Learning having High Academic Stress are not different from those with conventional Group having Low Academic Stress, was not rejected at the 0.05 level of confidence. The mean of both the groups may not be taken as different. It may be concluded that Conventional Group Learning students with High Parental Involvement having High Academic Stress attained equal gain means in Chemistry as those of Conventional Group Learning group having High Parental Involvement and Low Academic Stress.

- **With CBML / LPI**

HAS Vs LAS

It may be observed from the table 3 that the t-value for the difference between High Academic Stress Group taught with Computer Based Mastery Learning having Low Parental Involvement and Low Academic Stress Group taught with Computer Based Mastery Learning having Low Parental Involvement was not found to be significant even at the.05 level of confidence. This indicates that both these groups are not different on their gain means in Chemistry. The *Ho.7.7* stating Within computer based mastery learning students with low parental involvement, the achievement gain means in Chemistry are not different for high academic stress & low academic stress, was not rejected in favour of the finding that Computer based mastery learning group with Low Parental Involvement and High Academic Stress achieved equal gain means in Chemistry as Computer based mastery learning group with Low Parental Involvement and low Academic Stress group.

- **With CGL / LPI**

HAS Vs LAS

It may be observed from the table 3 that t-value for the difference between Low Parental Involvement Group taught with Conventional Group Learning having high academic stress and Low Parental Involvement Group taught with Conventional Group Learning having low academic stress was not found to be significant even at the.05 level of confidence. The gain means of both the groups were not found different. Hence, the null hypothesis; *Ho.7.8:* For Conventional Group Learning and Low Parental Involvement, High Academic Stress and Low Academic Stress groups are equal on achievement gain mean scores in Chemistry, was not rejected in favour of the finding that Conventional Group Learning

students with Low Parental Involvement and High Academic Stress are not different on their achievement gain means in Chemistry from their counterparts of Conventional Group Learning and Low Parental Involvement with Low Academic Stress.

- **CBML/ /HAS**

HPI Vs LPI

It may be observed from the table 3 that the t-value for the difference between High Parental Involvement group with High Academic Stress taught with Computer Based Mastery Learning and the Low Parental Involvement group with High Academic Stress taught with Computer Based Mastery Learning was not found to be significant even at the.05 level of confidence, suggesting that the two means were not different. The difference in gain means was considered to be contribution of chance. Hence, the null hypothesis; *Ho.7.9:* Within computer based mastery learning and High Stress group, gain mean scores in Chemistry for High Parental Involvement are not different from those in Low Parental Involvement group,was not rejected even at 0.05 level of confidence. It leads to conclude that students within Computer Based Mastery Learning group with High Academic Stress; High Parental involvement group achieved equal gain means as those with Low Parental Involvement.

- **With CBML / LAS**

HPI Vs LPI

It may be observed from the table 3 that the t-value for the difference between Computer Based Mastery Learning group having High Parental Involvement and Low Academic Stress and Computer Based Mastery Learning group having Low Parental Involvement and Low Academic Stress was not found to be significant even at the.05 level of confidence. This indicates that both these groups are not different on their gain means in Chemistry. The *Ho.7.10* stating 'Within computer based mastery learning students with low academic stress the achievement gain means in Chemistry are not different for high Parental Involvement & low Parental Involvement' was not rejected even at 0.05 level of confidence. It leads to conclude that within Computer Based Mastery Learning group and Low Academic Stress, students with High Parental Involvement achieved equal gain means in Chemistry as those within similar group having low parental involvement

- **With CGL/HAS**

HPI/LPI

It may be observed from the table 3 that the t-value for the difference between High Parental Involvement and High Academic Stress Group taught with conventional group learning and the other Low Parental Involvement and High Academic Stress Group taught with conventional group learning was not found to be significant even at the.05 level of confidence, suggesting that the two means were not different. The difference in gain means was considered to be contribution of chance. Hence, the null hypothesis; *Ho.7.11:* Within Conventional group learning and High Stress group, gain mean scores in Chemistry for High Parental Involvement group are not different from that of Low Parental Involvement,was not rejected even at 0.05 level of confidence. It leads to conclude that students of Conventional learning group with High Parental Involvement and with High Academic Stress achieved equal gain means as those with Low Parental Involvement and High Academic Stress studying through conventional group learning**.**

- **With CGL/LAS**

HPI/LPI

It may be observed from the table 3 that the t-value for the difference between High Parental Involvement group with Low Academic Stress taught with Conventional Group Learning and Low Parental Involvement group with Low Academic Stress taught with Conventional Group Learning was not found to be significant even at the.05 level of confidence. This indicates that both these groups are not different on their gain means in Chemistry. The *Ho.7.12: stating "Within Conventional Group Learning students with low academic stress the achievement gain means in Chemistry are not different for high & low Parental Involvement groups."* was not rejected. It leads to conclude that within conventional group learning with Low Academic Stress; students with High Parental Involvement and those in Low Parental Involvement group achieved equal gain means in Chemistry.

For some odd combination groups

Although the hypotheses relevant to the present investigation have been tested and conclusions were drawn. However it may be observed from the table 3 that t-ratios for the difference in gain mean scores in Chemistry were found to be significant at the.01 level of confidence for the following odd groups:

- CBML/LPI/HAS group achieved higher gain means than CGL/HPI/LAS group
- CBML/LPI/HAS group achieved higher gain means than CGL/LPI/LAS group
- CBML/LPI/LAS group achieved higher gain means than CGL/HPI/HAS group
- CBML/LPI/LAS group achieved higher gain means than CGL/LPI/HAS group

The table 3 also shows that some of the t-ratios for difference in gain means in Chemistry were found to be significant at the.05 level of confidence for the following odd groups:

- CBML/HPI/HAS group achieved higher gain means in chemistry than CGL/HPI/LAS group
- CBML/HPI/HAS group achieved higher gain means in chemistry than CGL/LPI/HAS group
- CBML/HPI/LAS group achieved higher gain means in chemistry than CGL/LPI/HAS group
- CBML/HPI/LAS group achieved higher gain means in chemistry than CGL/LPI/LAS group
- CBML/LPI/HAS group achieved higher gain means in chemistry than CGL/HPI/HAS group
- CBML/HPI/HAS group achieved higher gain means in chemistry than CGL/LPI/LAS group

However t-ratios for the difference in mean gain scores in Chemistry were not found to be significant for the following combination odd groups Viz.:

- CBML/HPI/HAS and CBML/LPI/LAS achieved equal gain means in Chemistry.

- CBML/HPI/LAS and CBML/LPI/HAS achieved equal gain means in Chemistry.
- CBML/HPI/LAS and CGL/HPI/HAS achieved equal gain means in Chemistry.
- CBML/LPI/LAS and CGL/HPI/HAS achieved equal gain means in Chemistry.
- CGL/HPI/HAS and CGL/LPI/LAS achieved equal gain means in Chemistry.
- CGL/HPI/LAS and CGL/LPI/HAS achieved equal gain means in Chemistry

Discussion of Results

On the Bases of findings there exists a significant difference between Computer Based Mastery Learning as against Conventional Group Learning as far as achievement of ninth graders in Chemistry is concerned. It is visible that in Computer Based Mastery Learning students achievement is higher as they get remediation according to their own need through the programmed instruction that suits to their individual needs of learning and speed, whereas, on the other hand, in Conventional Group Learning students are taught through similar traditional method of instructions for all, which is mostly difficult to understand to the weak students and boring for the students with high IQ level. In other words, it is not according to the individual interest and need of the students. In Conventional Learning they are unable to find instructions that could fulfill their individual needs, separately. They lose their interest in their studies as compared to the students who are taught through Computer Based Mastery Learning.

It has also been observed that students having higher parental Involvement achieve higher strides of learning in Chemistry as compared to those whose parents are low involved with academics of their children, even when both the groups are working with computer based mastery learning situation. The results of the present investigation were supported by research findings of *Bangert and Kulik, (1990)* who showed that mastery learning programs have positive effects on the examination performance of students in colleges, high schools, and the upper grades in elementary schools.

The researcher draws probable reasons that because of all these factors the students when taught through Computer Based Mastery Learning, show much better performance as compared to when they are taught through the Conventional Group Learning.

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