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Table of Contents – August 2009

Editorial

Decision Sciences

Donald G. Perrin

While exploring decision sciences and teaching a course in management science in a local MBA program, I came to realize that we make scores, even hundreds of decisions, every day of our lives. It is a skill we take for granted, and a task filled with hazards because of erroneous, distorted, or incomplete information, or the need to deal with forces beyond our control.

Edward Deming identified the importance of accurate data – lots of data – to facilitate making good decisions. He was a force for change in the Japanese automobile industry after his transformative ideas were rejected by U.S. automobile manufacturers. He became part of a quality movement that has continued under many names for over half a century.

Decision science optimizes variables we can control – decision variables. Logical decisions based on decision variables are *deterministic* – they have fixed answers. Uncontrollable variables include environmental variables. Where these occur within a range, such as daily temperatures, they can be factored into the decision process to produce a range of possible answers. Education involves optimization of a large number of decision variables and uncontrollable variables.

Learners can be described by name, age, sex, height, weight, intelligence, experience, aptitudes, learning style, maturation, personality, curiosity, motivation, focus, and attention span. Many of these variables are uncontrolled in that educators cannot change them. Education is based on decision variables we can control, such as curriculum, teaching methods, and learning environments to foster social and intellectual development. Every learner is unique, which is a challenge to our industrial model of education based on batch processing. It attempts to put similar students into groups, the way we grade oranges in a packing shed, so that all oranges in the box are uniform in size and color. In schools, we call this homogeneous grouping.

Homogenous groups include students of similar age, intelligence, aptitudes, and academic experience. Large schools have separate classes for high, average, and low performing students at any each grade level. This simplifies the job of the teacher by reducing variability in each class. So long as classes are small, the teacher can adapt lessons and provide individual tutoring to meet the educational needs of most of the students.

In the latter part of the 20^{th} century, integration replaced homogenous grouping and the classroom became a microcosm of U.S. society. This added variables of race, culture, language, social class, and intelligence. Students with disabilities were also “mainstreamed” into regular classrooms. Variability among students was greater than ever before, yet teachers were trained in teaching methods designed for small homogeneous classes. The problem was complicated by an explosion of new technology and urgent societal needs that changed the goals of education.

Technology, immigrant labor, and outsourced manufacturing, and global competition raised the bar for educational quality and relevance. Compliant and literate graduates were no longer sufficient. Advent of the information age created a demand for professionally trained persons who are innovative, creative, and entrepreneurial to work in high-tech, high finance, multi-cultural, global organizations. Graduates must be technically literate and creative problem solvers. They must be well versed in knowledge, skills and aptitudes with higher levels of learning. They must be able to research and interpret data to make optimal decisions.

Are we ready to change our schools and teacher training programs for the twenty-first century? Are our graduating students prepared to resolve global problems such as climate change, territorial disputes, wars, failed economies, food and water shortages, malnutrition, and public health issues? Education should be a powerful influence in finding and implementing solutions.

Editor's Note: The authors combine enthusiasm for the new course with a scientific approach to design and development. They recognize the newness of astrophysics to college level curricula in India, and in the absence of a suitable text book, embed much of the content in a multimedia package designed for distance learning. Best of all, the materials were pilot tested as they were developed, and the course can be web enabled and made available on a global basis. This is an inspiring and evocative article.

Design, Development and Effectiveness of a Digital Interactive Multimedia Package in Astrophysics for Undergraduate Students

G. P. Pimpale and R. V. Vadnere
India

Abstract

Though astronomy is the oldest and a very interesting branch of science, it is observed that talented students do not seek careers in this domain. Generally, they are interested in this subject as amateurs but do not pursue higher studies. Therefore, an interactive multimedia computer package has been designed and developed by the authors for undergraduate students in India to motivate them to pursue higher studies in Astrophysics. While designing the package, norms of distance learning were carefully followed. The textual part is given in easily palatable language and is well supported by a large number of diagrams, video clips, graphs, interactive numerical problems and self-evaluation tests. Two unbiased sample groups were formed by a simple random method from the population of undergraduate students in India. The experimental group was administered the whole package while the control group was exposed only to the textual material in the package. Both the groups were pre- and post-tested. A retention test was also given to the experimental group to know the effect of package with passage of time. Well known statistical tests were employed to interpret the data generated and assess the effectiveness of the package.

Keywords: Astronomy, astrophysics, multimedia, distance learning, interactive package, digital package, e-learning.

1. Introduction

A star studded night sky is loved by one and all, and the night sky is really an observatory available to everybody and anybody – free of charge! Astronomy refers to the study of positions and motions of objects beyond the earth's atmosphere while Astrophysics is a branch of physics which deals with the physical theory of these objects. However, many times the term Astronomy is used in broad sense so as to include Astrophysics also. Astrophysics can be looked upon as the 'Superset' of all the branches of science as it encompasses the entire Universe. Study of Astrophysics *begins* from the sky, hence one can aptly say --" Sky is the *lower* limit" for this study. Because of the vastness and challenging nature of this subject, the authors have selected this area for investigation.

One of the authors (Pimpale) has been a lecturer in physics since last 28 years. What he has gathered from this prolonged experience as a teacher is that Astronomy is liked by many students; however their interest in this subject remains only at amateur level and therefore they do not pursue higher studies in this area. Therefore, as an attempt to motivate students for higher studies in this mind-blowing branch of knowledge, authors contemplated development of an interactive digital multimedia package using the norms of distance learning. Since the package has been made with distance learners in mind and since it could be made available on medium like CD or DVD, learners can use the material at their own pace and place.

Many concepts and phenomena in Astrophysics require visualization in three dimensional space. There are a large number of three dimensional diagrams which can be perceived on a computer alone. Also, the number of heavenly bodies is incredibly large; hence huge amounts of data need to be handled in this domain. Owing to these factors, the computer becomes an asset for this subject and is a widely used tool in distance learning because of its interactive nature. The authors have, therefore, developed an interactive computer multimedia (MM) package for Astrophysics.

2. Objectives

1. Complete review of the MM material available in the market.
2. Review distance learning courses in Astrophysics run by various universities across the globe.
3. Develop the MM product taking into account the background and instructional needs of the target students.
4. Acquaint students with basic ideas from Astrophysics with the help of the developed package.
5. To assess effectiveness of the package.

3. Methodology

3.1 Background Study

There are many video cassettes and multimedia CDs [1 to 23] available in the market. There was a careful, in-depth review of the material. The study was carried out in context of both the text as well as the audio-visual contents. The authors discovered that many CDs are prepared by stalwarts in Astronomy and are, therefore, excellent to convey elementary information on Astronomy. However, they do not cater to the students who wish to take up a formal course of higher study in Astrophysics. Also, many CDs do not give graded knowledge – the method which is absolutely essential in distance learning.

Review included a large number of on-line courses conducted by various universities [24 to 33] across the globe. Many universities have designed the courses carefully and they are consistent with the methodology of distance learning. However, a major problem with these courses is that they charge heavy fees (in dollars) which students from a developing country like India cannot afford to pay. In western countries, Astronomy courses are part of curriculum. But in India we do not have such courses at the primary or secondary levels. Further, the number of courses in Astronomy and Astrophysics at the tertiary level is very small. In a very large country like India, it may not be possible for an undergraduate student to join such a course at a distant institution. Hence a dire need was felt to make a tailor made package for undergraduate students in developing countries like India. The package, when made available on a CD or when uploaded on the web, can make almost free-of-charge distance learning material in Astrophysics. According to the statistics given by the World Bank, 144 countries (out of 210) are classified as 'developing.' (http://web.worldbank.org/WBSITE/EXTERNAL/DATASTATISTICS/0,,contentMDK:20420458~menuPK:64133156~pagePK:64133150~piPK:64133175~theSitePK:239419,00.html), The authors hope that the present work could benefit students from these countries with a broad spectrum of normally available courses.

3.2 Developing the Multimedia Package

3.2.1 Design of the Textual Component

Firstly, a detailed syllabus for the package was framed. It included basic concepts from physics often required in the present area of study. Concepts included Newton's laws, Kepler's laws,

Laws of conservation of angular and linear momenta, Black-body radiation, Electromagnetic spectrum, Wien's law, Mirrors, Lenses, Resolution, Seeing, Magnification, Types of spectra, Doppler effect and red shift, Basic forces in nature, Nuclear reactions and Cosmic rays etc. The following elementary ideas from Astronomy and Astrophysics also formed a part of the syllabus-- Greenwich Mean Time (GMT), Universal Time (UT), Local and Sidereal Times, Julian Date, Big bang theory, Steady state theory, Hubble's law, Cosmic microwave background, Birth, evolution and future of the solar system, Classification of stars by spectral class and by the Hertzsprung-Russell diagram, Life cycle of stars, Classification of galaxies, The Milky way galaxy, Formation and evolution of galaxies, Galaxy Clusters, Search for life in the universe, Astrobiology, Methods of search for extraterrestrials, Drake equation, Missions undertaken, etc.

Since the syllabus is for undergraduate students in India, their background was kept in mind during this design. The relevant mathematical part was included in the syllabus but the conceptual part was given more emphasis. Experts from this area were consulted to validate the content. After it was approved by them, the entire course was divided into seven units. The units were further divided into sections. The pattern adopted was in agreement with that used in the self-instructional material developed by the Open Universities in India. According to this pattern, a Unit starts with Objectives followed by Introduction. Then various topics are covered in different sections. After a few sections, a self-evaluation test, 'Check Your Progress', was given. It was an interactive quiz indicating the score immediately. The last section 'Let Us Sum Up' summarized the discussion in that Unit. Many interactive problems were given to the target students wherein they can 'play' with the formula by substituting different values of variables.

The textual part was prepared by referring to standard reference books [34 to 40] in Astronomy and Astrophysics (A and A). The textual content also included two appendices – one corresponding to useful books and websites and the other to career options in A and A. A list of names and websites of leading institutions in this field is given in this appendix.

3.2.2 Visual Component

In all units, a large number of diagrams, astrophysical images, pictures and video clips [41 to 45] were incorporated to enhance the learning experience. In each section at-least one relevant diagram or one relevant image was included. Thirteen video clips were used in the package.

3.2.3 Audio Component

Almost all video Clips were supported by audio component to enhance the visual effect.

3.2.4 Soft-wares Used

Extensive use of the following soft-ware packages was made:

Macromedia Flash MX, Dreamweaver 9, Adobe Photoshop 6.0, Microsoft FrontPage 2002 (Version 10.2623.2625), Internet Explorer 7 (Version 7.0.6000.16711), Microsoft Excel 2002 (Version Microsoft Word 2002, 10.2614.2625) and Quick Heal Anti Virus Plus 2008 (Version 9.50), MiniTab 14.

3.3 Testing of the Package

To begin with, the package was made on a pilot basis. The pilot level package was then administered to a group of (12+) level i.e. undergraduate students. A tool in the form of an opinionnaire was designed by the authors. Opinions were sought as regards to the content, language, images, video clips and general structure of the package. Their feedback was taken into account seriously and the package was modified in light of the feedback received. Size of the final package is 233 MB and it is made up of 135 screens, 13 video clips, four interactive problems and 10 Self-evaluation tests.

3.4 Development of Print Material

Because Astrophysics has not been included in the curriculum of many universities in India, instructional material in the form of text book is not available. Therefore the authors developed a booklet giving basic concepts in that subject. This booklet was prepared for the control group. It had the structure similar to the multimedia package – seven units containing sections and subsections. The pattern adopted is consistent with that for the self-learning material in distance education.

3.5 Formation of Samples

The population for the present study was undergraduate students studying science. An appeal was made to such students in the city of Nasik (Maharashtra state) for this study. The authors received responses from 62 students. Out of these students, two equivalent groups were formed by a random sampling technique. One of the groups was arbitrarily designated as the experimental group and the other as control one.

3.6 Development of Tool for Testing:

In order to get the knowledge profile for Astrophysics of the target students, a pretest was given to them. For this testing, a tool was designed in the form of a questionnaire. It consisted of 30 multiple choice questions based on elementary knowledge of Astrophysics. Each question was given four options as possible answers – only one of them was correct. The questionnaire was validated with respect to subject contents and communication theory. For this validation, guidance from experts from these fields was sought.

A similar procedure was followed for the questionnaires developed for post and retention tests. All the three questionnaires contained questions of nearly the same difficulty level.

3.7 Testing of Samples:

Pre-test:

Both the groups -- experimental and control -- were pre-tested to get idea about their previous knowledge in Astrophysics. They were asked to attempt 30 questions in 30 minutes by ticking the option which they thought to be correct.

Post-test:

The experimental group was then exposed to the multimedia package developed by the researchers. A network of sixteen state-of-the-art computers was arranged for this purpose. The group was given nearly four hours of exposure. At the same time, the control group was given the print material to study. Then, both the groups were administered a post-test. The pattern of testing was the same as used for the pre-test.

Retention test:

A good package should have retention effect on the minds of users. To check whether the package developed by authors retained such impact or not, a retention test was given to the experimental group after one month.

4. Results and Discussion

4.1 Testing the scores for Normality

Before any data are subjected to statistical testing, it must be checked to see whether it fits in the normal distribution. If it does, a parametric test like the ‘t--test’ in statistics could be applied for the data analysis. If it does not, a non-parametric test needs to be used. To check for normality, the authors have plotted ‘probability graphs’ for the data.

"A probability plot is an alternative to the histogram that can be used to determine the shape, centre and spread of the distribution. It has the advantage that it is unnecessary to divide the range of the variable into class intervals, and it often produces reasonable results for moderately small samples (which the histogram will not)." [46]

To get the Probability Plot, the following steps were taken:

a. For such plot, a special "Paper" (scale) is used. Such "papers" are available for normal, exponential and several other distributions.

"Probability paper is structured in such a way that the values in the cumulative frequency distribution of a set of data from a normal distribution fall on a straight line. It can be used to assess sample data for normality." [47]

In other words, if the data generated are plotted on the normal probability paper and if the points lie exactly or nearly along a straight line then the data is said to obey normal distribution.

b. First, data points are arranged in ascending order. This is called as the ranking of data. The serial number is named as Rank and is denoted by j. The corresponding score is called Strength and is shown by Xj. Xj is plotted on the X axis.

c. Then the sample cumulative frequencies are calculated. The plotting positions of points, P_j corresponding to these frequencies are calculated as given below.

$P_j = (j – ½) / n$ where n = sample size.

Values of P_j are multiplied by 100 to get percentage and are plotted on the Y axis.

As an illustration of this procedure, let us consider the data generated in the pre-test of the control group. Table 1 given below is obtained by using steps a), b) and c) given above.

Table 1
Values of Variables for Probability Plot for Control Group- Pre-test

Rank j	Strength (score) X_j	Cumulative frequency in percent P_j
1	5	0.016129
2	5	0.048387
3	7	0.080645
4	7	0.112903
5	9	0.145161
6	10	0.177419
7	10	0.209677
8	10	0.241935
9	10	0.274194
10	10	0.306452
11	11	0.338710
12	11	0.370968
13	11	0.403226
14	12	0.435484
15	12	0.467742
16	13	0.500000

17	13	0.532258
18	13	0.564516
19	13	0.596774
20	13	0.629032
21	13	0.661290
22	14	0.693548
23	15	0.725806
24	15	0.758065
25	16	0.790323
26	16	0.822581
27	17	0.854839
28	18	0.887097
29	19	0.919355
30	19	0.951613
31	19	0.983871

The graph in Fig. 1 given below is plotted with the values of variables given in Table 1.

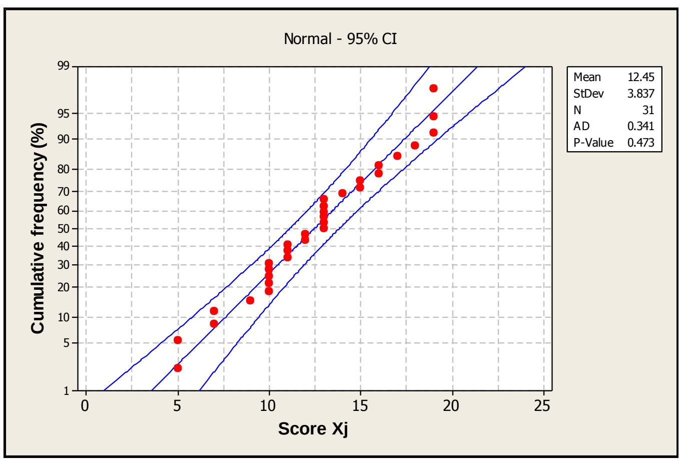

Figure 1: Probability Plot of **Pre-test of Control Group**
(The band implies 95% confidence interval).

From Figure 1 it can be observed that the data points lie nearly along a straight line. It implies that the data are normally distributed and we can proceed further for the parametric test. The P value of the Normality test is 0.473. It is greater than 0.05 which is the customary level of significance used in communication studies. This value of P obtained supports the statement that data are normal in nature.

Similarly the probability plots were obtained in Fig. 2, 3, 4 and 5. Figures 2, 3 and 4 indicate that the data points are normally or near-normally distributed with 95% confidence interval. Therefore the normality assumption is valid in these cases and employing parametric test could be justified. However Figure 5, which was plotted for the retention test of experimental group, showed that the data were not distributed normally. Hence, in that case, it was concluded that a non-parametric test was necessary.

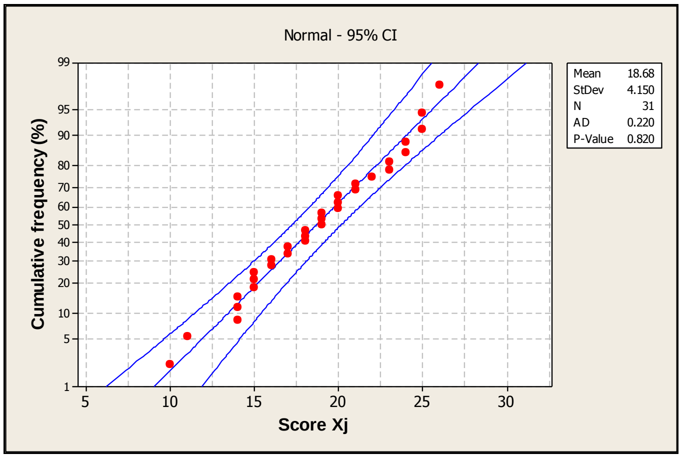

Figure 2: Probability Plot of Post-test of Control Group

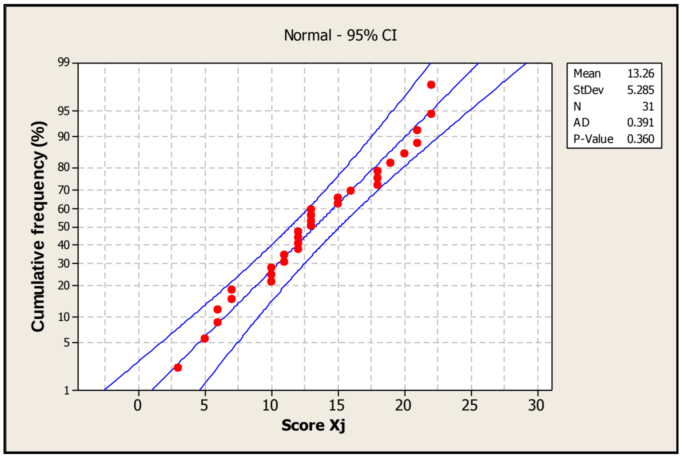

Figure 3: Probability Plot of Pre-test of Experimental Group

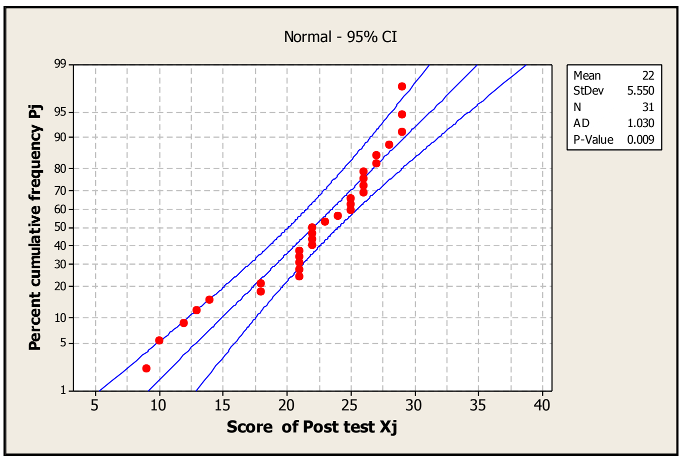

Figure 4: Probability Plot of Post-test of Experimental Group

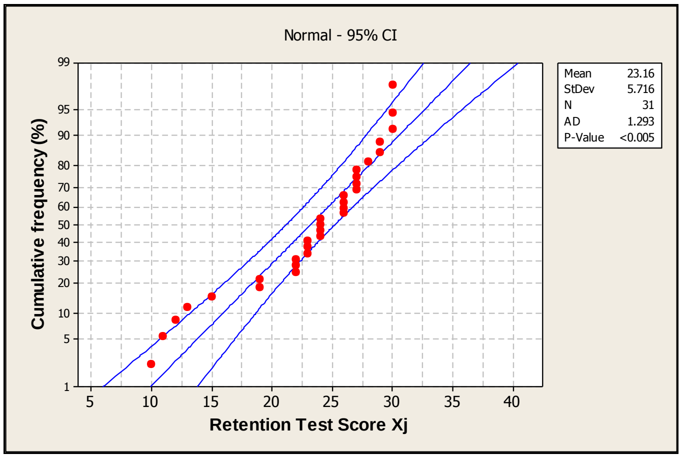

Figure 5: Probability Plot of Retention-test of Experimental Group

4.2 Comparison of Pre-tests of Experimental and Control Groups

Table 2
Two-sample t test for Pre- test (Experimental) and Pre-test (Control)

Sr. No.	Group	N	Mean	S. D.	t value
1	Experimental	31	13.26	5.28	0.66
2	Control	31	12.45	3.84	

The scores obtained in the Pre-tests clearly indicate that the Mean values and Standard Deviation values for both the groups are almost equal. The value of t is very much less than the table value 1.96. Hence from the tables given in the standard statistical books [48, 49] for area under the normal curve, we can conclude that there is no significant difference between the experimental and control groups formed by the researchers. Therefore it could be concluded that the previous knowledge of Astrophysics of both the groups is of the same level and hence they are unbiased.

4.3 Comparison of Pre and Post Tests of Experimental Group

Table 3
Paired t-test for Pre and Post tests of the Experimental Group:

Sr. No.	Test	N	Mean	S. D.	T value
1	Post	31	23.16	5.72	
2	Pre	31	13.25	5.29	10.35

Table 3 shows that the Mean value for post-test is much greater than the corresponding value for pre-test. The t value > the table value 2.58. Hence it can be inferred that there is significant achievement (at 0.01 level of significance) in the knowledge of experimental group after it was exposed to the package.

4.4 Comparison of Pre and Post Tests of Control Group

Table 4

Paired t-test for Pre and Post Tests of the Control Group

Sr. No.	Test	N	Mean	S. D.	T value
1	Post	31	18.68	4.15	7.45
2	Pre	31	12.45	3.84	

Table 4 shows that the Mean for Post-test is greater that the corresponding value for Pre-test. The test statistic i.e. t value > the table value 2.58. Hence it can be inferred that there is significant achievement (0.01 level of significance) in the knowledge of the control group after it was administered the print material developed by the researchers.

4.5 Comparison of the Experimental and Control Groups

Table 5

Two Sample t-test for the Difference between Mean Values of Experimental and Control Group

Sr. No.	Group	N	Mean	S. D.	T value	
1	Experimental	31	9.90	5.33	2.90	
2	Control	31	6.23	4.65		

Table 5 shows two sample t – test applied for the difference between the Mean values obtained for both the groups. The t value > 2.58. Hence it can be concluded from the probability area curve that the difference between the Mean values is not due to the sampling error but due to the treatment given to the Experimental group. There is significant achievement (0.01 level of significance) in the knowledge of the experimental group as compared to the control group.

4.6 Comparison of the Post and Retention tests of Experimental Group

From Figure 5 it is observed that the scores are non-normal. Hence a non-parametric test is required. In the present case, the scores are related to each other i. e. there are matched pairs in the data. Therefore the Wilcoxon matched-pairs test is applicable here. It is also called the Signed rank test. Results obtained are given in Table 6.

Table 6

Performance of Experimental Group in Post and Retention Tests

(Wilcoxon matched-pairs test)

N	n	T	U_T	σ_T	z value	Table value
31	28	10.5	203	43.91	(- 4.38)	(- 2.58)

where N = number of students in the experimental group

U_T = Mean = n (n+1)/4,

σ_T = Standard deviation = $[n\,(n+1)\,(2n+1)/24]^{1/2}$

z = Test statistic = $(T - U_T)/\ \sigma_T$

n = [(number of matched pairs) – (number of dropped pairs, if any)].

Table 6 shows that the test statistic z = (- 4.38). This value is smaller than the table value (-2.58). Hence from the area under probability curve we can conclude that the difference in means is not due to sampling error. It implies that there is significant retention (at 0.01 level of significance) of knowledge of Astrophysics for the experimental group even after one month.

5. Discussion of Results and Conclusions

In the present work, a digital interactive multimedia package and print material were developed for communicating elementary ideas from Astrophysics to undergraduate students in India. Therefore, the undergraduate students formed the target population. The sample consisted of 62 respondents. Out of the sample, two equal and equivalent groups were formed by simple random method. Thus each group consisted of 31 students. Arbitrarily, one of the groups was designated as the experimental group and the other as the control group. The t-test and the Wilcoxon matched-pair test were used for the analysis. They showed that the experimental group did very well compared to the control group. Also, there was statistically significant retention (at 0.01 level) of knowledge. All these results are indicated in Tables 1-5. Hence it can be inferred that the difference between achievements of the two target groups is not due to the sampling error but because of the treatment given to the experimental group.

The work can be extended by incorporating more 2D and 3D animations, more interactive problems and graphs, quizzes etc. The package can be made web-enabled so that all those across the globe who are interested in this work can be benefited. It is possible to make the package in vernacular languages or it may be made in bilingual mode (English + vernacular language) so that it is more convenient to use.

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Editor's Note: This is a study of teaching effectiveness for student teachers trained in classrooms and in distance learning environments. The principal finding is that skills taught are different to the way they are used in actual classroom situations. There is a need for reexamination of the way teachers are tauight in initial training and in-service training.

Comparative Study of Teaching Skills of In-Service Teachers Trained through Regular and Distance Mode

Anupama Bhargava
India

Abstract

Effectiveness of a teacher in complex classroom situations has always been an area of interest for researchers. Subject matter expertise is not the only criteria that the effective teacher has to fulfill. Creating an environment in the classroom where reshaping and redesigning of knowledge, stimulation of intellectual curiosity, and innovative and independent thinking can take place, is a real challenge for teachers. To inculcate these attributes in teachers, teacher training programmes put utmost stress on developing skills among student teachers. During teaching practice, the novice student teacher uses teaching skills strictly per guidelines given by the teacher educator, but this state of affairs become different in real class room situations.

The present study is designed to take into account the comparison of in-service teachers trained by regular and distance mode with respect to use of teaching skills in the classroom. No significant differences are observed in use of skills of set induction, illustration with example, recapitulation, blackboard writing and use of teaching aids. Significant differences at the 5% level are observed in questioning and evaluation skills.

Keywords: Teaching skills, effective teacher, pre service training, micro teaching

Introduction

Prime aim of teachers has always been to help students to learn effectively and efficiently. To comply with this pursuit, teachers have to be proficient in the usage of various teaching skills in the classroom. One of the ways to maximize learning and to achieve the learning objectives is to understand the importance of individual skill and the integration of different skills. This holds true even more for teachers teaching in secondary classes where to keep students involved in the classroom, a teacher has to deal with topics in such a way as to motivate them in discussions, use questions to move ahead and interact, change the sensory focus with the help of teaching aids and, above all, summarize to help students learn. A thorough knowledge of subject matter is vital for imparting instruction (James & Choppin, 1977). In addition to this, systematic presentation of content matter is another requisite for teaching effectively. To bring forward the instruction in a logical sequenced manner, teaching expertise is essential. Even experienced teachers need to refine this aspect and add value to maximize the effect of teaching in the classroom (Sharma 2000).

Effectiveness of teacher behaviour can be judged through two approaches (Van der sijde & Tomic, 1989). The first approach requires finding out efficient use of learned teaching behaviour (skills) by school teachers. The emphasis is on the teachers. The second approach deals with outcome of such behaviour on the performance of students. Here onus lies on the effect of teaching on students' learning outcome.

The qualities of an effective teacher include one who is intellectually effective, uses various approaches while teaching and helps students to achieve high performance**.** These foremost teaching behaviors have been supported by Rosenshine & Frust (1971), Walberg & Haertal (1990), Good & Brophy (2004) and Borich (1988).

A teacher not only affects but also modifies the teaching-learning environment through personal factors like nature, interest, and code of conduct. Veldman & Peck (1963) have listed five prominent characteristics of an effective teacher: friendly and cheerful, knowledgeable and poised, lively and interesting, firm control and, above all, non-directive. Smith (2002) opined similar views that an effective teacher makes his classroom lively and full of activities. Kuhn's Process Product Paradigm (1970) also establishes a positive relation between teacher behaviour and student's achievement in learning**.** Kwoklun & Lew (1981) revealed that an ideal teacher, besides having sound knowledge of the subject matter, has fluency of speech and is able to develop thought processe of students.

Relevance of teaching skills

Effective teaching skills are a precondition for translating theory into practice. Implementation of teaching principles in the classroom is facilitated with certain skills acquired by teachers through education and training. Farooq & Shahzadi (2006) revealed that students of trained teachers are better performers than students of untrained teachers.

Set induction, stimulus variation, questioning, illustration with example and closure are the essential teaching skills listed by Allen & Ryan (1969). **Passi (1976**) identified the following skills essential for a successful teaching: writing instructional objectives, introducing a lesson, questioning, explaining, illustration with example, stimulus variation, reinforcement, using blackboard, closure etc.

Verbal & non verbal expressions of a teacher (body language, facial expressions, and gestures) to facilitate learning are called Teaching Skills. These skills can be observed and measured in terms of a student's change in behaviour (objectives realized). This implies that teaching skills are instructional techniques and procedures put to use by teachers to make teaching learning feasible by initiating two way communications between teacher and student. An insight of when and where to apply relevant and different teaching skills is the yardstick for a teacher's performance.

Role of pre service educational training in developing teaching skills

Anderson (1989) stressed the importance of an effective teacher training programme in inculcating skills among teachers. Pre service training modules facilitate teachers in understanding various theories of teaching/learning, subject matter, principles of curriculum construction, students' development and application of knowledge (Cooper, 2003; Moore, 2003 & Aggarwal, 1999).

Pre-service training programmes employ various approaches like simulation techniques, demonstration, interaction analysis and more notably, micro teaching to build up teaching skills among student teachers. These learnedt skills are reinforced during a teaching practice session while preparing lesson plans or teaching in the class room. Much value is attached to proper use & sequence of teaching skills. As a consequence of this constant drill, a student teacher makes headway in the class with set induction and reaches the closure by giving home assignments. This practice is adopted by both regular and distance mode teacher training programmes.

Microteaching is a skill oriented programme (where content takes a back stage). Intrinsic skills can be mastered by microteaching. Allen (1966) described microteaching as scaled down teaching in terms of content, class size and time.

In regular teacher training institutes to develop teaching skills, one skill is demonstrated at a time by a teacher educator and later on practiced by student teachers in reduced class size and time.

Immediate feedback received from teacher and peer group help teachers to effectively adapt these skills. A re-teaching session, which is held after a time interval of an hour, strengthens the rectified behaviour. The integrated skill approach followed during teaching practice session later on becomes an irreplaceable part of teacher's behaviour in the classroom. Sachs (1999) put forth microteaching as an efficacious means to bridge the gap between theory and practice as more progressive and reflective approaches are adopted in teacher education.

Distance education teacher training programmes also lay emphasis on skill development among student teachers. For this, workshops are held during contact programmes. In such sessions, attendance of students is made mandatory. Teacher educators from a local college or experts from Distance University demonstrate various skills, this is followed by practice and preparation of micro lesson plans based on specific skills by student teachers. Instructions regarding steps followed in lesson plan are also imparted. These academic skills are acquired, sharpened and updated to make teaching learning more competitive Murthy (2008).

Objectives

Teaching learning is a complex process consisting of a host of activities to be performed by the teacher. To ensure understanding and assimilation of content matter by students, teachers use various skills. The main thrust areas of this paper are:

a. To find out how teaching skills are used differently by the teachers in the classroom

b. To investigate significance difference, if any, between teachers trained through regular and distance mode with respect to use of teaching skills.

c. To examine improvisations made by teachers while applying teaching skills in the classroom.

Methodology

The present study is survey based.

Sample

The population under investigation included secondary school teachers. A sample of 100 secondary school teachers was randomly selected from eight schools of the city. Sixty-two (62) teachers were trained by regular mode and 38 through distance mode**.** Out of the 8 schools, 3 were Government, 3 were semi-aided and 2 were public schools. Forty-nine (49) teachers from Government Schools, 31 from semi-aided, and 20 teachers from public schools responded to the questionnaire.

a. Government Schools: Schools that are run and managed by state government.

b. Semi aided missionaries: Schools managed by Christian missionaries but semi aided from the state government.

c. Public Schools: Schools managed by societies and trusts that have their own management and do not get aid from the central / state government.

Tools Used

Questionnaire

A questionnaire comprising of questions on seven skills practiced in the classroom was developed. To ensure content validity the draft was shown to colleagues who gave suggestions. Then it was applied to a sample of 5 student-teachers to assess the difficulty level and based on the feedback, the final version was prepared. Multiple choice questions were incorporated in the questionnaire and teachers were asked to tick the option being practiced by them more often in the class room. In case given choices didn't suit their methodology, blank space was given at the end of alternatives which could be used to write teacher's own preferred style. In the end, teachers were asked to write in two to three lines on classroom management skill.

Statistical Techniques

Cross tabulation analysis for two rows vs. four/ five columns was carried out by applying Chi-square test to find out significance difference between teachers of regular and distance mode in application of teaching skills.

The Chi-square test was estimated on the basis of cell frequencies and whenever cell frequency is less than five, Yates correction method has been applied.

Results and Findings

In this research an investigation was carried out into the different kinds of skills used by student-teachers. The different teaching skills can be broadly classified in the following categories-

a. **Basic / fundamental skills:** Set induction, illustration with example and blackboard writing are Basic or key skills. These skills form base for other skills which are used by teacher while teaching.

b. **Skill for interaction:** Questioning is a skill which is required by teacher to make interaction and communication between teacher and student a two way process.

c. **Skills for assessment:** Recapitulation and evaluation are the skills which are utilized by teachers to assess the achievement of teaching objectives in terms of student's performance.

d. **Allied skills:** To teach effectively and sustain interest in teaching learning environment, allied skills play crucial role. These include skills of using teaching aids and skills of classroom management.

The results pertaining to different skills are presented as follows: Figures in the tables given below denote cell frequencies. Figures in parenthesis are in percentage. Chi square test is based on cell frequency. '**R**' represents Regular mode and '**D'** represents Distance mode.

Skill of Set induction

Table-1 (a) depicts that 6.45 % of teachers (R) and 2.63 % of teachers (D) prefer giving long introduction, while 38.71% of teachers (R) and 44.74% of teachers (D) take more time to introduce a complex topic in comparison to an easier one. The value of Chi-square of 1.51 depicts no significant difference.

Table 1(a)
Skill of Set induction

Use of teaching skills → / Mode of Training ↓	Always give short induction	Always give long introduction	Take more time to introduce a complex topic than an easier topic	No set pattern	Chi square test
Regular	33.00 (53.23)	4.00 (6.45)	24.00 (38.71)	1.00 (1.61)	1.51 NS
Distance	20.00 (52.63)	1.00 (2.63)	17.00 (44.74)	0.00 (0.00)	
Total	53.00	5.00	41.00	1.00	

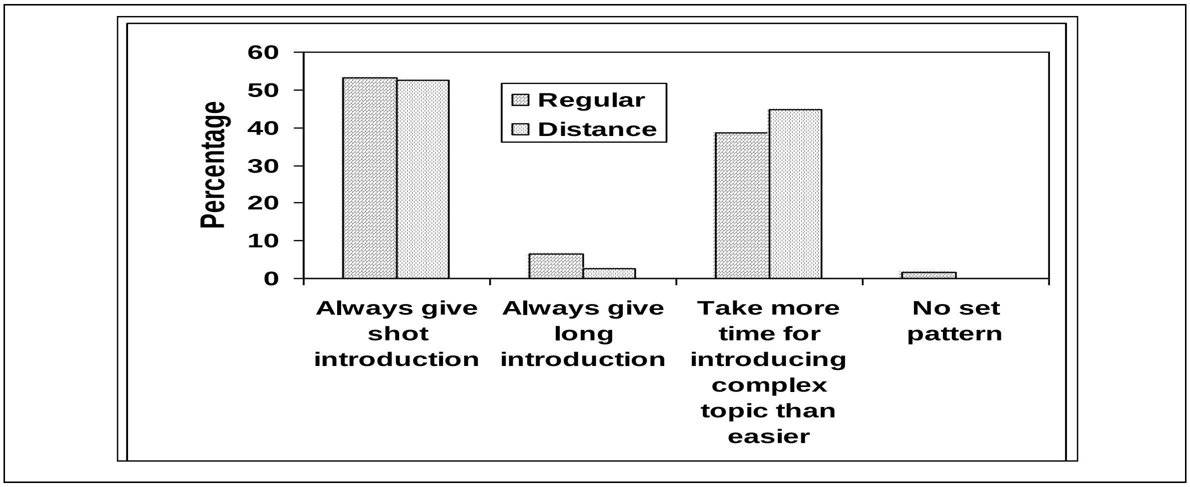

Figure 1a. Self Induction Skill

Table 1(b)
Skill of Set Induction

Use of teaching skills → / Mode of Training ↓	Ask questions based on previous knowledge	Use examples/ riddle/ story	Direct announcement of topic	No set pattern to introduce	Chi square test
Regular	30.00 (48.39)	19.00 (30.65)	9.00 (14.52)	4.00 (6.45)	2.72NS
Distance	21.00 (55.26)	11.00 (28.95)	6.00 (15.79)	0.00 (0.00)	
Total	51.00	30.00	15.00	9.00	

Table-1 (b) depicts that 48.39 % of teachers (R) and 55.26 % of teachers (D) ask questions based on previous knowledge while 30.65 % of teachers (R) and 28.95 % of teachers (D) give examples/ riddle / story to introduce a topic.

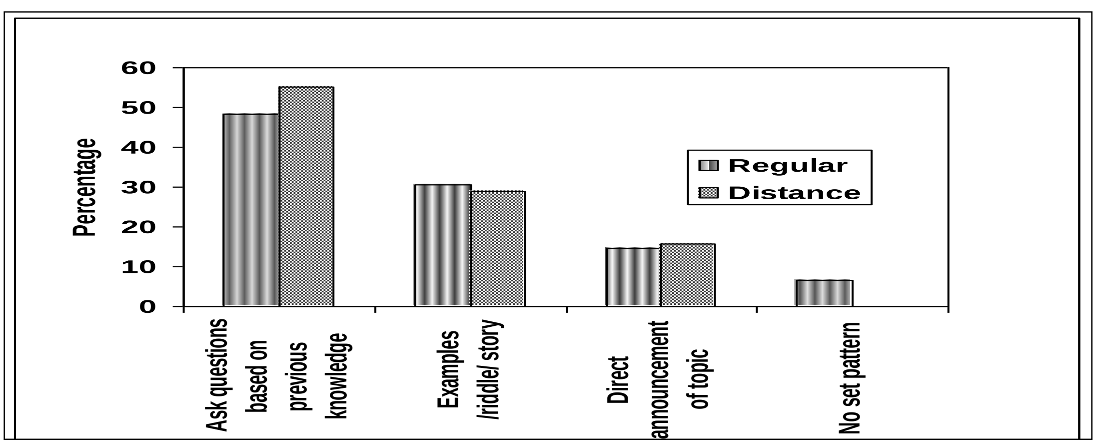

Figure 1b. Set Induction.

N.C.E.R.T has laid stress on many core teaching skills which include introducing lesson illustration with example, questioning, using teaching aids, use of blackboard, evaluation and management of class. Most of the trained teachers whether regular or distance mode use core teaching skills in the classroom. Marked differences in use of teaching skills are not prominent among teachers trained for regular or distance mode. In the present study, it is observed that 38.71 percent (regular) and 44.74 percent (distance) teachers take more time to introduce a complex topic in comparison to an easier one as shown in fig. 1(a). For majority of teachers i.e. 48.39 percent (regular) and 55.26 percent (distance), the chosen way of set induction is to ask questions based on previous knowledge as shown in fig 1 (b). This gives them scope to assess the understanding of students besides maintaining connectivity with previous chapter / content and helps in keeping the set induction short.

Skill of Illustration with examples

Table 2
Skill of Illustration with examples

Use of teaching skills → / Mode of Training ↓	Give many examples	Don't give examples	Give examples only when required	No set pattern	Chi square test
Regular	30.00 (48.39)	7.00 (11.29)	25.00 (40.32)	0.00 (0.00)	2.70NS
Distance	18.00 (47.37)	2.00 (5.26)	17.00 (44.74)	1.00 (2.63)	
Total	48.00	9.00	42.00	1.00	

Table-2 depicts that 11.29 % of teachers (R) and 5.26 % of teachers (D) don't give examples while teaching while 40.32% of teachers (R) and 40.32 % of teachers (D) give examples only when required.

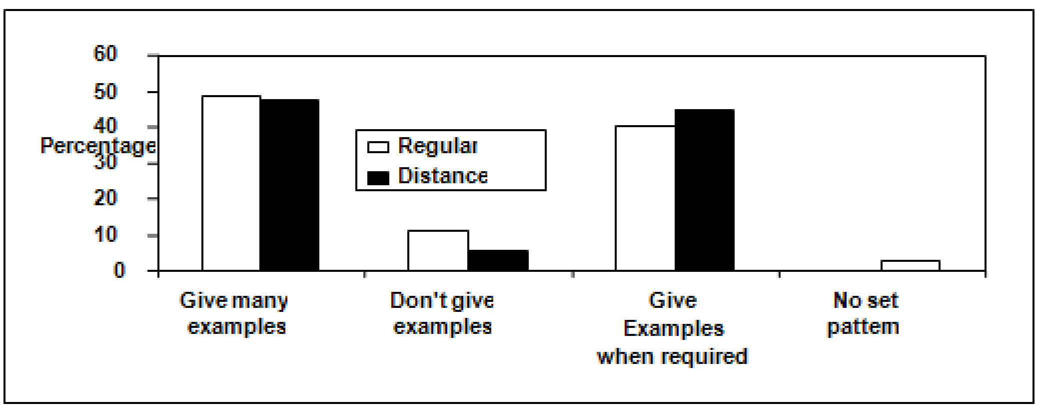

Figure 2: Illustration with examples

Skillful teachers take the help of examples to illustrate an idea, concept or principle. An example helps to engage student's attention provided it is at his level of understanding. 48.39 percent (regular) and 47.37 percent (distance) teachers quote various examples in the classroom, while 40.32 percent (regular) and 44.74 percent (distance) teachers feel that examples should be given only when necessary as shown in fig.2.

Skill of Questioning

Table 3(a)
Skill of Questioning

Use of teaching skills → / Mode of Training ↓	Teachers ask many questions	Ask questions only when required	No questions asked by teachers	No set pattern	Chi square test
Regular	9.00 (14.52)	46.00 (74.19)	4.00 (6.45)	3.00 (4.84)	0.92NS
Distance	7.00 (18.42)	28.00 (73.68)	1.00 (2.63)	2.00 (5.26)	
Total	16.00	74.00	5.00	5.00	

Table 3(a) depicts that 14.52 % of teachers (R) and 18.42 % of teachers (D) ask many questions in the classroom while 6.45% of (R) and 2.63 % of (D) prefers to not ask questions in the classroom.

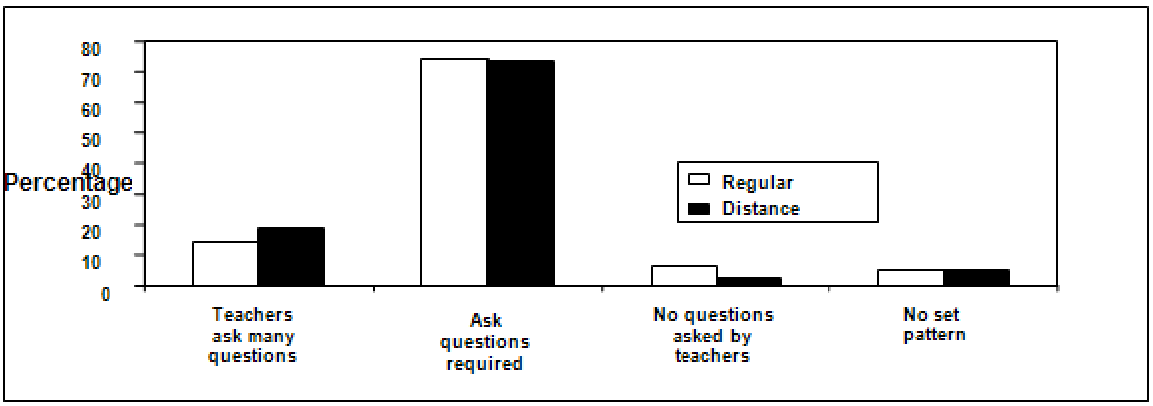

Figure 3a: Questioning skill

Questioning is a tool to make the teaching/learning process more lively and participatory. It can transform the teaching learning/environment from the usual routine type to an intellectually charged one. It helps teacher in various ways, to stimulate thinking among students, check previous knowledge and sometimes to maintain discipline in the class. This skill becomes efficacious only when used in thoughtful manner when judging the classroom's state of affairs. Keeping this in mind, 74.19 percent (regular) and 73.68 percent (distance) teachers ask questions as per requirement of content/ topic/ classroom circumstance as observed in fig. 3(a). Questioning can be from students also in terms of enquiries/ doubts. When it is expected from students to reflect upon issues / topics, then it becomes prime duty of teachers to respond to their queries. 37.10 percent (regular) and 60.53 percent (distance) teachers are ready to answer anytime questions/ doubt asked by the students while 53.23 percent (regular) and 36.84 percent (distance) teachers specify that they prefer if students ask questions after finishing the topic as evident from fig 3 (b) .

Table 3(b)
Skill of Questioning

Use of teaching skills → / Mode of Training ↓	Encourage students to ask questions any time	Give time for questioning after finishing topic	Don't like if students ask questions	No set pattern	Chi square test
Regular	23.00 (37.10)	33.00 (53.23)	3.00 (4.84)	3.00 (4.84)	7.84*
Distance	23.00 (60.53)	14.00 (36.84)	0.00 (0.00)	1.00 2.63)	
Total	46.00	47.00	3.00	4.00	

Table-3(b) depicts that 53.23 % of teachers (R) and 36.84 % of teachers (D) give time for questioning only after finishing the topic while 37.10% of teachers (R) and 60.53 % of teachers (D) encourage students to ask questions any time. Here for this skill set a *Significant difference at 5% level is observed.

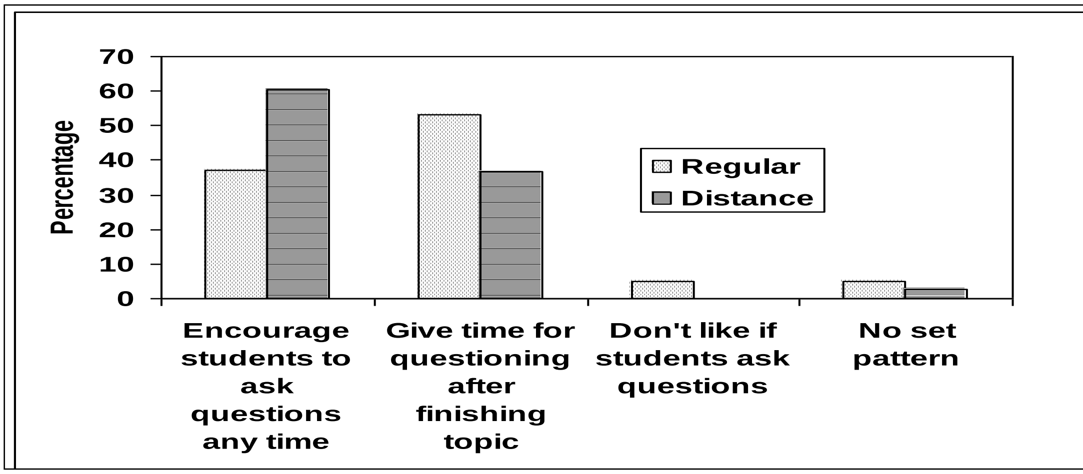

Figure 3b. Questioning Skills

Questioning skill can be used by the teacher to act as moderator during discussions or debates held in class. A significant difference at 5 percent level is observed (Figure 3b) among teachers of regular and distance mode in using this skill.

Skill of Recapitulation

Summarizing main points and retouching the complete topic in short is recapitulation. This helps in reinforcing the comprehension level of the students. 12.90 percent (regular) and 21.05 percent (distance) teachers recapitulate if time permits while 24.19 percent (regular) and 26.32 percent (distance) teachers improvise by combining recapitulation with evaluation as shown in Figure 4.

Table 4
Skill of Recapitulation

Use of teaching skills → / Mode of Training ↓	Always do recapitulation	Recapitulation if time permits	Don't recapitulate	Combine recapitulation with evaluation	No set pattern	Chi square test
Regular	33.00 (53.23)	8.00 (12.90)	6.00 (9.68)	15.00 (24.19)	0.00 (0.00)	1.44NS
Distance	17.00 (44.74)	8.00 (21.05)	3.00 (7.89)	10.00 (26.32)	0.00 (0.00)	
Total	50.00	16.00	9.00	25.00	0.00	

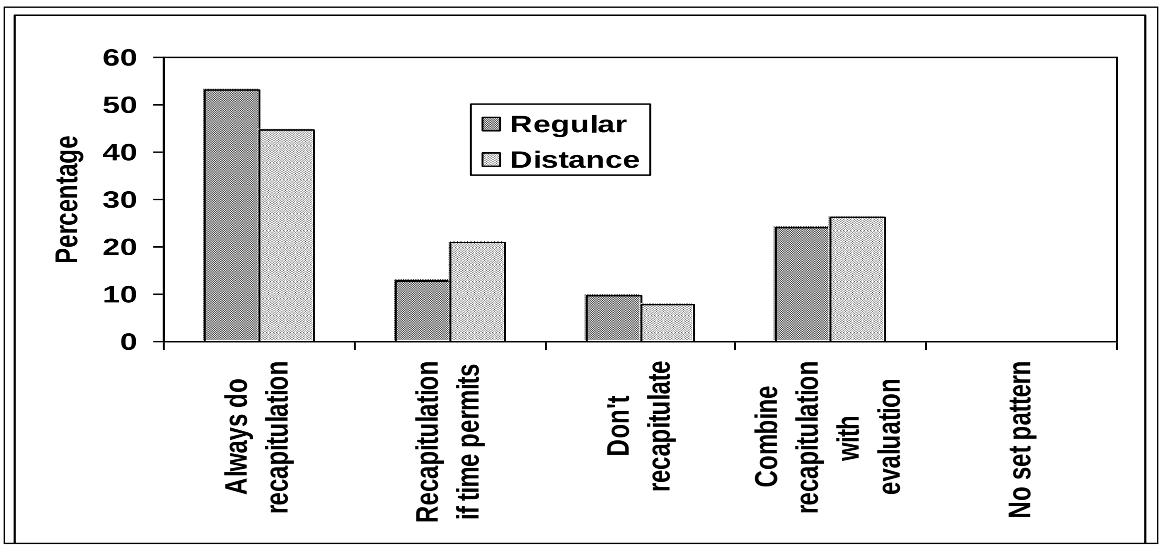

Figure 4. Recapitulation skill

Table-4 depicts that 53.23 % of teachers (R) and 44.74 % of teachers (D) always do recapitulate while 12.90% of teachers (R) and 21.05 % of teachers (D) recapitulate depending on the availability of time.

Skill of Evaluation

Table-5 depicts that 20..97 % of teachers (R) and 7.89 % of teachers (D) always ask oral questions while 24.19 % of teachers (R) and 15.79 % of teachers (D) evaluate on the basis of written work given in class. Here for this skill, a significant difference at 5% level is observed.

Table 5
Skill of Evaluation

Use of teaching skills → / Mode of Training ↓	Always ask oral questions	Always give questions to write	Evaluate Orally or in written form	Don't find evaluation mandatory	No set pattern	Chi square test
Regular	13.00 (20.97)	15.00 (24.19)	34.00 (54.84)	0.00 (0.00)	0.00 (0.00)	10.31*
Distance	3.00 (7.89)	6.00 (15.79)	25.00 (65.79)	1.00 (2.63)	3.00 (7.89)	
Total	16.00	21.00	59.00	1.00	3.00	

To assess outcome of teaching in the form of student learning or understanding, teacher evaluates. A significant difference at 5 percent level is observed among teachers of regular and distance mode in using this skill. 54.84 percent (regular) and 65.79 percent (distance) teachers specify that they opt for evaluation in either written or oral form (fig.5). Most of the teachers show flexibility and act as per context. Evaluation helps them to assess not only the cognitive but affective and psychomotor domain also.

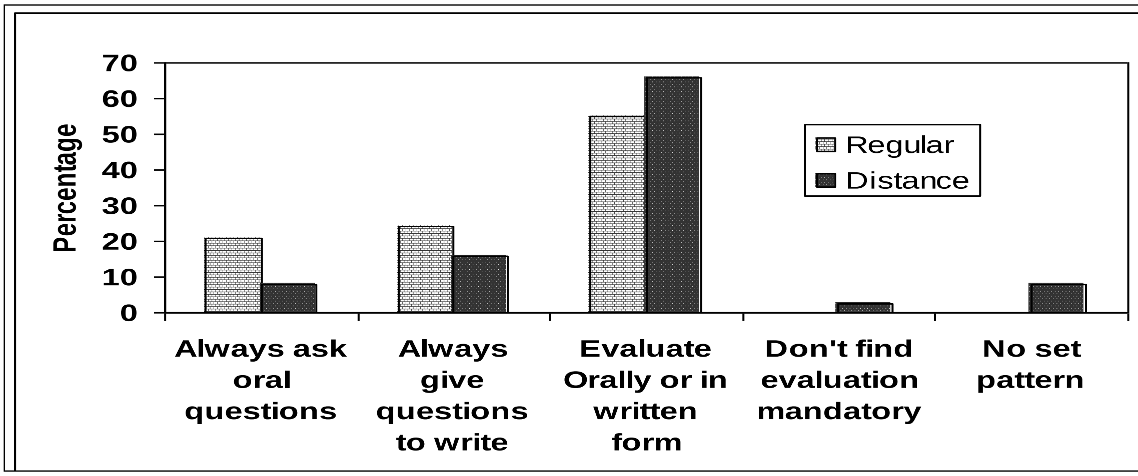

Figure 5. Evaluation Skill.

Skill of Black board writing

Table-6 depicts that 14.52 % of teachers (R) and 10.53 % of teachers (D) writes main points on the black board , 29.03 % of teachers (R) and 26.32 % of teachers (D) write complete information and 45.16 % of teachers (R) and 55.26 % of teachers (D) write main points & tough words on black board.

Table 6
Skill of Black board writing

Use of teaching skills → / Mode of Training ↓	Write main point only	Write tough words only	Write complete information	Write main points and tough words	No set pattern	Chi square test
Regular	9.00 (14.52)	5.00 (8.06)	18.00 (29.03)	28.00 (45.16)	2.00 (3.23)	2.07NS
Distance	4.00 (10.53)	3.00 (7.89)	10.00 (26.32)	21.00 (55.26)	0.00 (0.00)	
Total	13.00	8.00	28.00	49.00	2.00	

The blackboard is the most vital teaching aid in the classroom teaching. It not only helps in changing the sensory focus but also imparts correct information to the students. Use of blackboard depends on factors like class size, nature of the content, section (primary/secondary, senior secondary etc.). Irrespective of these, it has the status of most favored teaching aid by teachers. A total of 45.16 percent (regular) and 55.26 percent (distance) teachers write main points and tough words on blackboard (Figure 6).

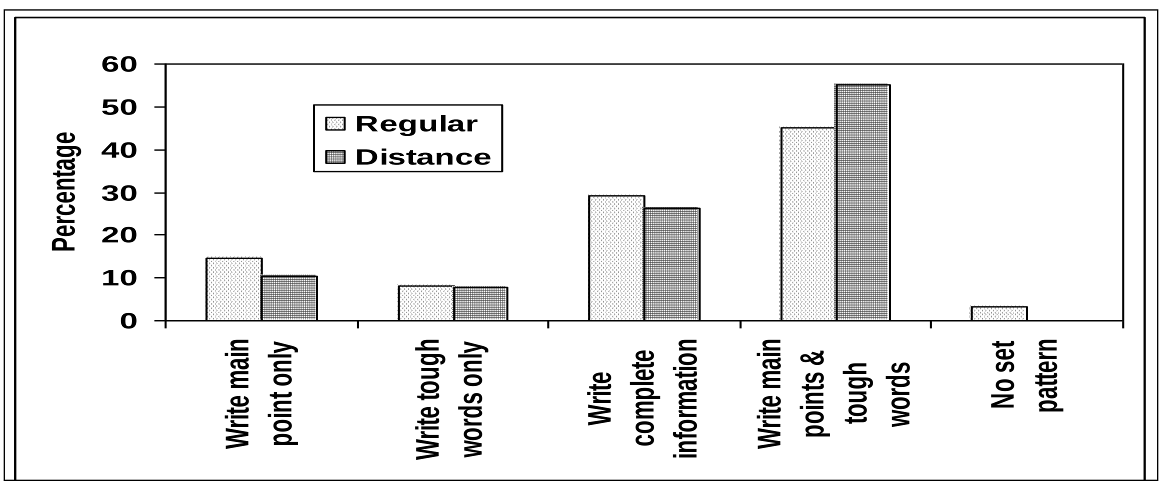

Figure 6. Blackboard writing skill.

Skill in using teaching aids

Table-7 depicts that 12.90 % of teachers (R) and 18.42 % of teachers (D) always use teaching aids while 29.03 % of teachers (R) and 18.42 % of teachers (D) do not use tTeaching aids.

Table 7
Skill of using teaching aids

Use of teaching skills → / Mode of Training ↓	Always use teaching aids	Use teaching aid only when necessary/ available	Don't use teaching aids	No set pattern	Chi square test
Regular	8.00 (12.90)	31.00 (50.00)	18.00 (29.03)	5.00 (8.06)	1.73NS
Distance	7.00 (18.42)	20.00 (52.63)	7.00 (18.42)	4.00 (10.53)	
Total	15.00	51.00	25.00	9.00	

Teaching aids not only help in capturing the attention of students but they make concept principles more clear and& self explanatory. 50 percent (regular) and 52.63 percent (distance) teachers use teaching aids only when available in school or they find it essential for a particular topic (fig.7). Teaching aids are not used by teachers on regular basis due to non availability resulting in their preferring the blackboard over other teaching aids. Some teachers believe that all the topics do not need teaching aids or simply because of not thinking on the lines that how a simple and small teaching aid could transform their classroom environment. For making use of teaching aids an integral part of classroom teaching, student help cn be usedd. Charts, models, clippings, power point presentations or simply a small speech related to topic or concerned issues prepared by students enrich their experiences and gives scope for creative expression.

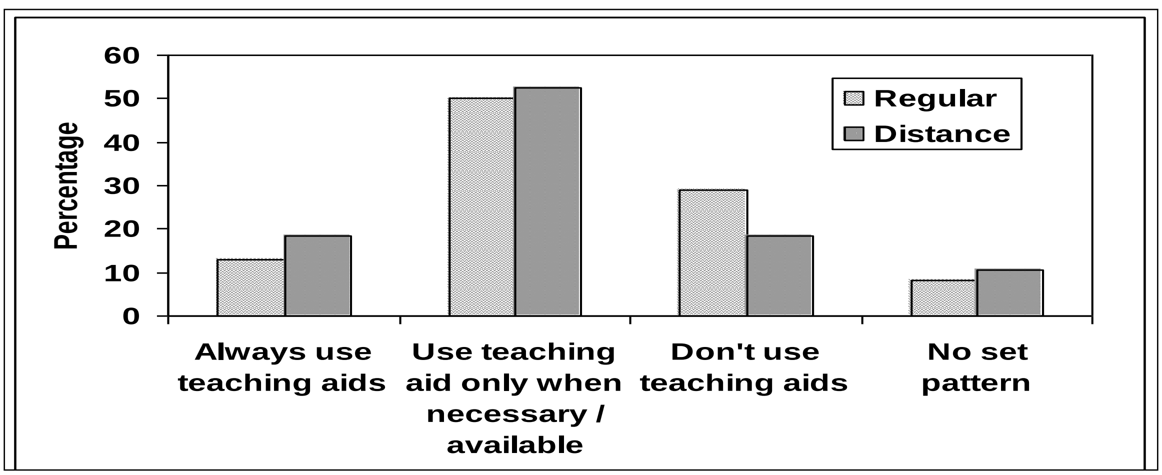

Figure 7. Use of Teaching Aids

Discussion and Suggestions

- Set induction can be based not only on what has been taught but also on what has to be taught. This can help teachers to distinguish between students as self learners and dependent learners.
- Student teachers are given theoretical and practical knowledge of teaching skills in teacher training programmes. During teaching practice session, they apply these skills in the same sequence and style as demonstrated by the teacher educator. As a result, the

whole process becomes very mechanical, monotonous and takes place in laboratory-like conditions. While instructing student teacher about various skills, the approach must be flexible. During teaching practice, skills should be practiced by the student teacher as required in real classroom settings.

- Teachers whether trained by regular or distance mode make various improvisations in using teaching skills. This is a practical aspect of classroom teaching. Due to heavy workloads, compulsion of covering the syllabus within a given time limit and overcrowded classes, teachers tend to combine certain skills like evaluation and recapitulation or overlook some skills like use of teaching aids. Experimentation, creativity and innovation do not find priority in the teaching practice of most of the teachers.
- Recapitulation and evaluation are integral part of teaching behaviour in the class. If, in a given period, teacher is unable to use these skills, in the next class these can be used as a set induction to introduce a new topic.
- Science and math teachers use the blackboard for drawing diagrams, writing formulae or solving problems. In language or social science classes, a picture, scene or mood related to content matter drawn on blackboard can be used to capture interest, stimulate thought process and promote divergent thinking.
- As per Ur (1996): Classroom discipline refers to a state where both teacher and students accept and follow a code of conduct to facilitate smooth, efficient teaching and learning in the class. 'A well-prepared content matter with interesting examples is the foremost condition for managing class well' is the view point of the majority of teachers. Some teachers use questioning skills to keep students attentive in the class. Seating arrangement (i.e. not allowing all the impish students to sit together), is another way to maintain discipline in the class. Using easy language, involving students in various activities like group work, using teaching aids, written assignments and giving every one chance to speak or answer in the class help in effective classroom management.

Conclusion

Teaching skills are imperative for teachers as the means to fulfill the ultimate aim of bringing positive and desired change in the cognitive and affective domain of the students. All the teaching skills are interrelated and influence one another. The way teaching skills are learned and practiced in teacher training institutes remain different from the style in which teachers use them everyday in the classroom. The difference between the two needs to be minimized. Effectiveness of a teacher's teaching behavior is determined not by number of skills she uses in the class, but depends on how these skills are interwoven, adjusted and refashioned to make pedagogy an effective tool in putting students in the mould of active learners, explorers and thinkers. Updated pre service and in service programs can act as suitable vehicles to achieve the desired goal.

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Editor's Note: The explosion of knowledge leads to curriculum overload. Common methods to limit curriculum size include moving knowledge and skills to lower grade levels, and weeding obsolete and irrelevant materials from the curriculum. It is refreshing to see essential knowledge and skills taught in a more efficient and effective manner. This research develops math reading skills to a higher level by appropriate use of animation and interactivity. This is creative teaching and learning inspired by technology

Potential of Using Web-based Animated and Interactive Maps in Teaching Geography

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Abstract

Students at upper secondary school are experiencing difficulty with mastery of geographic skills such as identification and interpretation of geographical information and also map reading. This trend may occur due to the nature of geography discipline that requires creative and critical thinking. Web-based technologies may have the potential to transform the way geography education is delivered to secondary school students. It may enhance teaching and learning process in the classroom and attract students to geography as a discipline. The aim of this study is to find whether the students trained to read animated and interactive maps via web are able to perform better than students using printed static maps in problem solving and explaining symbols. Students in form four were tested on three aspects of geography: map reading, feature recognition and geographical concepts. Students were not randomly assigned to instruction but randomly assigned for post-test. Multivariate analysis of variance (MANOVA) indicated that students performing using animated maps outperformed students using computer delivered static maps. This study reveals that students using web-based animated and interactive maps exhibit stronger understanding of geographical concepts and improve their map-reading skill.

Keywords: Geography, Maps, animation, Interactive Maps

Introduction

The World Wide Web (WWW) is the most recent and an interesting medium to present and disseminate geospatial data. The information on the Web is virtually platform-independent, unrivalled in its capacity to reach many users at minimal costs and easy to update frequently. The Web puts new life into the map as a metaphor. Maps can be defined as graphic representations of our environment. However, web maps are maps presented in a web browser which allows for dynamic and interactive dissemination of geospatial data and offering new mapping techniques compared to traditional printed maps.

Web maps classified into two main categories such as static and dynamic web maps. Each of these categories subdivided into view only and interactive maps. Most of view only maps are scanned and put as bitmaps on the WWW. The WWW offers several options to display dynamic maps via animations. Interactive dynamics can be created by using programmes such as Java, Java Scripts, Visual Basic, or via virtual environments such as VRML panoramas that allow three dimensional viewing.

The purpose of this study is to test the hypothesis that students trained to use Web-based animated and interactive maps have greater success in solving problems than students using static maps. Most of the students at schools have difficulty in mastering geographic skills such as identification and interpretation of geographical information and map reading. These problems could be solved by introducing educational technology tools in teaching and learning of geography. Technology may help these students acquire better understanding of map reading and geographical concepts. Web-based map reading may motivate the students to learn, to enjoy learning, and stimulate eagerness to learn more. Kozma and Croninger (1992) described several ways in which technology might help address cognitive, motivational and social needs of so called "at-risk" students. In 1965, renowned learning theorist, Robert Gagne, proposed the need to gain the attention of the learner as a critical first "event" in providing optimal conditions for instruction of any kind. In addition students find strong motivation in the feeling that they are in control of their own learning (Arnone & Grobowski, 1991; Relan, 1992). Further, Web-based activities make themselves cooperative, work in small-groups, develop hypermedia products, and conduct research projects using video discs and multimedia.

Gregg (1994) distinguishes among three methods of drawing information from maps such as map reading, map interpreting, and inferential use of maps. She argues that map reading involves retrieving information explicitly included on the map. According to Gregg interpreting merely integration of two pieces of information presented on the map to determine the connections and patterns. Mennecke, Crossland, and Killingworth (2000) argue that map reading occurs when reader has fully internalized the map to support problem solving. Peterson (1995) offers support to Mennecke, Crossland and Killingworth's view and suggesting that humans store information from maps by creating associations and store the information to be used later. In short, map reading occurs if a student able to identify, gather, record, organise and interpret geographical information from a map.

Piaget (1956) assumed that children's cognitive development depends on interaction with one's physical and social environment. He describes a set of skills necessary for full development of spatial understanding and transfer to graphical representations. Bruner's (1966) cognitive theory expands and complements Piaget's theory that students development in three stages towards mastery of map reading. In Bruner' model, students must go through a period of concrete interaction with space, move to ionic. Bruner felt that students were more likely to understand and remember concepts they had discovered in their course of their own exploration. Interactive animated maps allow students to interact and explore the maps individually.

This study takes into account the above learning theories and is designed according to students' ability in reading maps. Two types of maps were used to assess students' performance during the experimental testing. They are static maps and animated and interactive maps. Static maps present geographic information in a single image. A single image is unable to provide adequate information to support a decision on a particular geographic issue. Muir (1985) suggests multiple pages of related images may enhance learning. Computer-delivered, interactive maps might open with a blank map of an area of interest and offer the student the opportunity to overlay area and line data such as topography, vegetation, political boundaries, and print maps or the town and the cities. Peterson's (1995) suggested model for usefulness of interactivity in cartography takes into account the capacities of human mind in manipulating mental representations of cartographic information.

Assessment of students' map reading must measure students' ability to apply the techniques they learn into novel problem solving with unfamiliar maps (Jan D. McCoy, 2003). The assessment used in this study challenges a student's ability to solve problems through evaluation and explanation. Kane, Crooks, & Cohen (1999) states, "If we want to assess the students' abilities to formulate their own conclusions…and state these conclusions, it seems essential that we give them some time to develop their own ideas and an opportunity to state these ideas in their own words." Map reading occurs only when the reader has sufficiently internalized the map to support decision making and problem solving (Mennecke, Crossland, and Killingworth, 2000). In this study the students were involved in three different forms of assessment. The difference is found in the supportive materials used rather than questions presented. One group used web-based animated, interactive maps, another group used computer delivered static maps, and the third group used printed maps.

Gershmehl (1990) distinguishes between seven types of computer animation that are applicable to cartography. These seven can be grouped into two categories: frame-based animation and cast-based animation. The two differ in how the animation is created. In frame-based animation the individual frames do not share common elements, whereas with cast-based animation foreground objects can be moved against a background.

Methodology

In this study the researcher used frame based animations which were developed by using Macromedia Flash MX. The researcher designed the lesson according to the latest form for geography syllabuses. The contents are assessed by experienced teachers from both control and treatments groups.

A quasi-experimental design was used in this study. Four existing intact form 4 classrooms of sixteen and seventeen year old studentsfrom the urban schools were used as experimental and control groups. One group of students (2 classrooms, 46 students) received instructions using web-based animated maps while remainder (2 classrooms, 52 students) of students received instruction using computer-delivered static maps. The first group is the experimental group and the second is the control group. All maps regardless of treatment of condition were assessed via a computer interface to avoid novelty influence. The instruction was given by researcher to the whole group using Liquid Crystal Display (LCD) Projector. This enabled students to view the instructions simultaneously. All students used computers with access to the maps to give them control over their display. The researcher facilitates the classroom activities. This approach is to ensure that all students got equal and adequate exposure to the content.

Both groups used maps depicting three geographical skills appropriate to form 4 students'. Three different types of maps were used to identify symbols, map-reading and to interpret geographical information. The first map contains different types of symbols. These symbols categorized into five types such as dot symbols, line symbols, area symbols, pictorial symbols and abbreviations. Students in both control and experiment groups are expected to identify these symbols after the instruction. The experimental group will use th web-based animated map whereas thecontrol group will use computer delivered static map. The second map is related on interpreting geographical information. In this map students will learn to draw sketch maps after the instruction. A series of animated sketch maps will be presented via web to enable the experimental group to read and identify geographical information on the map. Whilst the control group will use computer delivered static map. The third map is used to identify and interpret geographical information on the presented map. The control group and experimental group were asked questions related ton interpreting and gathering geographical information.

Pre-test comparisons determined initial equivalence of the two groups in prior use of web-based animated and interactive maps and computer-delivered static maps. Their scores were compared across groups using an assessment both declarative and procedural knowledge (Alexander, Schallert, & Hare, 1991) in geography. Count in each group by gender is presented in Table 1.

In the pre-test, students were presented with a series of ten questions to identify symbols from the map of the local place. These questions were posed in multiple-choice format. Next, the students were asked to sketch maps related to information on the map such as drainage, relief and communications. These two portions of assessment addressed the skills identified by Gregg (1994). The first task reflects students map reading as simple recognition of symbols on the map. The second addresses skills involved in the map interpretation skill. The third portion of the pre-test, fifteen matching questions, requires students to match terms and their definitions. This was essentially used to grant a base line score to students performed poorly on the other two tasks.

Table 1
Counts Each Group by Gender

Assessment type	Gender	Instruction type		
		Animated	Static	Total
Static	F	15	18	33
	M	10	12	22
Animated	F	12	15	27
	M	9	7	16
Total		**46**	**52**	**98**

A post-test was administered to determine differences among the two assessment groups. The questions were designed to measure map reading skill, feature recognition and interpreting geographical information

Results

The pre-tests individual questions' reliability measured. Each question was correlated, using Pearson's R (Garson, 2003), to the total scores of each student. The map reading and geographical sub-tests showed a moderate relationship between map reading items and geographical concepts respectively. All correlations are positive and significant indicating moderate to strong correlations between items and their respective subset totals. Another test of internal consistency, Cronbach's alpha was calculated at 0.79. Table 2, shows the relationship between items and total score on the pre-test for Map Reading, Feature Recognition and Geographical Concepts.

Table 2
Relationship Between the Sub-tests and Total score on Pre-test

	Map Reading	Feature Recognition	Geographical Concepts
Map Reading Pearson Correlation	1.00	0.43	0.49
Feature Recognition Pearson correlation	0.43	1.00	0.56
Geographical Concepts Pearson Correlation	0.49	0.56	1.00

*All correlations are significant at the 0.01 alpha level (n = 98)

Inter-correlations among sub-tests showed in Table 3. Most of the indicators show moderate relationship among the sub-tests and total score. Inter-correlations of 0.3 to 0.7 are regarded acceptable (Presley, Austin, & Jacobs, 2000). Therefore, pre-test's individual questions are reliable for this study.

Students were grouped by both instruction and by assessment type for analysis of the pretest. A multivariate analysis of variance (MANOVA) compared performance as suggested by Keppel and Zedeck (1989). The results are shown in Table 3.

Table 3
Multivariate analysis of variance for pre-test sub-tests

Source	Sub-test	df	F	*p*
Instruction (I)	Map Reading	1	2.11	.15
	Feature Recognition	1	1.11	.26
	Geographical Concepts	1	2.32	.12
Assessment (A)	Map Reading	2	1.27	.11
	Feature Recognition	2	1.23	.14
	Geographical Concepts	2	1.43	.65
I × A	Map Reading	2	1.54	.34
	Feature Recognition	2	1.32	.12
	Geographical Concepts	2	1.62	.11

Indicators in the table show that no results are significant at the alpha = .05 level (n = 92)

Once intervention was completed, post-test was correlated to overall scores to determine reliability of the individual questions. As in the pre-test, results were grouped into three sub-tests scores. Table 3 shows all correlations are moderate to strong and all significant at the .05 alpha level.

Table 3
Relationship Between the Sub-tests and Total score on Post-test

	Map Reading	Feature Recognition	Geographical Concepts
Map Reading Pearson Correlation	1.00	0.41	0.53
Feature Recognition Pearson Correlation	0.41	1.00	0.56
Geographical Concepts Pearson Correlation	0.53	0.56	1.00

*All correlations are significant at the 0.01 alpha level (n = 98)

Table 4, shows the output of the study indicating student performance on sub-tests of the post-test by student assignment to group.

From the table we conclude that students were using animated maps for assessment task, regardless of their instructional condition, outperformed students using static maps for assessments in the map reading, feature recognition, and geographical concepts sub-tests.

Table 4
Students Performance on sub-tests of the post-test by group

	Instruction	Assessment	M	SD
Map Reading	Animated	Static	1.42	1.59
		Animated	2.54	1.84
	Static	Static	1.47	1.32
		Animated	1.93	1.11
Feature Recognition	Animated	Static	6.40	4.12
		Animated	7.78	5.56
	Static	Static	5.87	3.45
		Animated	6.12	4.01
Geographical Concepts	Animated	Static	6.89	4.54
		Animated	6.67	4.38
	Static	Static	6.99	4.54
		Animated	7.54	5.33

Post-test scores were analysed using multivariate analysis of variance (MANOVA). The MANOVA identifies the portion of the variance due do instructional condition, assessment condition and each of the sub-tests. The results are presented in Table 5.

Table 5
Multivariate analysis of Variance of post-test results

Source	Sub-test	df	F	*p*
Instruction (I)	Map Reading	1	0.11	.15
	Feature Recognition	1	0.11	.26
	Geographical Concepts	1	0.02	.12
Assessment (A)	Map Reading	2	7.27	.00*
	Feature Recognition	2	1.65	.14
	Geographical Concepts	2	0.43	.65
I × A	Map Reading	2	1.64	.34
	Feature Recognition	2	1.36	.12
	Geographical Concepts	2	0.56	.11

*Significant at the .05 alpha level

As shown in table, the three sub-tests were treated as dependent variables with assignment to assignment and assignment to instruction used as fixed factors. The map reading score is the only significant item in this MANOVA when analysed for assessment type.

Discussion

The results prove that students who trained to use animated maps out-performed students trained to use static maps. The results also indicated that those students attempting to learn and address questions about one of the problems were more successful when using animated maps. However we cannot totally deny the contribution of static maps in the teaching and learning process. Learners have used static maps for a long time to solve many geographical problems they encountered. New technologies may enhance the learning process in the field of geography as used in this study. In this study, web based animated, interactive maps appear to help student mastery of map delivered-content.

There are number of factors that might have mediated the findings in this study such as the medium (i.e. the computer as a delivery system), students' previous experience both with computer and maps, web applications, students' motivation for success, the content presented in the maps both instruction and assessment, efficacy of the materials, and quality of the measures. Each of these factors may have impact but isolating each and determining individual impacts are beyond the scope of this study. However efforts were made to control for these factors while others were not controlled because of their elusive nature. Randomization during assessment was used to control for variation in student experience, perception with both computers and maps in problem solving.

The researchers as geography lecturers made careful consideration on quality and appropriateness of the measures after reviewing these materials with experienced secondary school teachers. Students' past experience and perceptions were not measured but entirely variable since most of them came from different backgrounds and places. The first variable, motivation, is difficult to measure as is students' map management. Nevertheless, it appears that students using web-based animated, interactive maps were less effected by a motivation problem.

Another threat to this study is the short duration of the intervention. This was proven by the students' performance on the geographical concepts. Performance may have been effected because students were aware that there was no personal gain on the post-test. In short, there is no relation between performance and subject grade.

Even though here are limitations, as discussed above, it is important to recognize the outcome of the study. Web based animated, interactive maps are easily accessible so that even students who have not been trained to use them are more successful in addressing map reading exercises. They accurately identify map features regardless of the map type used for assessment.

Conclusion

This study needs further investigation on the impact of web-based map reading. A transition from static maps toward web-based animated, interactive maps for geography instruction in secondary schools should be advocated and pursued. This move would significantly improve performance of students as they attempt to read maps and solve spatial and temporal problems.

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Editor's Note: This study is a successful application of computer generated graphics, computer assisted learning and peer assessment to improve a Trigonometry course. It discovered real advantages for team (peer) learning and identified ways that learning styles can modify the outcome for some students. This is an interesting, provocative and well designed "action" research study.

The Roles of Computer Mediated Collaboration and Peer Assessment in Learning Trigonometric Curves*

Jale Bintas and Firat Sarsar
Turkey

Abstract

The aim of this study is to investigate the roles of computer mediated collaboration and peer assessment in learning trigonometric curves. The subject of this study was a group of 64 students of the Mathematic I class in the Department of Computer Education and Instructional Technologies, Ege Universitesi, Egitim Fakultesi, Bornova, Izmir, in the first semester of 2006-2007. All of the 64 students participated in the multimedia computer-based learning. They were divided in 16 groups and were assigned to use a single PC per 4 students. The duration of the research was planned for 2 weeks. During the first week of the research, we handed out the trigonometric curves formula y= I asinb(x-c) I +d to the class. Groups of the students were asked to draw this trigonometric curve by using Maple 7.0 software with the time limit of 75 minutes. During the second week of the research all the groups were subjects of a 10 minutes exam. We asked them to trace the changes that might occur if some variables of the given trigonometric curve were changed. Group leaders were expected to present their suggestions about the possible differences. In the assessment phase, we analyzed answers given by both the leaders of the groups with regard to the changes in the given trigonometric curve (their answers were video-taped) and their peer assessment. The result of the research demonstrated that students gained extra ability in drawing and analyzing trigonometric curves by using a computer based collaborative learning environment. Moreover, we were able to observe the effects of the computer mediated collaborative learning on the development of their self-confidence and good performance in sketching trigonometric curves.

Keywords: Mathematic teaching, trigonometric curves, computer mediated collaborative learning.

Introduction

With the current emergence of technology in the area of communication, a visible shift can be observed from people working individually towards team work and collaboration. We are finding ourselves at the border of the industrial age moving towards the information age where collaboration has become a necessity. This transition has brought transformations in the corporate and business world that were observed by researchers.

Reigeluth (1999) summarized the "key markers" that characterize the difference between industrial-age organizations and information-age organizations as follows:

Without a doubt, computers and technology have affected the means and modes of communication in education. The new technologies have not only transformed the way students communicate with professors, but also the way in which information is created, reviewed, distributed and stored.

* This paper was oral-presented at 2nd International Computer and Instructional Symposium at Ege University on 16-18 April 2008

Comparably to the changes brought by technology into the sphere of business, similar trends can be observed in computer mediated learning. Technology has customized learning through its capacity to respond to the individual learner's style. With the introduction of collaboration, learning is now seen as an interactive process where learners are required to construct their understanding instead of simply memorizing definitions given to them. The collaborative learning paradigm makes use of small groups so that students can work together to take full advantage of each other's learning.

Table 1
Differences Between Industrial-age Organizations and Information-age Organizations

Industrial Age	Information age
Standardization	Customization
Bureaucratic organization	Team-based organizations
Centralized control	Autonomy with accountability
Adversarial relationships	Cooperative relationships
Autocratic decision making	Shared decision making
Compliance	Initiative
Conformity	Diversity
One-way communication	Networking
Compartmentalization	Holism
Parts oriented	Process oriented
Planned obsolescence	Total quality

Without a doubt, computers and technology have affected the means and modes of communication in education. The new technologies have not only transformed the way students communicate with professors, but also the way in which information is created, reviewed, distributed and stored.

Comparable to changes brought by technology into the sphere of business, similar trends can be observed in computer-mediated learning. Technology has customized learning through its capacity to respond to the individual learner's style. With the introduction of collaboration, learning is now seen as an interactive process where learners are required to construct their understanding instead of simply memorizing definitions given to them. The collaborative learning paradigm makes use of small groups so that students can work together to take full advantage of each other's learning.

Advantages of collaboration were discussed in many previous researches. It was demonstrated that teamwork has significant impacts on student satisfaction (Fulford & Zhang, 1993), better academic performance (Lenning & Ebbers, 1999), higher levels of motivation (Hornbeck, 1990), and a positive attitude towards computer mediated environment (Thompson, 1990).

Collaboration in education improves a student's analytical, learning, and social skills; however, assessment of an individual's contribution in collaborative exercises is difficult to perform using traditional evaluation methods. Therefore, the use of an assessment approach that allows students to grade the success of their peers can prove very beneficial in this kind of setting. Peer assessment can be defined as an arrangement for peers to consider the level, value, worth, quality or successfulness of the products or outcomes of learning of others of similar status. (Topping, Smith, Swanson & Elliot, 2000).

Computer mediated communication, cooperative learning, and peer assessment are the main themes providing orientation for this research. These aspects of learning were used during the experimental class aimed on increasing positive academic outcomes of students in solving trigonometric curve problems.

The purpose of the study is to examine the effect of collaborative and computer-mediated learning on academic achievement of students together with their perception of it in the process of solving a trigonometric curve problem.

The study addresses the following research questions:

1. What is the relationship between the use of collaborative learning instructional techniques in the process of solving trigonometric curve problem and academic achievements of students?
2. How does the nature of the computer mediated learning environment impact student success in solving trigonometric problems?
3. What are some of the benefits of peer assessment in the collaborative learning setting?

Methodology

The participants for this study were selected among the freshmen students of the Computer Education Department. A total of 64 students who were enrolled in the Mathematic class offered by Ege University, School of Education, Department of Computer Education and Instructional Technology were chosen as the subject of the given research. At the time of the study students had been introduced to the use of MAPLE 7.0 software that will be utilized later in the process of research. The time frame of the study was planned for two weeks. During the first week the participants were to find their way of solving y= | a. Sin b (x-c) | + d. Discussions in groups of four provided a good atmosphere for analyzing the possible ways of solving this problem. Together they were to recognize or identify different approaches to the given trigonometric curve. Collaboration between peers is seen here as the act of shared creation. The second week was left for the recapitulation of the previous findings and exams. These two stages were followed by an assessment part. During this phase students were tested on what they have learned by two quizzes and an oral examination.

The same concepts are used in the research conducted by Ng and Hu (2006) "Use of web-based simulation in Learning Trigonometric Curves." The goal of the research was to investigate the impact of using trigonometric graphs, a teacher created web-based simulation, and asynchronous online discussion on students' understanding of and performance in sketching transformation of trigonometric curves. The same model was applied in creating the framework for our study. However, the objective of the given research was to investigate the roles of computer mediated collaboration and peer assessment in learning trigonometric curves.

Instruments

Different sources were used to collect the data for the study, namely: open-ended questionnaires to find students' attitudes in regards to the computer mediated collaborative learning, quizzes to measure each student's understanding of trigonometric curves transformation, and video recordings. All the activities were video-taped to monitor the process of student's collaboration.

Procedures

Sixty-four participants were divided into sixteen groups of four people. From these sixteen groups were formed two cohorts of eight groups each. All the groups were required to come up with a name they would be called during the class periods and to select a leader.

Table 2
Timing and Activity Process

Process	Activies	Time
1. Week	**y= | a. Sin b (x-c) | + d** • Using computer for analyzing • Investigating differences among the graphics • Discussing	75 min
2. Week	15 min. for remembering Two different questionnaires	10 and 15 min.
	Presentations	5 min per team 16X5 = 80’

For the first week the main trigonometric formula y= | a. Sin b (x-c) | + d was given to the students alongside with the keys. A key formula was given to students to begin. The key formula was y=asinx as you can see in Figure 1. They were to investigate this formula before finding the main solution.

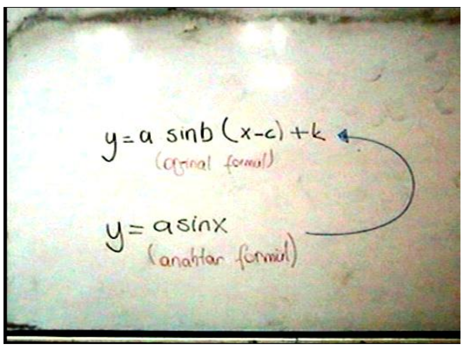
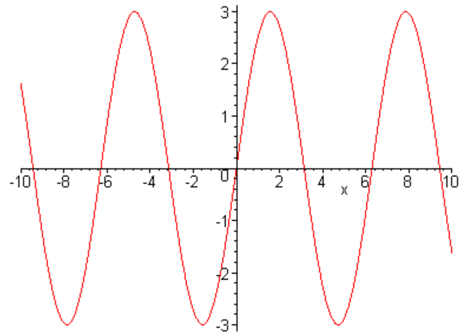


Figure 1. Formula (video recording)

Figure 2. Computer mediated Collaborative Learning Environment

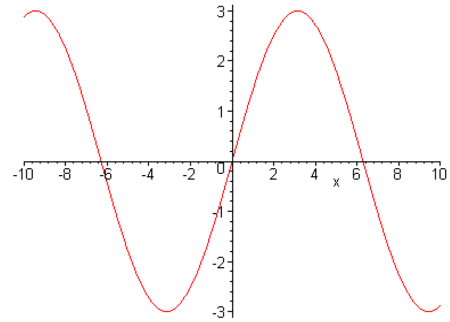
They spent 75 minutes in the computer laboratory working (see Figure 2.) on finding their way to solve the given problem. Each group had access to a computer. With the use of Maple 7.0 software they were to learn how to sketch transformations. They used Maple 7.0 for sketching graphs that can be seen from Graph 1 and Graph 2. The students had opportunity to learn new content with other group members. Thus we made use of collaborative learning environment. This kind of setting proved to be favorable for students in helping them independently recognize solutions to the given problem. In their groups they were expected to not only recognize some possible solutions, but also to analyze each one of them. As a result of the discussions with peers, they created a way out which in their opinion worked the best. Usage of technology is likely to have a considerable impact on students involved in the task solving process where the computer has a potential to increase motivation and to promote deeper learning. Consequently, students have been introduced to the computer-supported collaborative learning environment.

plot (3*sin(x),x);



Graph 1. **View of Maple Graphs.**

plot (3*sin(x/2),x);



Graph 2. **View of Maple Graphs.**

At the end of the computer lab session on the second week of study students were given a 15 minute time period for recapitulating what they have learned during the first week. Only at this time were they allowed to use the computers. A paper-based examination was held afterwards when students were asked to answer 5 questions. They had 10 minutes to complete their answers in groups. Each group received one copy of the questionnaire. In the allocated time they were to discuss possible responses. Leaders of the groups were required to write on paper the answers to the problems after listening to the comments of their peers. All the answer sheets were collected so that they could be graded by the teacher. The grades were distributed by the questions as follows:

1. Y=3sinx (2 points)
2. Y=sin1/2x (2 points)
3. Y=sin(x-30^0) (2 points)
4. Y=3sin1/2x (4 points)
5. Y=sin2(x-45^0) (4 points) Total of 14 points per 5 items quiz.

The results of the quiz were only known to the teacher and not to the students. A list of groups was created based on their success in passing the first quiz. The group with the best results was placed on top of the list and groups that scored less were placed respective to their scores.

Throughout the same week students were given a second test in the next class period. This time students received another 5 items quiz that contained open-ended questions. They had 15 minutes to complete this test. The grades were distributed by the questions as follows:

1	Y=**3**sinx	How the digit 3 can change the curve? Why changes occur?	10 points
2	Y=sin1/2x	How the digit 1/2 can change the curve? Why changes occur?	10 points
3	Y=sin(x-30^0)	How the digit -30 can change the curve? Why changes occur	10 points
4	Y=3sin1/2x	While solving this problem which steps did you follow? Do you think there can be another way out?	20 points
5	Y=sin2(x-45^0)	While solving this problem which steps did you follow? Do you think there can be another way out?	20 points

Total of 70 points per 5 items quiz.

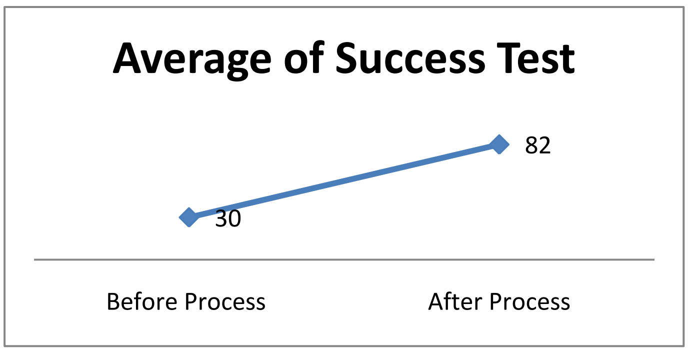
Assessment

The critical part of the study was left to the end when each team had to present its answers and solutions. Leaders of the groups were to give a five minute presentation while other groups of the first or second cohort had to evaluate the presentation and compare their answers with the ones that had already been presented. The maximum that a group could score during this phase was 100 points (30 points were assigned to the quality or manner in which presentation was made). On the other hand, the teacher was also involved in the evaluation process in grading the responses of students independently.

During the assessment stage, an evaluation paper was given to each group for estimating findings of other groups. The whole peer assessment process was managed confidentially. Teams had no access to the findings of others or to the scores they gave. The total of 16 groups was divided in 2 parts. The first 8 group's presentations were followed by the other 8 at the end.

Findings

As the result of this study we observed a significant increase of academics achievements for the group of participants. At the beginning of the study each student had to pass the evaluation test. A score between 60 and 100 points was considered as passing.



Graph 3. **Average of Student Test Score**

Prior to the research, the score of 30 points was the average outcome of the student success (see Graph 3). It shows that they were not successful enough in their academics before the beginning of the study. Upon the completion of the research students scored an average of 82 points. This shows a steep increase in students' success as the result of the experiment. Collaboration work in groups, computer mediated solutions, and inter-change of learning environments are the key factors for this achievement. Three aspects were taken into consideration when analyzing the outcomes of the study: i) collaboration, ii) computer mediated learning and iii) peer assessment.

Collaboration

Collaboration can be considered as one of the most important aspects of studying in various learning environments (Açıkgöz K., Sarsar F., Altun E., Bonk C.J., Lee, S., Liu, X., Su, B). This study aimed to evaluate the effects of collaboration on meaningful learning. We therefore asked students to answer a set of questions concerning collaboration. The answers to the survey questions facilitated our evaluation of their opinions regarding collaboration.

Table 3
Student's Views on Collaboration

Student's Views on Collaboration	Frequency (n=64)	Percents (%)
Positive Views	57	89
- To re-discover friends' behaviors	41	64
- To produce new ideas	38	59
- To share personal knowledge	33	51
- To save time	25	39
- To correct wrong knowledge	22	34
- Effective learning	18	28
- Multi- brain working	11	17
Negative Views	7	11
- To be a passive person	4	6
- To be shy	4	6
- Low responsibilities	3	5
- To argue	2	4
- Self-superiority	2	4

As Table 3 shows, 89% of all participants gave positive feedback on collaborative learning, comparing to 11% surveyed who had a negative opinion. The majority of respondents that brought out a positive side of the experience emphasized their rediscovering attitudes of their team members. It proved that the process is complex by its nature. Creating new ideas and sharing these ideas with their team members, correcting their misunderstandings and saving time prompted students to develop positive attitudes. In addition, participants defined this kind of environment as being beneficial for the effective learning and multi-brain working. This feedback represents one of the most important details for the research. It proves the environment being sufficient to supply students with the above mentioned abilities. Moreover, they came with the `multi-brain working` name for the lesson setting. However, there were some students that pointed out negative aspects of collaboration. The main concern of this group of students was their fear of becoming passive players in their teams. Additionally they recognized their avoidance of taking the responsibility and timidity in the group discussion. It might have had some negative influences on their successes with the subject. This lack of accomplishment advanced their negative views on collaboration. They draw attention to arguments occurring during discussions. It could be one of the factors that made them feel bad about the collaboration.

Computer mediated learning

Another part of the study was concerned with the use of the computer in the learning process. The computer mediated instruction was included in the original design of the study. Hence, the process combined collaboration with the use of the computer. In order to improve collaboration skills each group needed to use a computer. Consequently we asked students to answer some questions related to their experience of computer mediated collaboration in order to analyze their feedback.

Table 4

Students Views on Computer Mediated Collaboration

Students views on computer mediated Collaboration	Frequency (n=64)	Percents (%)
Positive Views	61	95
- To take rapid Feedback	52	81
- Visual	50	75
- To try different solutions	46	71
- To save time	38	59
- To improve self confidence	23	35
Negative Views	3	5
- Memorizing	3	5
- Lock of sharing computer	2	4

As Table 4 shows, the majority of students had positive opinions about their experience of the computer mediated learning environment. They benefited from the given possibility of receiving rapid feedback and the opportunity to experiment with different solution. The advantage of studying various solutions on a computer rather than on paper was also noted. Another important observation about this method was the improvement in students' self confidence. The environment helped them to believe in their abilities. On the other hand, several students complained that the computer mediated learning forced them to memorize solutions. Additionally, some of them had disagreements about sharing the assigned computer.

Peer assessment

Peer assessment represented another important part of the research. During the process of research, students were placed in a new position as that of a teacher. They were to evaluate their friends' activities.

We concluded our study with the peer assessment phase. The chart was given to the students to provide them with criteria for the evaluation. All the groups had to listen to the presentation of their colleagues. Afterwards they were expected to evaluate findings and quality of the presentation of their peers. There were five questions in the second quiz. Three of them were worth 10 points and the other two questions were 20 points each. The maximum of 30 points were left for the presentation. The highest score a group could receive during the evaluation was 100 points. As we mentioned above, the lecturer did not present correct answers to the questions. Therefore we could match the differences of the results as shown below:

Table 5

Matching Results of Evaluation

Result of Evaluation of Teacher (first 4 groups)	Result of Evaluation of Teams (first 4 groups)	Match
Team A (100 points)	Team A (100 points)	√
Team B (100 points)	Team B (100 points)	√
Team C (95 Points)	Team C (100 points)	√
Team D (95 Points)	Team D (95 points)	√

As we see in the Table 5, the list of groups was sorted according to the number of points they received from highest to the lowest. The first four groups on the list scored the best. The list which were evaluated by students was exactly the same as the teacher`s list.

At the end of the evaluation, the whole list and the scores were examined by the teacher. The teacher paid special attention to the last two groups that scored low to see to which group did their points go. The instructor concluded that even if students solved the problem wrong, they would give maximum points to the group that found the correct answer. It shows that they were able to correct themselves while listening to the explanations given by their peers. Moreover, it proves that the peer assessment had impact on the problem solving process.

Table 6
Matching Low-Scored Results of Evaluation

Result of Evaluation	Result of Evaluation of Teams (first 4 teams)	Match
Team F (Average 60 points)	Team A (100 points)	√
	Team B (100 points)	
	Team C (100 points)	
	Team D (90 points)	
Team G (Average 65 points)	Team A (100 points)	√
	Team B (100 points)	
	Team C (100 points)	
	Team D (90 points)	

Taking into account all the ideas previously presented in the research we can conclude that peer assessment contributed to the student's understanding of correct answers. Groups that scored the lowest were able to find the right answer and correctly decide how to distribute points among other groups. The following is some of the excerpts from the open-ended questionnaire that was created to evaluate student peer assessment experience:

A. *We learned the correct way of solving the problem while listening to the presentations of our friends.*

B. *His presentation made it so clear to me the way of solving the problem. I cannot believe that we could neglect such an obvious solution*

C. *My way of solving the problem was quite different from what I have heard in the presentation of my friends. They helped me to see the right way of solving the problem*

D. *After the presentation made by another group all the difficulties in understanding were gone*

However, the situation was not the same in the case of the other group. As we see in the Table 7, Team N received the lowest grade from teacher. Surprisingly enough, at the same time, they scored high in peer evaluation.

Table 7
Matching the Results

Result of Evaluation of Teacher (for second group)	Result of Evaluation of Teams (for second group)	Match
Team I (100 points)	Team I (100 points)	√
Team J (100 points)	Team J (100 points)	√
Team K (100 Points)	Team K (100 points)	√
Team L (95 Points)	Team N (95 points) **	-
Team N (80 points)*	Team L (95 points)	-

* Team N was the 7th from 8 teams for Teacher
** Team N was the 4th from 8 teams for students

It shows that friendship might negatively influence peer assessment. Their colleagues gave the following feedback:

A. *He was so funny while giving his presentation. This was the reason why we scored him high. Actually we didn't care much about his approach to the problem.*

B. *He is one of my best friends. I know that he will ask me how many points I gave him. So I tried to convince my fellow group members to give him highest points.*

C. *He was very clear in his presentation. Maybe he made some mistakes in his conclusions. But he was the best presenter.*

D. *One of my team-friends forced us to score the presenter high.*

The lecturer mentioned that "Team N had mistakes that resulted in a wrong conclusion. But the spokesperson of the group did well with the presentation. Moreover, the presenter is one of the most popular students in this class."

Discussion

This research addressed the process of solving trigonometric curve problems and helped find different methods leading to a solution. The design of the study was thought to incorporate various aspects of learning, namely collaboration, computer mediated collaboration and peer assessment. Collaboration is considered to be one of the most important methods in education. (Açıkgöz, K., Hoppe, H.U.). Collaboration in education helps students share their experiences.

Our study has led us to the conclusion that collaboration is a united effort of students to accomplish common learning objectives and to increase their own and their group members' individual achievements (Ng, M.W., 2002). There are numerous didactic advantages of collaboration that can add to the learning environment. As it has been demonstrated in the given research, students who work in small groups have been shown to achieve higher levels of academic outcomes. Some other benefits of collaboration are as follows:

- Reciprocal exchange of ideas and teaching each other fosters active learning.
- Teamwork enhances retention of study material and promotes a greater depth of learning.
- Development of stronger analytical skills. The student's ability to analyze, synthesize and evaluate study material increases.

- Improvement in communication and interaction among the students.
- Time is used more efficiently because the same amount of work is completed quicker.
- Discussion of theoretical concepts is a step closer to their practical application.

Notwithstanding, there are several concerns that were discovered with collaborative learning. These include indifference shown by some students, non-deliberate lack of contribution by some members due to a lack of self-confidence or passive personalities, arguments among peers and distracted attention from the subject of study.

Another problem is assessing individuals within the group. During the teamwork students have no direct supervision of the instructor. Therefore, it would be difficult for an "outsider" to assess the dynamics and collaboration within the group (Buchy, M., Quinlan, K.M., 2000). Whenever we are trying to involve students in a group effort there are two specific conditions that must be met, namely: the students require assurance that their efforts will be fairly evaluated and that students who did not contribute to the work of the group will not benefit from the efforts of others (Johnston, L., Miles, L., 2004).

One way of solving this problem can be found in use of peer assessment. This method of evaluation can engage students in their group work, have them take responsibility for their learning, and minimize the free-loaders. Peer assessment requires students to make the best use of their knowledge in order to review and correct work of a fellow student. In this way it contributes to the development of his/her reflection skills (Haekyung Lee, 2008). Peer assessment encourages students to be critical and independent learners, but as it has been shown in the study, special attention should be given to the obligation of students to be accurate and fair when assessing their peers. The negative side of the peer assessment is the effect that it may have on friendships and inter-personal relationships. In some cases students are aware of the necessity to give high points to a friend in order to maintain the friendship.

Students in the study worked as a team to determine the strategy to be used, but they still maintained their own individual ways of learning. They would articulate their own solution in every group discussion whether logical or not. We reformulated four different sessions in the research below:

Learning Process in a Team

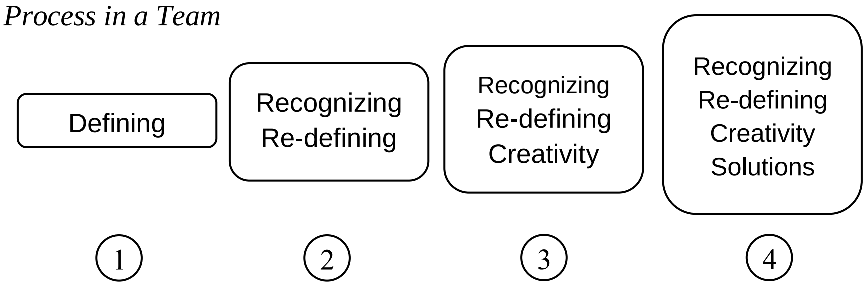


Chart 1. **Learning Process of Computer Mediated Collaborative Learning**

These four steps are shown on the video recording. Chart 1 explains the study. The first step of the chart is defining. The second step of the chart is presenting the process of recognizing and re-defining. According to the video tape, students were able to recognize the essence of the problem. However on the individual level, they had to re-defined the problem again. And as we see in step three they began to come up with solutions without even knowing whether they are correct or not.

Table 8
Keys of the Learning Process from the Video Record

	Defining	Recognizing Re-defining	Recognizing Re-defining Creativity	Recognizing Re-defining Creativity Solutions
Keys From Video Record (Some key verbs from video recordings)	Describe Explain	Describe Explain Understand	Describe Explain Understand Design Animate Plan	Describe Explain Understand Design Animate Plan Choose Decide

During the process of creating solutions they discovered new ways and as a result they had to re-define the problem again. The last part of the chart shows the efforts of students to finalize their solution. All the way through the process they still continued to recognize, re-define and create solutions.

Table 8 demonstrates that "to define" was considered to be a key process. Prior to finding a solution, students had to define the problem over and over again. They thus gained the ability to recognize the problem which led them to several options for solutions. Each group designed its own style of presentation. Some even made use of animation. This shows their creativity. The last phase of the process was to choose their solution and presents their decision. The chart above shows the results of this study. Many different variables affected this chart. For example, the way students used their computers differed. Groups were provided with a computer, but they started to actually use it only during the second phase. During the third phase they were still trying to solve the problem on paper. Such paper based approach was in a way limited. While using the computer they had the chance to see different animated ways of problem solving. It shows that computer mediated collaboration may incorporate different learning facilities. As it was mentioned before, the results may vary from research to research. These changes may help researchers to find learning solutions. Learning processes may change—not only from country to country, but also from student to student in the same class.

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Editor's Note: The question of student identity verification arises from time to time. In this instance, it is requested by a United States Federal Law, the Higher Education Opportunity Act of 2008. This study collects data from administrators and faculty to discover their levels of concern and actions currently undertaken to confirm correct identity for distance learning students.

Student Identity Verification and the Higher Education Opportunity Act: A Faculty Perspective

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USA

Abstract

This study examined faculty familiarity with Public Law 110-315, the Higher Education Opportunity Act (HEOA) of 2008, Section 602.17, Subsection G. This section of the HEOA addresses the challenge regarding the way in which online postsecondary institutions verify and validate that the students who are awarded college degrees actually completed the coursework. In addition to investigating the level of faculty familiarity with the law, this exploratory study sought to identify the level of student identity verification currently being utilized, the perceived need for improved methodologies, and the role of faculty in student identity verification.

Keywords: distance learning, e-learning, ethical issues, governance, on-line learning, technology in education, identity verification, Higher Education Opportunity Act

Section I: Introduction

Although online learning is in its infancy when compared to brick-and-mortar institutions of higher learning, the popularity of online programs and courses continues to outpace that of education in traditional venues. Allen and Seaman (2008) noted that the growth rate for online enrollments has been 12.9%, compared to a 1.2% overall growth rate of the student population in higher education. They reported that "over 3.9 million students were taking at least one online course during the fall of 2007 term" and that "over twenty percent of all U.S. higher education students were taking at least one online course in the fall of 2007. (p. 1). It is likely that this trend will continue into the near future as the United States continues to reinvent and reinvest in itself after a prolonged economic struggle.

In a speech delivered before a joint session of Congress, President Obama called for every "American to commit to attending at least one year of postsecondary education" (as cited in Lederman, 2009, ¶ 1). He further asserted that the dropout rate for Americans at the secondary level has grown and that Americans who have a secondary education and a postsecondary education has decreased. Obama asked "Americans to commit to attending at least one year of college so that the country can reclaim its mantle as the best educated nation in the world" (as cited in Lederman, 2009, ¶ 1). This presidential declaration came following congressional passage of the Higher Education Opportunity Act (HEOA) in 2008.

The HEOA is an amendment and extension of the Higher Education Act of 1965. The current bill was introduced to the 110th Congress in November 2007. The bill was passed by the House of Representatives in February 2008 and by the Senate in July 2008. The bill was ratified by President Bush on August 14, 2008, and became Public Law 110-315. Of particular interest to institutions that offer online courses is Section 602.17, Subsection G, which explains the application of standards in reaching an accrediting decision and includes the following passages:

> (g) Requires institutions that offer distance education or correspondence education to have processes in place through which the institution establishes that the student

who registers in a distance education or correspondence education course or program is the same student who participates in and completes the course or program and receives the academic credit.

The agency meets the requirement if it –

(1) Requires institutions to verify the identity of a student who participates in class or coursework by using such methods as –

(i) A secure login and pass code, randomly generated personal questions, or proctored examinations; and

(ii) New identification technologies as they become widely accepted; and

(2) Makes clear that institutions should not use or rely on technologies that interfere with student privacy (H.R. 4137: HEOA, 2007, n.p.)

According to Bailie and Jortberg (2008), this section of the HEOA supports the concerns of those who have been critical of distance education and the ways in which institutions attempt to validate the identities of students who complete the coursework. It further provides a foundation that will spawn additional requirements in the process of seeking and maintaining accreditation from regional and national bodies.

Discussion has ensued about students' opportunity and proclivity to cheat or plagiarize, factors that impact the level of academic integrity and the authenticity of their work (Virtual Student, n.d.). Although students complete the required coursework and receive their degrees, their universities are responsible for implementing safeguards and processes to maintain the integrity of the academic system. This includes the ability to confirm and verify online students' identities.

This study was an exploratory project directed at assessing the level of student identity verification currently being utilized by online postsecondary institutions from the perspectives of faculty and administration. This study also assessed the perceived need for improved methodologies to ensure that the students receiving the credit for coursework actually completed the work. A brief overview of current identity verification technology and new educational partnerships, as well as conclusions and insights gained from this study, is provided.

Section II: Methodology

According to the Bureau of Labor Statistics (2009), 1,672,000 people are employed as postsecondary teachers in the United States. This occupational category of postsecondary teachers served as the target population for this study. Applying a confidence level of 95% with a confidence interval of 5%, the researchers determined that a sample size of 384 respondents was required to obtain statistical viability, trustworthiness, and authenticity of the data.

The data collection instrument was a survey, and a sample of convenience was utilized. Distribution of the survey and the collection of the results were facilitated using a web-enabled survey that was administered by a third-party provider, SurveyMonkey. In the summer of 2009, during a 45-day period, an e-mail request containing a brief introduction to the study and a link to the survey instrument was transmitted to 4,093 people at the institutions for which e-mail addresses were made available. It was anticipated that approximately 10% of the requests would be bounced because of inaccurate or invalid e-mail addresses and that an additional 5% would be blocked by recipients who chose not to respond. The final response rate was expected to be 12%, but it was 10.4%, which represented 427 responses. Approximately 2.5% of the requests were blocked, and 4.7% were bounced back. The responses were provided in a blind manner and will be discussed in aggregated terms in this paper.

The researchers hypothesized that faculty members have limited knowledge about student identity verification and recent legislation on the topic. They further asserted that faculty members agree with the importance of the student verification process, the need for better methodologies, and the impact of said practices on the reputation of institutions' online programs in the marketplace.

Section III: Review of the Results

Following is a list of survey questions. The results are illustrated in each of the tables below the questions. The results are discussed in section IV.

Question 1: What best describes your role within the institution?

Answer options	Response percent	Response count
Administrator	5.4%	23
Chair	5.6%	24
Dean	2.1%	9
Faculty	84.5%	361
Other	2.3%	10
Total responses		427
Skipped question		0

Question 2: The level of student identity verification performed at my educational institution definitely confirms the identity of the student and ensures that the individual completing graded elements is in fact the student.

Answer options	Response percent	Response count
Strongly disagree	7.8%	33
Disagree	16.4%	69
Neutral	23.2%	98
Agree	38.4%	162
Strongly agree	14.2%	60
Total responses		422
Skipped question		5

Question 3: The process utilized for student identity verification is (or should be) embedded within the institutions learning management system (LMS).

Answer options	Response percent	Response count
Strongly disagree	3.1%	13
Disagree	2.4%	10
Neutral	13.8%	58
Agree	52.3%	220
Strongly agree	28.5%	120
Total responses		421
Skipped question		6

Question 4: The following methods are utilized as means to confirm student identity at my institution (select all that apply).

Answer options	Response percent	Response count
Username/Password	89.6%	380
Proctored exams (in person or remote)	51.9%	220
Security questions – 3rd-party driven	6.4%	27
Security questions – student driven	9.2%	39
Exam Passwords – Instructor/platform driven	25.7%	109
Other (please specify)	15.1%	64
Total responses		424
Skipped question		3

Question 5: The primary responsibility for student identity verification lies with the (select all that apply).

Answer options	Response percent	Response count
Instructor	59.4%	252
Registrar	40.1%	170
Information technology	40.8%	173
Administration	32.5%	138
Other (please specify)	12.0%	51
Total responses		424
Skipped question		3

Question 6: My institution is actively looking for improved methodologies to confirm student identity verification.

Answer options	Response percent	Response count
Strongly disagree	4.3%	18
Disagree	10.0%	42
Neutral/Do not know	63.1%	265
Agree	17.4%	73
Strongly agree	5.2%	22
Total responses		420
Skipped question		7

Question 7: The issues faced by institutions with online components in the area of student identity verification are similar to those experienced on traditional ground campuses.

Answer options	Response percent	Response count
Strongly disagree	13.8%	58
Disagree	41.8%	176
Neutral	14.0%	59
Agree	26.6%	112
Strongly agree	3.9%	16
Total responses		421
Skipped question		6

Question 8: The following best describes the nature of my institution's online learning environment.

Answer options	Response percent	Response count
Fully online	24.9%	105
Hybrid approach with both classroom and online course offerings	53.3%	225
Classroom instruction with online exams	2.4%	10
Supplemental learning only offers online. Graded elements completed in person or with proctor.	7.8%	33
Online components not offered	2.4%	10
Other (please specify)	9.2%	39
Total responses		422
Skipped question		5

Question 9: In my estimation, the need for improved methods of student identity verification is.

Answer options	Response percent	Response count
Not very important	8.9%	37
Important	40.2%	168
Very important	39.7%	166
Urgent	11.2%	47
Total responses		418
Skipped question		9

Question 10: The ability to confirm student identity in my institution's programs impacts its reputation in the marketplace and the quality of its graduates.

Answer options	Response percent	Response count
Strongly disagree	4.1%	17
Disagree	11.0%	46
Neutral	19.7%	82
Agree	43.4%	181
Strongly agree	21.8%	91
Total responses		417
Skipped question		10

Question 11: My level of familiarity of recent legislation leading to the reauthorization of the Higher Education Act (HEA), specifically the College Opportunity and Affordability Act (H.R. 4137), which contains verbiage directing accrediting agencies to "require an institution that offers distance education to have processes through which the institution establishes that the student who registers in a distance education course or program is the same student who participates in and completes the program and receives the academic credit"
(H.R. 4137, 110th Congress, 2007).

Answer options	Response percent	Response count
Not very familiar	59.9%	252
Somewhat familiar	20.4%	86
Familiar	14.3%	60
Very familiar	5.5%	23
Total Responses		421
Skipped Question		6

Question 12: I wish to share the following additional comments on the topic.

Answer options	Response percent	Response count
Total responses	18.7%	80
Skipped question	81.3%	347

It was clear from the feedback that this study addressed a topic that many of the participants were interested in. Some respondents noted that they had never really thought about student identity verification, so this study brought forth new information that allowed them to reflect on how student identity verification is currently conducted and the importance of improved methodologies.

Section IV: Analysis and Interpretation of the Results

The results of the survey were examined by all three researchers independently to identify emergent themes. Notes were then compared, consolidated, and agreed upon. The identified themes are discussed next.

Over 50% of the respondents stated that they agreed or strongly agreed that their institutions' current identity verification methodologies definitively confirm the identities of the students and ensure that the students who are registered actually are the students taking the course. The majority of respondents noted that a hybrid approach to online learning is being utilized. These outcomes, coupled with the data points indicating that username and password are the most widely used forms of verification, with a little more than half additionally using proctoring and a quarter using exam passwords, suggested that perhaps the term *definitively* was not clearly understood by the respondents or that they had given enough reflection to the question. Over 50% of the respondents suggested that improved methods of identity verification are very important or are urgently needed.

The respondents felt that the responsibility for student identity verification should be assumed by multiple parties within the academic institutions. In addition, there was a high level of support (over 65%) that the process should be embedded in the LMS. Despite the recognition that faculty have a significant responsibility in the process of student identity verification, the majority of the respondents were unaware of their institutions' efforts in this area. This finding suggested a communication breakdown or many institutions have not fully launched initiatives in this area.

Approximately 56% of the respondents felt that online and ground-based instruction face different issues in this regard; however, a substantial subset representing 30% of the sample believed that there are similarities. This finding suggested that adaptations or new methodologies need to be implemented in online learning environments and that institutions should not simply rely on the status quo. It also suggested that perhaps the methodologies utilized on ground-based campuses are not definitive in establishing student identities in all situations.

Although 60% of the respondents were not very familiar with the HEOA legislation, over 65% agreed or strongly agreed that the ability of institutions to verify student identities can impact the institutions' reputation and quality of their graduates. This finding was supported by the high level of importance placed upon developing improved methodologies, but it also clearly indicated that increased awareness of this law and the changes it potentially will drive are required.

Section V: Conclusions and Recommendations for Future Research

The results of this study strongly suggested that there is a need for additional education within the occupational category of postsecondary teachers in reference to the HEOA of 2008. The focus needs to be specific to Section 602.17, Subsection G, which

> Requires institutions that offer distance education or correspondence education to have processes in place through which the institution establishes that the student who registers in a distance education or correspondence education course or program is the same student who participates in and completes the course or program and receives the academic credit. (n.p.)

Regardless of this need for additional education, the respondents strongly felt that there is a need for improvement in the methods utilized to verify students' identities. A clear majority believed that the process currently being utilized should be embedded within the LMS; however, the respondents also recognized that technology is not the entire answer and that faculty must play a significant role in implementing safeguards and processes to ensure the integrity of the academic system.

A number of extant technologies and techniques can facilitate the validation of students' identities throughout their academic endeavors. These alternatives include, but are not limited to, improved course design that emphasizes student portfolios, projects, and papers; the utilization of proctored exams (in person and via webcam); technological solutions that validate biometric attributes such as fingerprints, retinal scans, and facial and voice characteristics; synchronous monitoring techniques that include such items as IP authentication, response pattern analysis, and telephonic callbacks; and the use of challenge questions derived from third-party data providers that are not student driven (Bailie & Jortberg, 2008). To be effective, multiple methods need to be utilized in conjunction with one another.

Pilots and partnerships are currently underway among educational institutions; corporations such as Acxiom and PupilCity; and education platform providers such as Blackboard, eCollege, and Moodle to develop, prototype, and test various methods to improve the student identity verification process. Although great strides are being made on this front, no system will fully eliminate the issue of student dishonesty. "If someone is determined to be dishonest, there is always a way around any system, whether it's online or classroom-based" (WCET, 2005, ¶ 14).

Future research should continue to focus on the relationship between the adoption of more advanced student identity verification techniques and the perceptions of faculty, students, and other stakeholders regarding improvements in academic honesty, institutional creditability, and program accessibility. Research to find effective and efficient student verification techniques should be pursued, and consideration should be given to the return on investment of the various implementation methods and tools, along with a determination of the best fit of these methods based on the nature of the learning environment.

Although the natural assumption is that student verification will be conducted using technology-based strategies, exploration into other avenues of student verification should be considered. For example, if the solution is a technology-based student verification method, consideration should be given to the IT departments of the learning institutions to determine the difficulty of implementing technologically enabled student verification solutions. In addition, one might wish to solicit the views and opinions of universities' boards of directors and executive bodies regarding the prioritization of online student verification. Finally, one might wish to determine whether policing compliance for student verification by online postsecondary learning institutions should become the responsibility of the accreditation bodies.

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