Benazir Research Journal of Humanities and Social Sciences
ISSN: 2790-7228 (Online) | 2790-721X (Print)
Vol. 1 | Issue 1
www.brjhss.com

EFFECTS OF 7E MODELS ON THE ACADEMIC ACHIEVEMENT OF STUDENTS IN MATHEMATICS AT SECONDARY LEVEL

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ABSTRACT

Objectives of the study were: i). To find out the effect of 7E's Instructional Model on the academic achievement of students. ii). To find out difference in performance between high, low and average achievers. Class X students of mathematics enrolled in public sector institutions governed by the Government of the Punjab situated in the Province of Punjab were population of the study. Class X of Government High School Bhakral, Tehsil KallarSyedan, district Rawalpindi was chosen as a sample of the study. Two equated groups (experimental and control) were organized having 30 students in each group. Control group was taught by the routine teachers and experimental group was given treatment for the period of eight weeks by the researcher as per 7E instructional model. Post-test was administered at the completion of the experiment and pre-test had been conducted at its inaugural session. Both the tests (Pre-test and post-test) were used as tools for data collection. Analysis of data had been completed applying t-test and one-way ANOVA using SPSS. It was concluded that 7E instructional model has positive effect on learning of students.

Keywords: 7E instructional model, academic achievement, conceptual teaching, traditional, conventional, classical

INTRODUCTION

Heavy, massive and huge flow of information and knowledge are challenging the world and nations to understand and then make it useful for the nationals. Mathematics subject can help the world and nation to pull out them from the challenges faced by heavy flow of information if it is taught with the methods of teaching those unfold all mysteries entangled with the stream of information. Curriculum for mathematics (2018) aims to support learners to make stable visionary bedrock for teaching Mathematics which would empower the learner and makes applicability of learner's knowledge. Mathematics is a complex phenomenon, which needs special attention to understand. Hasratuddin (2015) suggested that learners' portrayal may be focused first, that acknowledges and assists learners to solve mathematical complications converting imaginative ideas towards factualism like: photos, emblems, texts, drawings, tabulations, etc.

Basically, Mathematics gives its learners fundamental artistry and enlighten them to assume reasonably, ready learners for life and do accurately to cultivate skillful and capable brilliant nationals. It means that mathematics students face problem which demands their solutions as Juhrani (2018) have views that problem solving situation and mathematics are necessary for each other. Yeh et al. (2019) give their views about mathematics that it proves basic subject as computation and rational thinking, which becomes the baseline for scientific and technological education. Pakistan's National Curriculum (2006) about mathematics claims that learners may have skills to correspond in terms of mathematics, logics to scrutinize, assume and execute positively, grasp the thematic ideas, judge the efficacy by applying various approaches to take the identical issues to solve the problems and linking with mathematics, segregate applicable and non-applicable ideas with their examples assimilate ideas with mathematics and analyze the actual

activities with mathematics logics by reasoning mathematically. Mathematics has unique place among other subjects. Ngussa and Mbuti (2017) state that mathematics syllabus may be designed for the provision of information and abilities which has important place towards dynamic era of technology.

Enu et al. (2015) give opinion that mathematics plays necessary role for upbringing of science and technology environment of a country. Which gives support for solving the problem when it has firm link with life which included ways to examine, defining logics, anticipating, assessing and reverberation. Black and William (2018) have views that teachers may have commitment to create, define and do for quality and quantity of a person and for whole class. Evaluation may be taken for increasing learning level of learners. That mathematics has purely an approach to solve the problems. In other words, teaching mathematics in its true sense may be able students to tackle all life encountering problems. Fritz et al. (2019) gives views that generally Mathematics anticipated as an arduous one. After that it is necessary to analyze and assess attentively. Therefore, Mathematics gets outstanding place amid the various humane learning which is assumed like elemental necessity with respect to each and every domain of a person and proves stimulant which drives the community towards advancement crossing hurdles for having different constructive activities linked with person's normal life routine.

When problem-solving ability enhances then learner raise the next bar and reaches at its higher level. Sefiany (2018) adds more about problem-solving ability of a learner that the problems can be solved when previous learning is applied in current position engaging higher order thinking level.

Hargrove and Nietfeld (2015) warned that conventional ways of teaching obstruct the

enhancement of logic that keep crucial assignments for upper-level educational centers in present fast, dynamic and digitized era. In fact, academic achievement of learners has rare occurrence like academic, cognitive and sociocultural implication that means there are number of variables to count academic achievement. Academic achievement of learners is affected by different factors. Taghavinia and Motavassel (2015) describe academic achievement as that student's evaluation and relation of results and academic ambitions to understand how much success achieved, teachers and learners may be able to feel covet objectives. Academic achievement is affected by number of determinants linked different modes from one context to another. Those determinants are: economical position, educational organizations and personal characteristics of learners. Furthermore, Kang'ahi et al. (2012) counted that teachers' ways of teaching had positive effect on academic achievement of students. Teachers' styles of teaching exert influence on students' academic achievement. Similarly, Ali (2013) found that characteristics of teacher had significant difference against academic achievement level of students. It means if teachers characteristics are positive then they will reflect on enhancing students' academic achievement level and vice versa. Furthermore, Olaleye (2011) claimed that there had existed a connection amid the characteristics of teachers and achievement of the students. Adeyemo (2005) explained that practices in the study room were affected by the characteristics of the teacher.

REVIEW OF LITERATURE

7E's Instructional Model

7E's instructional model, which is the extended model of 5E's instructional model and was evolved by Eisenkraft in 2003. There were seven phases of 7E's instructional model. Those phases were:

1. **Elicit Phase**

Past experiences of the learning are important source of learning of a learner. It produces strength

for the remaining phases. This phase's intention is to support the students for communication, the instinctive learning that the learners are not like hollow container which demands its filling moderately the former knowledge works like healthy bedrock to add fresh learning and present learning is mobilized in this phase. Which enhances students' performance faithfully.

Role of teacher in elicit phase

Role of teacher is effective in this phase. Teacher plays as an extrinsic catalyst for in the shape of conceptual ideas.

Role of student in elicit phase

Elicit phase provides students opportunity to take part vigorously in learning process. They will link the current notion with prior learning.

2. Engage Phase

This phase employs the students in learning new concepts.

Role of teacher in engage phase

Here teacher boosts and encourage students for fruitful exercises for enhancing learning capacities.

Role of student in engage phase

Brainstorming activity works and students may be able to experience personal and fellows' concepts and notions. There is an opportunity to float queries among students.

3. Explore Phase

Invitation to students is given to guess voluntarily with in defined boundaries.

Role of teacher in explore phase

Teacher stimulates the students for learning as collaboratively and co-operatively. Investigative and perceptive habits may be developed here by the active role of teachers.

Role of student in explore phase

Prophecies of students were tested here. Students made hypotheses on behalf of proofs depicting the data and drawing the findings. Group work is appreciated in this phase.

4. Explain Phase

Students were offered to vocalize the perceptions.

Role of teacher in explain phase

Teacher stimulated the students to express about the notion in simple way. Explanations and confirmations were demanded by the teacher.

Role of students in explore phase

Students try to justify their understandings. They offer different logics defending their view points.

5. Elaborate Phases

Students were given opportunity to expand their learning about the current concept. Different exercises have been completed for confirming the idea.

Role of teacher in elaborate phase

Teacher made students easy to explain in different ways about the current idea.

Role of student in explain phase

On behalf of prior learning students made quizzes and took the final step to solve the problem.

6. Evaluate Phase

Teachers assessed students. Variation in learners mind skills were recorded. Different modes of assessment and evaluation were adopted by the actual position of the learners.

Role of student in evaluate phase

Students were asked different questions and demanded for answering critically.

7. Extend Phase

Checking the extent of knowledge transferred is completed in this phase. More practice produces

more knowledge and more understandings.

Role of student in extend phase

Students were given more time to exercise exchanging the learnt learning more and more, so that the learnt concept may be stayed in long duration of time in the mind of the students.

Related Studies

7E's instructional model proved fruitful in the light of different studies. Some studies are quoted here for information and authentication:

- Hepi et al. (2018) concluded that 7E's instructional model enhanced the problem-solving ability of the students.
- Renngiwur et al. (2017) state that learning on geometry side flat material exercises showed positive result and enhanced learning level students.
- Rahmayani et al. (2016) claim that 7E's instructional model improve the logical and reasoning skills of the learners.
- Al-Azmeyeh and Al-Shrahid (2015) explained the effectiveness of 7E's instructional model on achievement level and thinking skills. They concluded that 7E's instructional model gave significant difference as compared to conventional method of teaching.
- Chrismast (2013) gives views that result of students who were taught applying 7E's instructional model was greater than the result of students who had been taught using traditional method of teaching.
- Polyiem et al. (2011) state that 7E's instructional model gave positive effect on problem solving ability of students as compared to traditional method of teaching.

OBJECTIVES OF THE STUDY

Following objectives were designed for the study

1. To find out the effect of 7E's Instructional Model on the academic achievement of students.
2. To find out difference in performance between high, low & average academic achievers.

RESEARCH HYPOTHESES

Following null hypotheses were framed and tested in this study:

Ho_1: There is no significant effect of 7E's Instructional Model on the academic achievement of students.

Ho_2: There is no significant difference in performance between high, low and average academic achievers.

SIGNIFICANCE OF THE STUDY

Building of education mostly depends on mathematics. It has vital role in every field of life. This subject needs the clear comprehension and proves origin of knowledge and information for more subjects. If there is an effective structure with respect to quality education in mathematics is available then students learning level will be enhanced.

This study will help the educational managers for the development of an effective design interlinked with quality education in mathematics.

The teachers can take help for boosting the students' outcomes during mathematics teaching.

The study may be fruitful for the department of education to devise a plan of action for in-service training for the professional upbringing of secondary school teachers.

The findings would be the useful source for Board of Intermediate & Secondary Education for the improvement of evaluation and assessment.

Policy makers and implementer will also be the recipient of this study, while crafting the curriculum and programs for teachers training and may also acknowledge it at the time of designing further policies for education sector to make advance teachers' training course.

Teachers' training institutions may take benefit from the study while selecting and preparing syllabus for teachers training programs.

Delimitation of the study

Following were the study's delimitations:

1. Topics studied during the experiment period were; Mathematics X class syllabus (Quadratic Equation, Sets and Functions, Basic Statistics, Introduction to Trigonometry, Chord of a Circle, Practical Geometry –Circles).
2. Government High School Bhakral, District Rawalpindi.
3. 10^{th} class students.

PROCEDURE AND METHOD OF THE STUDY

Population of the study

The study was carried out to investigate the effect of 7E's Instructional Model with respect to the chalk and talk method of teaching to 10^{th} class students of mathematics. The targeted population was consisted of 10^{th} class students of mathematics enrolled in Public Institutions organized by Government of the Punjab anchored in Punjab Province. Students of all Public Schools in the province have been taught syllabus designed by Punjab Curriculum and Text Book Board (PCTB). Due to accessibility issue, Public Schools of Tehsil KallarSyedan, District Rawalpindi were selected for this study. There were fifty-one (51) secondary schools functioning in this Tehsil. Government High School Bhakral, Tehsil KallarSyedan, District Rawalpindi was one of them where ninety (90) students were studying in class X. Due to time, easy access and other resources issues, the population Government High School Bhakral, Tehsil KallarSyedan, District Rawalpindi was taken.

Sample of the study

Government High School Bhakral, Tehsil KallarSyedan, District Rawalpindi was selected by convenient sampling technique. The said school had adequate classrooms, required number of students for experiment, better infrastructure and facilitative behavior of the principal and staff. School had strength of ninety (90) students in class X. Sixty (60) students (thirty students in each group i.e. experimental and control) of class X were chosen through random assignment process (randomization). As Rosenberger and Lachin (2015) gave views about random assignments as those random assignments are assigned at the time of treatment considering the environment in which it is due.

Developing of Data Collection Tools

Pre-test and Post-test instruments was designed for data collection. Items of test covered concepts of Quadratic Equation, Sets and Functions, Basic Statistics, Introduction to Trigonometry, Chord of a Circle, Practical Geometry –Circles. By re-arranging the order of the items of pre-test a post-test was prepared.

Opinion and comments of five experts were taken for the validation of the instrument. The instrument was pilot tested using 30 students from the population who were not be the part of experimental/control groups. Reliability was determined by using method of Alpha Reliability Analysis.

After eight weeks treatment, students' achievement level was found through result sheets by conducting post-test.

Validation of test

Content validity was checked. Test items were selected after checking the content validity so that, objectives of the study may be achieved. Zaman (2011) quoted Lenon that the validity of the content shows characterization of universal items taken for achievement of the objectives of the

study.

Test was sent to five experts (three secondary school teachers and two PhD doctors) for its validation. Comments and suggestions given by the experts; test items were revised where necessary. Overall objection was to use Urdu and English language in writing test items for easy and quick understanding of the students.

Pilot Testing

For more improvement of the test pilot testing was administered on class X students (other than experimental and control groups) of Govt, High School KallarSyedan district Rawalpindi for judging difficulty level and perception of the students towards test. Zaman (2011) describes pilot study that it is beneficial to add facts for the deficiencies in tools of data collection and different obligations of research.

Reliability of test

Table 1

Reliability (Cronbach's Alpha) analysis of the test

Scale/Subscale	No of test elements	Alpha Reliability
Multiple Choice Questions (MCQs)	20	0.964
Short Questions Answers (SQAs)	10	0.821
Solvable Questions (SQs)	05	0.798
Overall	35	0.827

The above-mentioned table 2 represents that Cronbach's Alpha reliability for the scales and subscales. The outcomes portray the reliability for scales and subscales remained from $\alpha = 0.798$

(Solvable Questions) to $\alpha = 0.964$ (Multiple Choice Questions). Which shows that all the scales and subscales are stable and reliable to practice.

Variables of the study

1. Independent: 7E's Instructional Model
2. Dependent: Academic Achievement

Design of the study

Design of study was experimental: Pretest-Posttest design was used. The topics were assigned randomly to experimental and control groups as shown in Fig. 1.6. As Keppel (1991) says that, experimental research design works with the random assignment of subjects to treatment conditions. The study was based on constructivist theory and philosophy. Experimental group was given treatment as per 7 Es instructional model while control group had been treated in traditional method. Manipulations' effects (the independent variable on the dependent variable) were examined.

Experiment Implementation

Researcher taught the experimental group as per 7E's instructional model for the period of eight weeks. Because the routine teachers were not experiencing the 7E's instructional model and there was much more need to train those teachers. In spite of that practice there may be a chance to have a huge gap between 7E's instructional model and traditional methods of teaching. Whereas control group had been taught by routine teachers.

There were some more logics which compelled researcher to teach the experimental group by himself. Those logics are as follows:

1. The 7E's instructional model demands training and accuracy for teaching. There were time constraints to train the routine teachers.

2. For the objectivity of the study there was necessary for the researcher to teach the experimental group by himself.
3. Earlier studies Yan (2013), Tuckman (2012), Zaman (2011) etc. give information that researcher by himself taught the experimental group.

Analysis of the data

Table 2

Significant difference between the means scores of students of experimental and control groups on pre-test

Group	N	Means Score	SD	t-value	p-value
Experimental	30	19.83	7.764		
				0.84	.2021
Control	30	18.10	8.214		

Table 2 portrays that 30 participants who had to receive the 7 Es instructional model teaching treatment (M = 19.83, SD = 7.764) compared to the 30 participants in the control group (M = 18.10, SD = 8.214) did not indicate significant different scores, ast(58) = 0.840, p = .2021>0.05. It shows that there is no significant difference in mean score of experimental and control groups in pre-test. Hence both the groups were statistically equal on pre-test.

Table 3

Significant difference between the means scores of students of experimental and control groups on post-test

Group	N	Means Score	SD	t-value	p-value
Experimental	30	47.33	16.359	5.649	.00001
Control	30	27.90	9.349		

The table 3depicts that 30 participants who received the 7 Es instructional model teaching treatment (M = 47.33, SD = 16.359) compared to the 30 participants in the control group (M = 27.90, SD = 9.349) indicate significant different scores as t(58) = 5.649, p = .00001 > 0.05.It shows that there is significant difference in mean score of experimental and control groups in post-test. Mean of experimental group= 47.51 is greater than mean of control group= 27.9 which represents the positive effect of 7 Es instructional model on academic achievement of students in mathematics at secondary level and reveals that 7 Es instructional model enhances academic achievement level of students.

CONCLUSIONS

1. On the basis of pre-test score analysis both the groups (experimental and control) were statistically equal.
2. On overall post-test score experimental group students enhanced high academic achievement level than control group students. Which depicted the positive effect of 7E's model on academic achievement of students in mathematics at secondary level, which helps students to raise their academic achievement bar.

Discussion

Education plays vital role in the life of a person. Every nation needs quality education and for quality education there is a need to have innovative teaching methods to impart quality education. It is mentioned in OECD (2014) that every nation in the global world is on the way impart quality education to its children by changing the curricula, have reforms in educational systems and making comprehensive evaluation of teachers training programs. Pakistan has been trying to introduce various programs in education sector to meet the international standards. The utmost desire is to have conceptual learning programs those support logical thinking and problem-solving abilities.

Amir (2012) discusses that mathematics curriculum 2006 has been designed according to international principles. He furthermore views that curriculum has been aimed to meet the international standards but classroom practices are mismatched with conceptual framework. Many studies pointed out that classroom exercises and curriculum demand have extensive gap in Pakistan, that's why educational goals are not being achieved. Mathematics needs to impart the education according to conceptual framework. Whereas many researchers concluded that clearance of concept and application of knowledge is still a dream especially in mathematics. Mathematics performance remains low which has many reasons but the main reason is teaching methodology that affects a lot positively or negatively. So, there was need to exercise a teaching method different to conventional teaching method. PISA (2012) hinted out that outcomes of conceptual learning could not be availed using traditional methods of teaching. Similarly, Sadia (2010) is of the views that Pakistani students can only solve simple problems and they show poor performance against reasoning and logical problems. Method of teaching has great importance in entire teaching learning process. Traditional teaching methods proved deficient to clear the concepts of learners in reasoning and logical questions. Zaman (2011) is of the view that traditional

methods of teaching have not capability to transfer the knowledge resultantly a large number of students get result of disappointment in mathematics subject specifically.

Khashan (2016) quotes Sadeq that 7 E' instructional model has seven learning and teaching phases, teachers use them during teaching for strengthening students learning in a scientific way. He further explains that 7E's instructional model supports learners to clear the concepts, enhances motivational level, improves learning skills, raise level of motivation, boosts interest, makes students ready for clarification and fast analysis power.

Turgut (2016) elaborates that 7E's instructional model offers best results and enhance students' academic performance as compare to traditional methods of teaching. Furthermore Khan (2020) concluded that 7E's instructional model has capability to transmit the knowledge in an effective way. Education is imparted in a qualitative way and enhances the academic achievement level of learners.

RECOMMENDATIONS

1. The 7E's instructional model had shown its positive effects while teaching mathematics at secondary level against conventional method of teaching. 7E's instructional model may be practiced at secondary, elementary and primary level for other subjects. It is recommended to make it a part of different teachers training modes.
2. Teaching as per 7E's instructional model, which indicated positive effects on the performance of students. It is proposed to prepare lesson plans as per 7E's instructional model for routine teaching practices.

Acknowledgement

It is acknowledged that the present study is our original work. It is not published or submitted for publication in any other journal. If anything is found against us, we will be responsible. No grant

is availed for this research work.

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