Effect of 7 E'S Model on Problem Solving Ability of Students in Mathematics at Secondary Level

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Abstract

The utmost and unique aim of the research was to find out the effect of teaching using 7E's model against conventional method of teaching. The design of the study was pretest-posttest control group. Sixty students of mathematics enrolled in 10th class of Government High School Bhakral, Rawalpindi were selected purposively. Experimental group students were given treatment using 7E's model while control group students were instructed using conventional method of teaching. Pretest-posttest were used as data collection instrument. Three hypotheses were tested using t-test and ANOVA. Independent sample t-test showed that there was a significant difference in the mean scores of experimental and control groups. 7E's model proved more effective than the conventional method of teaching. Findings and conclusions would be beneficial for the educationist and curriculum wing for the development and implementation process of new approaches for the upbringing of classroom practices.

Introduction

Education brings comfort, ease and emerging trend in the life of its learners. It teaches the lesson to solve the problems and mathematics education helps learners to solve daily life problems and supports the learners to spend their life in a mode of ease. Every field of life needs the understanding of mathematics. Syllabus of mathematics is destined to equip learners with learning and enhancing abilities which are part and parcel of dynamic era of technology (Ngussa and Mbuti, 2017). Abilities to understand mathematics are compulsory component for enhancement of academic achievement as well as enabling for daily life routine (Carey et al, 2017). Mathematics education supports learners to channel the thinking, reasoning and logics, enhancing problem solving abilities and enable them to perceive

knowledge or exchange concepts via different modes like: Vocal activities, in black and white form, drawings, graphs and illustrations (Rizqi and Surya, 2017). Understanding of mathematics has unique importance as it is necessary component of economic upbringing of the communities (Lipnevich et al, 2011). Similarly Abe and Gbenro (2014) are of the views that multifaceted character of mathematics has exclusive position in the subject of science, technology and commerce. Phonapichat et al. (2014) explained that the utmost aim of mathematics education is to empower learners how they will be able to solve the routine life problems.

Every person faces different problems in daily life. Problem solving ability might be enhanced as instruct the learners to guess and discover resolution of the problems, whereas problem solving is an important part of the syllabus and demands concentration in the process of education (Widiawati et al, 2018). Similarly Pinter (2012) expresses as the prime responsibility of mathematics is not only to enable the learners to enhance their problem solving ability but necessary to prepare them for routine life problems.

Problem can be solved following some sort of steps. As Rustam et al. (2019) refer Polya's problem solving steps.

Fig. 1 *George Polya's Problem Solving Phases*
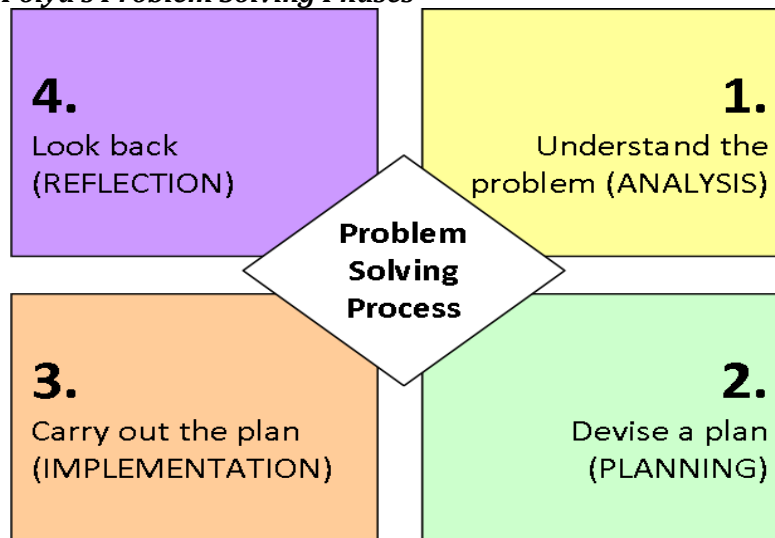
Source: Rustam, E. S., Saragih, S. & Hasratuddin. (2019). Improving students' mathematical problem solving ability and self-efficacy through guided discovery learning in local culture context. *International Electronic Journal of Mathematics Education*, **14, (1), 61-72.**

Those steps are given as follows:
- Understand the Problem
To know the nature of the problem is the first step to solve the problem
- Plan Solutions
Relationship of the problem is needed to follow the solutions
- Carry Out the Plan

Overall plan to solve the problem
- Look Back

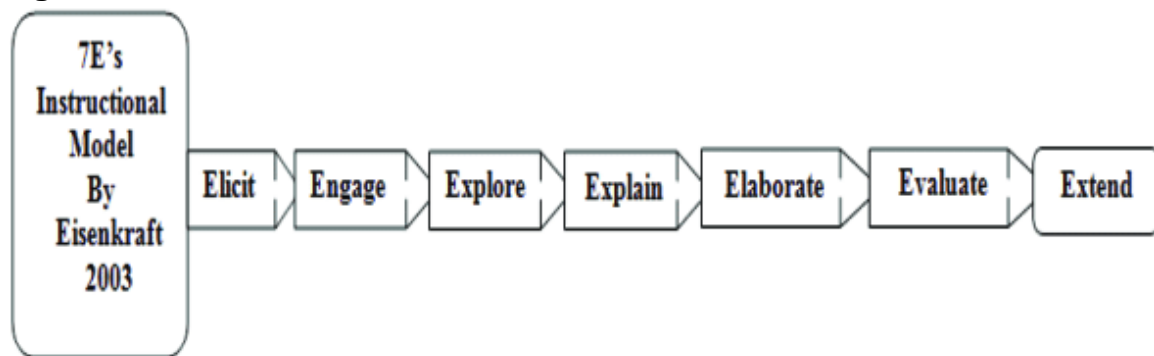Revise the whole plan i.e. what is plan and what is its solution?
How solution will be carried out?

Review of Related Literature
7E's Model
7E's model has seven phases such as: Elicit, Engage, Explore, Explain, Elaborate, Evaluate and Extend (Eisenkraft, 2003).

Fig. 2 *7E's Model*

Source: Eisenkraft, A. (2003). Expanding the 5E model. *Journal of Social Sciences*, 5(4) 57-59.

Phases of 7E's Model
Elicit
In Elicit phase complete concentration is given to link earlier memoir with current learning situation. Because current learning is based on earlier ones. Elicit phase supports learners to recognize the fundamental knowledge (Santi and Atun , 2011) and Suardana et al. (2018) are of the views that fundamental knowledge of the learners may be determined with the interaction of community that may help to impart the appropriate education, which means that previous learning becomes beneficial to improve learning level of the learners and in elicit phase teacher earns attention of learners on prior learning and then the required goal is achieved (Adesoji and Idika, 2015).

Engage
Learners are engaged with content and opportunity of exchange of ideas is also given for better understanding. Convincing and inspirational strength pushes learners to get involved in the practice of education (Aydin and Coskun, 2011). Zuhdiyan et al. (2020) describes that teacher can use particular feelings of learners to achieve desired goals and engagement phase may be made fruitful on utilizing feelings of the learners.

Explore
Learners are advised to tabulate contest, separate variables, sketch out the statistics, draw diagrams, display outcomes and arrange final statements and then teacher evaluate the learner's level of learning. 7E's model "Explore" phase improves learners' level of inspiration

and boosts them to take up the lesson with series of experiments (Yaman and Karasah, 2018). Celik et al. (2013) opine that practices of experiments enable students to hold learning in the form of current situation and observations, improves motivational level and inculcate conclusive approach for better understanding level.

Explain

After examining the learner's level of learning, now teacher explains more about the topic to unfold more information which were not given them before. Learners are also invited to present their observations and experiences, so that they may be able to clarify and enhance their learning level. This phase of 7E's model boosts confidence level of learners with the approach to involve them in questioning answering gatherings (Purnamasari et al., 2017). Khaeruman and Saleh (2016) are of the views that motivational level may be raised with enhancing confidence level of students.

Elaborate

Here learners are encouraged to share their understanding in a new situation and they may be boosted to raise the questions and rationale to investigate more. This phase specially helps learners to solve the problems. Eisenkraft names this phase as a transfer of knowledge phase. The elaboration phase provides opportunity to learners to discuss their completed tasks (Riconscente, 2014). Cetin-Dindar and Geban (2017) describe that 7E's model promotes conceptual teaching approach and removes learners' misunderstandings on behalf of constructivist learning theory. Elaboration phase of 7E's model improves learners' thinking and logical reasoning skills and upholds academic learning and helps them to solve the complicated problems (Adesoji and Idika, 2015).

Evaluate

According to situation evaluation is exercised to judge the learning level of learners. Evaluation phase helps learners to enhance and raise their confidence level when understood that they have met the task (Lay and Cahndrasegaran, 2016) and Suardana et al. (2018) are of the view that evaluation phase offers chance to uphold learners' notions, principles and favor for knowledge application.

Extend

Here learners are given opportunity to exercise exchange of learning level with teachers and fellows. Teacher guides the learners to express their learnt ideas in an extensive mode. 7E's model gives opportunity to students to understand in a limited time period. (Balta and Sarac, 2016). Qarareh (2012) claims that 7E's model raises students level of inspiration that leads towards higher level of academic achievement.

Conventional Methods of Instruction

Lecture method of conventional teaching methods is called teacher centered method of teaching and teachers use lecture method to teach the students (Hightover, 2011). Harmon (2017) is of the view that elementary school teachers teach their students using lecture method and they do not apply dynamic learning methods to clear the concepts of the students. Whereas teachers are the element who are the implementer of the syllabi (Orlich et al, 2012). Conventional teaching methods do not involve students resulting students understanding remains low. Learners are involved passively while teaching using lecture method, whereas conceptual learning is done with concentration and active participation

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(Ullah and Iqbal, 2020). Different conventional instructional framework have been discussed below (Saskatchewan Education, 1991):

Fig. 3 *Instructional Framework*
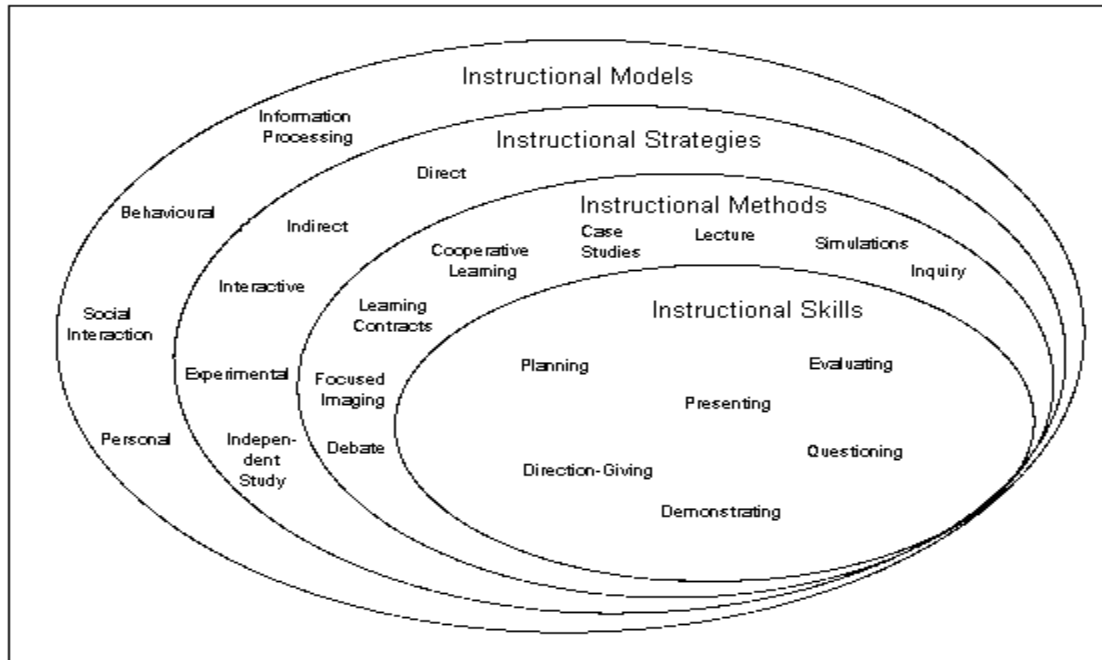
Source: Education, Saskatchewan. (1991). *Instructional approaches: A framework for professional practice .* **Regina, SK: Saskatchewan Education.**

Objectives of the Study
1.   To determine effect of 7E's model on problem solving ability of students.
2.   To compare effect of 7E's model on problem solving ability of students of experimental and control groups.
3.   To compare effect of 7E's model on problem solving ability of high, average and low achievers of experimental and control groups.

Hypotheses of the Study
Ho_1:   There is no significant effect of 7E's model on the problem solving ability of students.
Ho_2:   There is no significant difference between performance of experimental and control groups' students on problem solving ability.
Ho_3:   There is no significant difference between performance of experimental and control groups' students' high, average and low achievers on problem solving ability.

Methodology of the Study
Following strategies and methodology were used to complete the study.

Population of the Study

Class 10th students studying mathematics (Science) in fifty-one institutions of Tehsil Kallar Syedan under the administrative control of government of the Punjab were considered accessible population for this specific research study. This population was called universal as that curricula is same all over the Punjab.

Sample of the Study

Class 10th students enrolled in mathematics (Science) of Government High School Bhakral, Tehsil Kallar Syedan, District Rawalpindi, Punjab were selected purposively for the study. The outcomes announced by Board of Intermediate and Secondary Education (BISE) for 9th class were used to equate the groups. Two groups (experimental and control groups) thirty students in each group were selected through randomization process.

Research Design

The aim of the research was to examine the effect of 7E's model. Pretest-Posttest control group design was opted for the accomplishment of this true experimental study. The concise depiction of the design as supposed by Askari and Noah (2013) is shown in Fig. 4.

Fig. 4 *Pretest-Posttest Control Group Design*

Group	Pre-test	Treatment	8th week Post-test
RE	O1	X	O2
RC	O3	-	O4

Note: RE = Experimental group   X= Treatment
     RC = Control group   O = Observation
     R = Randomization

Source: Askari, M. and Noah, S. M. (2013). Comparison of the effects of communication and conflict resolution skills training on mental health . *International Journal of Psychological Studies*, 5 (1), 91-104.

Data Collection Instruments

Pre-test was used as a data collection instrument. Post-test was prepared after re-arranging the order of test items of the pre-test. The pre-test had thirty-five items with 100 marks.

Data Analysis

Mean, standard deviation and difference of means were calculated after collecting data. Significant difference was obtained for the mean scores of both the groups' at .05 significant level applying t-test.

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Pre-test Score

Table 1 *Mean Scores of Experimental and Control Groups on Pre-test*

Group	N	Mean Scores	SD	t-value	P-value
Control	30	18.10	8.216		
				.840	.2021
Experimental	30	19.83	7.764		

t= 1.672, α= .05

Table 1 interprets the outcomes drawn based on the independent sample t-test analysis of pre-test scores of control and experimental groups. The results of the independent sample t-test reflects that there was no significant mean difference with respect to pre-test scores of the control group (MS=18.10, SD=8.214) and experimental group (MS=19.83, SD=7.764), (t(58)=.840, p=.2021) before treatment. It announced that both the groups were distributed equally.

Post-test to test the Null Hypotheses

7.2.1 Ho_1: There is no significant effect of 7E's model on the problem solving ability of students.

T-test was used to test the first null hypothesis. Summary of the perceived results is shown in Table 2.

Table 2 *Difference between the Mean Scores of Experimental Group on Problem Solving Questions (PSQs) in Pre-test and Post-test*

Group	N	Mean Scores	SD	t-value	P-value
Pre-test	30	3.13	3.224		
				9.252	.0000
Post-test	30	17.23	7.700		

t= 1.672, α= .05

Table 2 depicts the results drawn based upon independent sample t-test analysis of pre-test and post-test scores of experimental group. The results of the independent sample t-test reflects significant mean difference with respect to pre-test and post-test scores of experimental group pre-test (MS=3.13, SD=3.224) and experimental group post-test (MS=17.23, SD=7.700), (t(58)= 9.252, p=.0000). Hence Ho_1 is not accepted.

Table 3 *Difference between the Mean Scores of Experimental and Control Groups on Problem Solving Questions (PSQs) in Post-test*

Group	N	Mean Scores	SD	t-value	P-value
Control	30	6.27	6.839		
				6.839	.0000
Experimental	30	17.23	7.700		

t= 1.672, α= .05

The above mentioned table results control group (MS=6.27, SD=6.839) and experimental group (MS=17.23, SD=7.700), (t(58)= 6.839, p=.0000) indicated that there was significant mean difference between attainment scores of control and experimental groups on problem solving questions. It guides that 7E's model had positive effect on achievement level of experimental group students as compared to conventional methods of teaching. Thus Ho_2 is not accepted.

7.2.2 Ho_3: There is no significant difference between performance of experimental and control groups' students' high, average and low achievers on problem solving ability.

Table 4 *Comparison of the Mean Scores of Control and Experimental Groups High, Average and Low Achievers on Problem Solving Ability in Post-test*

Source of Variations	Sum of Squares	Mean Squares	F	P-Value
Between Groups	2955.292	591.058		
			29.391	.000
Within Groups	1085.958	20.101		
Total	4041.250			

Table 4 reflects comparison of the mean scores of control and experimental groups' high, average and low achievers on problem solving ability in post-test, which guides that the calculated value of F (29.391) is bigger than Table (4.02) value at .05 significant level. Significant difference between the mean squares of control and experimental groups high, average and low achievers on problem solving ability in post-test as F (1, 58) = 29.391, p = .000 is seen. This explains that 7E's model has positive effect on experimental group high, average and low achievers on problem solving ability as compared to conventional methods of teaching. That's why Ho_3 is not accepted.

Findings

1.   The mean scores of control and experimental groups in pre-test on problem solving ability were 18.10 and 19.83 respectively. SD of control and experimental were 8.216 and 7.764. Value of t and p was .840 and .2021 respectively. Which showed there was no significant difference in mean scores of control and experimental groups in pre-test portion. Hence the null hypothesis (Ho_1) was accepted.

2.   Sample t-test analysis of pre-test and post-test scores of experimental group reflects significant mean difference with results as of experimental group pre-test (MS=3.13, SD=3.224) and experimental group post-test (MS=17.23, SD=7.700), (t(58)= 9.252, p=.0000). Hence Ho_1 is not accepted.

3.   The results of control group (MS=6.27, SD=6.839) and experimental group (MS=17.23, SD=7.700), (t(58)= 6.839, p=.0000) indicates that there was significant mean difference between outcomes of control and experimental groups on problem solving questions, which explains that 7E's model has strength to enhance achievement level of experimental group students as compared to conventional methods of teaching. Thus Ho_2 is not accepted.

4.   Scores of control and experimental groups' high, average and low achievers on problem solving ability in post-test demonstrates that determined value of F (29.391) is higher than Table (4.02) value α = .05. Significant difference is seen between the mean squares of control and experimental groups' high, average and low achievers on problem solving ability in post-test as F (1, 58) = 29.391, p = .000. Which announces 7E's model's positive effect on experimental group high, average and low achievers on problem solving ability against conventional methods of teaching. That's why Ho_3 is not accepted.

Conclusions

Following conclusions were conceived on behalf of findings:

1.   Outcomes of pre-test shows there is no difference in mean scores of control and experimental groups students achievement. Which witnesses that formation of both the groups were equal in nature.

2.   Performance of treatment group's students in problem solving ability is better as that of control group students.

3.   Consequential difference in post-test scores of students of 7E's model and conventional method of teaching was endorsed as treatment group students substantially portrayed exceptional achievement level than control group students.

4.   Excelling results of high, average and low achievers of treatment group performance is witnessed of the positive effect of 7E's model as compared to control group's high, average and low achievers.

Discussions

Education is a weapon which helps to defeat ignorance and societal evils. Effective and quality education can be imparted using active and innovative methods of teaching. Present study was aimed to examine the effect of 7E's model against conventional method of teaching. The hypothesis testing results guided that there was subsequentially difference between the performances of experimental and control groups students as 7E's model had positive effect

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and enhanced the learning level of the students of experimental group. The present study explained that 7E's model helped students of experimental group to understand better and enhanced their problem solving ability. Findings of Gok (2014), matches with the present study findings that 7E's model makes students easy to understand better. Factually 7E's model is an activity based teaching methodology, which provides students opportunity to participate in the lesson fully that makes their learning level high. Adebola (2007) also concluded that 7E's model teaching strategy enhances problem solving ability of students which supports the findings of present study. In present study researcher found 7E's model better for understanding of students. Another study conducted by Githae et al. (2015) supported the findings of present study that 7E's model proved consequentially better for the learning of the students of experimental group as compared to conventional method of teaching.

Similarly in present study the scores of the independent sample t-test depicted meaningful mean difference in post-test outcomes on problem solving questions of the control group and experimental group that proves massive evidence that the skills of problem solving abilities of students of experimental group enhanced as compared to control group students. Which means that 7E's model helped experimental group students to understand better and enabled them to solve the daily life complicated problems. Furthermore Mulyono and Noor (2017) study second the present study finding that 7E's model raised problem solving ability and made them to do the task orderly consistently.

Recommendations

The main purpose of teaching of mathematics is to make better understanding of solving the complications of the daily life. That's why it is necessary to find novelty and link new notions to previous ones. Teachers may opt and make it clear that concepts of the students may be cleared at the end of the lesson. Findings of the study guides that 7E's model significantly enhanced the problem solving ability of the students. So it is recommended that 7E's model may be used as an instructional method in daily classroom practices.

7E's model helps students to avoid misconceptions and supports them to clear the concepts. So, institutions heads and top to lower formations of the education department may provide opportunities to teachers like: conferences, seminars, symposiums, trainings and workshops about 7E's model to enhance their teaching skills, resulting gaining highest academic achievement level of learners.

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