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Effect of Teaching of Fractions through Constructivist Approach on Learning Outcomes of Public Sector Primary Schools Teacher

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Abstract

A 6-days (April 11th to 16th, 2011) experimental study as a part of Continuous Professional Development was launched at three districts i.e. Dadu, Naushahro Feroz, Mirpurkhas to enable public sector primary school teachers (PSTs) to translate the abstract concepts of fractions (grade 2 to 5) into concrete learning using low or no cost available resources through a module based on collaborative, activity-based, and learner-centered approach. The present mixed research focuses to evaluate the said training at District Dadu quantitatively and qualitatively. One-group pre and posttest model was used for this experimental study. The 30 (14 male, 16 female) public primary school teachers represented two-stage sample. The t-test analyses revealed that overall the treatment yielded extremely positive and significant learning; however, no significant statistical difference found between male and female trainees' previous knowledge and training effect. The phenomenological qualitative data analysis revealed that the said training was unique. Respondents overall believed that for the first time they practically observed and practiced activity-based teaching through individual and group work, think-pair-share, two-way questioning, discussion, KWL, problem solving, and empathic listening techniques. However there was language barrier to comprehend the module provided in English that was fully tackled by the resource persons who used local language (Sindhi). The researcher suggested measures to overcome the weaknesses for similar projects in future.

Keywords: Fractions, Learner-centered Pedagogy, Activity-based Learning, Piaget's Concrete Operational Stage, Concrete Learning, Evaluation

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Introduction

Teacher is the back bone of formal education, instruction, and training. Generally teacher is one whose profession is to teach or instruct. We have a long range of definitions of effective teacher. "Effective teaching produces beneficial and purposeful student learning through the use of appropriate procedures" (Diamond; 1987). In their book Milhollan Frank and Forisha Bill E. (1972) suggested that effective teachers are those who use empathic listening and communication thus a situation creates where learners feel no external threat and are more open and thus one is able to not only deeply understand learners phenomenological field, emotions and fears but also to change their 'self-concept' (or teach or influence) (Milhollan Frank and Forisha Bill E., 1972). A well trained and innovative teacher is he who can use the available resources and even can teach without books (UNESCO, 2005).

Teaching like other formal professions is incomplete without professional development. Professional development is the process through which a professional gets skills and knowledge for both personal and career development. Reflection on one's practices leads to professional development. According to Borg, (1965) action research directly relates to teachers' classroom practices and its primary goal is in-service training and professional development (Borg, 1965, p. 313). In-service training caters professional development for the teachers. The Bureau of Curriculum and Extension Wing (BoC) and Provincial Institute for Teacher Education (PITE) are the primary providers of both pre and in-service teacher education and training **(**UNESCO, 2006).

Multiple projects have been launched as a part of Teacher Professional Development of public sector primary teachers of Sindh with local and foreign funding through both public sector and private institutions and organizations. Asian Development Bank's Teacher Training Project 1992-2000, Girls Primary Education Project 1998-2005 etc; United States Agency for International Development's (USAID) multiple programs i.e Education Sector Reform Assistance (ESRA) 2002-2007, Creating Democratic Schools 2002-2008, Releasing Confidence and Creativity: Building Sound Foundations for Early Learning 2002-2006, Aga Khan University Examination Board, 2003-2006, Pakistan Teacher Education and Professional Development Program (PTEPDP) 2003-2006; United Kingdom's supported Save the Children project introduced Quality Education For All 2004-2007; United Nations' UNESCO, UNICEF; and British Council among others contributed toward uplifting of teachers' professional development at primary schools level (UNESCO, 2006, pp. 25-36). Government of Sindh has been allocating funds for in-service trainings and professional development of teachers since 2002-03 (UNESCO, 2006, p. 36).

The 6-days (April 11th to 16th, 2011) Continuous Professional Development (CPD) pilot project for the professional development of public sector primary school teachers was launched in three districts i.e. Dadu, Naushahro Feroz, and Miripurkhas for teaching of fractions (grade 2 to 5) through collaborative and activity-based learning. A module on fractions was collaboratively developed by a consortium of Iqra University Karachi, Notre Dame Institute of Education Karachi, and Dada Bhoy Institute of Higher Education Karachi. It aimed at facilitating the trainees to translating the concepts of fractions into concrete one using low or no cost resources, learner centered activities and techniques so that the younger students at primary level could easily understand and learnt the concepts of fractions. The present mixed research aims at to evaluate the effect of teaching of fractions using concrete learning resources and constructivist's activity-based approach on learning outcomes of public sector primary school teachers of District Dadu Sindh. The Study focus on following objectives

- To find out the effect of teaching of fractions using activity-based constructivist approach and concrete learning material on the learning outcomes of public sector primary school teachers of District Dadu.
- To assess the impact of activity-based constructivist approach and concrete learning material on the learning outcomes of male and female public sector primary school teachers of District Dadu.
- To assist the public and private administrative and funding agencies for proper launching of the similar project throughout Sindh.
- To assist the public and private administrative and funding agencies for launching of future CPD training projects for catering routine and serious problems in local context.

Background of the Study

It was a pilot project involving the three districts of Sindh-Dadu, Naushahro Feroz, and Mirpurkhas—regarding training of public sector primary school teachers (both male and female) to not only observing their facilitators (Resource Persons) but also to using hands on approaches, appropriate pedagogical strategies, and low or no cost resources for teaching of 'Fractions' covering grade 2 to 5 [Module on Fractions Grade II to V (2006 Curriculum) for the Pilot Programme of the Continuing Professional Development—jointly developed by sonsortium of Iqra University, Karachi; Notre Dame Institute of Education; and Dadabhoy Institute of Higher Education; Feb 26, 2011; p-3].

The module was based on the National Mathematics Curriculum (2006) for the conceptual understanding of fractions and for the development of operational, pedagogical, and application skills using the said curriculum's scope and sequence at primary school level (Module on Fractions, p-3).

The module was developed on the learner centered approach through brainstorm; questions and answers; discussion; graphic organizers; KWL (what you already Know, you Want to Know, and you have Learnt); jigsaw, small-group, structured-collaborative work, think-pair-share, pair work, presentations; station-based; and gallery-walk techniques (Module on Fractions, p-3).

The knowledge and skills to be developed among public sector primary school teachers through the module were determined and organized by maintaining the standards of the National Professional Standards for Teachers in Pakistan (2009) and the Certification of Continuous Professional Development Programs (Module on Fractions, p-3).

The Training of Resource Persons, Field Coordinators, Monitoring & Evaluation Experts

All the major stakeholders i.e. Resource Persons (RPs), Field Coordinators (FCs), and Monitoring and Evaluation Experts (MEs) were selected on merit and higher professional qualification. The RPs and MEs had M. Phil. (Education) degree. All the above stakeholders went through rigorous orientation/training of the manual with additional administrative and evaluation orientation/training for Field Coordinators (FCs) and MEs for two full days at Notre Dame Institute of Education Karachi.

Daily Check and Balance for the Training

The RPs took attendance of trainees twice i.e. just after start of the training session in the morning and after the lunch break and also got the reflections of trainees once at the end of each day. Pre and post tests were also conducted at the start and end of the program. The Coordinators provided a lunch with two tea breaks, and learning material. The ME observed and recorded the findings of whole classroom teaching for each RP on alternate day, and conducted interviews with trainees (PSTs) and RPs during break or spare time for knowing deeply the effectiveness of the program or any difficulties and challenges. Additionally, M/E had to submit daily reflection and report about the training and to evaluate all the provided tools thereafter. The trainees had a lot of involvement in learning activities and presentations along with submission of daily reflections on prescribed forms, and

maintained day-wise portfolios mentioning the activities, excerpts from daily work, and attaching relevant presentations and resources made or used. The two Observers i.e. one from local college where the training was held and the other from Provincial Institute of Teacher Education (PITE) Nawabshah were also there for full time throughout the training, they had to submit their observatory reports and evaluation tools to Reform Support Unit (RSU) Sindh.

It was aimed to be a collaborative and team work of all the trainees (PSTs), RPs, ME, FC, and two observers from PITE through which the objectives of training were meet.

Literature Review

In theory our public sector educational system at all levels is learner centered; however, the actual teaching practice reflects a contrast picture. Lack of positive reinforcement, two-way questioning, discussions, individual and group work, and use of corporal punishment are general hallmarks prevailing at public sector schools (Bhutto, 2011). The professional training courses for teachers i.e. PTC, CT, B. Ed, and M. Ed explicitly bound all the teachers not to use authoritarian and teacher-centered approach towards teaching (Allama Iqbal Open University Islamabad, 2005). The professional degrees clearly emphasize that teachers must plan their lessons and provide opportunities for individual and group work, lot of students' activities, two way questioning, discussions, role-plays, presentations to properly facilitate learners to achieve desired learning outcomes.

With regard to Blooms Taxonomy, a qualitative study was conducted at District Mirpurkhas; the researchers concluded that existing teaching caters only the knowledge and comprehension skills out of six levels of the cognitive domain i.e. knowledge, comprehension, application, analysis, synthesis, and evaluation. The researcher claims that the affective and the psychomotor domains or educational objectives that develop and links the textual concepts with students' feelings and emotions, and skills and performance were almost ignored and untouched (Mansha, Chaman et al., 2011).

Educational psychology tells us that heredity, environment, maturity, and motivation among others are the key factors that play vital role in acquisition of learning (Morgan Clifford T. et al. 1986). Saleha Parveen Dr. (2008) cites extract from Government of Pakistan's National Education Policy (Iqra) 1998-2010 document stating detriorating quality of education and emphasizing the need of quality professional development programs:

> *"The quality of education is directly related to the quality of instruction in the classrooms. Teacher is considered the most critical factor in the entire education system being the major implementer of all educational reforms at the grass root level. It is well-established fact that the academic qualification, knowledge of subject matter, competency and skill of teaching, and the commitment of teacher produces similar impact on the quality of education of the students at relevant level. Recognizing the deteriorating quality of education at various levels, efforts need to be intensified to accord adequate priority to the effectiveness of teacher education programmes in the country" (Government of Pakistan, 1998, p. 61. as cited by Saliha Parveen Dr.; 2008).*

Fractions is integral part of mathemetics. Like other fields mathematics also have evolved therefore unlike their traditional role to develop competency in repetitive computation in isolation from day to day life the need of the hour is to integrate mathematics and algebra with practical life through developing critical thinking and reasoning. It can be done through through learner centered and constructive approach (Solangi et al., 2008). In our local context Solangi et al., (2008) conducted pure experimental study and concluded that treatment group that was taught mathematics through constructivist approach excelled in achieving exteremely statistical significant learning outcomes than control group taught through traditional teaching.

Among the propagators of developmental psychology, Piaget is a prominent figure who believes that maturity is one of the most important influencing factors towards child's learning. In his theory of cognitive development he proposes the four stages of development of an individual: the sensory-motor stage, pre-operational stage, concrete-operational stage, and formal operational stage (Johri Pardeep Kumar, 2005). Teaching of mathematics starts from grade two while 'fractions' start from grade 3 to 5 involving 8-10 years age group children thus comes under concrete-operational stage (7-11 years). According to Piaget, children in this stage start to think logically and they develop the sense of conservation, reversibility, multiple classifications, and transformations; however, they are still too young to perform abstract thinking and hypothetical deductive reasoning. Therefore they cannot understand abstract ideas and one-way lectures and instruction, but when the abstract ideas are converted or presented in concrete things they understand (Johri Pardeep Kumar, 2005). For example a grade three learner could have problems in understanding the concept of ½ + ½ = 1, but when a teacher transforms the problem into concrete form and provides two equal half-shaded circles and explains that each circle is a whole having two equal parts (or fractions) one is shaded and other is not,

then folds one circle so that only shaded part is visible and he or she places it on the other half-shaded circle to form one whole shaded circle, and then asks what you get from both of half shaded circles (Answer: one whole shaded circle). The teacher further explains that total equal parts of a thing (whole) represents denominator while the part taken or shaded one represents numerator. Finally teacher represents shaded circles with symbolic equation.

The concepts of mathematics like fractions, algebra, geometry etc at primary level do require to be presented and explained using concrete things. To cater those needs Iqra University Karachi with collaboration Notre Dame Institute of Education Karachi and Dadabhoy Institute of Higher Education Karachi launched a pilot experimental study funded by the government of Pakistan to teach and train public sector primary school teachers to translate abstract concepts of 'fractions' upto grade 5 into concrete learning through constructivist, collaborative, activity-based and learner centered approach. Present study focuses to find out its effect from both quantitative and qualitative perspectives.

Research Questions and Hypotheses

The main research questions for this study were:

Ho_1 What is the effect of teaching of fractions using activity-based constructivist approach and concrete learning material on the learning outcomes of public sector primary school teachers of District Dadu?

Ho_2 How do public sector primary school teachers of District Dadu perceive teaching of fractions using activity-based constructivist approach and concrete learning material?

The above research questions were broken down into these specific sub questions:

i) What is the overall difference between pre and post test scores all members of the experimental group?
ii) What is the difference between pre and post test scores of male and female public sector primary school teachers of the experimental group?
iii) How do male public sector primary school teachers of District Dadu perceive teaching of fractions using activity-based constructivist approach and concrete learning material?
iv) How do female public sector primary school teachers of District Dadu perceive teaching of fractions using activity-based constructivist approach and concrete learning material?

The null hypotheses of this study were:

i) There is no significant difference between the overall pre and post test scores of public sector primary school teachers of District Dadu.
ii) There is no significant difference between the pretest scores of male and female public sector primary school teachers of District Dadu.
iii) There is no significant difference between the pre and post test scores of male and female public sector primary school teachers of District Dadu.

Ethical Considerations

The official permission and collaboration was sought from the Executive District Officer and other concerned officers of education department of Dadu District. They selected the 30 primary school teachers including almost equal number of male and female teachers (trainees). They extended their full coordination and cooperation for the study and arranged the appropriate venue and ensured selectees' attendance at the centre throughout therefore respondents' consent was legal in nature. Moreover, selected respondents extended their free and volunteer consent for in-depth interviews and discussions.

The respondents were ensured that strict confidentiality would be followed and their identity would not be disclosed at any cost to avoid any harm to them during and after (by reporting findings) the study.

Methodology

This section of paper describes method of the study.

Theoretical Perspective

The present study finds its place in framework of 'epistemology' using its both objective and subjective traditions. Objective in a sense that effect of the treatment was measured through objective and quantitative test scores of pre and posttests while controlling other variables that might influence learning outcomes. On the other hand, human beings since possess unique phenomenological field that is formed by one's subjective emotions, feelings, meanings, experiences, and unique interaction with outer world therefore people often perceive differently of single concept or thing. In this regard how the public sector primary school teachers perceive the activity-based teaching and learning constitute subjective interpretation of the phenomenon therefore exploring learners subjective meaning, opinions, or perspective through in-depth interviews makes up 'subjective' part of this study.

Design of the Study

The present study is both quantitative and qualitative in nature. Experimental design and its quantitative (test-scores) data collection and analysis constitute quantitative part. Whereas, exploring teachers' subjective perceptions, feelings, and meanings attached through phenomenology relate to its qualitative part.

Population and Sample

All public sector primary school teachers (PSTs) of Tahsil Dadu comprise the target population. Whereas the 30 (14 male, and 16 female) public sector primary school teachers more or less representing all union-councils of Tehsil Dadu represented a mix of convenient and two-stage sampling because they were nominated by the Executive District Officer (Education) Dadu.

The Monitoring and Evaluation Expert (ME) who also served as researcher monitored and observed all the 30 public sector primary school teachers along with 03 Resource Persons (RPs or trainers). The researcher played dual role as an observer and an ME (Monitoring & Evaluation Expert) in that experimental study.

Data Collection

The quantitative data were collected from pre and posttests, whereas, qualitative data were collected through 09 semi-structured interviews of public primary school teachers (trainees) with the ratio of 5:4 (five females and four males) public sector primary school teachers. Additionally, direct observation of all trainees was used as a tool of data collection throughout the training.

Reliability of the Instrument

The internal consistency or reliability of pre/post test was judged through triangulation of quantitative data with qualitative one and vice versa. Statistical analysis through t-test analysis, revealed that the effect of treatment or training had exteremely positive statistical significance which was strongly confirmed through thematic analysis of qualitative data derived from in-depth interviews, discussions, and observation.

Data Analysis

The quantitative and numerical data i.e. the mean scores of pre and post tests were analyzed using t-test. Three patterns of analyses were done: pretest vs posttest (overall whole group), pretest vs pretest of male and female PSTs, pretest vs posttest of male and female PSTs.

On the other hand inductive themes were drawn out from the transcribed interviews and observatory data to find out emerging patterns and a theory reflective of their subjective perspective through thematic-analysis.

Findings and Discussion (Quantitative Data):

The one-group pre and posttest model for assessing statistical significance of the treatment. Quantitative data collected through pre and post tests were analyzed through paired t-tests. The t-test analyses revealed that overall the effect of treatment was extremely statistically significant, however no statistical difference was found between male and female trainees' previous knowledge and training effect on the learning outcomes.

For this purpose three patterns of analyses were done:

1. Pretest vs Post test (overall or whole group)

   The first null hypothesis was:

   i. There is no significant difference between the overall pre and post test scores of public sector primary school teachers of District Dadu.

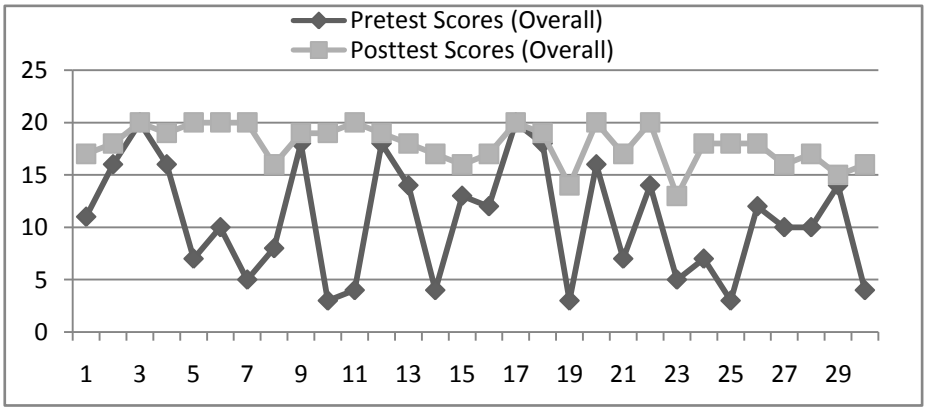

Figure 1: Comparison of pre and post test scores of one-group experimental design

The t-value (observed) was 7.6148 greater than its critical value 2.045 at 0.05 (95%) confidence level and 29 degrees of freedom. The p-value reamained less than 0.0001, therefore the null hypothesis was rejected. It implies that the effect of treatment was statistically extremely significant.

Table 1: *Presents summary of important statistical aspects of pre vs post test (overall)*

Statistical aspect	value	Result
Two-Tailed P-value is→	less than 0.0001	Statistically extremely significant;
Mean of Group One minus Group Two→	7.13	
Confidence level →	0.05 or 95%	
Standard Error of Difference	0.937	Null-hypothesis rejected.
df (degrees of freedom) →	29	
t-value (tabulated or critical)→	2.045	
t-value (observed) →	7.6148	

Table 2: *Presents mean, SD, SEM, and N of pre and posttest of on-grooup experimental model*

Group	Pretest (overall)	Posttest (overall)
Mean	17.87	10.73
SD	1.93	5.53
SEM	0.35	1.01
N	30	30

2. Pretest vs Pretest of male and female trainees (primary school teachers)

   The second null hypothesis was:

   i. There is no significant difference between the pretest scores of male and female public sector primary school teachers of District Dadu.

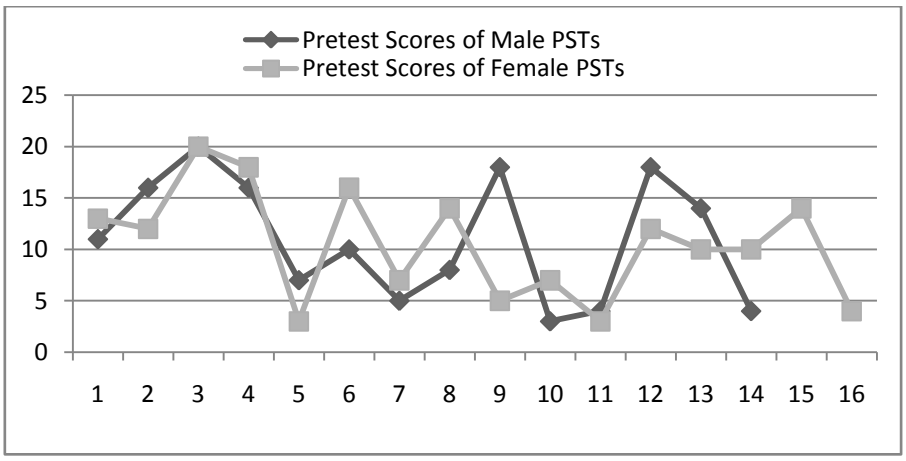

Figure 2: Pretest scores of male and female PSTs (trainees)

The t-test findings reveal that t-score observed (0.1955) was lesser than it critical value (2.16) at 0.05 level of confidence and 29 degrees of freedom for the pretest scores of male and female PSTs (trainees) therefore the null hypothesis could not get rejected (but accepted). It implies that male and female trainees' previous learning regarding 'fractions' was almost equivalent before the training.

Table 3: *Presents summary of important statistical aspects of pretest scores of male and female PSTs*

Statistical aspect	value	Result
Two-Tailed P-value is→	0.8480	Not Statistically
Mean of Group One minus Group Two→	0.29	significant;
Confidence level →	0.05 or 95%	
Standard Error of Difference	1.462	Null-hypothesis
df (degrees of freedom) →	13	accepted
t-value (tabulated or critical)→	2.16	
t-value (observed) →	0.1955	

Table 4: *Presents mean, SD, SEM, and N of pretest scores of male and female PSTs*

Group	Pretest (Males)	Pretest (Females)
Mean	11.00	10.50
SD	5.96	5.30
SEM	1.59	1.33
N	14	16

3. Posttest vs posttest scores of male and female trainees (PSTs)

The third null-hypothesis was:

i. There is no significant difference between the pre and post test scores of male and female public sector primary school teachers of District Dadu.

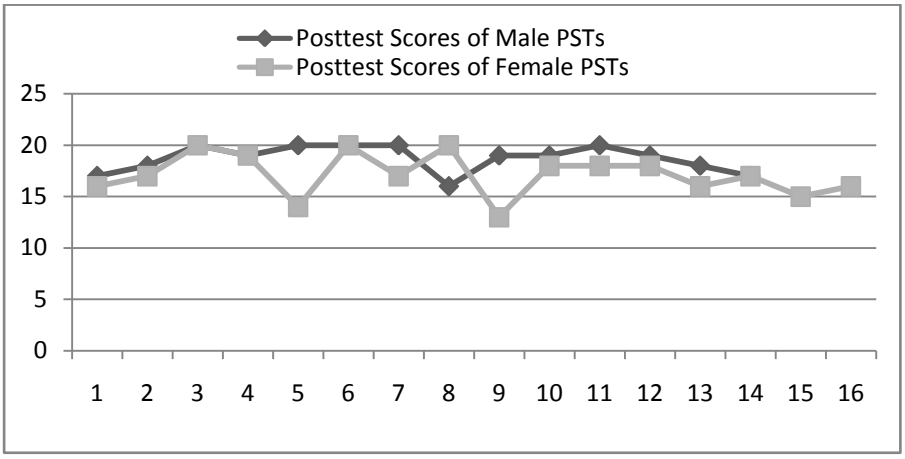

Figure 3: Posttest scores of male and female PSTs (trainees)

The t-test findings reveal that t-score observed (2.0071) was lesser than its critical value (2.16) at 0.05 level of confidence and 29 degrees of freedom for the posttest scores of male and female PSTs (trainees) therefore the null hypothesis could not get rejected (but accepted). It implies that male and female trainees' learning outcomes remained equivalent after completion of the treatment (training on 'fractions').

Table 5: *Presents summary of important statistical aspects of posttest scores of male and female PSTs.*

Statistical aspect	value	Result
Two-Tailed P-value is→	0.0660	Not quite statistically
Mean of Group One minus Group Two→	1.36	significant;
Confidence level →	0.05 or 95%	
Standard Error of Difference	0.676	Null-hypothesis
df (degrees of freedom) →	13	accepted
t-value (tabulated or critical)→	2.16	
t-value (observed) →	2.0071	

Table 6: *Presents mean, SD, SEM, and N of posttest scores of male and female PSTs:*

Group	Posttest (Males)	Posttest (Females)
Mean	18.71	17.13
SD	1.33	2.09
SEM	0.35	0.52
N	14	16

Findings and Discussion (Qualitative Data):

The thorough observation of the PSTs or trainees by the researcher (ME), semi structured interviews and other formal and informal feedback and discussions revealed a lot of descriptive and qualitative data. The general themes were drawn out of the transcribed and observatory data for thematic and qualitative analysis. The lived experience of trainees and treatment is discussed into following general themes.

About the CPs of Dadu

There were 30 trainees including 17 female and 13 male public sector primary teachers at Dadu centre. The Government Elementary College of Education (men) was the venue for this training. The list of trainees was provided by the office of Executive District Officer (Ed) Dadu. The trainees' (PSTs) teaching experience ranged from 05 to 30 years. Almost all had been teaching mathematics including fractions with traditional lecture method or one way teaching method as reflected from their perceptions and practices. A few of them had enriched conceptual knowledge about mathematics and fractions; however, they explicitly recognized that they had no idea to convert abstract math-concepts into concrete so that their 5-10 year students could understand properly the concepts of fractions. They were talented, cooperative and eager of learning new things.

Teaching and Learning Process

The researcher's (ME) observation reveals that the RPs maintained learner-centered approach using a range of diverse activities and techniques throughout. They followed the module mostly; however, sometimes giving adequate time to learners to pose questions and to clarify their point of view caused deviation. But it was so necessary, because without empathic listening the RPs could never understand the hurdles or related explanations of the trainees during teaching learning process. In researcher's opinion, it was the way through which the RPs got rapport and their unconditioned cooperation. The teaching learning process during the 6-days training remained absolutely interactive, interesting, fruitful, and according the module.

The trainees during formal and informal discussions and interviews with ME revealed that initially they believed that like other trainings it was also the training where they only would come, have tea and lunch, put their signatures on the attendance sheet, and nothing more. However, they admitted from time to time that all their pre conceptions proved totally wrong; and unanimously claimed the present training was actually the best opportunity for interacting and learning through active participation, and learner-centered approach.

> One CP revealed, *"I believed that there will be no new learning, as I have been teaching mathematics and fractions for last ten years; but, here I come to know that I was totally wrong. I usually used lecture method with pure abstract teaching, and resulted in lower students' learning for which I blamed on their intelligence. Here, I come to know that my basic approach was not correct; I never used low or no cost materials for concrete learning. A simple paper and pencil could be used to teach almost all the concepts of fractions".* (An equivalent English translation of the Sindhi conversation)

Professional Development

The researcher (ME) observed that the trainees at the start of the training were quite unaware about the collaborative and interactive learner centered methods and techniques of teaching. But it was the clear cut effect of the said training that they not only practically observed the appropriate using above methods and techniques through two-way questions and discussions, individual and group work, TPS and KWL, problem solving and presentations according to the situation, but they also were involved in all those activities throughout six days.

The PSTs (trainees) revealed through interviews that they had learnt lots of new teaching skills, techniques and methods with regard to the teaching of fractions, their properties, and operations. Mostly admitted, that their professional skills were developed by accepting a change in their basic understanding and teaching approach. One of the trainee revealed that he did not get bored even for a single minute and it was the most unique and interesting experience he ever had. They unanimously accepted that the whole team including RPs and ME worked as a team and the day wise plan was covered regularly.

The proper completion and following of the instructions of the module was the key to achieve all the desired objectives of the training. From ME's or researcher's perspective the module was completely covered and followed according to day-wise plan of studies. However, a few classroom activities were modified as home-work assignments because of emerging discussion and empathic listening to the trainees' point of view and experiences in order to fully understand and guide them properly; that modification was a must to ensure practically learner-centered approach. The daily review during the start of the session provided opportunity to reintegrate the learned concepts and repeat the same so that they could become permanent part of learning.

It is important to note here that the RPs had a vast experience of teaching mathematics including fractions; thus they were able to see the module with different angles, and tackled the situations confidently and patiently. They were able to link the abstract ideas of fractions with real and classroom situations using the equal parts of doors, windows, ceiling, and even male and female participants, RPs, and observers to explain the required fraction in concrete form. Through their laborious work and proper facilitation, a vast majority of trainees at the end was observed to be able to translate abstract concepts of fractions into concrete one through drawing pictures or providing concrete things using available low or no-cost learning material; they were able to explain the basic operations of addition, subtraction, multiplication, and division of equal, like or unlike fractions through pictures/drawings or through concrete things. Most of the trainees were also capable of doing same for the associative and commutative properties of fractions. Their portfolios also reveal such ability. One male trainee teacher who was one of the most competent participants exclaimed and wished that all areas of the mathematics would be taught through such strategy and training involving the same RPs and the other team.

Uniqueness of the Training Project

From the trainees' perspective the training program was found totally unique in their district. The general perceptions of the trainees revealed that most of the participants had attended in-service teacher trainings throughout their professional career; however, they claimed that they did not think of such challenging and interesting training through competent and the most talented RPs and with regard to strict monitoring and guidance as well.

> One female trainee exclaimed, *"This training is marvelous; here we came to know the ideal classroom teaching with regard to fractions through no distinction of male or female participant".* The other male RP exclaimed, *"Through positive interaction with other CPs I even understood and explored the potentials my local colleagues".*

Regarding monitoring mostly held that it was for the first time they observed throughout monitoring. In this regard one participant revealed:

> *"Normally, we had concept of monitoring as a brief visit by a monitoring officer occasionally as a routine; and such regular visit we regarded strict monitoring; but, here the things were totally different the monitoring officer (M/E) was present all the time throughout the training. He assisted not only the RPs but also the trainees as well to fully achieve the targets."*

They unanimously admitted that the whole team including RPs, ME, and the two other 'Observers' were specifically trained for their tasks and jobs done.

> A female trainee teacher revealed, *"I could not find the words to appreciate our RPs and ME; they listened to us, treated us with respect and love, and taught us in an interesting way. Your team filled us with new enthusiasm to use low or no cost material to make abstract concepts of fractions concrete and easy for our younger students to learn."*

Administration and Monitoring

From monitoring point of view, the training involved proper and well-planned administration and management. The centre reflected a good and conducive training environment. The trainees did not complained about the administration and monitoring process; in fact, they were very happy to be part of that training.

Issues and Challenges and Suggested Measures

Overall, the training went beyond the targets; however, there were a few issues and challenges needed to be addressed for future reference in the process of training from the perspective of CPs':

- The RPs, FCs, and MEs went through the same 2-days' training/orientation except the last workshop that was devoted for FCs and MEs administrative and monitoring purpose. The overall duration should have been atleast for 4 days because 2 days were even felt short for covering whole manual properly. Moreover, the FCs, and MEs needed additional time (at least a full day) to properly understand their specific tasks, and to fairly comprehend the observation and evaluation tools and reports to be submitted daily.
- The first-day of the training at the District was not quite good because despite our whole team (RPs, and ME) reached at the centre almost in time, the RPs and ME could not manage to organize the available resources (worksheets, handouts, audio visual aids etc), therefore difficulties observed and experienced to follow the manual properly on that day. The resources sent to the District should have been organized day-wise.
- The trainees knew the concepts but hardly benefited from the manual provided in English because of their poor English. Despite the resource persons (RPs) used local language (Sindhi) as medium of instruction and communication and enabled trainees to thoroughly understand and practice the manual, but language barrier made them passive to use it on their own.

Most of them even did not know the term 'Fractions' not because of lacking in conceptual knowledge but due to poor English. Mostly were struggling to remember English terms i.e. numerator and denominator; addition, subtraction, multiplication, and division; like, unlike, and equal fractions; commutative and associative properties of operations etc.

- There were a few typing/ printing and translation mistakes in the manual and material provided.
- The trainee teachers repeatedly demanded and shared their concerns that there was a great work load on both the trainees and RPs. As they had to make hurry all the time to cover the day wise schedule. They wanted to have more time to discuss their experiences and hurdles. Trainees unanimously demanded even to extend the training for 12 working days with existing timings as there was no time for pasting or displaying their work or maintaining portfolios.
- One of the responsible officers of the District wasted trainees' precious time (2-3hours) repeatedly by his irrelevant political speech. It created the worst troubles for trainees, RPs, and ME to cover and follow the daily schedule of teaching learning activities. It could be worked out by approaching the responsible executive officer to issue such formal directions to all visitors for not to waste trainees precious time and learning opportunity.
- There was a great workload on ME for preparing daily reports, conducting interviews with trainees and RPs, submitting and evaluating the observatory tools for each trainee teacher and RP. Extension of duration i.e. 12 working days instead of 6 could solve the issue.

Conclusion

The 6-days experimental study and training of the public sector primary school teachers at Dadu remained extremely and equally fruitful for both male and female trainees in terms of their previous knowledge and learning outcomes. Teaching of fractions through activity based and learner centered approach where learners had greater opportunities to think, question, and discuss while being facilitated or engaged in individual and collaborative tasks went beyond the expectations of trainees.

The manual was covered through learner-centered and collaborative learning approaches with appropriate individual and group work. The learning techniques i.e. Two-Way Questioning, Discussion, KWL, TPS, and Problem Solving learning techniques were used throughout the training.

Quantitative and qualitative data collection and analysis support that the objectives of the training were achieved and the teacher-trainees were able to understand and teach the concepts of fractions in their respective schools (from class 2 to 5) by translating the abstract concepts of fractions into concrete ones using low or no cost resources (using at least paper and pencil, and linking the idea with real life situations through innovation), individual and group work, allowing two-way questions and empathic listening and discussions.

Both the male and female public primary school teachers (trainees) perceived the training or treatment as extremely positive, unique, and productive. All of the trainees admitted that it was a unique training they ever had; they learnt a lot; and wished if such training had gone beyond fractions to whole curricula of mathematics up to grade five. Despite the resource persons (RPs) used local language (Sindhi) as medium of instruction and communication and enabled trainees to thoroughly understand and practice the manual provided in English, but language barrier made them passive to use it on their own. The teachers believed that they could even learn better had it been provided in local (Sindhi) language.

Recommendations

- The activity-based and learner centered professional development programs and refresher courses are need of the hour for public sector primary school teachers as prevailing traditional teaching and pedagogy cannot cater psychological needs of younger learners.
- Such training should be launched in all the districts of Sindh to enable the public primary school teachers to translate abstract concepts of curricula especially mathematics and general science into concrete ones through appropriate use of low or no cost available learning resources.
- This study though did not study the English language skills of public sector primary school teachers directly; however it was observed and explicitly revealed through trainees perceptions and interaction that they had serious language problems in all skills i.e. reading and writing, listening and speaking. Therefore, it is strongly suggested that prompt solid measures be taken to enhance functional and communicative English of public sector teachers.

- Regular funding should be ensured for refresher courses and professional development programs in order to bring our public sector institutions in line with well reputed private institutions to provide quality education for future generations.

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