HANDS-ON ACTIVITIES VS MULTIMEDIA CONTENT IN SCIENCE IN DEVELOPING PRE-SERVICE TEACHERS' COMPETENCE

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This paper reports the finding of our study with the use of hands-on activities and multimedia science content in training of pre-service teacher trainees of elementary level. A pre- and post-test design was chosen for the study. Two groups of trainees formed the experimental group 1 (PTHA, N=39) and group 2 (PTMC, N=34). The experimental groups were oriented on some selected chemistry related content of NCERT science textbooks. The interventions were made by the first Investigator on second year trainees of District Institute of Education and Training of East and North East districts of Delhi. The pre- and post-test scores of both the groups were compared by subjecting the data with appropriate statistics. The analysis of data indicates that the post-test gain scores of both the experimental groups were improved. However, the group treated with hands-on activities showed a marked and significant improvement in their pedagogical content knowledge of the topics covered in the intervention.

Key words: *Hands-on activities, multimedia science content, pre-service teachers*

Introduction

The development and application of ICT has affected all aspects of human life and education is no exception. Thoman E. and Jolls T. (2004) have rightly pointed out that: "the convergence of media and technology in a global culture is changing the way we learn about the world and challenging the very foundations of education". Laurillard, D. (1993) in Taylor, J. (1997) stated that: "various educational media (print, audio, video, computers, etc.) can be compared and contrasted for the contribution they each make to supporting different aspects of teaching-learning process. Roschelle, et al., (2000; p. 79) have also explored the use of multimedia in education. Elliot, et al., (2014) affirm that "multimedia technology has transformed science learning ...radically different learning experiences ensued."

Barnett et al., (2005, p. 351) reported that Computer-based modelling tools "create exciting opportunities for students to create, manipulate, and interact with their own constructions, which in turn support them in developing understandings through their first-hand experience". Similarly, Kozma and Russell (2005, p. 411) argued for use of Multimedia Learning of Chemistry and they said that "in addition to allowing students to mirror the processes that scientists themselves engage in, these representations enable students to explore and discuss phenomena and objects that may otherwise be intangible, such as the molecular structure of a reagent". However, Roger (1991) advocated that "Properly designed educational MULTIMEDIA on Multimedia computers supports active participation and puts the student in control". Tony, et al., (2010) in their study found that "not only was

scripted collaborative multimedia ESCoM mapping more effective than the traditional teaching approach, it was also more efficient in requiring far less teacher guidance." The authors (Singh and Husain, 2015) have also reported the effectiveness of multimedia in enhancing the achievement of elementary level students.

As far as use of hands-on activities are concerned, all along these have been emphasised for all quality initiatives particularly in teaching-learning of science education ever since Piaget, the great educationist has also stressed the importance of learning by doing, especially in science. David and Peter (1994) argued that: "Teachers who embrace hands-on learning in science seem to recognise certain desirable outcomes and endorse student-centered instructional approaches." Brian J. Foley and Cameron McPhee (AERA 2008) have reported 'Students' Attitudes towards Science in Classes Using Hands-On or Textbook Based Curriculum.'

Several attempts are being made world over for improving the effectiveness of teachers' preparation. The use of ICT and multimedia in training of teachers, and hands-on activities have their own place in such endeavors. The present paper reports a comparative account of the two approaches in developing elementary teachers' competence.

Objective of the Study

1. To compare the two approaches—hands-on activities vs multimedia content in science in enhancing conceptual understanding and pedagogical skills of pre-service elementary teacher trainees.

Hypotheses 1 (H1): There is no significant difference in the level of competence of pre-service elementary teacher trainees trained through hands-on activities and multimedia science content.

Methods and Procedure

Material: For the intervention, multimedia science content developed by Dove Multimedia Pvt. Ltd., Mumbai, Tirumala Softwares, Delhi and CAL unit of Sarva Shiksha Abhiyan, Delhi, were procured and used for organising the teaching-learning of the selected topics /units. For the hands-on activities low-cost kits were developed and used while orienting the trainees.

Sample: The sample consisting of two groups of trainees were formed for the intervention from the DIETs located in District East and District North East of Delhi. Two groups of trainees formed the experimental group1 (PTHA , N=39) and group2 (PTMC, N=34).

Tools: The achievement test containing 35 items was developed in consultation with the practising teachers of sample schools. The test was administered as pre-test and post-test to the sample of trainees.

Procedure: After formation of two groups the pre-test was conducted followed by teaching sessions with both the groups. The selected topics were taught to the groups by hands-on activities, and by using multimedia content and also to a control group by the investigator himself. At the end of series of sessions the same tool was administered as post-test and scores were subjected to statistical treatment.

Result and Discussion

The performance of both the experimental groups (the one exposed to a set of hands-on activities and the other exposed to multimedia content) was also compared by analysing their mean scores obtained through pre- and post-test. The pre- and post-test data analysis are given in Tables 1 and 2, respectively.

P value and statistical significance (pre-test): The two-tailed P value equals 0.4978. By conventional criteria, this difference is considered to be not statistically significant. The t value (0.955) was also non-significant at all levels between .20 to.001 (two-tailed), which confirmed that the two groups were at par in the beginning of interventions.

Table 1

Pre-test data of both the experimental groups — hands-on activities and multimedia content

Statistics	Exp. Gp.1: PTHA (N = 39)	Exp. Gp.2: PTMC (N = 34)
Mean	16.97	16.32
SD	3.74	4.42
SEM	0.60	0.76
df	71	
t	t = 0.6814	
SED	0.955	
P value (two tailed)	0.4978	

Table 2

Post-test data of both the experimental groups

Statistics	Exp. Gp.1: PTHA (N = 39)	Exp. Gp.2: PTMC (N = 34)
Mean	23.15	19.03
SD	4.50	3.65
SEM	0.72	0.63
df	71	
t	t = 4.2615	
SED	0.968	
P value (two tailed)	←0.0001	

P value and statistical significance (post-test): The two-tailed P value is less than 0.0001. By conventional criteria, this difference is considered to be statistically significant. The t value (4.2615) is also highly significant at even at .001 level which confirms that difference in the achievement of both the groups as a result of intervention.

The performance of the group exposed to hands-on activities showed more enhancement than that of the group exposed to multimedia content during the course of the training. Thus, on the basis of this observation one can conclude that in comparison to the use of multimedia content, hands-on activities seems to be more effective in enhancing the conceptual understanding and competence of pre-service teacher trainees. The mean scores of both the groups as obtained through pre- and post-test are also presented in Fig. 1.

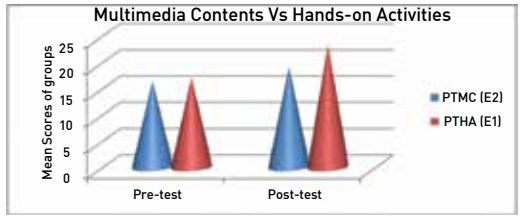

Fig. 1: Mean scores of both experimental groups on pre- and post-test

Comparison of performance of the three groups, Control group and both the experimental groups of Pre-service Teacher Trainees – (ANOVA)

In order to compare all the three groups (control Gp., Exp. Gp. 1 (PTHA) and Exp. Gp. 2. (PTMC), the Analysis of Variance (ANOVA) of the pre-test scores and post-test scores of the trainees was carried out and the statistical analysis is summarised in Tables 3 and 4, below.

Table 3

Analysis of variance of pre-test score of control and the treatment groups- ANOVA summary

Source	SS	df	MS	F	P
Treatment (between groups)	16.33	2	8.17	0.55	0.5785
Error (within groups)	1656.03	111	14.92		
Total	1672.36	113			

Tukey HSD test: This test is not applicable because the analysis of variance did not yield a significant F-ratio. The analysis of variance of the pre-test scores and the smaller F –ratio and higher p←0.5785, indicate that the performance level of all the three groups was similar, in the beginning of the treatment.

Table 4

Analysis of variance of post-test score of the three groups- ANOVA summary

Source	SS	df	MS	F	P
Treatment (between groups)	463.77	2	231.88	13.88	←.0001
Error (within groups)	1854.49	111	16.71		
Total	2318.2544	113			

Tukey HSD Test

HSD [.05]=2.24; HSD [.01]=2.8

M1 vs M2	P<.01
M1 vs M3	non significant
M2 vs M3	P<.01

M1= Mean of Sample 1-Control (TLM); M2= Mean of Sample 2- Exp. Gp. 1 (PTHA); and M3= Mean of Sample 3- Exp. Gp. 2 (PTMC)

HSD = the absolute [unsigned] difference between any two sample means required for significance at the designated level.

HSD [.05] for the .05 level; HSD [.01] for the .01 level. (http://vassarstats.net/anova1u.html)

The analysis of variance also confirmed the effectiveness of teaching through hands-on activities (PTHA) over the teaching through lecture method (PTLM) and teaching through multimedia content (PTMC). The analysis of variance of the post-test scores and the larger F –ratio and P<.0001, indicate that the three groups showed marked difference after treatment which could be attributed to the effectiveness of the treatments.

On the basis of analysis of data as presented in Tables 1,2,3 and 4, Hypotheses1 (H1.: There is no significant difference in the level of competence of pre-service elementary teacher trainees trained through hands-on activities and multimedia science content) is rejected. The statistical results suggest that use of hands-on activities in training and development of teachers is more effective than the lecture method or multimedia method. Thus this methodology of using hands-on activities could bring a significant difference in the competence of pre-service teacher trainees.

Conclusion

On comparing the effectiveness of hands-on activities and multimedia science content with traditional method of training of pre-service elementary teacher trainees, it has been observed that the performance of the group exposed to hands-on activities showed greater enhancement than that of the group exposed to multimedia content during the course of the training. Thus, on the basis of this observation one can conclude that in comparison to the use of multimedia content, hands-on activities seem to be more effective in enhancing the conceptual understanding and competence of pre-service teacher trainees. The analysis of variance also confirmed the effectiveness of teaching through hands-on activities (THA) over the teaching through traditional method (TTM) and teaching through multimedia content (TMC). The analysis of variance of the post-test scores and the larger F –ratio and P<.0001, indicate that the three groups showed marked difference after treatment which could be attributed to the effectiveness of the treatments.

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