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SECONDARY SCHOOL TEACHERS' USE OF CLASSROOM LEVEL ASSESSMENT TECHNIQUES IN MATHEMATICS

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ABSTRACT

Assessment is the essential part in the teaching learning process. The study explores the mathematics teachers' assessment techniques at secondary level in the province of Khyber Pakhtoonkhwa, Pakistan. Survey research was conducted in which a five point Likert scale questionnaire was used for data collection from the target population. The questionnaire was validated through research experts and reliability coefficient of the questionnaire was 0.80. After validity and reliability of the questionnaire, 681 mathematics teachers were surveyed through multistage cluster sampling method. In these, 16 teachers were from urban areas and 465 were from rural areas. Findings of the study show that mathematics teachers did not use informal assessment techniques such as observation in the classroom. Projects, peer review and classroom presentation were also not in practice for the assessment of students in teaching of mathematics. Mostly mathematics teachers assessed their students through conventional teacher

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made test and review of homework. The lack of using multiple techniques in mathematics classroom is probably referred to insufficient training of teachers regarding use of various techniques for students' assessment, overloaded classrooms and workload of teachers.

Keywords: *Classroom Level Assessment, informal assessment, mathematics teaching, teacher training, assessment practices.*

INTRODUCTION

Education being the process of developing human being holistically can be undertaken both in formal and in formal ways. The former one consists of teaching learning process in the classroom as the vital part of education (Dhiman, 2007). The teaching learning process is considered effective if the personnel involved in the process are experts in instructions and assessment, as these are the instrumental parts of teaching process. Assessment in educational circumstances is to support and develop teaching learning process (Black & William, 2003; Maki, 2002; Wiliam, 2007, pp.1053 – 1098).

The better teaching learning process of teachers is conditioned with the best assessment techniques they use for students' learning (Reynolds, Livingston, & Willson, 2011) as it is an important element in teaching learning process. Assessment is basically the collection of information, its interpretation and its use about learners' responses to educational tasks (Lambert & Lines, 2000).

Assessment makes major contribution in the raising of school standard regarding teaching, learning and students' achievement. Through the use of quality assessment techniques by the teacher, students increase their own understanding about learning and are able to improve themselves. It is used for multiple purposes like promotion of learners to the next stage, classifying students' position and improves students' learning to report on group or individual achievement (Brown, 2001; Moreland, & Jones, 2000). The quality assessment techniques provide relevant information about learners' learning performance and improvement to all the stake holders i.e. parents, teachers and learners (Cohen, Mannion, & Morrison, 2007) more importantly it provides feedback to teachers and to the students. Assessment has far reaching consequences in learners' future lives (Morgan & Watson, 2002) and has positive impact on their attitude towards learning (OFSTED, 2003).

Different learners have different learning characteristics, so no single assessment technique is advantageous for all kind of students (Leder, Brew, & Rowley, 1999). Due to different learning characteristics of students, multiple ways of assessment are helpful because for weaknesses in one type of assessment can be balanced by using other type of assessment. In these multiple assessment techniques teachers are supposed to adopt such assessment technique that can meet the future needs of all the students (Birenbaum et al., 2006).

According to Morgan (1996) for the improvement of teaching learning process research studies recommend the use of different assessment methods. Some assessment methods can become fruitful in one situation while others in another situation in the teaching learning process. In these, classroom level assessment of students is one of the methods, whose importance is internationally recognized (Moreland & Jones, 2000). It is highly valued for the advancement of teaching learning process and it needs much attention (Stiggins, 2002).

Classroom level assessment may be done either formally through quizzes, projects, homework, tests prepared by teachers or informally by observing, interviewing interacting and listening to students (Florence, William, & Stenwark, 2003; Guskey, 2003; Rodriguez, 2004; Cohen, Mannion, & Morrison, 2007). Keeping in view the importance of classroom level assessment it should be the essential characteristic of classroom practice that links teaching, learning and curriculum' (Ronis, 2007, p.3).

Using different assessment techniques together with classroom level assessment in all subjects including mathematics can provide a more comprehensive picture to students, teachers and parents (Wilson & Kenney, 2003). In mathematics; assessment is a practice of gathering confirmation about a learner's knowledge of capability to use mathematics and temperament towards mathematics (Wilson & Kenney, 2003, p.53).

Various reports have been published about classroom level assessment. Generally students' assessment in the classroom is criticized by the scholars and viewed as not up to the mark. It promotes shallow and rote learning, focused on remembering of isolated details, usually items of knowledge which students do not remember after some time (Wilson & Kenney, 2003).

Watt (2005) has identified various assessment methods teachers use by investigating the assessment practices of Sydney (Australia) secondary mathematics teachers. The main assessment way, used by teachers was the conventional mathematics test, as 100% teachers used this method for all grade level (grade 7 to 12) learners' assessment. Apart from the conventional test, the other alternative assessment techniques teachers used rarely were practical work, oral task, observation, homework, problem solving and group work assessment. For grade 9 – 10 level students over all 11% teachers used homework for students' assessment, 16% teachers used observation, 4% teachers used problem solving and practical work, 9% teachers used oral task and no one in the whole sample used group work for students' assessment.

McMillan, Myran, & Workman (2002) studied the elementary mathematics teachers' classroom assessment and grading practices in seven urban/ metropolitan school districts in Virginia. The summary results of this study show that essays, projects, presentation, teacher made examinations and objective assessments were methods of assessment frequently used by mathematics teachers. In another study, McMillan & Suzanne (2000) surveyed 700 secondary and elementary English and Mathematics teachers about their grading practices and classroom assessment. According to them varieties of methods have reported by the teachers they used for learners' assessment. The assessments teachers used were in relation to the learning objectives of the teacher concerned, individual teacher's students, and were based on the teachers' own experiences. The types of assessment teachers reported included tests, participation, performance assessments, quizzes and homework.

Objectives of the Study

Following were the objectives of the study:

1. To explore mathematics teachers' practices regarding students' assessment in mathematics.

2. To compare urban and rural teachers' practices about students' assessment in mathematics.

Research Questions

Following research questions were designed to address the issue:

1. What assessment practices do mathematics teachers use in their

mathematics classroom?

2. Is there any difference between urban and rural teachers practices about students assessment in their mathematics classroom?

METHODOLOGY

It was a survey research. The objective was to investigate assessment techniques of mathematics teachers of secondary schools. The study followed quantitative approach for data analysis.

Population

There are total 4220 senior school teachers in the province of Khyber Pakhtoon Khwa (KPK) (Annual statistical report Govt. of NWFP, 2008-2009). Usually senior science teachers with more than 15 years teaching experience in science subjects are supposed to teach mathematics to grade 9th & 10th students. In some cases, other teachers also teach mathematics to grade 9th & 10th students. The total number of science teachers is 1115. In which 328 teachers are in urban areas and 787 teachers are in rural areas. So, these 1115 mathematics teachers in the province of KPK constituted the population of the study.

Sample

In the study multistage cluster random sampling method was applied. Total sample districts were 8 out of 24 (33%) of the whole population. The schools were selected on proportionate basis randomly, 1/3 proportion each from urban and rural areas. The number of schools participated in this study were 191 out of 569 schools of the sample districts. Total 681 mathematics teachers were surveyed 216 from urban schools, and 465 from rural schools.

Instrument

A five point Likert scale questionnaire was developed for surveying the target sample of the study. For validity of the questionnaire expert review approach (Colton & Covert, 2007, pp.40-71) was adapted. The questionnaire was distributed for review to five prominent education experts who had ten or more than ten years research experience. After reviewing, each item of the questionnaire, it was discussed in detail with the experts. As a result of these discussions, some of the items were included, some were revised, and a few of the items were removed from the questionnaire as suggested by these experts.

Pilot Testing of The Questionnaire

The questionnaire was piloted in nine schools, randomly selected from Tehsil Takht-e-Nasrati of district Karak. A total of 27 teachers in nine schools were surveyed. In each school the questionnaire was given to three mathematics teachers by the researcher. The teachers were asked to complete the questionnaire and asked for suggestions for improving the wording and format, which they considered ambiguous, incomprehensible, or confusing. Again the researcher personally visited these teachers for the collection of questionnaire. The questionnaire was revised in light of the feedback received in pilot testing. Resultantly from the questionnaire, which had initially total 15 items, 4 items were removed, and 11 items were retained.

Reliability of The Research Questionnaire

For reliability of the instrument after revising in light of feedback received in pilot testing the questionnaire was administered to 24 mathematics teachers twice in eight high and higher secondary schools of Tehsil and district Karak. The test retest reliability method was used based on the comments that, in many methods for reliability assessment e.g. parallel forms, eye balling, test-retest, split half method, interclass correlation, inter-rater and intra-rater reliability. (Colton & Covert, 2007, Gliner, Morgan, & Leech, 2009, p.117) most common (Gliner, Morgan, & Leech, 2009) and important way of measuring the reliability of research tools or question is test-retest reliability (David et.al., 2004, pp.88-89). The gap between the administrations of the questionnaire for second time was four weeks. Reliability coefficient of the questionnaire by using correlation between the two sets of scores through test-retest reliability method was 0.80.

Data Collection

The researcher himself collected the data. Total 476 out of 681 respondents returned the questionnaire. From urban areas 172 out of 216 (79%) and from rural areas 304 out of 465 (65%) respondent returned the filled questionnaires. In these returned questionnaires a total 15 questionnaires 3 from urban and 12 from rural areas were not included in the analysis because these were either incomplete or were not properly filled. The remaining total questionnaires 461out of 681(169 of urban & 292 of rural areas) were used for data analysis. The overall return rate of the questionnaires used for data analysis was 68 %. This 68% response rate was adequate as the respondents and non-respondents were similar and in such case acceptable response rate is 50% (Babbie, 1990; Mertens, 2005).

DATA ANALYSIS

For the overall analysis of data, Chi Square test was used. For comparing the responses of urban and rural areas an independent sample t-test was used.

Table 1: Item wise Likert Scale responses (in percentage) of sample with their Chi Square (χ^2) values about students' Oral Assessment.

Item #	Item	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree	Chi Square $\chi 2$
1	Students' assessment through observations and enquiry when they work individually.	9.76	15.62	12.80	31.32	26.90	102.85
2	Students assessment through observation when they work in groups	11.06	12.80	16.05	33.19	26.90	85.02
3	Students' assessment through reviewing their homework	22.12	27.55	17.6	21.04	11.37	27.71
4	Students' assessment through long-term mathematics project	17.2	15.40	15.83	29.07	25.38	41.94
5	Students' assessment through class presentation.	15.62	20.61	13.66	26.90	23.21	27.10

In table 1, the calculated χ^2 values in all the items are greater than the table value (9.488) at 0.05 significant levels. It shows that teachers do not assess their students when they work in groups or individually. Similarly teachers do not assess their students through long term mathematics project and classroom presentation. The teachers only assess their students through reviewing their home work.

Table 2: Item wise Likert Scale responses (in percentage) of sample with their Chi Square ($\chi 2$) values about students' written assessment.

Item #	Item	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree	Chi Square χ^2
1	Students' assessment through objective type test.	20.17	24.08	10.63	22.34	22.78	**27.12**
2	Through open-ended response questions	21.48	27.12	12.36	21.69	17.35	**27.88**
3	Problem solving tasks and its interpretation	11.37	17.14	13.23	29.93	21.13	**46.19**
4	Through peer review	19.3	20.17	11.4	28.42	22.78	**33.02**
5	The same questions as given in their textbook	22.99	31.24	11.71	18.22	15.84	51.72
6	the problems in applied situation	15.83	17.79	15.84	30.37	20.17	33.91

The calculated χ^2 values of all the statements are greater than the tabulated $\chi2$ value i.e. 9.488 at significant levels 0.05 as shown in Table 2. It can be concluded that in the written mode of assessment teachers usually assess their students through the same questions as given in their textbook by applying objective type tests and open-ended response questions. Table 2 further shows that teachers do not prefer to assess their students through peer review and the problems setting in applied situation.

Table3: Results of t-test based on locality for students' oral assessment

Item #	Students' assessment through;	Urban			Rural			t	P-value
		N	M	SD	N	M	SD		
1	Observation and enquiry when they work individually	169	2.9	1.356	292	2.2	1.176	-6.25	< 0.0001

2	Observation and enquiry when they work in groups.	169	2.7	1.365	292	2.1	1.220	-5.00	< 0.0001
3	Reviewing their homework	169	2.9	1.380	292	3.1	1.391	1.55	0.1228
4	Long-term mathematics projects	169	2.8	1.323	292	2.5	1.407	-2.00	0.0461
5	Classroom presentation	169	2.9	1.365	292	2.7	1.434	-1.19	0.2361

In Table 3, the *p*-value < 0.0001 at significance level of 0.05 of item no.1 & 2. Hence the null hypotheses that there is no significant difference between urban and rural teachers' practices about students' assessment in their mathematics classroom through observation when they work individually and in group are rejected. Urban teachers do not assess their students through observation when they work individually or in groups while rural teachers assess their students through observations when they work individually or in groups. Similarly, in item number 4 of table 3, the *p*-value= 0.0461 is less than the significant level of 0.05. Hence the null hypothesis that there is no significant difference between urban and rural teachers' practices about students' assessment through long-term mathematics project in their mathematics classroom cannot be accepted. Urban teachers neglect the use of students' assessment through long-term mathematics project while rural teachers use it while assessing their students.

The *p*-value = 0.1228 and p-value = 0.2361 of item number 3 and 5 respectively are greater than 0.05. Hence no significant difference exists between urban and rural teachers' while assessing their students through reviewing their homework and classroom presentation.

Table 4: Results of t-test based on locality for students' written assessment

Item #	Students' assessment through;	Urban			Rural			t	p-value
		N	M	SD	N	M	SD		

1	Objective type tests	169	3.0	1.432	292	3.0	1.507	0.20	0.8379
2	Open-ended response questions	169	3.9	1.364	292	3.3	1.435	3.23	0.0013
3	Problem solving tasks and its interpretation	169	2.7	1.395	292	2.6	1.403	- 0.66	0.5069
4	Through peer review	169	2.7	1.348	292	2.7	1.409	- 0.75	0.4523
5	Written test by reproducing the same questions as given in the textbook	169	3.0	1.422	292	3.1	1.399	0.29	0.7736
6	Problems based on the concepts in applied situation	169	2.7	1.323	292	2.8	1.400	0.50	0.6186

Table 4 shows that the *p*-value = 0.0013 of item # 2 is less than 0.05. So there is a significant difference between urban and rural teachers' practices about students' assessment open-ended response questions in their mathematics classroom. The urban teachers use open-ended response questions in assessing their students while rural teachers avoid it.

While the *p*-values = 0.8379, 0.5069, 0.4523, 0.7736 and 0.6186 of items # 1,3,4,5 and 6 respectively are greater than the significance level of 0.05, hence there is no significant difference between urban and rural teachers' practices about students' assessment through objective type tests, problem solving tasks and explanation of the results, peer review, reproduction of the same questions as given in their textbook and practices through the use of problems based in applied situation.

FINDINGS

The majority of teachers did not assess their students through observations when they work in groups or they work individually. About half of the teachers assess their students through reviewing their homework. More than one half of the teachers avoid assessing their students through classroom presentation and giving them long-term mathematics project.

Almost one half of the teachers didn't assess their students through objective type tests while nearly one half of the teachers use open-ended response questions for students' assessment in mathematics. Students' assessment through problem solving tasks and its interpretation is avoided by more than half of the teachers and in the same way peer review method for assessing students in mathematics' classroom is avoided by more than half of the teachers. The most prevailing method for assessing students is the use of the same questions as given in the textbook. Majority of the students are not assessed through setting problems of mathematics in applied situation.

There was a significant difference in the urban and rural teachers' practices while assessing students through open-ended response questions. Urban teachers used open-ended response questions for students' assessment more often than rural teachers. Further, as compared to rural teachers, urban teachers were more likely to avoid students' assessment through observation individually and in groups and long-term mathematics projects. In the remaining items there was no significant difference between urban and rural teachers' assessment practices.

DISCUSSION

Pakistani mathematics teachers didn't use the informal assessment techniques of observation when the students are working either in groups or individually. The report differs from the research report of Watt (2005) that in Australia some mathematics teachers assess students through observation. Teachers' avoidance of students' assessment through observation is inconsistent with the idea of Florence et al., (2003) that students' successfulness is enlightened through different assessment techniques including observation.

Teachers assessed their students through review of their homework. Teachers' practices are consistent with the research reports of Watt (2005) and McMillan & Suzanne (2000). However, no long-term projects are given to students in mathematics so there is no students' assessment by mathematics teachers through long-term mathematics projects. The report is not consistent with research report of McMillan et al. (2002).

Classroom presentation was not utilized for students' assessment in mathematics classroom, teachers' this practice is inconsistent with the report of

McMillan, Myran &Workman (2002). Students were mostly assessed through tests including open ended and objective response questions and these practices are consistent with Watt's (2005) report.

Despite the importance of problem-solving tasks in mathematics, teachers didn't use it for students' assessment. Furthermore, no peer review techniques were utilized for students' assessment in mathematics classroom. Mostly students were assessed through tests by reproducing the same questions as given in the textbook, no efforts were made by the teachers to prepare tests that focus on conceptual understanding in applied situation from real life situations.

Mathematics teachers used only few assessment techniques in their classroom for instance tests and review of homework assignment. No diverse methods were used for students' assessment in mathematics classrooms. These results support the research report of Wilson & Kenney (2003, pp.53–67) that carrying students' assessment in the classroom promote shallow and rote learning which focus only on memorization of isolated detail and students forget the information after some time.

RECOMMENDATIONS

The use of very limited techniques of students' assessment in teaching of mathematics might be because of their insufficient training in assessment. To enhance teachers' competency regarding students' assessment, it is recommended to arrange special training for teachers of mathematics about students' assessment in the classroom.

There might be some other reasons for instance; overloaded classrooms, time constraints and workload of teachers which compel teachers to use only single method for assessing students in mathematics classroom. It is recommended to lessen the workload of the existing teachers, minimize the number of students in the classroom through the induction of more teachers and increase of sections of the class.

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