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Evaluating the Achieved Objectives: Performance of Grade-IV Students in Mathematics

Hafiz Muhammad Iqbal* & Shafiq ur Rehman*

Abstract

Evaluating performance of students with reference to the curricular aims and objectives is of critical importance. It provides insight into students' expertise in the subject and in its different content areas and help in developing future plans. National curriculum set the goals and provides framework around which different educational experiences are organized for the students to learn, master and understand different mathematical skills which they can apply in solving their real life problems. The focus of the present study is to find out to what extent students in Pakistan have attained the objectives delineated by the national mathematics curriculum for grade IV students. Level of students' attainment and their expertise in different content areas of mathematics has also been explored. For this purpose, the secondary analysis of the data collected during the national assessment study conducted by the NEAS in 2006 was used, which involved more than 5000 students of about 700 randomly selected schools from all over Pakistan. The achievement test used for this study comprised of 32 objective type items, including 25 multiple choice items and 7 fill in the blank items, with a high reliability coefficient of .859. Analysis of test revealed that the content area of natural number was given more weight in the test and the content area of decimal fraction was given less weight in the test as compared to their weights in the national curriculum. Further analyses of results indicate that students have performed well in the content area of 'factors and multiples', while their achievement has been dismal in the area of 'information handling'. Item person map indicates that most of the items are beyond the ability level of the students. Similarly the trend line of students' performance shows gradual decline in students' performance towards the last part of the test.

Keywords: Mathematics, Pakistan, Grade IV, Achieved objectives

Introduction

The world conference on Education For All (EFA) in 1990 not only emphasized the literacy and numeracy for all but it also stressed improving the quality of learning of all students. At this large gathering of international community link between the education and poverty was highlighted. It was identified that poverty and education are two associated factors as poverty reduces the chances of getting quality education and low quality education

*IER, University of the Punjab, Lahore – Pakistan

pushes people towards poverty. Therefore, quality education was declared as the necessary element to the future well-being of children. In quality education, basic learning needs of children like literacy, language for expression, numeracy, values and attitudes were emphasized. These skills were suggested as necessary means to achieve EFA and Millennium Development Goals (MDGs) to develop the young minds into useful and productive human beings (UNESCO, 1990, United Nation, 2000). According to these goals the basic mathematical skills and abilities have become the essential component of the quality primary education which is aimed at training and producing skilful workforce capable of developing and progressing in a society. Commitment, to provide quality education and eventually to reduce poverty was made in 2000, in Dakar framework of action, which aimed at developing responsibility in future generations (UNESCO, 2000). The global community also pledged to achieve universal primary education within stipulated timeframe, enabling all children to learn basic literacy and acquire numeracy skills. It was recommended to work in collaboration with each other to educate the youth of the world in a manner so that they can thrive in the society, expand and develop their abilities, live quality life, and continue their process of learning through out their entire lives.

In Pakistan the National Education Policy 1992 was prepared within the framework of World Conference on Education for All (EFA) and hence suggested strategies for improving the quality of primary education. The policy pledged to provide learning opportunities to all the Pakistani children and achieve universal primary education within the next decade. The foremost aim of 1992 education policy was to eliminate disparity in education and to provide equal opportunities of quality education to the under privileged and poor strata of the society. But little progress was made and the disparity between different sections of the society increased. This policy was revised and new education policy of 1998-2010 was framed to cater for the national needs and emerging trends of the modern and technological world. Meanwhile the Dakar Framework of Action (UNESCO, 2000), which set Millennium Development Targets to be achieved by 2015. Following the Dakar Framework of Action and also the National Education Policy 1998-2010, the Government of Pakistan initiated Education Sector Reforms (ESR) National Plan of Action 2001-2015 to overhaul the education system in Pakistan. The main focus of ESR was to develop individuals' into as literate, skilful and responsible citizens through quality education (Government of Pakistan, 2001). In the action plan steps such as reforming curriculum, improving assessments and enhancing teaching quality were suggested for achieving these highly desired goals.

The road map to attain these objectives is detailed in the national curriculum. The national curriculum document can keep the primary education focused and on track and can provide guidelines in this respect. It

provides a list of required educational goals to be achieved by the students. It emphasizes the important content areas by giving them more weight and setting higher level objectives for these particular areas. It is assumed that by achieving curriculum objectives students will be able to attain basic numeracy skill as well as thinking, reasoning and problem solving skills. These skills are very important for primary students and any deficiency and low attainment or poor performance in mathematics may obstruct students' ability to learn and acquire sufficient level of mastery in a content area.

Prakitipong and Nakamura (2006) viewed mathematics an essential tool to develop thinking, creative, reasoning and rational minds which are capable of developing individuals who can solve problems and succeed in future lives. Therefore the performance of students in mathematics has always been evaluated to find out to what extent national objectives have been achieved. It also provides guideline for remedial work for underperforming students especially in the areas in which the performance is particularly does not meet expectations. Reporting student performance is also important because it enable the policy maker to develop educational programmes so that all students are successful in reaching the intended objectives. According to Robitaille and Donn (1992) educational system comprised of three basic component, 1) educational inputs; 2) process and 3) outputs and assessments are conducted to investigate the influence of elements underlying these components on the students' achievement and the success of an educational system.

Background

The success of an educational system is reflected by the level of achievement and the extent of curricular goals attained by its students (Robitaille & Donn, 1992). According to Durry (1999) there is direct link between the curriculum and the student achievement, and hence it is believed that clearly defined goals and objectives positively influence students' performance. An efficient education system requires a curriculum which enables the children to attain knowledge, skills, values and attitudes which help them to become a successful citizen in the today's world of communication and information technology (Khan & Saeed, 2010). Analyzing the TIMSS results, Cogan, Schmidt and Wiley (2001) found that curriculum was the main cause of differential achievement of grade VIII students in mathematics in USA. They also recommended for delineation of curricular objectives in a very clear manner for proper and successful implementation of educational programmes. Therefore, it is important that educational objectives are defined and classified to cater the emerging needs of the country. There are different ways of classifying and categorizing educational objectives to enable the system and the teachers to focus on them for the betterment of new generation. Although the Benjamin Bloom

(Bloom, 1956) presented its classifications of educational objectives more than half of century ago, but it is still the widely used classification system. This classification of objectives helps in defining the levels of students' performance with respect to three domains and sub-domains. In a test, questions are set aiming to assess a particular level of thinking required by a student in solving a test item. It is important to enlist educational objectives and curricular goals in the curriculum document so that students, teachers and parents know what students are expected to know, acquire and performed in terms of knowledge, skills and attitudes. Curriculum document provides a framework which help in arranging and organizing the appropriate and adequate content domains based on the wants and level of the students and also facilitates students in learning and understanding of the content (Beane, 1995 & 1997). Elliott and Compton (2007) described that curriculum provides a well-designed list of skills and performance standards, which were required to encourage commitment and improvement of essential communication skills and measurement of these portray students' level of achievement in the context of national standards. The national mathematics curriculum is developed to present specifications in terms of curriculum goals to be attained by all the individuals. In the teaching and learning process, communicating the level of attainment of the individuals to the stake holders is a very important aspect (Western and Northern Canadian Protocol for Collaboration in Education, 2006) which could result in building conducive, effective and encouraging learning environment.

As the community needs are changing over the time it is the responsibility of the curriculum developers and educational policy makers to be aware of these needs and adjust the curriculum accordingly. The changes in the content demands systematic understanding of the relationships between the different content segments and help others (teachers, students, administrator, parents) to see these connections as well (Schlechty, 2001). Hopmann (2003) described that for improvement and change in students' achievement researchers must investigate what affects students' learning and understanding of the content. Tomlinson (1999) stated that exploring students' ability to learn the content and finding their performance can be utilized to effectively teach them according to their learning style and needs. Studies were conducted to explore the methods to help students attain higher level of performance and improvement in learning (DuFour, 2000, Childs-Bowen, Moller, & Scrivner, 2000). Cross (1994) related differences in achievement of students to the differences in expectations from students, clarity in stated objectives and monitoring of achievement.

Content of a field of study is divided into different areas aiming to develop specific skills and expertise in these content areas. These different content areas are connected and integrated through educational goals explained in the curriculum (Pate, McGinnis, & Homestead, 1995). Students are provided with a variety of educational experience and involved in

different educational activities to achieve national curricular goals. These educational activities are organized for the students to learn, master and understand different mathematical skills which they can apply in solving their real life problems (Thomson, McKelvie & Muranane 2006). While developing an assessment it is imperative to balance a test using classification of objectives pertaining to different levels of thinking, so that different content areas of the curriculum are assessed. Sergiovanni (1989) pointed that a strong association of objectives with the content and the assessment is critical for students' higher attainment. Tests evaluate the extent to which educational objectives are achieved for a particular content. Testing and assessment are used for curriculum implementation and for determining the extent to which the objectives described in the curriculum are achieved so that performance level can be communicated to the students (Mullis, *et al.* 1998, 1999, 2000). Achievement test are used to measure and assess the students' performance and skills in different content areas by the inclusion of test items representing those content areas.

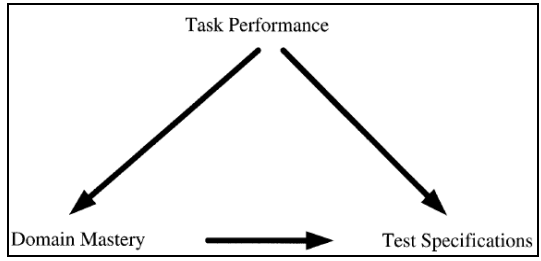

Figure 1: Test development process
Source: Leighton 2004

Leighton, (2004) described that performance is influenced by the content list and the expected mastery level for a particular domain (figure 1) and for this purpose presented a model for test development. It showed what is expected to be measured by the test items and what students have actually understood and knew. Evaluating the performance of grade-IV students is important as it reflects their learning and provides guideline and feedback on their achievement. Moreover, as lot of resources are being spent on students' education therefore it is very important to investigate the factors affecting the students' learning (Suryadarma, Suryahadi, Sumarto, & Halsey, 2006). It is also very important that students' level of performance is communicated to them in time which could help all (teachers, students, parents and administrators) in focusing on the areas of the content on which the level of performance is not upto the expectations (Armstrong, Laird & Mulgrew, 2006). Achieving high level of proficiency in mathematics has become more important because of the changing demands of our society, need of educated citizens, its use in the development of technology and scientific knowledge

(US department of education, 2000). While evaluating the students' level of performance main focus was placed on determining their mastery and understanding of mathematical concepts and skills (Mullis, *et al.* 1998, 1999, 2000). Testing students for different content domains provides a window through which students' achievement in the basic as well as advanced topics can be viewed and then reported to all the stakeholders for the implications of the data thus gathered. Mathematics content is divided into several content domains and for each domain different sub-topic areas are mentioned which are then used for assessment. Students' performance can be assessed in line with these content domains to find their level of achievement in these domains and determine a pattern across the curriculum (Thomson, McKelvie & Muranane, 2006).

The task of assessing students' achievement accurately is quite complex and a serious effort is required to minimize the effects of the factors like the appropriateness and representativeness of the content (Robitaille, Sherrill &O'Shea, 1980). Tests and examinations lack relevance with the curriculum and with what is being experienced by the students in classrooms (Pardhan and Thiessen, 2006). It was found that students who performed better on items assessing higher level skill (reasoning) also did well on lower level skills (facts and procedure) indicating that different level of mathematical skills support each other in learning mathematics (Ginsburg, Cooke, Leinwand, Noell & Pollock, 2005). Burns, VanDerHeyden & Jiban (2006) expressed that disparity among the factors like students' mathematical skills, curriculum and instructional material may result in poor performance of students in mathematics. Research indicated that success in the learning of advanced mathematical concepts can be ensured by the inclusion of basic concepts of algebra and geometry (US Department of Education, 1997). Assessment results can be used to determine the level of students' achievement and to improve the effectiveness of primary education by emphasizing on schools, teachers, counsellors and curriculum (Lopez, Gallimore, Garnier & Reese, 2007).

Another use of assessment was presented by Flynn (2002) according to which improvement in classroom teaching and learning and realization of curricular goals can be achieved by assessing performance and understanding of students for the mathematical content and processes which are important for them to acquire the required level of proficiency in mathematics. He also presented a model to assess mathematics which was based on 1) the important content areas of mathematics; 2) content which was important to enhance their learning; and 3) providing opportunity to every student to learn important mathematics (Figure 2). It presented that assessment should be planned and organized in such a way that test items represent the important content domains, improve learning of essential mathematical skills and provide equal opportunity to each student to demonstrate their mastery of mathematical knowledge and processes.

Researches in Pakistan has been conducted to explore students' achievement in Mathematics (Mirza, Hameed and Iqbal, 1997, Iqbal and Shayer, 2000, UNESCO, 2010) showing that students achievement in mathematics is lower as compared to other subjects and the overall achievement level of students in mathematics was found unsatisfactory. National Educational Assessment System (NEAS), 2006, has also assessed students' achievement in mathematics at grad IV and grade VIII levels indicating that students' achievement level is lacking behind the international standards. Halai (2010) in her study suggested the necessity of investigating NEAS results more to find the factors effecting students performance in mathematics. Mathematics national curriculum in Pakistan aimed at developing mathematical skills and thinking abilities in Pakistani students. It was organized to address the problems faced by the teachers and students in teaching and learning mathematics. It sets learning outcomes for each content areas to be achieved the students.

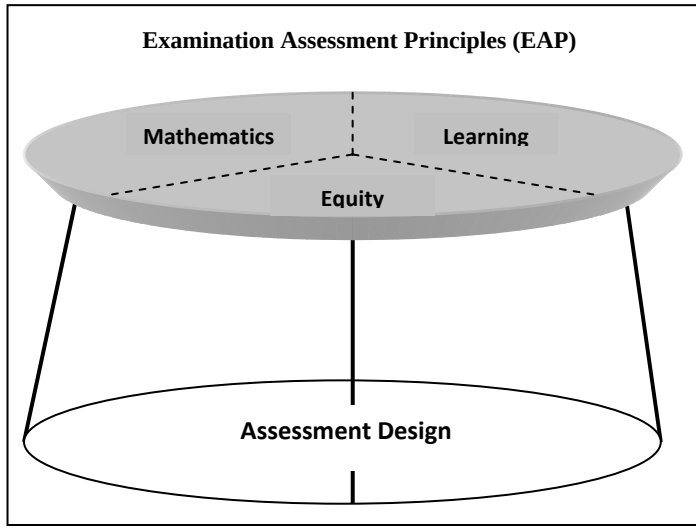

Figure 2: Examination Assessment Principles (EAP) Framework
Source: Flynn, 2003

Now to improve students' attainment in mathematics, it is needed to build and promote useful and prolific mathematics curriculum with achievable targets and goals. For this it is important to investigate the level of students learning in different content areas and the extent to which they have attained the set objectives.

In this article the researchers sought to answers to the following questions:

1) What is the performance level of students in different content areas in mathematics?
2) To what extent have the objectives mentioned in the national curriculum of mathematics been achieved?
3) In what content areas students have not performed well and need improvement?

Method

Population and Sample

The data collected by NEAS in 2006 for the national assessment in the subject of mathematics was used for this study. Both male and female students of grade IV studying mathematics in different regions of Pakistan constituted the population for this assessment. Sampling criteria used for drawing a representative sample from all the different areas of Pakistan was in line with the directions set by International Association for Evaluation of Educational Achievement to remove the possible bias in the results. Using a two-stage stratified random sampling technique, 5643 students were selected from 784 public sector schools from eight geographical locations (four provinces: Balochistan, NWFP, Punjab, Sindh and four federally controlled areas: AJK, FANA (new name Gilgit-Baltistan), FATA and ICT). As the different regions vary considerably in terms of size in population therefore probability proportional to size (PPS) technique was employed to draw a representative probability sample from different regions of Pakistan.

Data and Instrument of the study

Data from NEAS (2006) provides an opportunity to examine the achievement of grade-IV students in the subject of mathematics on the basis of objectives set in the national curriculum. National assessment for grade-IV students in mathematics was conducted using an achievement test which consisted of 32 items related to different content area of grade-IV mathematics. Items in the test included the students' attainment with respect to three sub-domains (knowledge, understanding and application or problem solving) of cognitive domain. Out of 32 items 26 (1 to 26) were multiple choice items carrying 1 mark each while items 27 to 32 were supply type items where item 28 carries 2 marks and item 32 carries 3 marks and the remaining the remaining carry 1 mark each. Thus the total possible test score is 35. All these items were set according to three levels of students' thinking knowledge, understanding and application. The distribution of items for three cognitive levels was knowledge 41%, understanding 43% and application 16%.

Data Analysis

National curriculum of mathematics (2000) has defined the intended objectives for grade-IV mathematics students and in this study student performance was evaluated and compared against the intended objectives to find to what extent objectives were achieved. Facility index were calculated for all the 32 item of the achievement test to find the performance of students on different items. Facility index indicates the percentage of students who have attempted the item correctly. Discrimination index is used to identify between the more able students to less able students. Then the items were grouped according to the seven content areas as defined in the curriculum and the mean score of students in these areas were calculated to view the performance level of students in these content areas. Using item-person map, facility and discrimination indices, difficult items and the easy test items were identified. From these items weak and strong areas of the content were indicated. Gap between expected level and the level achieved by the students was pointed out using facility and discrimination indices. Item-person map helps in examining which ability group has higher probability of attempting an item correctly. It showed the spread of items across different ability groups.

Results

National curriculum for grade-IV mathematics (2000) consisted of seven content domains and their importance were pre-defined in terms of their weight in the curriculum (see Table 1).

Table 1
Mathematics Curriculum – Grade IV-Topic-wise Weight and Time

Sr. #	Topic		Weight	Total periods Recommended (35 min each)	
				Number of Periods	% of Periods
I	Natural Numbers		17½ %	47	17.4
II	Factors & Multiples		10 %	27	10.0
III	Common Fractions	Concepts	7½ %	20	7.4
		Operations	10%	27	10.0
IV	Decimal Fractions	Concepts	7½ %	20	7.4
		Operations	7½ %	20	7.4
V	Quantities and Measurement	Units	10 %	27	10.0
		Operations	7½ %	20	7.4
VI	Geometry	Concepts	7½ %	20	7.4
		Operations	7½ %	21	7.8
VII	Information Handling		7½ %	21	7.8

Source: Government of Pakistan, (2000).

It showed that the content areas like natural numbers, common fractions, and decimal fractions were given the highest weight 17½ % each (i.e., 52½% of the whole content collectively) and the content area of information handling was given the least weight (7½%). When the test items were analyzed it was found that most (11) of the items were set from the first topic of the curriculum (natural numbers) carrying the highest score points (11) 31.43 % of the total score point which is about twice the weight mentioned in the curriculum for natural numbers.

The content area of factors and multiples was slightly over represented while the areas like common fractions, quantities and measurement and information handling were given the almost same weight as described in the curriculum. But no item was set to directly represent the content area of decimal fraction which has a weight of 15 % in the curriculum. Moreover, half of the items (17 out of 32) were set from the two content areas (natural numbers and quantities and measurement). The content area of common fractions contributed six score point from five items (item-28 carried 2 points) towards the total score points. One item was set from the content area of information handling which was of 3 marks (table-2).

Table 2
Item distribution over different content area and their score points.

Sr. #	Content Area	Number of Items	Score Points	Weight in	
				Test	Curriculum
I	Natural Numbers	10	10	29%	17½ %
II	Factors and Multiples	4	4	11%	10%
III	Common Fractions	5	6	17%	17½%
IV	Decimal Fractions	1	1	3%	15 %
V	Quantities and Measurement	6	6	17%	17½%
VI	Geometry	5	5	14%	15 %
VII	Information Handling	1	3	9%	7½%

Facility index were calculated for each item which showed that the highest Facility index (69.9%) is for the item-22 which belongs to the content area of factors and multiples. The most difficult item (item -28) was found to be from the area of common fractions. It contributed two score points and facility index for this item were 9.5% and 8.9% (for mark = 1 and marks = 2, respectively). The overall reliability of the test was .859 which indicated a high internal consistency of the achievement test.

Table 3
Facility Index of Different Items in the Test

Sr.	Item Statements (1-25:MCQ, 26-32:Fill in the Blanks)	Content Area	Cognitive Level	Facility Index	Discrimination Index
1	Place value	I	U	45.4%	0.29
2	Prime number	I	K	30.4%	0.37
3	Biggest quantity	I	K	42.9%	0.41
4	LCM	I	U	48.7%	0.28
5	Conversion ml to litres	V	K	26.4%	0.44
6	Conversion km to m	V	U	50.4%	0.24
7	Divisibility test by 2 and 5	I	U	65.3%	0.38
8	Formula for Perimeter of rectangle	VI	U	31.5%	0.70
9	Write word in figures	I	K	59.6%	0.42
10	Word problem related to quantities and measurement	V	K	32.3%	0.38
11	Word problem related to quantities and measurement	V	A	35.6%	0.25
12	Identification of shapes	VI	K	66.6%	0.32
13	Perimeter of a square?	VI	K	50.0%	0.35
14	Measure of a right angle?	VI	K	46.7%	0.49
15	Properties of an equilateral triangle	VI	K	28.0%	0.34
16	Conversion of quintal in kg	V	K	40.4%	0.33
17	Changing common fraction into decimal fraction	IV	A	28.8%	0.37
18	Addition of numbers	I	U	67.9%	0.32
19	Identification of associative property	I	K	21.2%	0.16
20	Word problem related to prime number	III	A	28.9%	0.28
21	Solving an expression for priority of operations	I	A	35.6%	0.39
22	Word problem related to LCM	II	K	69.9%	0.35
23	Word problem related to HCF	II	U	37.9%	0.47
24	Identifying the operation	II	U	32.5%	0.22
25	Use of units of lengths	V	K	60.7%	0.36
26	Word problem related to multiplication	I	U	42.4%	0.53
27	Writing numbers in words	I	U	15.9%	0.19
28	Word problem related to fraction and rupees	III	U	9.5% 8.9%	0.19
29	Word problem related to fraction	III	A	20.8%	0.41
30	Addition of fraction	III	U	11.5%	0.25
31	Interpretive exercise for the Use of graph	VII	U	20.9% 9.0% 16.9%	0.4
32	Word problem related to equivalent fractions	III	U	59.6%	0.26

K: Knowledge; U: Understanding, A: Application

The overall facility index for all the items (32) in test was 37.11 %. The facility index for the three cognitive levels, knowledge, Understanding and application were 44.24%, 36.29% and 29.94% respectively. It indicated that students' performance in knowledge level items was highest and lowest in application level items. At grade IV, the major emphasis of teacher is on

learning procedure to find answers, therefore, more items assessing students' understanding were included (44%) followed by knowledge (41%) and then application (15%). From the above table it was found that the two item (28 and 31) both carry more than one mark but very few students can attain the full marks in these items (9.0 % and 16.9 %) respectively. Items from 26 to 32 were supply type items and out of these seven items four items were found to be difficult items for the students and three of these items were related to the area of common fractions. Item-22 (with facility index 69.9% and content area of common fraction) and item-18 (with facility index 67.9 and content area natural numbers) were found to be relatively easy for the students (see table-5). Facility index of group of items related to different content area revealed that grade-IV students have attained the highest facility index (43.21%) in the content area of natural numbers followed by factors and multiples (46.77%), quantities and measurement (40.97%) and geometry (44.56%) in which performance was better than the facility index for the whole test. It was also found that the performance was particularly lower in the content area of common fractions (23.20%) and the lowest in the content area of information handling (15.60%) (see table-4). The discrimination index was lowest for the items 8, 19, 27,28 and 31. These items also have low facility index reflecting that both high and low achievers were unable to perform well on these items.

Table 4
Item distribution over different content area and their score points.

Sr #	Content Area	Facility index
I	Natural Numbers	43.21%
II	Factors and Multiples	46.77%
III	Common Fractions	23.20%
IV	Decimal Fractions	28.80%
V	Quantities and Measurement	40.97%
VI	Geometry	44.56%
VII	Information Handling	15.60%

Item level results indicate the proportions of students attempting an item correctly. This reflects the mean ability of the students and the items requiring high ability level to be attempted correctly. The probability of an item to be attempted correctly shows an item's difficulty level and the students' mean ability and can be used to estimate the proportion of students expected to answer an item correctly (Downing & Haladyna, 2006). The easiest item (with facility index 69.9%) was from the content area of natural number and the most difficult item (with facility index 8.9%) was from the content are of information handling. Item-person map (IPM) represents the relationship between the item difficulty and students ability (Yu, 2010). The distribution of item difficulty is shown by the item-person map along with the students ability on the logit scale (figure-2) constructed using ConQuest

software. It revealed that the students below the average ability (ability level = - 1) had more than fifty percent chance to attempt items 7, 12, 18 and 22 correctly and students with above average ability (+1 ability level) had more chances to attempt correctly the items 27, 28, 29 and 30. IPM also showed students with above average ability had more chances to attempt most of the items (18 items). It is revealed that items in the upper half needs higher ability to be attempted correctly and are beyond the average ability students. Similarly the items in the lower half are easy items and average and below average ability students have high probability of attempting them correctly.

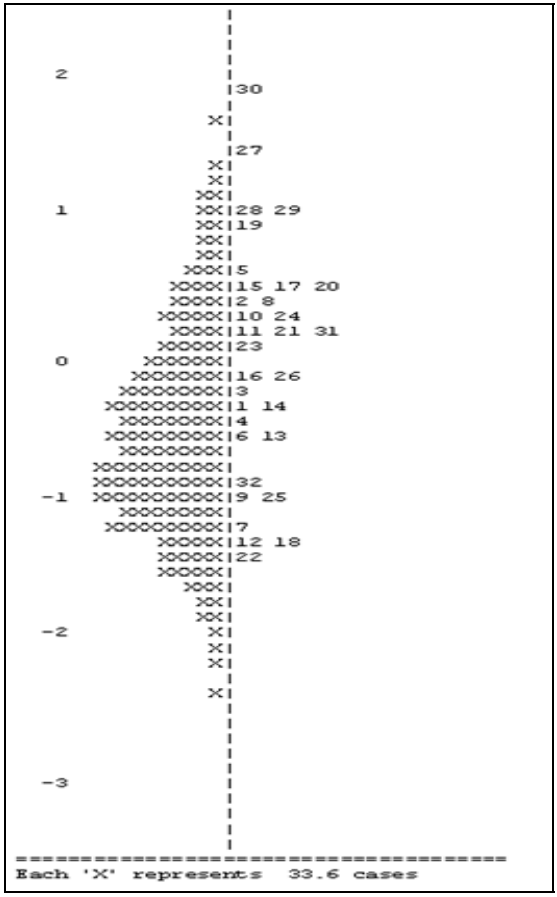

Figure 2: Item-person map

From the facility index it was found that that items 27, 28, 29, and 30 were difficult items for which the facility index was from 8.9 % to 20.8 % and item 7, 12, 18, 22 were easy items with facility index from 65.3 % to 69.9 % (tables-5). The easiest item is of from the content area of natural number but still 30% student are not able to perform this simple calculation.

On the other hand the most difficult item is from the content area of fraction and multiples with only 8.9% students were able to attempt the correctly. The facility index together with the discrimination index indicated that these items were non-discriminating for high and low achievers.

Table 5
Statistics for Difficult / Easy Items

	Item #	Statement	Facility Index	Discrimination Index
Easy Items	7	Divisibility test 2 and 5	65.3%	0.38
	12	Identification of shapes	66.6%	0.32
	18	Addition of numbers	67.9%	0.32
	22	Word problem related to LCM	69.9%	0.35
Difficult Items	27	Write figures in words	15.9%	0.19
	28	Word problems in fraction and Rupees	8.9 %	0.19
	29	Word problem in fraction	20.8%	0.41
	30	Addition of fraction	11.5%	0.25

The overall performance of grade IV students was illustrated in figure 4 which indicates that there is a decreasing trend of students towards the second half of the test. This could be due to the fact that in this part of the test items are not of selection type and students have to perform calculations and then respond to the question. Secondly more word problems were set in this part of the test and the problem solving ability of students is found below average.

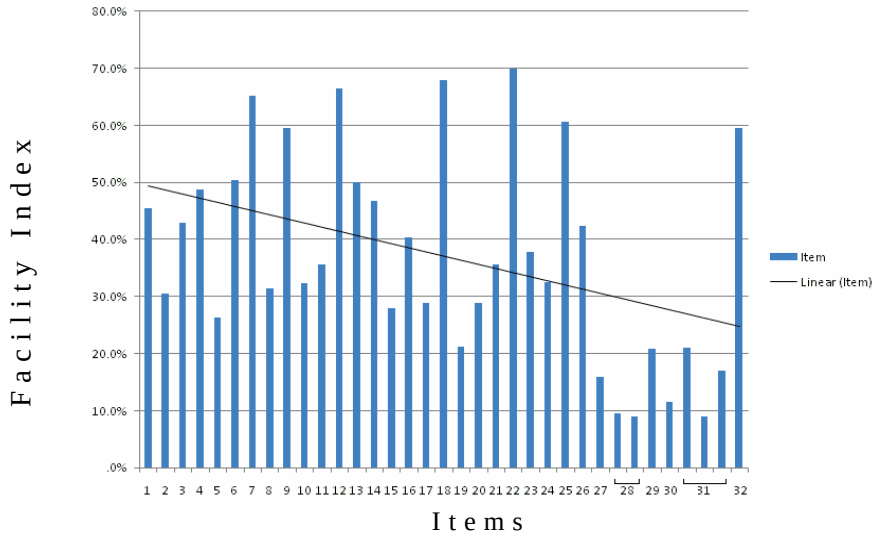

Figure 4: Performance on different Items and Trend Line.

Conclusions

Competencies in literacy and numeracy are important and integral to effective learning. In their daily life children encounter problems where they have to use numbers and apply some mathematical operations to solve problems. These numeracy skills they need at home, school and work to participate in a variety of activities. EFA objectives and MDGs clearly states that numeracy skills are essential for every child and every nation has to take steps for achieving these targets. Hemmings, Grootenboer, and Kay, (2010) expressed that mathematical skill are important for progressing in the life and career. This article was aimed at evaluating the extent Pakistani students possessed such mathematical skills. NEAS data for national assessment of grade IV students in mathematics was used to explain students' attainment and expertise in different content areas. In this study students' performance in the subject of mathematics was analysed by calculating facility and discrimination indices and item-person map. Results showed that students' command over different areas of content was best in the content area of factors and multiples followed by natural numbers and lowest in the area of information handling followed by common fractions.

Mathematics curriculum describes the expected level of expertise a student must attain in a particular content area. National curriculum, 2000 has defined that a grade IV student must possess sufficient level of mathematical skill such as writing figures in words, doing calculations involving fractions and solving real life problems. All these skills are essential in students' daily life and could motivate them in pursuing further education as well as efficiently handling their daily chores. The analysis showed that most of the students were able to perform only the very basic level of mathematics items and were unable to attempt successfully the items involving deeper understanding and grasp of the concepts.

The analysis of results revealed a grey picture of students' attainment in mathematics with only 37.11% facility index. It reflected that majority of students have performed well below the expected level which presents a threat to the target of achieving literate individuals who have sufficient numeracy skills. It also emphasized that these students get distracted and discontinue their education or may not be able to aim for higher education. The lower performance level could result in inability of students to think logically and act rationally in their daily lives.

In the curriculum maximum numbers of periods were allocated to the content area of natural numbers (47) and students have shown better performance on the items related to this content area. Whereas, the least number of periods were allocated to the content area of information handling, and consequently, the least performance was observed in this content area. This situation demands that either more time should be allocated for the teaching of information handling or its teaching should be made more effective with the use of teaching aids. A notable aspect is that

the content area of common fraction is given same number of periods as of natural number but the attainment shown by the students is the very low which requires the need of investigation on the teaching methodology for teaching this content area and the contents of the text as well.

Analysis of items showed that students were able to attempt knowledge type items more successfully as compared to application level items. In the national curriculum it was expected that students will be able to perform basic computations in four fundamental operations. It was found that 30% students are not even able to perform the simplest task in mathematics. In case of most easy items three of them are from the content area of natural numbers and one very basic question from the content area of geometry. Three of the most of difficult items are from the content area of common fractions and students find it difficult to attempt items related to this content area. It is also revealed that almost 85% students are unable to write figures in words in the national language (Urdu) which also explains their poor performance in word problems.

In case of divisibility tests by 2 and 5, identification of shapes and addition of number the majority of students were able to attempt them successfully. It is also found that students' have shown the least level of ability in the area of common fractions both for the word problem as well as for the addition of common fractions. As the content area of decimal fraction was not represented by the sufficient number of items therefore, students' attainment can not be judged in this important area of the subject. Mathematical skill requiring high order cognitive skills such as understanding, reasoning and problem solving were revealed as the weak areas. It was also revealed that students' performance decrease for the later part of the assessment which could be attributed toward the length of the test or the time allotted for the test. It was revealed that students' performance word problem in the area of common fraction and writing figures in words. For these items less than 20% students were able of attempt items correctly. One of the objective of the national curriculum states that students should be able to understand the visual presentation of data but less than 10% students have attained this skill. It demands that more attention is required to improve the students in this content area.

The results indicated that the overall competencies of the students in mathematical skill are unsatisfactory and their performances in problem solving items are especially far from the desired level as explained in the national curriculum. It emphasized that students should be able to solve practical problems related to time, money and other measuring units. This kind of students' performance in mathematics has been hindering their future prospects and restricting their chances for progressing in the professional life. Therefore, in order to achieve the EFA targets and MDGs it is necessary to improve students' attainment in mathematics and steps should be taken to bring the student to level as expressed in the national

curriculum. For this further investigations should be conducted to find the factors which effects students' performance in mathematics and then efforts should be made to eliminate or control these factors.

In the light of these results it can be concluded that mathematics education, which can play a key role in the developing skilful manpower, needs immediate attention. To raise the students' attainment in mathematics teachers should be trained for teaching problem solving techniques. For reducing gap between the intended and the achieved expertise level in mathematics, modern teaching aids should be provided in schools and teachers should be encouraged to use these teaching aids. Students and teachers should be provided with more learning materials which they can use along with the textbooks. Home assignments should be designed so that difficult content areas could be strengthened and students can practice concepts in which low performance was indicated. Students should also be motivated to learn mathematics through mathematics competitions like table contests or mental mathematics competitions. It is hoped that in this way students could be motivated to learn mathematics and positive attitudes towards mathematics could be developed in them. All these efforts are necessary to achieve the goals of EFA, MDGs and UPE. It will help in providing quality education at primary level in Pakistan.

Note:

The ConQuest software was used to draw IPM. It provides comprehensive analysis to explore examinee's characteristics of performance in assessments. It is also helpful in item analysis.

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