# Research-led curriculum development: Pilot study on Mathematics

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Executive Summary

## Introduction

The EDU of BRAC's education program has made changes in its curriculum based on the monitoring, research and internal survey reports which suggested that learners faced difficulty with many sections of different subject areas. The new curriculum covers the competencies specified by the NCTB, and gives focus on making books more activity based and providing separate workbooks and teachers' guides. This pilot study attempted to develop an assessment methodology for assessing what learners know, can do and understand in terms of expected learning outcome as well as the appropriateness of content, context and methodology for achieving expected learning outcome, in order to evaluate the curriculum towards research-led curriculum development with special reference to problem solving in Mathematics of grade 4. This study being part 1 of two studies is a joint study of RED and EDU.

## Methodology

This pilot study was an assessment based on achievement test, interview and group discussion with different respondents, and looking at work and documents. Many sources were considered appropriate in designing the data collection which included learners, teachers, staff and their documents as well as work. The study was done in two teams of Jamalpur region of BEP, of which one administered government Mathematics text and other one administered BRAC Mathematics text. Four grade 4 schools from each of the teams were randomly selected for the study. All learners, teachers in the sample schools and all staff in sample teams were included in the study. Apart from these 6/7 learners from each sample schools were interviewed individually.

A number of different methods were examined and followed for data collection in this study. These included an achievement test, interview with individual learners, interview with teacher, discussion with staff, and looking at learners' work and teachers' documents.

Four sets of instruments those of a test instrument consisting of items measuring learners' achievements in terms of expected learning outcome related to problem solving in Mathematics of grade 4, three set of checklists for interviewing discussion with teachers and staff, and looking at work and documents, were used in this study. Data collection in this study was done by the researchers themselves, and these were coded and analysed manually as well as using computer software.

**Findings and recommendations**

The mean score of 40% on the achievement test found to be low and should be discussed with the teachers involved and the MTs in teams 1 and 2. The item analysis and spread of marks should form the basis for an action plan to remedy the areas of weakness highlighted by the research. Future research using an achievement test should widen the scope of the test to include other aspects of Mathematics, such as measurement, shape .etc. after consideration of the priorities for learners in the curriculum as specified by the government through national competencies.

The learner interview was found to be a useful method of exploring learners' understandings in Mathematics. In the light of the pilot study findings it needs to become refined so that there is a proper procedure followed by all researchers carrying out the interviews. This will generate useful data on learners' errors and misconceptions in Mathematics.

Teacher interviews and discussion with staff generated data which gave insights into their perceptions of their learners' abilities (very optimistic) as well as teachers' abilities and the clarity of the learning outcomes in the chapters under the study (some confusions). In addition, some views were given on the content, context and methodologies of the particular research focus. The interviews and discussion should be the feature of any future research but should be carried out at both the individual teacher and group of teachers level, and group of staff level. These, allied to carefully devised and trialled interview and discussion schedules, will provide more detailed data.

The teacher interview data indicated that some teachers could review content, context and methodology in a constructively critical way. However, the fear that to try anything that was not prescribed was also evident and this needs to be addressed in training days and through the work of MTs and QMs.

The data from discussion with staff indicated that staff lacking  being critical of content, context and methodologies which further indicated a mechanistic way of performing their responsibilities and lack of awareness about these. This needs to be addressed in meeting and training days and through the work of QMs and EDU members.

The data concerning why teachers and staff think some learners fail to learn indicates that the teachers as well as staff do not consider themselves as part of the problem. This needs to be discussed and addressed on training days.

Looking at learners' work and teachers' documents generated useful information on the level and volume of practices learners did on the particular chapters which the achievement test was based on. The level and volume of practices is an important factor in learners' achievements in a particular subject specially in Mathematics. Looking at learners' work and teachers' documents should therefore be a feature of any future research but should include both the activities/ assignments those are in learners' work and teachers' documents, and those are in learners' work but not in teachers' documents. This will provide wide range of data.

Each of the research methods and instruments used need refining in the light of the pilot study to increase their effectiveness in providing relevant data suited to the specific objectives of the study.

The use of classroom and refreshers observation techniques should be considered in any future research study as, properly done, it would validate the teacher planning documents and the teacher interviews as well as discussion with staff.

# Table of contents

# INTRODUCTION

Curriculum is indeed the heart of the educational process. The quality of education, irrespective of the system under which it is provided, depends ultimately upon the individual, and the social relevance of the curriculum and the extent to which it is effectively transacted in educational system. The direction to the curriculum is provided by its educational objectives from which, in a manner of speaking, it derives its shape as well as identity (Sabharwal,1997 ). Curriculum is everything that impacts upon the child at school, not simply a plan or series of teaching materials. Curriculum may be explained as what happens in the classroom or laboratory. It is the manner in which the teacher provides for the needs of the children and achieves the desired goals. Therefore the curriculum must be relevant to the developing child's needs and abilities, both today and tomorrow (Eliason and Jenkins, 1981).

According to Sabharwal (1997), curriculum consists of five dimensions or components of (I) assumptions about the learner and society; (ii) aims and objectives; (iii) structure of the subject-matter, and selection, scope and sequence of content; (iv) recommended models of transaction ih terms of methodology and supported learning environments; and (v) evaluation of various aspects of the attained curriculum.

BRAC's education program has its own Material Development Unit (MDU) currently known as Education Development Unit (EDU) which was expanded and became twice its previous size in phase II (BRAC, 1999). The focus of this unit is to providing improved materials and refining the curriculum to suit the needs of the students. Based on the monitoring reports and internal survey reports which suggested that students faced difficulty with many sections of different subject areas, the EDU has made changes in its curriculum. The new curriculum covers the competencies specified by the National Curriculum and Textbook Board (NCTB), and gives focus on making books more activity based and providing separate workbooks and teachers' guides (BRAC, 1999).

Although BRAC Education Program BEP) has been operating since 1985 and has made changes in its curriculum from time to time, there has not been a study on BRAC's curriculum in the strict sense. The study done by Ghosh (1999) was an appraisal focusing on the coverage of competencies outlined by NCTB, in BRAC's curriculum of three year non-formal primary education. Being part 1 of two studies the present pilot study is an attempt to develop a methodology for assessing learners' achievements, and appropriateness of content, context and methodology for teaching in order to evaluate the curriculum towards research-led curriculum development with special reference to problem solving in Mathematics of grade 4. This is a joint study of RED and EDU.


**Research-led curriculum development**

Education as a means of developing human resources for a nation in the making and on the highway to development-social as well as economic-has to be multifaceted activity. While each of its facets would have some commonality with other facets, yet it should have its distinctive identity too. And this identity should be reflected in its curriculum and the curriculum should be purposive and functional in attaining its objectives. The role of research as an ongoing critical inquiry, whose result can be ploughed back to improve the curriculum, assumes tremendous significance in our context (Sabharwal, 1997) .

To be effective, the development of the curriculum follows the continuous process of curriculum plan, material development, implementation, assessment of learners' achievement and evaluation of curriculum, and again the same cycle based on evaluation. This has been outlined in the following figure of a research-led curriculum development cycle.

Figure 1: Research-led curriculum development cycle

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                    ┌─────────────────────┐
                    │   Curriculum plan   │
                    └─────────────────────┘
                   /                        \
  ┌──────────────────────────┐      ┌──────────────────────────┐
  │  Evaluation of curriculum │      │  Materials development   │
  └──────────────────────────┘      └──────────────────────────┘
                   \                        /
  ┌──────────────────────────┐      ┌──────────────────────────┐
  │     Assessment of        │      │    Implementation        │
  │   learners' achievement  │      └──────────────────────────┘
  └──────────────────────────┘
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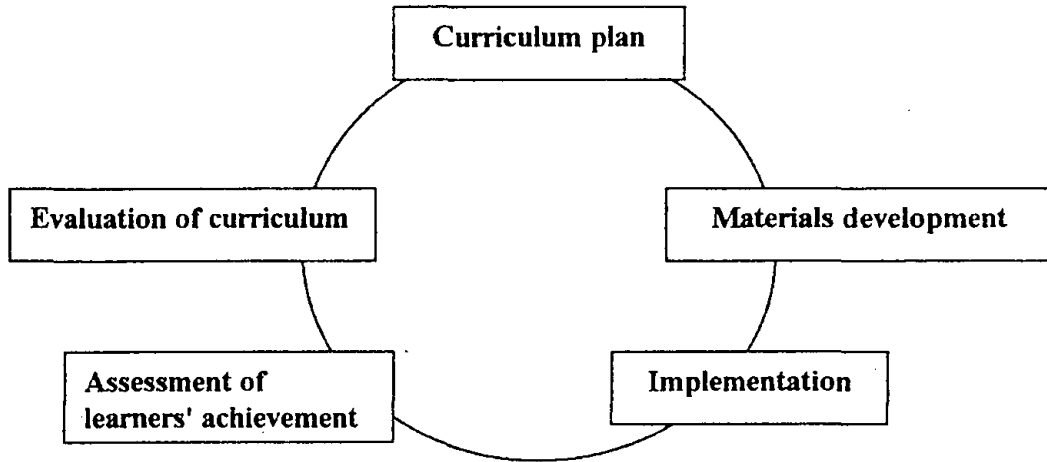
The effectiveness of curriculum is examined through evaluation. Evaluation of the curriculum can only take place if we know what knowledge, skills and understanding pupils gain through it. Effective intervention in the curriculum development cycle can best be achieved by strengthening the quality of assessment information available. Assessment of students' achievements or learning outcomes is therefore crucial in developing the curriculum to be as effective as possible. The assessment of the appropriateness of content, context and methodology can also help in better understanding of learners' achievements. So it is necessary to assess students' achievements i.e. what children know, can do and understand in terms of expected learning outcomes as well as appropriateness of content, context and methodology, which can best inform the evaluation of curriculum.

**Objective of the study**

The overall objective of the study is to develop an assessment methodology in order to evaluate the curriculum towards a research-led curriculum development. To achieve this objective, some methods were examined in terms of their effectiveness in assessing learners' achievements in problem solving in Mathematics, and appropriateness of content, context and methodology for teaching problem solving in Mathematics.

97

# Methodology

### The study design

This is a pilot study based on the assessment of what children know, can do and understand as well as the appropriateness of content, context and methodology for achieving expected learning outcomes. These assessments were based on achievement test, interview and group discussion with different respondents, and looking at documents and work. The assessment of what children know, can do and understand i.e. the achievements of learners against expected learning outcomes, was in this study, basically a criterion-referenced test which aims to assess the learner by comparison with some pre-determined or negotiated criteria (eg. a competency or a specified attainment target) (Harris and Bell, 1990:101).

### Data source

Many sources are considered appropriate in designing the data collection of the study. These include learners, teachers and staff (immediate supervisors), and their documents as well as work/activities.

### Sample

Two BEP team offices, one from each of the areas where BRAC prepared and government prepared curriculum of Mathematics have been implemented in grade 4 respectively, were selected purposively for the study. These two teams were of average performance. Four schools of average performance (category B) from each of the teams were randomly selected from grade 4 schools in these areas for the purpose. All learners and teachers of sample schools, and all staff members (immediate supervisors) of sample area were included in the study as respondents. For the purpose of questioning to the learners 6/7 learners from each of the sample schools were randomly selected.

## Methods/Techniques

A number of different methods were examined and followed for data collection in this study. These are (I) an achievement test with open ended questions; (ii) looking at learners' work and teachers' documents; (iii) questioning to individual learners; (iv) interview with teacher; and (v) group discussion with staff.

## Instruments

A test instrument consists of items measuring learners' achievements in expected learning outcomes related to problem solving in Mathematics of class IV, was developed for the study. Apart from this, three sets of checklists for interviewing and group discussion with teacher, staff and looking at work and documents, were used in the study. Details of these instruments are given in the findings section along with each method/ technique. The methods/techniques and instruments were pre-tested before finalizing these.

## Data collection and analysis

Data for the study were collected by the researchers themselves during a period of one and a half weeks. Sharp after the collection, the data would be coded and analysed manually as well as using computer software.

The report will describe and evaluate the findings and the methodology of each aspect in turn. As the overall objective of this study was to develop an assessment methodology in order to evaluate the curriculum towards research-led curriculum development, the findings will describe each of the methods/ techniques used and examined in this study. The description and evaluation of each methods/ techniques will follow the chronological order of rationale/ objective, description of the instrument, sample size and type, procedure, analysis, main findings and recommendation for future research. Finally the report will present conclusions and recommendations.

## 1. ACHIEVEMENT TEST

*Rationale/objective*

The objective of the achievement test was to assess learners' achievements in problem solving specifically in the four rules of basic operation of numbers in Mathematics in grade 4.

*Description of the instrument*

A test instrument consisting of items measuring learners' achievements in the expected learning outcomes i.e., learning continua related to problem solving in Mathematics of grade 4, was developed for the study. These learning continua are those of learners could solve problems of three steps involving addition and subtraction and maximum five digit numbers; learners could solve problems involving multiplication and division; learners could solve problems of two steps involving any two of addition, subtraction, multiplication and division, and maximum three digit numbers (NCTB, 1988). Items in the instrument cover one to three steps, two to five digit numbers, and different combinations of addition-subtraction, addition-multiplication, addition-division, subtraction-multiplication, subtraction-division and multiplication-division in problem solving. The reason for selecting these combinations is that it is expected, according to the national competencies, that learners will be able to solve the problems involving the above mentioned combinations of the four basic operations after completing grade 4 (NCTB, 1988). Items in each of the combinations were constructed based on language difficulty from simple to difficult. The number of items in the test stood at 24 (see appendix 3).

*Sample size and type*

Two teams from Jamalpur region of BRAC Education Program (BEP) were chosen. Out of these one administered the BRAC Mathematics text (team 2-Boira) and other administered the government Mathematics text (team 1- Nandina). Four schools from each of the two teams were selected randomly. These schools were from category B so that the

result can not be influenced by the low (C) and high (A) performing schools. These categories of A, B and C are the categories through which the BEP categorise its schools in terms performance using certain indicators. All the learners present on the day of the test are included in the study. Table 1 shows the total sample. All schools under the study were single teacher schools (as are all BRAC schools). The fixed class size was 33.

Table 1: Distribution of sample by team, school and sex

| School no | Team 1 | | | Team 2 | | | Total | | |
|---|---|---|---|---|---|---|---|---|---|
| | Boys | Girls | Both | Boys | Girls | Both | Boys | Girls | Both |
| 1 | 15 | 14 | 29 | 13 | 16 | 29 | 28 | 30 | 58 |
| 2 | 09 | 20 | 29 | 07 | 22 | 29 | 16 | 42 | 58 |
| 3 | 10 | 17 | 27 | 00 | 26 | 26 | 10 | 43 | 53 |
| 4 | 11 | 17 | 28 | 10 | 16 | 26 | 21 | 33 | 54 |
| Total | 45 | 68 | 113 | 30 | 80 | 110 | 75 | 148 | 223 |

*Procedure*

The test was administered by the researchers in June, 2000 after the learners completed these lessons on which the achievement test was based. The test was administered in two sessions of morning and afternoon in the same day. Each of the sessions took two hours. The test papers were taken away and marked by the researchers following a manual.

*Analysis*

Table 2 presents the average number of items learners got right by team and sex. Out of 24 items, on an average, learners got 9.45 items (about 40%) right. This result may be considered disappointing in that problem solving aspects covered in the test were based on the four rules of numbers which were revised regularly throughout the year. The possible reason for such low achievement may be as BRAC extended its school to grade 4 and 5 very recently, trainers and supervisors are still in a preparatory stage. Due to this staff may still suffer from weakness in Mathematics which further resulted in teacher's weakness in Mathematics as Mathematics in grade 4 and 5 is quite different and has a higher level of

101

difficulty than the earlier grades. So, in most cases, teachers may teach sum not the rule of problem which is reflected in learners' performance in achievement test.

Learners in team 1 did better (10.23) than the learners in team 2 (8.65) and the difference in performance is statistically significant (p<.004). The possible reason for the lower performance of the learners in team 2 may be the difficulty level of the test. The difficulty level used in the problems of the test was a bit more difficult than the difficulty level in the text administered in team 2. This particular text administered in team 2 used lower digit numbers in most cases and a very few problems involving more than one step. About two-thirds of the items in the test were those of involving more than one step problems. However, review of the texts indicated that in the text administered in team 2 only about one-thirds of the sums are of more than one step whereas in other text administered in team 1 about two-thirds of the sums are of more than one step (Appendix 1). This might be another reason for comparatively low score by the learners in team 2. However, if the learners know the rule, than they could do this kind of problem but this is not reflected in the test results. On the other hand, though it administered the government text, there was no MT in team 1 which might be a reason for low achievement of the learners in team 1.

Table 2: Means and Standard Deviations of items learners got right by team and sex

| Sex of learner | Team 1 | Team 2 | Total | Level of significance |
|---|---|---|---|---|
| Boys | 11.13 (4.09) | 10.73 (4.66) | 10.97 (4.30) | ns |
| Girls | 9.63 (4.18) | 7.86 (3.40) | 8.68 (3.87) | P<.006 |
| Total | 10.23 (4.19) | 8.65 (3.97) | 9.45 (4.15) | P<.004 |
| Level of significance | ns | P<.004 | P<.001 | |

Note: Figures in the parentheses indicate the Standard Deviation

Boys did better than girls as on an average boys and girls got 10.97 and 8.68 items right respectively. The difference between the performance of boys and girls is significant. Although boys did better than girls in both the team area, however, the difference in performance is significant in the case of team 2. Variation in performance of boys and girls

102

might be due to one school in team 2 has got only girls and the performance of that school was vary low which skewed the result (Table 2).

Proportion of learners by range of items they got right and team, is shown in table 3. Most of the learners (33.60%) got 5-8 items right. Two learners got none of the items right and only one learner got 21-24 items right. In team 1 most of the learners (34.50%) got 9-12 items right whereas most of the learners (41.80%) in team 2 got 5-8 items right.

Table 3: Proportion of learners by range of items they got right and team

| Range of items learners got right | Proportion of learners | | |
|---|---|---|---|
| | Team 1 | Team 2 | Total |
| 0 | 00 (0.00) | 02 (1.80) | 02 (0.90) |
| 1-4 | 11 (9.80) | 10 (9.10) | 21 (9.40) |
| 5-8 | 29 (25.70) | 46 (41.80) | 75 (33.60) |
| 9-12 | 39 (34.50) | 32 (29.10) | 71 (31.90) |
| 13-16 | 26 (23.10) | 15 (13.60) | 41 (18.40) |
| 17-20 | 07 (6.20) | 05 (4.50) | 12 (5.30) |
| 21-24 | 01 (0.90) | 00 (0.00) | 01(0.40) |

Note: Figures in the parentheses indicate the percentage of learners.

The graph 3a reflects the general trend in all mixed attainment classrooms. It has been observed that the brighter learners have been asked to complete the exercise because of the pressure of time, so the weaker learners are just left behind.

Graph 3a: Proportion of learners by range of items they got right and team

**Proportion of learners by range of items**
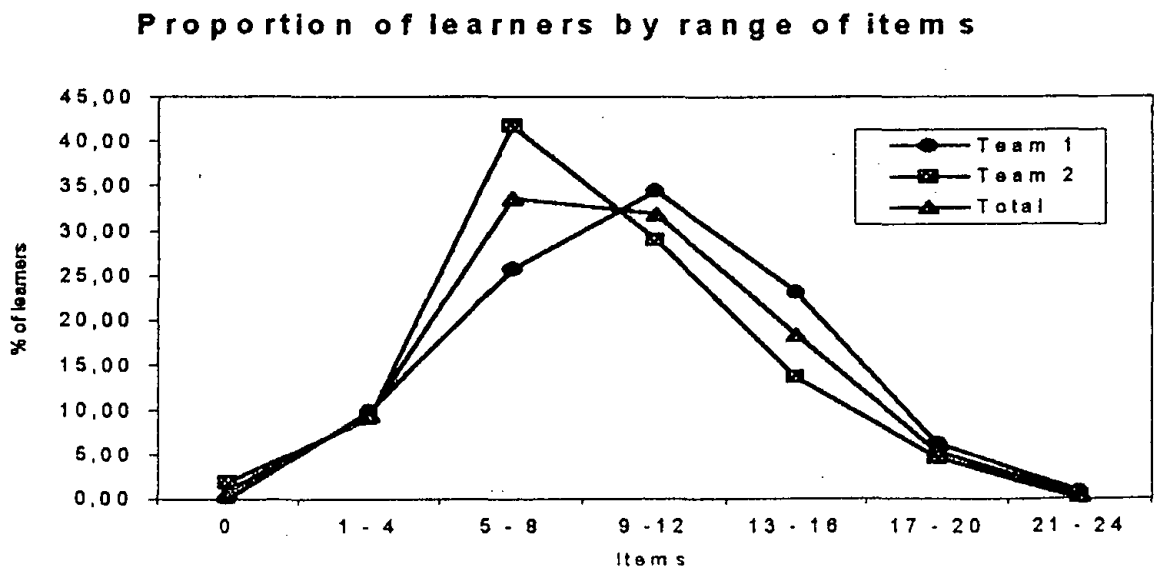
Average number of items learners got right by school and sex is presented in table 4. Learners of school 2 of team 1 and school 5 of team 2 scored the highest- 11.24 and 11.21 respectively. Learners of school 7 of team 2 scored the lowest (5.34). Boys in most of the schools except school 6 did better than girls. But the difference in performance of boys and girls are significant in the case of school 3 and school 5. On the other hand girls in school 6 did better than boys, but the difference is not statistically significant.

Table 4: Means and Standard Deviations of items learners got right by school and sex

| Schools | Boys | Girls | Total | Level of significance |
|---------|------|-------|-------|------------------------|
| School 1 | 9.87 (3.85) | 8.64 (4.45) | 9.24 (4.12) | ns |
| School 2 | 12.33 (4.18) | 10.75 (2.25) | 11.24 (3.00) | ns |
| School 3 | 12.40 (3.24) | 9.41 (3.10) | 10.52 (3.42) | P<.030 |
| School 4 | 10.73 (4.90) | 9.35 (6.24) | 9.89 (5.70) | ns |
| School 5 | 12.69 (3.45) | 10.00 (3.06) | 11.21 (3.46) | P<.038 |
| School 6 | 5.57 (4.58) | 7.68 (3.58) | 7.17 (3.86) | ns |
| School 7 | -- | 5.35 (1.13) | 5.35 (1.13) | ns |
| School 8 | 11.80 (3.55) | 10.06 (3.21) | 10.73 (3.39) | ns |
| Total | 10.97 (4.30) | 8.68 (3.87) | 9.45 (4.15) | P<.001 |

Note: Figure in the parentheses indicate Standard Deviation

Table 5 represents the proportion of learners who got right different items by team and sex. There are five items where learners did excellently. The items are those of ka-1 (77.10%), ka-3 (71.70%), kha-1 (79.80%), kh-2 (65.90%) and kha-3 (75.30%). There are some other items where learners did not so well as less than 20% of the learners got these items right. These items include ka-5, ka-6, ka-7, ka-11, ka-12, kha-6 and kha-10. Learners in team 2 did better than learners in team 1 in 7 items- ka-1, ka-3, ka-6, kha-1, kha-3, kha-5 and kha-8. However, learners in team 1 did better in the remaining 17 items. Girls in team 1 did better than boys in 8 items- ka-2, ka-7, ka-10, ka-11, kha-2, kha-4, kha-10 and kha-

10

11 and in the remaining 16 items boys did better than girls. On the other hand, girls in team 2 did better than boys only in two items- ka-1 and ka-3, and in the remaining 22 items boys did better than girls. None of the girls in team 2 got the items- ka-11, ka-12 and kha-6 right.

Table 5: Proportion of learners who got right different items by team and sex

| Items | Team 1 | | | Team 2 | | | Total % |
|---|---|---|---|---|---|---|---|
| | Boys % | Girls % | Both % | Boys % | Girls % | Both % | |
| Ka-1 | 77.80 | 58.80 | 66.40 | 83.30 | 90.00 | 88.20 | 77.10 |
| Ka-2 | 40.00 | 52.90 | 47.80 | 46.70 | 26.30 | 31.80 | 39.90 |
| Ka-3 | 66.70 | 63.20 | 64.60 | 76.70 | 80.00 | 79.10 | 71.70 |
| Ka-4 | 71.10 | 60.30 | 64.60 | 50.00 | 33.80 | 38.20 | 51.60 |
| Ka-5 | 15.60 | 13.20 | 14.20 | 6.70 | 3.80 | 4.50 | 9.40 |
| Ka-6 | 13.30 | 8.80 | 10.60 | 30.00 | 12.50 | 17.30 | 13.90 |
| Ka-7 | 6.70 | 7.40 | 7.10 | 13.30 | 2.50 | 5.50 | 6.30 |
| Ka-8 | 51.10 | 38.20 | 43.40 | 40.00 | 27.50 | 30.90 | 37.20 |
| Ka-9 | 51.10 | 26.50 | 36.30 | 46.70 | 22.30 | 28.20 | 32.30 |
| Ka-10 | 44.40 | 50.00 | 47.80 | 50.00 | 27.50 | 33.60 | 40.80 |
| Ka-11 | 20.00 | 20.60 | 20.40 | 3.30 | 0.00 | 0.90 | 10.80 |
| Ka-12 | 11.10 | 5.90 | 8.00 | 10.00 | 0.00 | 2.70 | 5.40 |
| Kha-1 | 88.90 | 63.20 | 73.50 | 86.70 | 86.30 | 86.40 | 79.80 |
| Kha-2 | 64.40 | 67.60 | 66.40 | 70.00 | 63.80 | 65.50 | 65.90 |
| Kha3 | 75.60 | 61.80 | 67.30 | 90.00 | 81.30 | 83.60 | 75.30 |
| Kha4 | 66.70 | 69.10 | 68.10 | 53.30 | 28.80 | 35.50 | 52.00 |
| Kha-5 | 46.70 | 32.40 | 38.10 | 80.00 | 71.30 | 73.60 | 55.60 |
| Kha-6 | 28.90 | 27.90 | 28.30 | 6.90 | 0.00 | 1.80 | 15.20 |
| Kha-7 | 91.10 | 76.50 | 82.30 | 36.70 | 30.00 | 31.80 | 57.40 |
| Kha-8 | 37.80 | 19.10 | 26.50 | 50.00 | 31.30 | 36.40 | 31.40 |
| Kha-9 | 51.10 | 38.20 | 43.40 | 43.30 | 22.50 | 28.20 | 35.90 |
| Kha-10 | 22.20 | 27.90 | 25.70 | 26.70 | 8.80 | 13.60 | 19.70 |
| Kha-11 | 26.70 | 33.80 | 31.00 | 40.00 | 23.80 | 28.20 | 29.60 |
| Kha-12 | 44.40 | 39.70 | 41.60 | 33.60 | 13.80 | 19.10 | 30.50 |

*Main findings*

1. The study found that learners' level of achievement on this particular test was very low as on an average they got 9.45 items out 24 items right.
2. The performance of learners in team 1 was found to be better than that of the learners of team 2.
3. Overall, boys did better than girls, however, the difference between the performance of boys and girls was found significant in the case of team 2.
4. In overall terms, learners did excellently only on a few of the items and they did worse in many of the items in achievement test.

*Recommendation for future research*

Design: The test should be constructed using the national competencies for whatever grade is being tested, not particular text books. Instead of all the learners a sample consisting of a portion of learners in a school may be included in the study because of the pressure of space. Achievement results must be related to learners' age and socio-economic status. This data is related to grade 4. It may be appropriate to test or see if in other grades, the findings are similar.

Administration: The test should be administered as soon as possible after the teacher has taught the concepts.

Timing: The length of the time for the test should be appropriate to the age and stage of the learners.

Analysis: While this section of the report presents a few of the findings, the achievement test can give a wide range of information on learners' achievement.

## 2. INTERVIEW WITH LEARNERS

*Rationale/ objectives*

1. To know whether the learners are clear on the concept of problems relating to simple

   1) addition(+),

   2) subtraction(-),

   3) multiplication (×),

   4) division(÷);

   and the combinations of

   5) subtraction and subtraction(-, -);

   6) subtraction and addition(-, +);

   7) addition and multiplication (+, ×);

   8) addition and division (+, ÷);

   9) subtraction and multiplication (-, ×);

   10) division and multiplication (÷, ×);

   11) subtraction and division (-, ÷);

   12) addition, subtraction and addition (+,-, +); and

   13) subtraction, division and addition (-, ÷,+).

2. To know whether the learners can explain the logic of the specific Mathematical problem.

3. To explore the nature of the mistake the learners made in the achievement test at an individual level which would provide information for better understanding of the result of achievement test.

## Description of the Instrument

The items chosen specifically for study, were some of those that the learners got wrong in the achievement test. The selection of the items lay with the researchers which were chosen randomly from those the learners got wrong.

## Sample size/Type

Six to seven learners from each of the schools were randomly selected. These learners were selected randomly, mainly on the basis of boys-girls ratio attended in the school on that day. Among the total of 44 learners boys were –12 and girls were -32 .

## Procedure

Two weeks after the achievement test, the researchers went to different schools individually and interviewed the learners separately. Each interview took 25 minutes. Due to time required, researchers took only a few items the learners got wrong in the achievement test. Researchers first asked the learners to read the problems and then asked what s/he should do to do the sum. If the learners gone wrong what should s/he should do, then the interviewer proceeded to another problem. If s/he went right with what should s/he do, then the researchers asked , why should you do that and finally asked the learners to do the sum, and the researchers took note/comments on the test.

## Analysis

Appendix 2 presents performance of learners on the item they got wrong in the achievement test to explore the nature of mistakes, with special reference to their nature of understanding of the concept of problems. The data shows that the learners got the majority of cases right in interviews (about 60%) in terms of understanding of the concept of problems. This might be due to the interviews taking place several days after the achievement test which could provide scope for practicing these items by the learners themselves as well as along with the teachers. It also might be due to the way interview took place where researchers gave scope for thinking deeply by asking the learners what to do next. This might help learners finding the way out of solving the problems. Even then a

portion of the learners got some of the cases (about 40%) wrong in terms of understanding of the concept of problems.

In a majority of cases (6 out of 11 combinations) with a few exceptions among the pair of the items involving the same combination of operation, learners performance was found to be better in items using a normal level of language difficulty then the item using higher level of language difficulty. For example, item ka-6 and kha-5 involve the same combination of operation using higher level and normal level of language difficulties respectively, and the learners did better in kha-5 ( normal level of language difficulty) then that of item ka- 6 in the interview( Appendix 1).

### *Recommendations for future Research*

1. It is important to interview the learners to find out their Mathematical thinking and this was attempted in the pilot study. The data generated however is not sufficient in depth for this to be done. Any future study should plan to interview and record the learners thinking process as they work through a specific Mathematical problem. For example the learners will be presented with a written problem and asked how to find the answer. Whatever the learner says will be recorded. The interviewer will keep prompts to an absolute minimum.

2. Interviews must be taken as soon as possible after the achievement test, if possible on the same day to prevent practice of the items.

3. Choose 5/6/7 items the learners mostly got wrong in the achievement test. Make a random sample of the learners to interview who got it wrong and equal number of learners who got it right. Try to include both the sex for the purpose.

## 3. NTERVIEW WITH TEACHERS

*Rationale/ objective*

The objectives of interviewing teachers are:

- to explore teachers' perception of the learning outcomes of the chapters on which the achievement test was based;

- to explore teachers' perception of learners' performance on those particular chapters; and

- to explore teachers' perception of the appropriateness of the content, context and methodology suggested for those particular chapters.

*Description of the instrument*

The interview schedule was designed to include several questions to examine each of the three objectives. The final schedule contained 17 questions (see appendix 4 ). In designing the interview schedule both the group of Mathematics and Social Studies worked together. This was finalized after piloting it with some teachers.

*Sample size and type*

All the teachers (8) of the sample schools were interviewed for the purpose.

*Procedure*

·While the learners were having their achievement test, the researchers took the teacher away from the learners and interviewed her. The interview took approximately an hour. Researchers asked questions from the interview schedule and the teachers' answers were written down by the researchers on the schedule.

*Analysis*

1) Expected learning outcome and teachers' perception:

All the teachers responded to this issue. Teachers' responses have been paraphrased from the interview in the findings regarding this. Teachers responses showed that they mentioned many learning outcomes although most of them are not very specific to the expected learning outcomes. For example, teachers' perceived learning outcomes of 2, 3, 4,

6 and 7 are not specific to the expected learning outcomes (table 6 ). On the other hand, they mentioned some learning outcomes which are to some extent related to the expected learning outcome. For example perceived outcome no 1 and 5 to some extent are related to expected learning outcome no 3 and 1 respectively. The reason for this, may be teachers are not familiar with learning outcomes in the fashion it might be. Another reason for this might be the interview took place a few months after they taught these chapters. This also might be due to staff's lacking of knowledge on learning outcome which will be discussed in another section of the report.

Table 6: Expected learning outcome and teacher's perception

| Expected learning outcome | Learning outcome perceived by teachers | Frequency | |
| --- | --- | --- | --- |
| | | Team 1 | Team 2 |
| 1. Could solve problems of three steps involving addition and subtraction, and maximum five digit numbers | 1. Could do different forms of problem solving like this (addition, subtraction, multiplication and division) | 4 | 4 |
| 2. Could solve simple problems involving multiplication and division | 2. Could do familial accounting | 2 | 3 |
| | 3. Could do this type of problems in higher classes | 2 | 1 |
| 3. Could solve problems of two steps involving any two of addition, subtraction, multiplication and division, and maximum three digit numbers | 4. Could understand problem through reading the sum | 1 | 1 |
| | 5. Could do problems with three steps involving addition and subtraction, and 2/3/4 digit numbers | 1 | 1 |
| | 6. Could teach younger and members of family in future | 1 | 0 |
| | 7. Could make problems of this type ownself | 0 | 2 |

1) Teachers' perception about their learners' achievement:

Teachers are very optimistic about their learners' achievement. Seven out of eight teachers were found to be very optimistic about their learners' achievement as they expected that

more than 60% of their learners achieved 100% learning outcomes. However, this expectation is not reflected in the achievement test result (Table 7). This might be due to the way teachers evaluate their learners which might give them misleading information about their learners' achievement.

Table 7:    Proportion of learners achieved 100% learning outcomes according to the perception of teachers

| Schools | Perceived by teachers | |
|---|---|---|
| | Team 1 | Team 2 |
| School 1 | 28/29= 97% | 14/29= 48% |
| School 2 | 20/29= 69% | 25/29= 86% |
| School 3 | 18/27= 67% | 24/26= 92% |
| School 4 | 17/28= 61% | 20/26= 77% |
| Total | 83/113= 74% | 83/110= 76% |

3) Reason for failure of some learners:

Teachers were asked to state the reason for the failure of some of their learners. Six reason have come up from the eight teachers (Table 8). The reasons most teachers mentioned were those of learners' irregularity in school, learners being less intelligent and learners don't read at home. All the six reasons they mentioned are not related to teaching effects and indicates that teachers do not take responsibility for learners' failure.

Table 8: Reason for failure of some learners according to teachers

| Reasons | Frequency | | |
|---|---|---|---|
| | Team 1 | Team 2 | Total |
| 1.  Irregular in school | 3 | 2 | 5 |
| 2.  Inattentive | 2 | 1 | 3 |
| 3.  Less intelligent | 1 | 4 | 5 |
| 4.  Don't read at home | 3 | 2 | 5 |
| 5.  Forgetting | 1 | 2 | 3 |
| 6.  Lack of practice (can do getting little help) | 1 | 1 | 2 |

4) Prescribed techniques for evaluation and teachers' perception:

Most of the teachers mentioned the same techniques of evaluation which are somehow very consistent with the prescribed techniques of evaluation. Some of the teachers mentioned a few techniques which are additional to the prescribed ones (Table 9 ).

Table 9: Prescribed techniques for evaluation and teachers' perception

| Prescribed techniques for evaluation | Perceived by teachers | Frequency | |
|---|---|---|---|
| | | Team 1 | Team 2 |
| 1. Evaluation through giving same type of problems to learners (on-teaching evaluation) | 1. Evaluation through giving same type of problem to students | 4 | 2 |
| | 2. Weekly evaluation | 2 | 2 |
| | 3. Evaluation at the end of page/ chapter | 3 | 3 |
| 2. Weekly evaluation | | | |
| 3. Evaluation at the end of page/ chapter | 4. Giving chance to teach others | 2 | 0 |
| | 5. Giving the same problem to solve later on (on slate, note, board) | 3 | 1 |
| 4. Evaluation at end of grade | | | |
| | 6. Home work | 2 | 2 |
| | 7. Evaluation through verbal practice | 0 | 1 |
| | 8. Evaluating previous knowledge | 0 | 1 |

5) Reflection of expected learning outcome in the text:

Teachers in both team areas mentioned that expected learning outcome as they perceived was reflected at least satisfactorily in the content. However, some of the teachers in both team areas mentioned that expected learning outcome was well reflected in the content.

6) Suggestions for developing text in order to fulfil 100% learning outcome:

The teachers remained largely hesitant to be critical. In fact, the majority of responses came from three to four teachers. The suggestion most teachers gave is that of incorporating more problems in the text with larger numbers (Table 10). The findings indicate two things

at least important to pick up in this regard to develop content in order to achieve 100% learning outcome. These include- more training in Mathematics for teachers and more examples in the text using smaller numbers.

Table 10: Suggestions for developing text in order to fulfil 100% expected learning outcome:

| Suggestions | Frequency | | |
|---|---|---|---|
| | Team 1 | Team 2 | Total |
| 1. More scope for instruction using abstract and semi-abstract objects | 1 | 0 | 1 |
| 2. More problems should be given in text with larger numbers | 1 | 2 | 3 |
| 3. More scope for evaluation | 1 | 0 | 1 |
| 4. More example should be given in text using smaller numbers | 1 | 1 | 2 |
| 5. Need training on Mathematics | 1 | 0 | 1 |
| 6. Problems should be given in different forms | 0 | 1 | 1 |
| 7. More scope for verbal practices | 0 | 1 | 1 |

7) Appropriateness of text in terms of language so that the learners can understand through reading themselves and suggestion for 100% appropriateness:

Three out of eight teachers mentioned that text was not fully appropriate in terms of language for learners to be independent learners. Among these three, one teacher mentioned that it is 60% appropriate. All the three teachers are from team 1. The remaining five teachers mentioned that text is 100% appropriate in terms of language for learners to be independent learner. To make the text, more precisely the government text, 100% appropriate in terms of language for learners to be independent learner teachers suggested that language should be simplified; examples should be provided using smaller numbers; and scope for examples of problems using pictures should be provided. This indicates the teachers can critically reflect on the materials they use.

8) Reflection of urban-rural, gender and rich-poor sensitivity, and religious neutrality:

All the teachers in both the team areas of team 1 and team 2 mentioned that urban-rural, gender and rich-poor sensitivity are well reflected in the texts (government and BRAC). One teacher in both two areas mentioned that religious neutrality is not properly maintained in the texts as most of the names used in these are Muslim, very few from Hindu and none from the other religious groups.

9) Prescribed methods/ techniques for teaching and teachers' perception:

The paraphrases from the teachers' words on methods/ techniques indicate that teachers' perception on this are very close to the prescribed ones. Teachers mentioned many methods/ techniques for teaching of which one or more than one are matched with any of the prescribed methods/ techniques. The methods of 1, 2 and 7 most teachers perceived are related to prescribed method no 1, 2 and 5 (Table 11). The variation in level of matching may be due to different instructions being given at different times by the supervisors and trainers to handle the problems.

Table 11. prescribed methods/ techniques for teaching and teacher's perception

| Prescribed methods/ techniques | Perceived by teachers | Frequency | |
|---|---|---|---|
| | | Team 1 | Team 2 |
| 1. Doing the problem verbally through drawing picture on board | 1. Making learners understand through verbal instruction using small numbers | 2 | 3 |
| 2. Getting learners to do the problem through changing the figures | 2. Giving problems to learners using small numbers to solve these verbally | 2 | 3 |
| | 3. Teacher does problem on board using small numbers | 2 | 2 |
| 3. Making problems using numbers of smaller digits | 4. Giving learners problems using small numbers to do on slates and checking, and helping them in understanding if they don't | 2 | 2 |
| 4. Doing problems from a handout | | | |
| 5. Doing the problems from teacher guide and text. | 5. Teacher does problems from the handout those are same as problems in text | 3 | 0 |
| | 6. Giving learners problems from handout to do and checking their work | 3 | 0 |
| | 7. Giving problems from text to learners to do and checking their work | 3 | 3 |
| | 8. To do problems using pictures and concrete objects | 1 | 3 |
| | 9. Getting learners to make problems verbally | 1 | 2 |
| | 10. Giving learners problems to solve through fixing and changing price | 1 | 1 |
| | 11. To do problems from teacher's guide | 0 | 2 |

116    22

10) Appropriateness of prescribed methods/ techniques for teaching:

All the teachers in team 1 area said that the prescribed methods/ techniques are appropriate (70-80%) for teaching. However, few of them suggested that there must be scope for more evaluation; and evaluation of previous knowledge. All the teachers in team 2 area said that the prescribed methods/ techniques for teaching are fully appropriate.

11) Methods/ techniques of teaching followed by teachers other than prescribed one:

A very few of the teachers mentioned that they followed other methods/ techniques of teaching other than prescribed methods/ techniques. None of the teachers in team 2 used other methods/ techniques. Two out of four teachers in team 1 used other methods/ techniques. They were those of preparing some problems by themselves using small numbers; evaluation on previous knowledge; and trying again and again to make student understand until they don't.

12) Problem faced by teachers in following the prescribed methods/ techniques for teaching:

All the teachers responded to this question but in somewhat different ways. None of the four teachers in team 2 mentioned any problem they faced in following the prescribed methods/ techniques for teaching. Three out of four teachers in team 1 mentioned that they faced some problems in following the prescribed methods/ techniques for teaching. The problems they faced included difficulty in forming problems; and learners don't understand even after do the problems again and again on the board.

13) Problems faced by the learners with the prescribed methods/techniques for teaching followed by the teacher:

Half of the teachers in both the areas of team 1 and team 2 mentioned that learners faced problems in some cases while they (teachers) were following the prescribed methods/ techniques for teaching. The problems mentioned by the teachers in team 1 include, learners have not got handout in their hands; difficulty with problem involving multiplication and division; and forgetting. The problems mentioned by the teachers in

team 2 include, difficulty in forming problems; and difficulty with problems involving three steps problems. Advance learners can be used for the purpose of helping learners facing problem with multiplication and division.

14) Suggestions for added methods/ techniques for teaching additional to prescribed ones: Very few of the eight teachers responded to this and most of the responses are from team 1. These few teachers suggested six methods/ techniques for teaching additional to prescribed methods/techniques which are presented in table 12.

Table 12: Methods/ techniques for teaching suggested by teachers additional to prescribed ones

| Suggestions | Frequency | |
|---|---|---|
| | Team 1 | Team 2 |
| 1.  Scope for practicing  mental math | 1 | 0 |
| 2.  More problems  of same type with small numbers | 2 | 0 |
| 3.  Evaluation of previous knowledge | 1 | 0 |
| 4.  More scope for evaluation | 1 | 0 |
| 5.  More scope for verbal practice | 1 | 0 |
| 6.  Some other easy techniques needed | 0 | 1 |

*Main findings*

Interaction among learners, teachers and curriculum is important for learning. But the teachers did not take responsibility for learners' learning; they made learners only responsible for learning. However, staff mentioned that teachers lacking skill are also responsible for learners' failure (detail is in the next section of the report).

Teachers were reluctant to talk because of the working environment and culture of the society as well as organization. For example- responding to a question of why don't you give problems to learners to solve which are not either in text or teacher guide or handout,

teacher said that the thing or activity, I am not asked to do by the Bhais and Apas (supervisors), I can't do that. If I do that then I would be caught by the Bhais and Apas.

Teachers are not fully aware of the learning outcomes and this may be overcome by putting the specific learning outcome of each chapter at the top of the chapter in both text and teacher guide. It is very important for teachers to be aware of the specific learning outcome which will dictate what they are going to teach the learners in a particular chapter.

Teachers showed that they are more or less aware of most of the methods/ techniques for teaching. However, their perception is not very specific to the prescribed methods/ techniques for teaching this particular issue of problem solving.

All the teachers except one were very optimistic about their learners' achievements though this was not supported by the achievement test result. This might be due to the way the teachers evaluate their learners' achievements. It was found that teachers used to review the chapters before evaluation and often they include those questions in the evaluation instruments which were discussed in the review. This gives learners opportunity to answer the questions they practiced the previous day. It was also found that in few cases, teachers overlook learners' mistakes by putting tick mark on the problems learners got wrong while they were checking learners' work. These indicate that teachers may need further development in assessing their learners' achievement.

The teachers can critically reflect upon the materials they use.

*Recommendation for future research*
**Design:** It is necessary to have both individual interview and group discussion with teachers because of the different nature of data needed to be collected. The problem teachers identified should be taken seriously and should be included in any research for solution. Test paper should be supplied to teachers while interviewing them on learners performance.

119          25

Administration: MTs/ QMs might be the data collector from teachers in future. Teachers words should be elaborately collected and written. Interviewing the teachers about learning outcome, content, context and methods as soon as the achievement test is finished.

Timing: Time for interviewing the teachers should be fair enough to give them time to talk. Recording their words as specifically as possible will produce rich data.

Analysis: Findings should be shared with the MTs in order to develop the teachers.

## 4. DISCUSSION WITH STAFF

*Rationale/ objectives*

The objectives of discussion with staff are:

- to explore staff's perception of the learning outcomes of the chapters on which the achievement test was based;
- to explore staff's perception of learners' performance on those particular chapters;
- to explore staff's perception on the appropriateness of the content, context and methodology suggested for those particular chapters; and
- to know staff's perception about teachers.

*Description of the instrument*

The schedule for discussion with staff was designed to include several questions to examine each of the three objectives. The schedule contained 18 questions. In designing the schedule both the group of Mathematics and Social Studies worked together. The schedule was finalized after piloting it with some staff in other areas.

*Sample size and type*

Most of the staff (the immediate supervisors- Pos and RTs including team in-charge) of both the sample teams were included in the discussion.

*Procedure*

The discussion with staff were took place few days after the achievement test with learners. The researchers had the discussion with staff at respective team offices and it took approximately an hour for each discussion. Researchers asked questions from the discussion schedule and the staff discussed on it among themselves, reflected on the question, and their reflection or responses were written down by the researchers on the schedule.

*Analysis*

1) Expected learning outcome and staff's perception:

While the discussion was taking place on this particular issue, in both team areas, some of the staff were less responsive. As in teachers' interview, staff's words have been paraphrased from the discussion with them in the findings. It was found that staff mentioned six learning outcomes though most of these were not very specific to the expected learning outcomes. Three of the perceived learning outcomes (no 2, 4 and 6) are not related to expected learning outcomes in any way, however, the remaining three perceived learning outcomes (no 1, 3 and 5) are, to some extent, related to expected learning outcomes no 3 and 1 respectively (table 13). These indicate that staff are not fully aware about the learning outcome of the chapters which is consistent with teachers' perception on this issue. The reason behind this may be they are not familiar with learning outcome very specifically which is resulted in the teachers' misperception about the learning outcome. This may be overcome by putting learning outcome very specifically at the top of the each chapter in text as well as teachers' guide, and also highlighting learning outcomes in the training sessions.

Table 13: Expected learning outcome and staff's perception

| Expected learning outcome | Perceived by staff | | |
|---|---|---|---|
| | Learning outcome | Team 1 | Team 2 |
| 1. Could solve problems of three steps involving addition and subtraction, and maximum five digit numbers | 1. Could do problems of two steps with addition, subtraction and multiplication | ✓ | ✗ |
| | 2. Could make problems of this type ownself | ✓ | ✗ |
| 2. Could solve simple problems involving multiplication and division | 3. Could do problems of two steps with addition, subtraction, multiplication and division | ✓ | ✓ |
| 3. Could solve problems of two steps involving any two of addition, subtraction, multiplication and division, and maximum three digit numbers | 4. Could do problems of one step with addition, subtraction, multiplication and division (four digit numbers) | ✗ | ✓ |
| | 5. Could do problems of three steps with addition and subtraction | ✗ | ✓ |
| | 6. Could do any problem | ✗ | ✓ |

2) Staff's perception about learners' achievements in their areas:

Staff in both the team areas are very optimistic about learners' achievements in their areas as they (staff) in team 1 and team 2 mentioned that 92% and 90% learners respectively achieved 100% learning outcomes. This indicates that supervisors are more optimistic about learners' achievements than the teachers which further indicate that teachers are less ignorant than supervisors (staff) about learners achievements, although perception of both the groups of teachers and staff are not consistent with the achievement test results.

3) Reason for failure of some learners:

Five reasons have been come up from the discussions with staff among which three and four respectively mentioned by staff in team 1 and team 2 (Table 14). Of these five reasons two (no 2 and5) are related to teachers and the remaining three (no 1, 3 and 4) are related to learners. Learners' problems are identified by the teacher also. The staff identified

teachers' problems whereas none of the teachers identified their own problem related to learners' failure. Result showed that staff also did not mentioned any problem of their own related to learners' failure which further indicates that staff do not take responsibility of learners' learning.

Table 14. Reason for failure of some learners according to staff

| Reasons | Mentioned by staff | |
| --- | --- | --- |
| | Team 1 | Team 2 |
| 1. Basically less intelligent | ✓ | ✓ |
| 2. Less emphasis was given by teachers to these students | ✓ | ✗ |
| 3. Lack of practice | ✓ | ✓ |
| 4. Irregular in school | ✗ | ✓ |
| 5. Teacher's weakness in presenting the lesson | ✗ | ✓ |

4) Techniques of evaluation:

Staff evaluate learners' achievement using different techniques as they mentioned while discussion was going on with them. They mentioned about six techniques (Table 15) of evaluation some of them (technique no 4 and 5) are very similar to those mentioned by teachers. Of these six techniques three (technique no 2, 4 and 6) were mentioned by the staff in both teams of 1 and 2, one (no 1) was mentioned exclusively by staff in team 1 and two (no 3 and 5) were mentioned exclusively by the staff in team 2.These indicate that although there were some variations, however in most cases staff in team 1 and 2 mentioned the very same techniques of evaluation.

**123**    29

Table 15: Staff's perception on techniques of evaluation

| Techniques for evaluation | Mentioned by staff | |
|---|---|---|
| | Team 1 | Team 2 |
| 1. Separate evaluation only on problem solving | ✔ | ✘ |
| 2. Evaluation while visiting schools | ✔ | ✔ |
| 3. Observing while teachers were presenting the lessons to students | ✘ | ✔ |
| 4. Evaluation at the end of the chapter is taught | ✔ | ✔ |
| 5. Weekly evaluation | ✘ | ✔ |
| 6. Evaluation at the end of grade | ✔ | ✔ |

5) Reflection of expected learning outcome in the text:

Although some of the teachers mentioned some deficiency in reflection of expected learning outcomes in the text as they mentioned that the expected learning outcomes were satisfactorily reflected in the text, however, staff in both the team areas expressed the view that expected learning outcomes were well reflected in the text. This indicated that supervisors (staff) do not look at text critically or they remain reluctant of being critical of text.

6) Suggestions for developing text in order to fulfil 100% learning outcome:

Though staff in both the team areas did not mention any deficiency in reflection of learning outcome in the text, however, they suggested few suggestions for developing text in order to fulfil 100% learning outcomes. They mentioned about three suggestions of which one (suggestion no 2) was mentioned by staff in both the teams (Table 16). The other two were respectively mentioned by the staff team 1 (suggestion no 1) and team 2 (suggestion no 3). All the three suggestions were also mentioned by the teachers.

Table 16: Suggestions for developing the text in order to fulfil 100% learning outcome

| Suggestions | Mentioned by staff | |
| --- | --- | --- |
| | Team 1 | Team 2 |
| 1. More example should be given in the text | ✓ | ✗ |
| 2. Multiple sum should be given on each type of problem in the text | ✓ | ✓ |
| 3. Problems with larger numbers should be given in the text | ✗ | ✓ |

7) Appropriateness of text in terms of language so that learners can understand through reading by themselves and suggestions for 100% appropriateness:

Staff in team 2 mentioned that the text is 100% appropriate in terms of language for learner to be independent learner. On the other hand staff in team 1 mentioned that the text is not fully appropriate in terms of language so that the learners can understand through reading by themselves. According to them it is about 60% appropriate in the above mentioned context. To make the text 100% appropriate in terms of language the staff in team 1 suggested that there should be multiple sum on each of the type of problem in the text; more problem involving smaller numbers should be given in the text; and there should also be scope for mental maths in the text.

8) Reflection of urban-rural, gender, rich-poor sensitivity, and religious neutrality in the text:

Staff in team 1 mentioned that urban-rural, gender and rich-poor sensitivity are well maintained in the text, however religious neutrality is not maintained so well as maximum names used in the text are from Muslim, very few from Hindus and other religious groups. On the other hand staff in team 2 mentioned that gender and rich-poor sensitivity are well maintained in the text. They, however, mentioned that urban-rural sensitivity and religious neutrality are not maintained so well in the text as there is more rural issues and Muslim names are used in the text.

9) Prescribed methods/ techniques for teaching and staff's perception:

Staff's responses towards this issue indicated that they mentioned as much as nine methods/ techniques of which one or more than are matched with any of the prescribed methods/ techniques of teaching the problem solving. Out of nine methods/ techniques, two (perceived method no 2 and 6) were mentioned by staff in both the teams and are matched with prescribed method no 1 and 5 respectively (Table 17). Perceived methods/ techniques no 1, 3, 4, 5 and 7 were mentioned exclusively by staff in team 1 of which 3, 4and 5 are somehow matched with prescribed methods/ techniques no 4 and 5. On the other hand, perceived methods/ techniques no 8 and 9 were mentioned exclusively by staff in team two which are somehow matched with prescribed methods/ techniques no 3 and 5. These indicate that methods/ techniques the staff mentioned are very closer to the prescribed ones.

Table 17: Prescribed methods/ techniques for teaching and staff's perception

| Prescribed methods/ techniques | Perceived by staff | | |
|---|---|---|---|
| | Methods/ techniques | Team 1 | Team 2 |
| 1. Doing the problem verbally through drawing picture on board | 1. Teaching using abstract object | ✓ | ✗ |
| | 2. Teachers do problems on board using picture | ✓ | ✓ |
| 2. Giving learners to do the problem through changing the figures | 3. Giving students to read the problem from handout two or three times | ✓ | ✗ |
| 3. Making problems using numbers of smaller digits | 4. Knowing answers from students through questioning segments of the problem | ✓ | ✗ |
| 4. Doing problems from handout | 5. Practicing the problems from handout | ✓ | ✗ |
| 5. Doing the problems from teacher guide and text. | 6. Giving problems to student from text to do and checking | ✓ | ✓ |
| | 7. Evaluation | ✓ | ✗ |
| | 8. Making problems verbally using given numbers | ✗ | ✓ |
| | 9. Solving problems from teacher guide | ✗ | ✓ |

These also indicate a variation in matching of perception of staff in two teams on methods/ techniques of teaching. This might be due to different texts are administered in two teams which again might have additional different methods/ techniques of its own.

10) Appropriateness of prescribed methods/ techniques for teaching:

Staff in team 2 mentioned that the prescribed methods/ techniques for teaching is fully appropriate. However staff in team 1 mentioned that the prescribed methods/ techniques for teaching is about 75% appropriate as there are some gaps- less example and less scope for practice, according to them, is prevailed there.

11) Methods/ techniques followed by the teachers other than prescribed one:

Staff in both team 1 and team 2 did not mention any method/ technique followed by teachers other than prescribed ones.

12) Problem faced by teachers in following prescribed methods/ techniques for teaching:

Staff in team 1 mentioned that they did not notice any problem faced by the teachers while the teachers were following the prescribed methods/ techniques for teaching. On the other hand, staff in team 2 mentioned some problems they noticed faced by the teachers while the teachers were following the prescribed methods/ techniques for teaching. These problems include, some (20%) of the teachers faced problem in making problem and teachers faced problems in teaching problems through picture as they can't draw the picture. However, none of the teachers informed any problem they faced to staff which is consistent with teachers' interview data as they did not make them responsible for learners' failure which again indicate that teachers are not ready to mention their problem anywhere.

13) Problems faced by the learners while the teacher were following the prescribed methods/ techniques for teaching:

Staff in team 1 did not mention any problem faced by the learners while the teachers were following the prescribed methods/ techniques for teaching. On the other hand, staff in team 2 mentioned one problem they noticed, faced by the learners that of when the teacher fails

127

to make problem on any situation correctly, this creates problem for learners also as they faced problem accordingly.

14) Suggestions for added method/ techniques for teaching additional to prescribed ones: Staff in team 2 did not mentioned any additional method/ technique for teaching. However, staff in team 1 mentioned that the technique of more and more practice can be added to the prescribed methods/ techniques for teaching.

15) Teachers performance in following the prescribed methods/ techniques for teaching to teach the lesson:
Staff in both the team area mentioned that 80- 90% teachers used the methods/ techniques successfully. However, staff in team 2 mentioned that some (20%) teachers were not able to make problem and some other (20-30%) teachers were also not able to draw pictures for making learners understand the problems.

*Main findings*
Staff were a bit reluctant to talk about some issues those of appropriateness of content, context etc. Some staff remained less responsive in discussion on many issues. This indicates that staff are not in a position of being critical of the activities they do. This may further indicates a mechanical practice of what they are assigned to do.

As it is in the case of teachers, staff are not fully aware of the learning outcomes and it may therefore be overcome by putting the specific learning outcomes of each chapter in the top of the chapter in the text and highlighting learning outcomes in the training sessions. This will help the staff in helping teachers in their teaching.

It was found that staff were more or less aware of the most of the methods/ techniques for teaching problem solving, however, there were gap between the perception of staff in two teams.

Staff were very optimistic, even more optimistic than teachers about learners' achievements though it was not reflected in the achievement test result. This, as the case in teachers, indicates that staff also may need further development in assessing learners achievements.

Though staff (supervisors) is the part of school functioning i.e. educational environment where learning take place, they did not take responsibility of learners' learning. They made only learners and teachers responsible for learners' learning and failure.

Although staff noticed that few of the teachers faced some problems with prescribed methods/ techniques of teaching, however, none of the teachers could hardly mention any problem to staff, they faced regarding methods/ techniques. This might be due to the teachers do not express their own weakness and problems to supervisors.

*Recommendation for future research*

Design: It is important to have discussion with staff (supervisors) on issues related to learners' learning because they are the part of educational environment i.e. curriculum in which learning take place. Given this, checklist for discussion with staff may need some refinement with sufficient prompts. The problems and gap staff as well as teachers mentioned should be considered with due importance and should be included in any research for solution.

Administration: QMs might be used in collecting data from staff, but in area they are not working. Staff, words should be elaborately collected and written. Discussion with staff should be taken place after having achievement test.

Timing: Time for discussion with staff should be appropriate enough to give them think and talk, and recording their words elaborately.

Analysis: A number of problems and gaps have been come up from the discussion with staff. This findings should be shared with QMs in order to develop staff.

## 5. LOOKING AT LEARNERS' WORK AND TEACHERS' DOCUMENTS

### Rationale/ objective

The objective of looking at learners' work (note book/ home work/workbook, examination sheets etc) and teachers' documents (lesson plan, evaluation register etc) was to examine the extent of reflection of learning outcomes which the achievement test based on, in these documents. This will help in understanding learners' achievements in a particular issue.

### Description of the instrument

A checklist was designed to include several items/ combinations of problems to examine the above mentioned objective. The items/ combinations in the checklist included 12 items out 13 items those were used in the achievement test instrument. The reflection of each of the 12 items was determined examining the reflection of these in both the learners' work and teachers' documents. The reflection was qualified in qualitative terms of not reflected, satisfactorily reflected and well reflected. These three categories of reflection were defined as follows:

*Not reflected:* Particular combination is not there.

*Satisfactorily reflected:* Combination is there, learners could not correct but the teacher in some cases put tick mark on this, and/ or combination is there with smaller digit numbers and learners could correct it.

*Well reflected:* Combination is there with appropriate digit numbers and learners could correct it.

### Sample size and type

All the teachers (8) of sample schools and all the learners (6/7 learners from each school) included in interview with learners, were selected for looking at their work and documents.

## Procedure

Few days after the achievement test, the researchers went to different sample schools individually and examine learners' work and teachers' documents following the checklist. The approach followed for the purpose was researchers looked at teachers' documents first, if the particular combination of problem was there then they examined its reflection in learners' work, and based on these two finally decided upon which category of reflection this particular combination fall in. This exercise of looking at learners' work and teachers' documents in school took about two hours.

## Analysis

As the data collection from work and documents was done few weeks after the completion of grade 4, in some cases teachers' lesson plan and learners' note book were not found. It was found that different learners did the same activities in Mathematics as the teachers used to give the same assignment to all learners in a school. These activities or assignments were also documented in teachers' documents. So the level of reflection of the combination of problems was determined on the basis of combining information from both teachers' documents and learners' work, and unit for analysis remained the school.

Data revealed that about half of the cases of the combinations of problems were not reflected in the work and documents in both the teams (Table 18). Only, in one fourths of cases out of a possible 48, the combinations of problems were well reflected in the documents, and in addition to this, other more than one fourths cases combinations of problems were satisfactorily reflected in the documents. This indicates a poor reflection of problems in documents which further indicates a less scope for practice by learners. This has been reflected in the poor performance of learners in the achievement test This may be overcome through making teachers aware about learning outcomes and assignment so that teachers can create scope for more practice on each of the learning outcome by the learners.

Out of the 12, eight combinations (no 1, 2, 3, 4, 5, 6, 8 and 9) got comparatively better reflection as at least in 50% cases these were either satisfactorily or well reflected in the documents. Four combinations (no 1, 2, 3 and 4) out these eight, are problems of one step involving addition, subtraction, multiplication and division, and learners did better in these combinations in the achievement test. Reflection was found worse in case of three combination (no 7, 11 and 12).

In five combinations of problems (no 1, 2, 3, 6 and 10) reflection was found better in team 2 and in four combination (no 5, 7, 9 and 11) reflection was found better in team 1, and in remaining combinations it was found the same in two teams.

Table 18: Reflection of different combination of problems in work and documents

| SL No | Combination of problem | No of schools according to level of reflection | | | | | |
|---|---|---|---|---|---|---|---|
| | | Not reflected | | Satisfactorily reflected | | Well reflected | |
| | | Team 1 | Team 2 | Team 1 | Team 2 | Team 1 | Team 2 |
| 1 | One step- addition | 02 | 01 | 01 | 02 | 01 | 01 |
| 2 | One step- subtraction | 02 | 01 | 01 | 02 | 01 | 01 |
| 3 | One step- multiplication | 01 | — | 02 | 01 | 01 | 03 |
| 4 | One step- division | 01 | 01 | 02 | 02 | 01 | 01 |
| 5 | Two step- subtraction | 01 | 02 | 01 | 01 | 02 | 01 |
| 6 | Two step- addition, subtraction | 02 | — | 01 | 04 | 01 | — |
| 7 | Three step- addition, subtraction | 02 | 03 | 02 | — | — | 01 |
| 8 | Two step- addition, multiplication | 01 | 01 | 01 | 02 | 02 | 01 |
| 9 | Two step- addition, division | 01 | 02 | 01 | 01 | 02 | 01 |
| 10 | Two step- subtraction, multiplication | 02 | 02 | 01 | — | 01 | 02 |
| 11 | Two step- subtraction, division | 02 | 03 | 01 | — | 01 | 01 |
| 12 | Two step- multiplication, division | 03 | 03 | 01 | 01 | — | — |
| Total cases | | 20 | 19 | 15 | 16 | 13 | 13 |

*Main findings*

It is important to look at learners' work and teachers' documents. It can provide valuable information on their activities related to a particular chapter which can further be an indication of learners' achievements.

It was found that teachers used to assign same activity and assignment for each learners in a school. This may create a scope for copying and prohibit individual learner's creativity.

Documents and records were not found to be well preserved as in some cases teachers' documents as well as learners work were not found.

In few cases teachers' performance in evaluating learners' work found to be poor as they overlook learners' mistakes by putting tick mark on the activity learners got wrong.

In most of the cases, work and documents showed that learning outcomes are not reflected in these which leads to less scope for practicing by the learners. This has been reflected in the low achievements of learners in the achievement test. This needed a further orientation of teachers 'on activity and assignment they give learners so that these activity and assignment cover wide range of variation of combinations.

*Recommendation for future research*

**Design:** While looking at work and documents, activities those are in learners' work but not in teacher's documents should also be looked at. Otherwise information may therefore be misleading. This will give whole range of information on learners' work which provides very important contribution in producing their achievements in a particular issue/ subject.

**Administration:** Looking at learners' work and teachers' documents should be taken place as soon as possible after the teaching on the particular topic is completed, or before the grade is ended. Some work and documents should be collected through photo copying as sample of learners' work and teachers' documents.

Timing: Time for looking at learners' work and teachers' documents should be according to the volume of issues whose reflection one is going to examine.

Analysis: The problems those of teacher put tick mark on activity which learners got wrong and assigning same activities to all learners by the teacher should be shared with QMs and MTs to address these in the training sessions for teachers.

## CONCLUSIONS AND RECOMMENDATIONS

The study attempted to develop a methodology for assessing learners' achievements, and appropriateness of content, context and methodology for teaching a particular concept, in order to evaluate the curriculum towards a research-led curriculum development. This section highlights the potentials of the methods examined and provides recommendations for future research in the light the pilot study.

The mean score of 40% on the achievement test should be discussed with the teachers involved and the MTs in teams 1 and 2. The item analysis and spread of marks should form the basis for an action plan to remedy the areas of weakness highlighted by the research.

Future research using an achievement test should widen the scope of the test to include other aspects of Mathematics, such as measurement, shape .etc. after consideration of the priorities for learners in the curriculum as specified by the government through national competencies.

The learner interview was found to be a useful method of exploring learners' understandings in Mathematics. In the light of the pilot study findings it needs to become refined so that there is a proper procedure followed by all researchers carrying out the interviews. This will generate useful data on learners' errors and misconceptions in Mathematics.

Teacher interviews generated data which gave insights into their perceptions of their learners' abilities (very optimistic) and the clarity of the learning outcomes in the chapters they taught (some confusions). In addition, some views were given on the content, context and methodologies of the particular research focus. The interviews should be a feature of any future research but should be carried out at both the individual teacher and group of teachers level. These, allied to carefully devised and trialled interview schedules, will provide more detailed data.

The teacher interview data indicated that some teachers could review content, context and methodology in a constructively critical way. However, the fear that to try anything that was not prescribed was also evident and this needs to be addressed in training days and through the work of MTs and QMs.

The data concerning why teachers think some learners fail to learn indicates that the teachers do not consider themselves as part of the problem. This needs to be discussed and addressed on training days.

Discussion with staff also generated useful data which gave insights into their perceptions of learners' abilities (very optimistic, even more than teachers) and teachers' abilities, and the clarity of the learning outcomes in the chapters the achievement test was based on. They showed some confusions in later one. Addition to this, some views though very few, were given on the content, context and methodologies of the particular research focus. Discussion with staff should be a feature of any future research and it needs carefully developed and trialled checklist for discussion so that it will provide more detailed data.

The data from discussion with staff indicated that staff lacking being critical of content, context and methodologies which further indicated a mechanistic way of performing their responsibilities and lack of awareness about these. This needs to be addressed in meeting and training days and through the work of QMs and EDU members. The other thing which

needs to be addressed in this connection is that staff do not consider themselves as part of the problems of learners' failure.

Looking at learners' work and teachers' documents generated useful information on the level and volume of practices learners did on the particular chapters which the achievement test was based on. The level and volume of practices is an important factor in learners' achievements in a particular subject specially in Mathematics. Looking at learners' work and teachers' documents should therefore be a feature of any future research but should include both the activities/ assignments those are in learners' work and teachers' documents, and those are in learners' work but not in teachers' documents. This will provide wide range of data.

Each of the research methods and instruments used need refining in the light of the pilot study to increase their effectiveness in providing relevant data suited to the specific objectives of the study.

The use of classroom and refreshers observation techniques should be considered in any future research study as, properly done, it would validate the teacher planning documents and the teacher interviews as well as discussion with staff.

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# Appendix

Appendix 1: Reflection of the different combinations of problems in the BRAC text and government text for grade 4

| SL No | Combinations of problems | No of problems in govt text by digits | | | | | | | No of problems in BRAC text by digits | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 2 | 3 | 4 | 5 | 6 | Total | | 1 | 2 | 3 | 4 | 5 | 6 | Total | |
| | | No | No | No | No | No | No | % | No | No | No | No | No | No | No | % |
| 1 | 1 step addition | -- | 01 | -- | 01 | -- | 02 | 2.8 | -- | 08 | 02 | 03 | -- | -- | 13 | 12.5 |
| 2 | 1 step subtraction | -- | -- | 04 | 01 | 01 | 06 | 8.3 | 03 | 10 | 07 | 01 | 01 | 01 | 23 | 22.1 |
| 3 | 1 step multiplication | -- | 06 | 01 | -- | -- | 07 | 9.7 | -- | 14 | 01 | 02 | -- | -- | 17 | 16.4 |
| 4 | 1 step division | -- | 05 | 08 | -- | -- | 13 | 18.1 | -- | 11 | 01 | 01 | -- | -- | 13 | 12.5 |
| 5 | 2 step addition, subtraction | -- | 08 | 03 | 02 | -- | 13 | 18.1 | 02 | 03 | 04 | 05 | 03 | -- | 17 | 16.4 |
| 6 | 2 step addition, multiplication | 04 | 02 | -- | -- | -- | 06 | 8.3 | -- | -- | -- | -- | -- | -- | -- | -- |
| 7 | 2 step addition, division | 01 | 01 | -- | -- | -- | 02 | 2.8 | -- | -- | -- | 02 | -- | -- | 02 | 1.9 |
| 8 | 2 step subtraction, multiplication | -- | 01 | -- | -- | -- | 01 | 1.4 | -- | -- | 01 | -- | -- | -- | 01 | 1.0 |
| 9 | 2 step subtraction, division | -- | 04 | 01 | -- | -- | 05 | 6.9 | -- | 01 | -- | -- | -- | -- | 01 | 1.0 |
| 10 | 2 step multiplication, division | -- | 02 | 02 | -- | -- | 04 | 5.6 | -- | -- | 01 | -- | -- | -- | 01 | 1.0 |
| 11 | 2 step subtraction | -- | 01 | -- | -- | -- | 01 | 1.4 | 01 | -- | -- | -- | -- | -- | 01 | 1.0 |
| 12 | 2 step addition | -- | -- | -- | 01 | -- | 01 | 1.4 | -- | 03 | -- | -- | -- | -- | 03 | 2.9 |
| 13 | 3 step addition, subtraction | 01 | 01 | 01 | -- | -- | 03 | 4.2 | -- | 02 | 02 | -- | -- | -- | 04 | 3.9 |

138

44

Contd. Appendix 1

| 14 | 3 step addition, subtraction, division | 01 | 03 | -- | -- | -- | 04 | 5.6 | -- | -- | -- | -- | -- | -- | -- | -- |
|----|----------------------------------------|----|----|----|----|----|----|-----|----|----|----|----|----|----|----|----|
| 15 | 3 step subtraction, multiplication | -- | 01 | -- | -- | -- | 01 | 1.4 | -- | 02 | 01 | -- | -- | -- | 03 | 2.9 |
| 16 | 3 step addition, multiplication, division | -- | 01 | -- | -- | -- | 01 | 1.4 | -- | -- | -- | -- | -- | -- | -- | -- |
| 17 | 3 step addition, multiplication | -- | -- | -- | -- | -- | -- | -- | -- | -- | 02 | 02 | -- | -- | 04 | 3.9 |
| 18 | 4 step addition, multiplication, division | -- | 01 | -- | -- | -- | 01 | 1.4 | -- | -- | -- | -- | -- | -- | -- | -- |
| 19 | 4 step subtraction, multiplication, division | -- | 01 | -- | -- | -- | 01 | 1.4 | -- | -- | -- | -- | -- | -- | -- | -- |
| 20 | 5 step addition, subtraction, multiplication | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 01 | -- | 01 | 1.0 |

139

Appendix 2: Performance of learners in understanding concepts of problem solving in mathematics on items they got wrong in achievement test

| Item | Language difficulty level | Number of learners | | | Performance in Concept | | |
|------|------|---|---|---|------|------|------|
| | | B | G | T | Boys (%) | Girls (%) | Total (%) |
| Ka.1. ( + ) | (H) | 0 | 4 | 4 | 0 ( 0) | 3 (75) | 3 (75) |
| Kha. 2. ( + ) | (N) | 0 | 2 | 2 | 0 (-) | 1 (50) | 1 (50) |
| Ka. 2. ( - ) | (H) | 1 | 8 | 9 | 1 (100) | 7 (87.5) | 8 (88.89) |
| Kha. 1. ( - ) | (N) | 1 | 0 | 1 | 1 (100) | 0 (-) | 1 (100) |
| Ka. 3. ( × ) | (N) | 2 | 2 | 4 | 2 (100) | 1 (50) | 3 (75) |
| Kha. 4 . ( × ) | (H) | 0 | 4 | 4 | 0 (-) | 0 (0) | 0 (0) |
| Ka. 4. ( ÷ ) | (H) | 0 | 7 | 7 | 0 (-) | 6 (85.71) | 6 (85.71) |
| Kha. 3. ( ÷ ) | (N) | 0 | 2 | 2 | 0 (-) | 1 (50) | 1 (50) |
| Ka. 5. (- -) | (N) | 3 | 15 | 18 | 1 (33.33) | 6 (40) | 7 (38.89) |
| Kha. 6. ( - - ) | (H) | 1 | 4 | 5 | 0 (-) | 2 (50) | 2 (40) |
| Ka. 6. (+ - ) | (H) | 5 | 6 | 11 | 4 (80) | 4 (66.67) | 8 (72.73) |
| Kha. 5. ( + - ) | (N) | 3 | 6 | 9 | 3 (100) | 6 (100) | 9 (100) |
| Ka. 7.( + - +) | (H) | 7 | 10 | 17 | 3 (42.86) | 3 (30) | 6 (35.29) |
| Kha. 8. ( + - +) | (N) | 6 | 1 | 7 | 4 (66.67) | 1 (100) | 5 (71.43) |
| Ka. 8. ( + × ) | (H) | 5 | 7 | 12 | 4 (80) | 4 (57.14) | 8 (66.67) |
| Kha. 7. ( + × ) | (N) | 1 | 2 | 3 | 0 (-) | 1 (50) | 1 (33.33) |
| Ka. 9. ( + ÷ ) | (N) | 1 | 5 | 6 | 0 (0) | 3 (60) | 3 (50) |
| Kha.10. ( + ÷) | (H) | 2 | 6 | 8 | 2 (100) | 2 (33.33) | 4 (50) |
| Ka. 10. ( - × ) | (H) | 0 | 3 | 3 | 0 (-) | 2 (66.67) | 2 (66.67) |
| Kha. 9. ( - × ) | (N) | 2 | 9 | 11 | 2 (100) | 7(77.78) | 9 (81.82) |
| Ka. 12. ( ÷ × ) | (N) | 0 | 4 | 4 | 0 (-) | 2 (50) | 2 (50) |
| Kha. 11. ( ÷ × ) | (H) | 1 | 10 | 11 | 1 (100) | 4 (40) | 5 (45.45) |
| Kha. 12. ( - ÷ ) | (N) | 1 | 8 | 9 | 1 (100) | 6 (75) | 7 (7.78) |
| Ka. 11. ( + - ÷ ) | (H) | 3 | 7 | 10 | 2 (66.67) | 3 (42.86) | 5 (50) |
| Total | | 45 | 132 | 177 | 31(68.89) | 75(56.82) | 106(59.89) |

Note: N= Normal, H= High