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Enhancing Primary Mathematics learning using assessment practices: an initiative taken up by pre-service teachers

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ABSTRACT : *This paper attempts to study two important aspects: (1) To foster the skills for quality assessment in mathematics among prospective teachers. (2) To explore the extent to which these practices helped in improving quality of learning as well as teaching. The study has been done in MCD primary schools from class II to V with the involvement of pre-service B.El.Ed teachers, during their primary school internship in 4th year. The study comprises four phases, In the first phase, authors did a survey of the assessment practices that have been followed in these schools. Second phase comprised making student-teachers aware of the assessment practices going on in the schools, reviewing it critically, orienting them to prepare assessment profiles of their students. In the third Phase, students implemented these assessment practices in their respective classes for around three months under the supervision of authors. The final phase allowed a discussion with student-teachers and analysed the feedback of pre-service teachers as how these assessment practices helped them to take up decision regarding teaching as well as students' progress in understanding the concepts. Findings revealed that these assessment practices helped interns to monitor and modify their pedagogy. Further, Responses of the students in the assessment tasks improved progressively. However, some of the Interns faced many challenges related to recording individual progress, to assess through students responses while teaching as it became difficult for them to interpret individual responses.*

KEY WORDS: *Assessment Practices, Primary Mathematics, Pre-Service Teachers*

I. INTRODUCTION

There is significant focus on assessment practices among all grades from school to university education after the implementation of recommendation of NCF-2005. Efforts have been made to integrate assessment with the process of teaching and learning i.e. the focus from assessment of learning to assessment for learning. Classroom assessments should be integrated with the instructional process for mathematics teachers to understand and strengthen pupils' learning. These are the key principles of assessment for learning or formative assessment as encouraged by many assessment experts (Black & Wiliam, 1998; Shepard, 2000). Assessment for learning is a process by which assessment information is used and interpreted by teachers to adjust their teaching strategies for improvement in subsequent learning and teaching (Black, Harrison, Lee, Marshall & Wiliam, 2003; Black & Wiliam, 1998). Assessment of learning is commonly associated with school examination usually done during mid and annual term. PERI report also specifies that there is a need to "shift assessment practices away from an over-emphasis on assessment of learning as an end-outcome, especially at the primary levels and shape mindsets to view assessment as an integral part of ongoing processes to support learning" (Ministry of Education, 2009, p. 30).

However, in subject like mathematics, it becomes more crucial as there is also a shift of focus to assess in order to examine students' mathematization abilities from procedural knowledge (NCF, 2005).Further, Assessment is expected to be among the most litigious issues in the primary mathematics classrooms where a practicing teacher requires to assess students learning with an assurance that no child held back in the same class as per the Right to education act in India as well as in order to prepare children for the challenges they face further in life by the elementary stage (NCF2005). In the present scenario, at primary stage, there are no formal exams at primary level Instead of taking formal examinations; pupils of primary stage go through "bite-size formal assessment". These bite-sized assessments are supposed to inform primary school children, teacher and parents about the pupil's areas of strength and areas to work on in his or her overall development. So to make this kind of assessment a continual and authentic assessment specifically at primary level, teachers must use assessment tools such as rubrics to assess and provide pupils with richer feedback on their development in both academic and non-academic area (ministry of Education, 2009). Keeping on the same line, it But the way, this kind of assessment practices held in India is merely restricted to paper pencil test, not only that assessment tasks are usually procedural in nature.

In other words, assessment have been continual, rather than limited to the mid-year and year-end examinations. With all these changes in the lower primary mathematics classroom, teachers must use assessment tools such as rubrics to assess and provide pupils with richer feedback on their development in both academic and non-academic areas (ministry of Education, 2009). (Source book of assessment, 2008) also indicates a holistic view of assessment rather than merely classifying and labelling children on the basis of a test and examination. The source book on mathematics assessment focuses on assessment of mathematical concepts, mathematical reasoning, Application of mathematical concepts, mathematical communication and Attitude towards mathematics. As assessment is a critical part of the teaching and learning process in classrooms, mathematics teachers need to keep abreast of new developments in assessment and be equipped with the necessary knowledge and skills in implementing various assessment practices. The main purpose of this paper focuses on implementing the above mentioned principles in pragmatic ways in pre-service education. An important priority of the same is that other alternate assessment practices should involve minimal disruption to the teaching process and not to impose additional workload on the primary teachers.

II. OBJECTIVES

Webb (1992) claims that tests are important quantitative assessment tools, but they do not represent the totality of assessment. Thus in this age of accountability, teachers need more varied information about their pupils' mathematical understanding and competence. One of the most important practices is for teachers to use effective classroom assessments that measure what pupils are learning and how they are learning it. Subsequently, The need of periodic recording of students' learning arises. Further, Even though there is a strong belief to implement formative assessment practices, it has been found that it is quite challenging (Carless, 2005; Dixon and Haigh, 2009; James, Black, McCormick, Pedder, and Wiliam, 2006) . Hence, in this perspective the present study focus on two major objectives:

(1) To foster the skills for quality assessment in mathematics among prospective teachers.
(2) To explore the extent to which these practices helped in improving quality of learning as well as teaching.

III. METHODOLOGY

The study was done in MCD primary schools of Delhi from class II to V with the involvement of pre-service B.El.Ed. Student-Teachers during their primary school internship in 4th year. The study comprised of four phases. **In phase I**, authors did a survey of the assessment practices that have been followed in these schools. Student- teachers also observed the kind of assessment practices being pursued in their respective schools of teaching. **In II phase**, Student-teachers reviewed the assessment practices going on in the schools critically. They were given an orientation to prepare assessment profiles of their students in order to monitor the progress of their students as well as to measure the extent of fulfilment of their learning objectives. In this phase, authors and students-teachers prepared format for assessment profiles of individual students comprising four point rubrics (Annexure A) and anecdotal records through extensive discussion. The rubrics laid down concepts /sub concepts to be dealt, assessment indicators corresponding to the developmental, enrichment and assessment tasks prepared in the lesson plans, four categories (Excellent for full accomplishment, proficient for Substantial, Marginal for Partial, Unsatisfied for little) and comments . **In the III Phase**, students implemented these assessment practices in their respective classes for around three months under the supervision of authors. Student- teachers were supposed to prepare rubrics for each student periodically viz. a record for pre-requisite skills/knowledge in the beginning of teaching a theme, cumulative record having the sub-concepts to be dealt in a lesson plan, assessment indicators in correspondence with the activities prepared to deal with those sub concepts, to the extent students have achieved those concepts and comments (if any). **Phase IV,** the final phase allowed a discussion with student-teachers and analysed the feedback of pre-service teachers as to what extent and how these assessment practices helped them to take up decision regarding teaching as well as students progress in understanding the concepts.

IV. RESULTS AND DISCUSSION

The review of the assessment practices followed in MCD schools showed that it was based upon Paper-Pencil Test comprising of mechanical numerical questions with emphasis on assessing learners' ability of rote memorizing and proficiency of learning an algorithm or procedural skills, this kind of testing results into the termed as 'Illusion of competence'(Schoenfeld, 2007). Examples of some of these questions are:

Class II Q1. Write 1 to 100;

Q2.

6	5	9	8
+ 3	+ 4	- 4	- 5
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Q3. Write Number Names for Numerals:
1= 7=
5= 10=

Class III Q . 5 3 6 2 3 4 8 7
+2 5 + 5 8 -2 3 - 5 4
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Q. Writing of Multiplication Tables of 5 and 7
Class IV Q. Write in expanded form: 35,789
Fill in the blanks: a) ¼*20=_____ b) 12*5=___ c) 2 hours= …… min. d) I kg=……..gms

It was also observed that these tests were checked and students were informed about the marks obtained by them, but the students were not given any qualitative feedback. The review of the prevailing Mathematics assessment practices in these schools led to arise the need to record the students' progress periodically in order to inform students as well as teachers about the same. This further led to a call for means to record. Hence the rubrics and anecdotal records were suggested to record the assessment. The interns initiated the process of recording the assessment of pre requisite knowledge/ skills and periodic recording of the development of the concept being taught by interns.

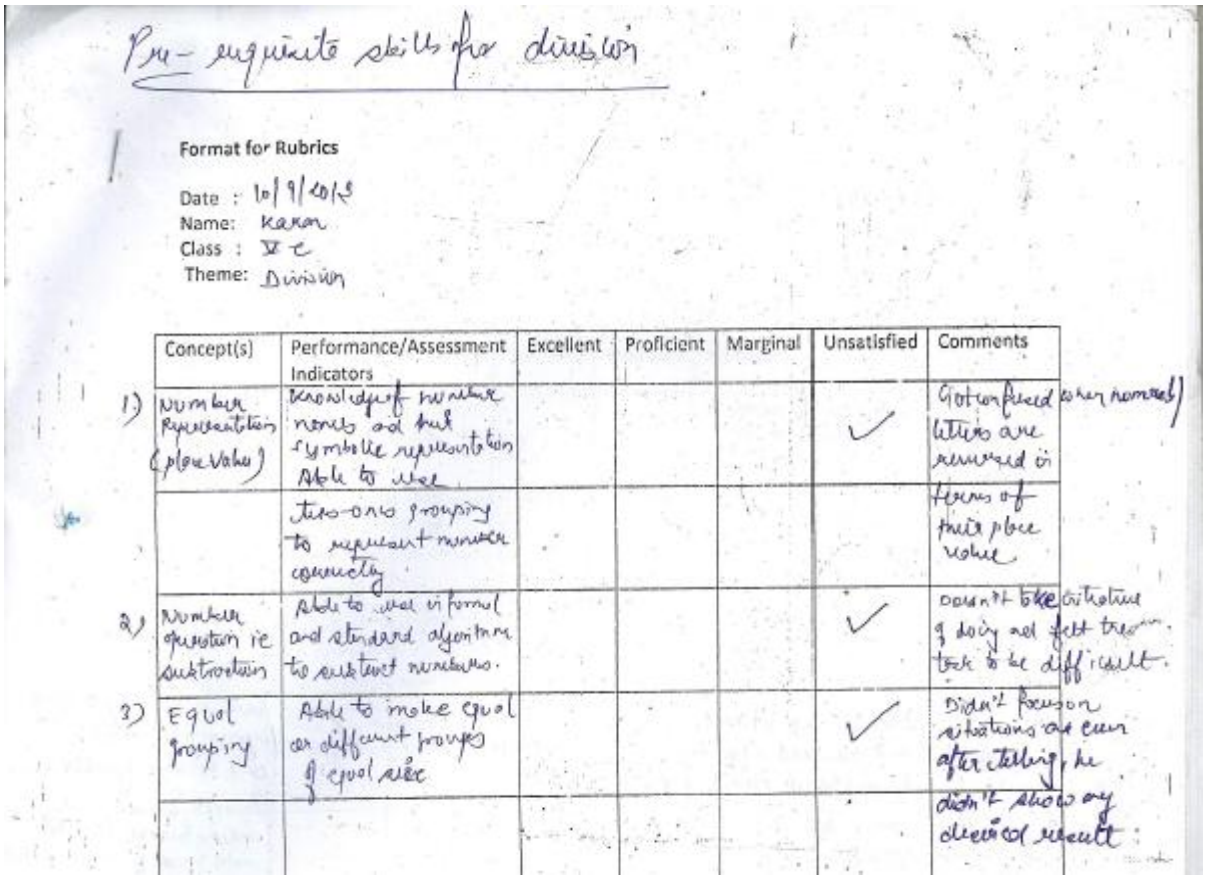
Layout of Rubric : A rubric format usually consisted of seven columns. First two columns were made for writing concepts or sub concepts to be taught in a particular Lesson Plan and Performance/ assessment indicators corresponding to the tasks/ activities planned for developing/enriching/assessing those concepts/ sub concepts. The next four columns were depicting four point/ scale to decide the extent the student is performing for particular sub concepts. The last column was for writing the qualitative description pertaining to the performance and understanding of the student in correspondence with the concept taught. Apart from the comments, interns use to write description about the process of students' learning through observation in anecdotal records.

Description of Karan's assessment profile made for division concept : One of the interns has taken number representation (place value), number operation (Subtraction) and equal grouping as pre requisite concepts for teaching division in class V. The assessment indicators corresponding to the task prepared to assess these concepts were able to use knowledge of number names and its symbolic representation and grouping of ones and tens to represent a number, Able to use informal and standard algorithm to subtract numbers, able to make equal or different groups of equal size. She found one of student karan got confused when numbers are reversed in terms of their place value, didn't know how to subtract (as observed by intern that Karan asked her to do the sum on the blackboard) and found it to be difficult and when required to make equal groupings of the material provided say pebbles ;didn't comprehend the situation and no desired outcome given by him(as observed by the intern in the task given to distribute 20 pebbles in 5 groups equally he responded there will be 6 groups and when asked to reason out he just smiled….).
The assessment indicators corresponding to the concepts in lesson plan 1 namely Repeated subtraction; Equal Sharing; Equal Grouping and Division Facts were Comprehend division as repeated subtraction in different contextual as well as other tasks designed in the plan; able to divide equally the objects in respective number of sets provided during activities ; divide equal groups when number of objects are provided and able to write in symbolic language the division situation respectively . It was recorded that Karan shows marginal comprehension as needs persistent help to do repeated subtraction and with this has improved consistently and graduated from marginal to being proficient; develops little understanding of equal sharing and only by scaffolding can understand division as equal grouping and not able to formulate the division facts .

The observations and anecdotal records recorded by intern:
Observation and Ancedotal Record corresponding to equal grouping
Intern : Provides with a paper strip of length 10 cm and asks to cut out strips of 2cm each and find how many such strips can be cut off .
Karan 's Response : Performed the task but couldn't verbalize it and responded "Panch baar katenge" (We will cut five times)
Intern I have 12 pebbles to be distributed equally among 4 students .How many will each student get ?
Karan :4
Intern : Karan how will each get 4 ?
Karan : No Reply
Intern : Do it and tell

Intern You have to distribute among 4 friends so make 4 friends (scaffolds to draw four faces) and distribute pebbles to the friends equally
Karan performs as scaffolded
Intern How many did each get ?
Karan Each gets three
So it was observed that with consistent scaffolding Karan responded but when provided with no scaffolding he was not able to perform on the contextual situations related with equal grouping.

Observation corresponding to Division as Equal sharing
Intern presented a situation to children in order to observe how students respond to equal Sharing approach
Intern : Kareena bought 25 mangoes from the market and placed 5 mangoes in one basket .How many baskets does she require for 25 mangoes .
Karan : Places 5 pebbles (each pebble considered as one mango) at different places
Intern : But Kareena placed 5 mangoes together in one basket ,not separately
Karan : places 5 equal mangoes (5 pebbles) in each group and continues with the process till all 25 pebbles i.e the visualized mangoes are used and responds 5 baskets are required
Intern observes and records that along with persistent scaffolding she requires the use of different modes of representation and Karan does responds to do these tasks physically however not able to write the corresponding Division facts employing the symbolic language
The concepts in third lesson plan were Relationship between multiplication and Division ;Factors ;Division facts; Patterns in Division ;Division in Everyday life ;Informal and Formal Algorithm for Division and respectively the assessment indictors were Demonstrate initial understanding of Division and Multiplication situations and represent correctly using mathematical symbols ;demonstrate initial understanding of factors in division ;able to use symbolic language of division; able to recognize different patterns in division ;able to comprehend meaning of division in everyday life and able to use algorithm (formal and informal) to divide numbers correctly. It was recorded that Karan showed marginal performance in relationship between * and ÷ and knowledge of division facts .He was proficient in responses related to division in everyday life but showed unsatisfactory response in Patterns in division and Informal and Formal Algorithm in Division.



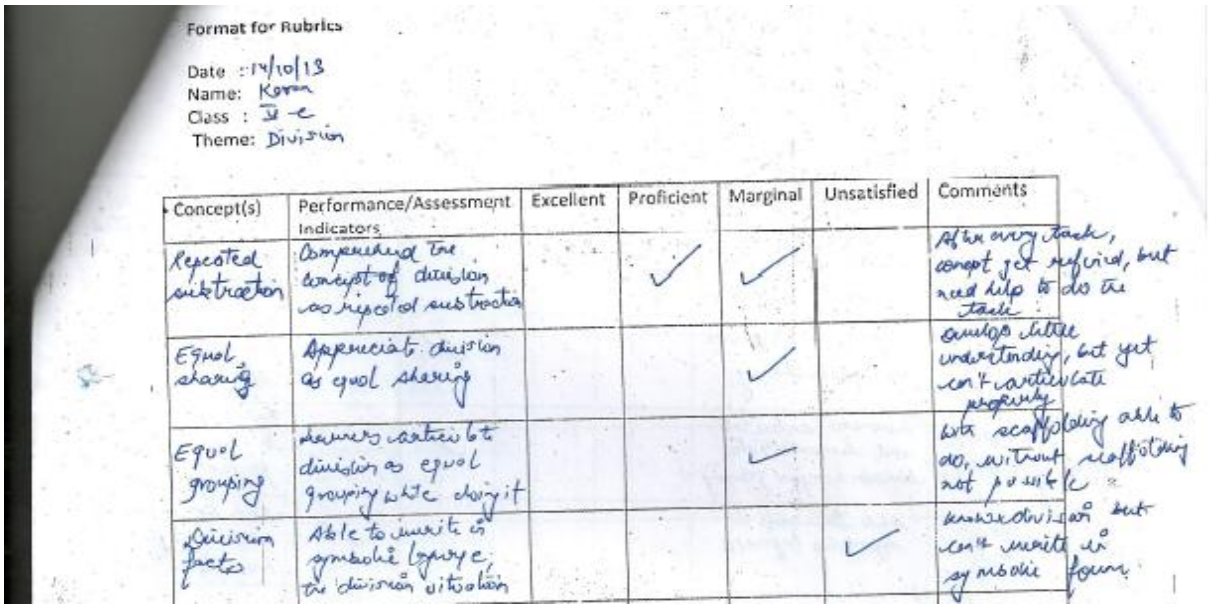
Pre-requisite skills for division

Format for Rubrics

Date : 10/9/2013
Name: Karan
Class : V c
Theme: Division

	Concept(s)	Performance/Assessment Indicators	Excellent	Proficient	Marginal	Unsatisfied	Comments
1)	Number Representation (place Value)	knowledge of number names and their symbolic representation Able to use				✓	Got confused when numerals/ letters are removed in terms of their place value
		One-one grouping to represent number correctly					
2)	Number operation ie subtraction	Able to use informal and standard algorithm to subtract numbers.				✓	doesn't take initiative of doing and felt the task to be difficult.
3)	Equal grouping	Able to make equal or different groups of equal size				✓	Didn't focus on situations and even after telling, he didn't show any clear result.

Rubric in the beginning of the theme Fig. 1

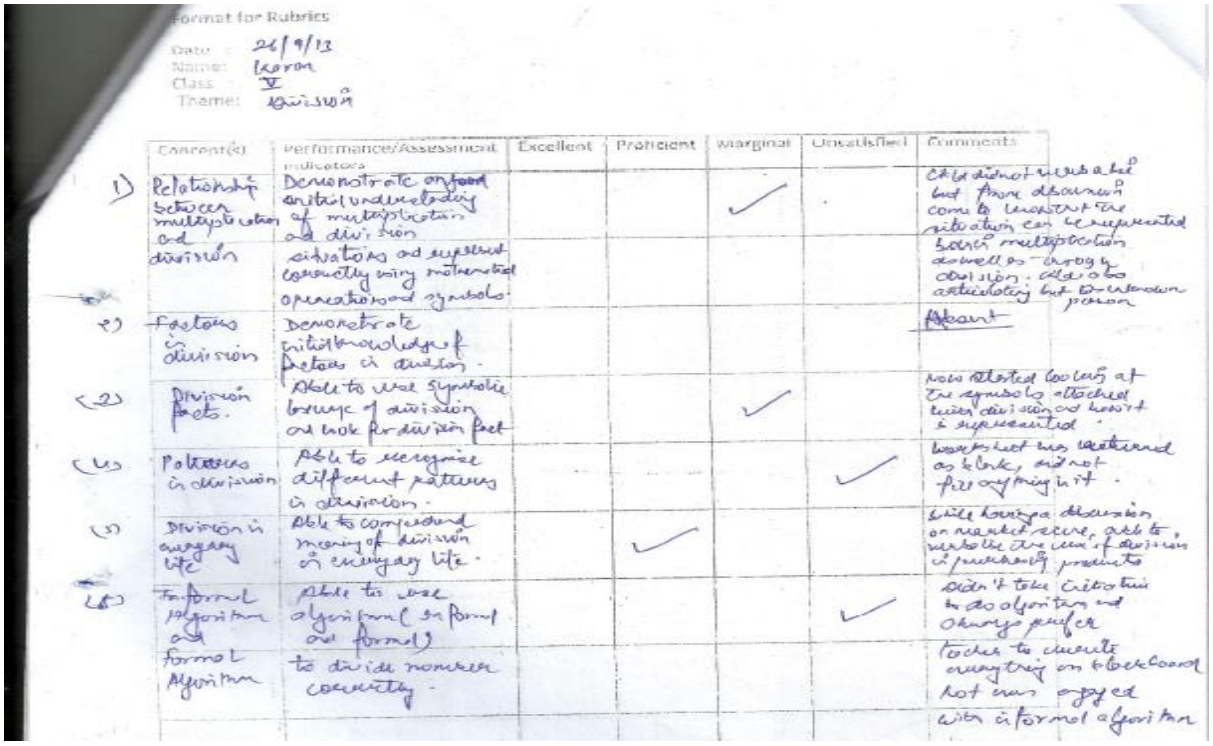


Format for Rubrics

Date : 14/10/13
Name: Karan
Class : V-e
Theme: Division

Concept(s)	Performance/Assessment Indicators	Excellent	Proficient	Marginal	Unsatisfied	Comments
Repeated subtraction	Comprehend the concept of division as repeated subtraction		✓	✓		After every task, concept get reflected, but need help to do the task.
Equal sharing	Appreciate division as equal sharing			✓		Emerge little understanding, but yet can't articulate properly
Equal grouping	Learners contribute division as equal grouping while doing it			✓		With scaffolding able to do, without scaffolding not possible
Division facts	Able to write in symbolic language, the division situation				✓	Knows division but can't write in symbolic form.

Rubric of LP 1 fig. 2



Format for Rubrics

Date : 26/9/13
Name: Karan
Class : V
Theme: Division

	Concept(s)	Performance/Assessment Indicators	Excellent	Proficient	Marginal	Unsatisfied	Comments
1)	Relationship between multiplication and division	Demonstrate an understanding of multiplication and division situations and represent correctly using mathematical operations and symbols			✓		Child didn't recollect but from discussion comes to know that the situation can be represented both multiplication as well as through division. Child also articulating but unknown person
2)	Factors in division	Demonstrate initial knowledge of factors in division.					Absent
(2)	Division facts.	Able to use symbolic language of division and look for division fact			✓		Now attested looking at the symbols attached with division and how it is represented.
(4)	Patterns in division	Able to recognize different patterns in division.				✓	Knows but was understood as blank, and not processing with it.
(5)	Division in everyday life	Able to comprehend meaning of division in everyday life.		✓			Little bit on discussion on market scene, able to verbalise the use of division in purchasing products
(6)	Informal algorithm and formal Algorithm	Able to use algorithm (informal and formal) to divide numbers correctly.				✓	Didn't take initiative to do algorithm and always prefer Teacher to execute anything on blackboard Not even exposed with informal algorithm

Rubric of LP 2 Fig. 3

In the above format assessment was recorded for all the students and for all the themes taught by the interns during their Internship.

The consequent discussions with the interns revealed that this exercise of periodic assessment and subsequent recording assisted them and enabled them to use assessment profile as a resource in many ways:

- Interns were able to design group tasks; the groups were made to optimize peer learning as the group members were chosen in correspondence with assessment profiles and provision made to facilitate the construction of heterogeneous groups empowering peers to be involved in the process of interacting with each other; An Excellent category learner often assisting the learner…....with marginal indicators.
- It gave intern a chance to observe and interact with learner sincerely and look into their processes of learning.

- Designing of tasks to accommodate the individual needs of the learners. Assessment profiles suggested that learners are at different levels of responses; so interns ought to design the further task in correspondence to these responses and therefore assisted by different modes of representation.

However, there are many challenges faced by interns while keeping the record:

- Apart from observations, interns had to interact personally a lot with students in order to write anecdotes in order to explore learners' conceptual understanding and reasoning.
- Plan for scaffolding or interacting can be a part of the rubric in order to assist the child regularly though a peer or teacher herself.
- It was found to be difficult to maintain record for each student during internship.
- Some interns suggested- why not to record only unexpected outcomes of the students or unusual outcomes. In other words, class performance should be seen holistically, there is no need to record for every student in the class as teachers of the class usually aware of students' level of understanding.
- Absenteeism of students made it difficult to maintain these records.

V. CONCLUSION

The study concludes that there is need to prepare pre-service teachers for alternate assessment practices. However it imposes some extra work load on them as per the discussion. The results of the study also revealed that categorizing students on different scales depends largely on student-teachers mathematical Knowledge for teaching. In the study, the assessment profiles lay explicitly the assessment of Mathematical Concepts; Mathematical Reasoning and Application of Mathematical Concepts .Mathematical Communication and Attitude of the students towards Mathematics though observed but has not been recorded. Modified forms of the rubric can be implemented with pre-service education. Future researches can be done in the area of forming assessment indicators, concept maps and the relevant assessment tasks.

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Note: there is no second author in the paper. Both have equally contributed.

Annexure I

Format for Rubrics

Name:

Class: Theme:

Excellent-Full Accomplishment; Proficient- Substantial; Marginal- partial; Unsatisfied-Little

Concepts	Performance/assessment Indicators	Excellent	proficient	Marginal	Unsatisfied	Comments