

Using Classroom-based Tasks as Contexts for Reflection and Situating Teacher Learning

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Teacher learning remains a significant concern in the context of teacher education. The current discourse on teacher professional development places high demands on teacher educators to design tasks which facilitate teacher learning. However, little support is offered to teacher educators to equip and encourage them to design tasks such that the aim of continuous professional development of teachers as well as their own can be attempted for.

The paper reports a case study where students' responses on different mathematical tasks were used as contexts for stimulating discussions and reflection with the teacher. Findings of the study suggest that such a framework for reflection encourages teachers to explicate their knowledge and reflect on classroom teaching. An analysis of classroom gives valuable insights into ways in which children think through mathematical problems. Also, it is suggested that design and initiation of tasks, coupled with teachers engagement in critically analysing their classroom discourses, serve as meaningful contexts for teacher learning.

An attempt of this kind has implications for preparation of teacher educators in planning their pedagogic discourses with teachers by contextualising them. Teacher educators can engage with more realistic and complex experiences of teachers arising in situ and support teachers in ways where a mutual learning environment can be created. Pedagogical approaches where teacher educators offer such situations and listen to teachers, would lead to useful insights into teacher (and teacher educators) learning from practice.

Introduction

National Curriculum Framework (2005) places the role of a teacher at the centre stage of educational processes in which education is envisaged to bring about social transformation. A teacher needs to be prepared in relation to the needs and demands arising from the school context, to engage with questions of school knowledge, the learner and the learning process (NCTE

2009/10). Besides acknowledging the need for informed and reflective teachers, it is important to recognise the value of teachers who have developed in themselves an attitude of learning through teaching. The larger aim of 'teacher learning' can be achieved through teacher education programs, which engage teachers in intense academic deliberations with the teacher educators. Ironically, the vision among teacher educators on how effective learning opportunities can be created for teachers through pre-service and in-service teacher education programs seem to be quite hazy. The field thus encounters a paradoxical situation. On one hand, there is an absence of a curricular space that encourages teacher educators to critically analyse concerns in teaching practices and in designing purposeful engagements for teachers to learn from. On the other, freedom to designing teaching experiences is loaded with hidden agendas, socio-political shades of context that seep in and quite often perturb the motivated teacher.

Although NCTE (2009/10) makes an attempt to specify the domains that teachers should be exposed to in teacher education programs, it remains silent on (a) how could teacher educators design such learning experiences, and (b) what are the sources that teacher educators can rely on to plan these experiences. This paper proposes to address these important issues and illustrates through the example of a case the value of such an outlook. A task-based approach to organise learning experiences for teachers by the teacher educators is being proposed in this paper. For teacher educators, tasks play a dual purpose – they serve as an important medium for engaging teachers to think about crucial issues in teacher learning, and provide the content and means by which learning (of teachers) is facilitated through a reflective process of designing, implementing, and modifying tasks. In doing so, tasks evolve into authentic means for mediating teacher educator's learning. The design and implementation of tasks for teacher preparation not just orients teachers to a way of thinking but also decides the nature of classroom processes that a teacher would like to initiate in their classroom. To gain a comprehensive understanding of tasks and its value for teacher development, it may be useful for us to study similar efforts by teacher educators in the past, in India and elsewhere to operationalise the goal of teacher learning .

Defining tasks

One of the common aims of teacher development programs is to help teachers gain the necessary content and pedagogical knowledge required for teaching as well as the epistemological knowledge of students' learning. Teacher education strives to make prospective and practicing teachers more knowledgeable, reflective, adaptive, insightful, resourceful, and competent in handling difficult classroom situations (Zaslavsky & Sullivan, 2011). Teacher educators are expected to create opportunities for learning where teachers are encouraged to challenge their existing orientations

(beliefs, ideas, views, etc.), appreciate teaching as learning, learn content and skills required for effective communication of the knowledge, and develop sensitivity to issues concerning the social context of students' learning in a diverse classroom. The aims can be achieved through designing effective tasks (as different from activities) where teachers gain knowledge and reflect on their learning.

A *task* is defined as a planned engagement with a pre-decided goal and definite purpose(s). It is designed keeping in mind the nature of learning that we aim to elicit and ways in which it can be achieved or attempted for. A task has the power of doability, purpose, meaning, concept, and the necessary challenge to evoke a response. There is substantial literature that has established the critical role that tasks play in creating opportunities for teacher learning, especially in the domain of mathematics education. The paper draws on the literature and empirical work to build conceptual arguments for the significant value in harnessing tasks for teacher learning. It may be worthy to state that a task-based approach has its implications for other disciplines as well. Implicit in our stance for a task-based approach is the premise that 'teachers and teacher educators are to be considered as constant learners who continuously reflect on their work and make sense of their histories, their practices, and other experiences' (Zaslavsky & Peled, 2007). Thus it is important that the selection, design, and implementation of a task chosen is determined by the contextual variables like the social setting of the school, classroom culture, students' backgrounds and foregrounds, etc.

Potentials of tasks in mediating teacher learning

Tasks can be used with teachers in multiple ways. Teachers can be prompted and encouraged to cogitate on their personal experience of doing tasks individually or in groups. A general framework for designing tasks for teachers can be classified based on the mathematical, pedagogical, and curricular aspects. Each of the three aspects have an established legitimacy as factors which are necessarily a part of teacher education programmes. Zaslavsky and Sullivan (2011) have developed a conceptual framework with eight unifying themes considered to be the goals of designing tasks for teachers by teacher educators. There are two mutually significant ways of considering these themes. *First*, these are qualities that teacher educators must exhibit when they work with teachers and *second*, these are set of goals that teachers may be expected to develop through the task-based approach. Each of the themes is briefly elaborated along with a few suggestive practices which address the specific goal.

1. *Development of Adaptability* – Teachers need to be flexible in their approach towards teaching and learning in classroom. This kind of an orientation would mean considering variations to questions, strategies, curriculum, time spent, resources, and unpredictable

classroom events. Everything in teaching cannot be planned. Teaching needs to be tailored to suit the cognitive level of students and should be done in a manner which is adaptive to the learners' needs. Spontaneity to respond to situations arising in the classroom is related to teacher's in-the-moment decision making. Openness to alternatives and different mathematical ideas and procedures, ways of thinking and problem solving would help teachers to utilise mathematically rich opportunities arising in the classroom. Practices which exemplify adaptability are – changing a problem for different levels of cognitive challenge, deciding on the difficulty level of questions, identifying and calling upon connections across the curriculum, etc.

2. *Fostering awareness to similarities and differences* – A fundamental aspect of mathematical thinking is to look for commonalities and contrasts in mathematical objects. Classification is based on the ability of connectedness. Considering links between concepts, methodologies, solutions, procedures, strategies, and contexts helps in making learning meaningful. Teachers should be equipped to classify classroom situations as those which serve as learning opportunities for students from others. Learning to distinguish between the surface and deeper features of a problem, is another example where the teacher is expected to analyse the problem (through compare and contrast) and decisively sort different textbook problems on the criteria chosen. Apart from sorting, different kinds of mathematical problems/ situations where mathematical objects can be categorised in more than one ways are challenging and attention grasping.
3. *Coping with conflicts and dilemmas* – The dilemmas or conflicts that arise in the routine teaching are beyond the control of teachers. However, teachers can be prepared to address such unanticipated problems by reflecting on situations where an unplanned event occurs. Teachers' responses and shared knowledge of such situations would prepare them for reflection-in-action and encourage them to re-examine their and each others' personal response. Discussions and creating a shared response to such situations in teaching is a valuable task in itself. Literature with psychological studies looks at conflicts as an important landmark in learning. It also suggests that conflicts need to be addressed through counter explanations and by creating opportunities where confrontation for inconsistencies can be made possible through social interactions.
4. *Designing and solving problems for use in mathematics classrooms* – Teachers need to be exposed to different kinds of problems that relate to a particular mathematical concept. Engaging teachers in solving a variety of problems creates familiarity and awareness to different problem structures and helps them to become more fluent and confident while

handling them in classroom. Also, needed is an exposure to different ways of approaching the problem and different solutions that the same problem may offer. Solving and framing problems with multiple solutions is a stimulating, and insightful task. Problems that offer different representations or which make use of knowledge from different domains other than mathematics are other such examples.

5. *Learning from the study of practice* – The most closer resource for learning, available to all teachers, is their own practice. Most often, it is argued that the teacher education curricula is theoretical in nature. This means that the complexities of practice are not entertained in such a framework. Bringing in the field experiences of immersion into school and classroom practices are not only useful in giving a real picture of the context of teaching, but will also prepare teachers to work in the setting and reflect on it. Various theoretical stances can be appreciated and assessed vis-a-vis their practical implementation, so that the commonly stated problem of the gap between the theory and practice can be utilised to gain insights for teaching and learning (Takker, 2011). It is important to acquaint teachers with tasks where they reflect on their own as well as others' teaching, through video-analysis of exemplary lessons. Classroom situations can be posed as situations for teachers to ponder upon.
6. *Selecting and using appropriate tools and resources for teaching* – Examples of tools used in teaching are textbooks, manipulatives, reference material, technology, graphs, etc. An appropriate selection of tools and communicating the mathematical idea through its use is an important skill that teachers need to possess. It is important for teachers to make educative choices about tools used and how to use them in accordance with the purpose. The cultural and contextually available tools like language, objects, etc. can also be utilised to supplement teaching. The knowledge of tools should be accompanied with an awareness of the strengths and limitations of these tools for various purposes and contexts, along with building the confidence in using them.
7. *Identifying and overcoming barriers to students' learning* – There are certain social, epistemological, and political factors that operate in the environment of schooling where teaching and learning takes place. It is important for teachers to know about the effect of each of these factors on students' learning. The lags in students' learning arising from prior knowledge or lack of connections established, biases in learning from home or society (like gender, class, caste) or physical differential abilities should be sensitively addressed. Teachers need to learn to handle a verity of such factors and their combinations in their classroom. By building communities of learners, carefully choosing examples while explaining, and being open and sensitive to students' thinking could be ways in which

teachers can make their classrooms more inclusive.

8. *Sharing and revealing self, peer, and student dispositions* – Teachers and students come with their own baggage of beliefs, attitudes and behaviours towards the subject, setting, and others in the group. It is worthwhile for teachers to be aware of their own dispositions with respect to the discipline, teaching and students' learning. Situational tasks need to be designed for teachers to articulate and understand different kinds of orientations (that they might have) and their impact on learning in classroom. Openness and flexibility in a classroom where students have different kinds of preferences, attitudes and beliefs can be achieved by designing differential learning experiences for students and observing students' actions and interactions with self and others.

Teacher educators can utilise from a synthesis of resource materials as well as draw from the experiences of teaching which prospective and practicing teachers bring to their classroom. Some of the significant resources for teacher educators are research papers (on teaching and learning), books, visits to academic institutions, field experiences of teaching, observing classroom of their peers, and most importantly reflecting on the experience aimed towards learning about and through teaching.

Design of tasks by teacher educators

The socio-cultural perspective on professional learning discussed above is promising, it gives scope for continuous learning to those involved while being a part of the process. It also emphasises that sources of our learning lie in the people around us who scaffold our learning at different levels and mediate it through the use of appropriate tools. Teacher educators can mediate teachers' learning through planning and orienting actions to pre-planned goals. A task-based approach is grounded on the belief that teachers learn not only from the tasks posed to them but also by observing ways in which they are executed by teacher educators. For designing and implementing tasks, teacher educators need a strong knowledge base of mathematics as well as knowledge of mathematics for teaching. Teacher educators need to be receptive to teachers' questions, flexible and adaptive to different situations arising through discussions, and explicate their reflections. These serve as sources for teachers to learn from and prepares them to respond to situations arising in-the-moment in classroom. Such ways of dealing by teacher educators serve as examples for teachers to learn from and also help them develop a rapport and comfort for addressing the complexities in different settings.

Teacher educators can use tasks as cognitively coherent entities, which provide context for discussions on mathematical knowledge, pedagogical aspects, and for understanding the dynamics

of classroom teaching and learning. Tasks are designed by teacher educators in ways which benefit their interactions with teachers by focussing on central issues that concern the process of teaching and learning. In this process, teacher educators use tasks to pose challenge to teachers' intuitive notions about mathematical concepts and pedagogy, resolve conflicts arising from the dissonance between intuitive and analytical thinking. A variety of tasks should help teachers to think mathematically; build an informed framework to ground their arguments, practices, and ideas; and learn ways in which these ideas could be communicated effectively to students for learning to take place. Reflections through carefully crafted tasks will open avenues for the community of teachers and teacher educators to learn from each other.

Taking tasks to practice – case study of a mathematics teacher

Keeping these theoretical ideas in the background, an attempt was made in the direction of designing and implementing a task for teacher *learning from practice*. The development of task evolved with increased interactions with the teacher and familiarity with the settings. The study reported here is a case study of a practicing mathematics teacher of Grade VII, working in a private school in Mumbai. An important consideration for the task developed was that the attempt was made to use teacher's own classroom teaching as a resource for discussions among the teacher and researcher. Since the task was conducted *in situ*, the focus of discussions were classroom teaching processes and students' responses to mathematical tasks posed by the teacher. The objectives of the study were to understand and develop teacher's knowledge and responses to students' mathematical thinking in classroom. An assumption underlying such an attempt was that teacher's *knowledge of practice* is a significant source for teacher *learning from practice*.

Knowledge about students' thinking was operationalised as knowing the details of how ones students are making sense of a particular mathematical concept as well as, knowing in general, how students learn different mathematical concepts (Franke et al, 2007). It is argued here that discussions about students' mathematical thinking offers an appropriate context for engagement and reflection with the teacher, thus leading to teacher learning about her students as well as her own teaching. Teacher's awareness and/or openness to students' strategies or ways of solving problems and channels through which these can be utilized for building on students' mathematical learning constitutes this part of teacher's knowledge. Many researches inform our understanding that teachers who understand their students' thinking can support the development of mathematical proficiency. It is said that preparing teachers to teach in new ways requires that they be provided opportunities to reason in and about practice and to learn to listen to, hear, and watch students (Sowder, 2007). It is well known that teachers are engaged in different kinds of academic and non-

academic work apart from teaching. An expectation from them to think about their students' thinking and articulate that knowledge is a task in itself, which requires a different orientation towards teaching. For a teacher to be able to talk about her students and their mathematics requires a closer observation to individual (or groups of) children, along with a general understanding of how students of a grade respond to the mathematical ideas being discussed. In the study elaborated below, teacher's knowledge about her students' learning of mathematical ideas and how she responds to it in classroom was the major focus of discussion, reflection and therefore learning of teacher and researcher.

A different methodological framework was employed to collect data about teacher's knowledge and students' responses, details of which can be found from the main work. The classroom observations were complemented with interactions with students and the teacher prior to and post teaching. The data from each classroom segment (before, while and after teaching) was used for discussion with the teacher. After completion of a cycle of observations for one of the mathematical concepts (proportion), teacher was requested to anticipate students' responses on different proportion word problems (with reference from research literature) posed by the researcher. Mixed ability students were selected by the teacher to solve these problems. These students were interviewed as they solved these problems to understand their thinking while they were working on these problems. The written and oral responses from students were used as contexts for furthering discussions with the teacher.

Insights from classroom observations and interactions with the teacher and students were useful to get an overview of the classroom processes – nature of discussions, routines and norms of classroom, expectations from students, etc. It was also helpful in getting to know how students, teacher, and the researcher viewed the same classroom in different ways. The data obtained from the two sources – observations and interactions was analysed for patterns in (a) students' thinking through the questions raised by them and strategies used to solve problems posed by the teacher and researcher, and (b) teacher's responses to students and in-the-moment decisions in the classroom.

The findings of the study illustrate that teacher's conceptions about students and their learning are restricted to students' performance and articulation in classroom. There is less awareness and sensitivity to students' errors and difficulties in learning the particular concept. Also, although there are attempts to know about students' responses to mathematical problems, what is implicitly encouraged is the algorithmic way of solving these problems. On probing the teacher, it was found that she justified her classroom practices in two ways – *first* through her goals of teaching mathematics understood as preparation for the board examinations and *second* by distinguishing between the informal from formal mathematics learnt at school. Lack of awareness about students'

mathematical knowledge and ways of thinking led the teacher to classify students' sophisticated strategies as 'common-sensical' and informal, and therefore indicating no learning of the concept taught by her. Teacher's belief in the algorithmic way of solving mathematical problems and in emphasising the method proposed by her as 'the method of working' was evident in thinking aloud about students' responses. Understanding that teacher has an orientation towards teaching and learning mathematics algorithmically and conceptualisation of her role in preparing students for performing in the standard examination, was insightful. The discussion on students and their classroom responses created a discussion where teacher's beliefs, goals, and ideas were explicated and were available as 'content' for reflection and learning. However, as the teacher moved on to anticipating her students' responses to some of the mathematical problems (similar to what she had done with the students), there was an explication of the expectation that students would use the method taught and concepts which are not taught will be left unanswered by the students. The cognitive conflict was created in the teacher's mind when she saw that students solved all those problems which involved concepts which were not taught and for which the teacher expected a response that "*it is out of our syllabus*". Reflections with the teacher in reference to examples from her classroom and (correct) strategies used by students on the 'not-taught' set of problems, were sources which were utilised for challenging teacher's orientation about students and their learning of mathematics. It can be said that this juncture of the study marked the beginning of a shift observed in teacher's thinking about students' knowledge of mathematics. There was rethinking and conscious reflection on what the teacher believed were ways of teaching and learning mathematics

This study points towards a need for teacher educators to begin making themselves and teachers aware of their dispositions towards teaching and learning of mathematics. Like students, teachers' experiences are varied in nature. It is important for teacher educators to take into account what teachers have learnt from their practice. An acknowledgement of the nature of knowledge possessed by teachers will provide a direction for a focused interaction between teacher and teacher educators. Also, such an environment where teachers get to share their experiences will help teachers reflect on their practices as well as serve as a potential source of learning for other colleagues. An important insight from the study is the need to sensitise teachers to students' thinking and ways of learning as important sources for planning and conducting their lessons. Discourses centred around students' thinking and learning have to be tied with discussions about the conceptual understanding in mathematics and in choosing appropriate pedagogies for transacting the content. Understanding and appreciating students' prior knowledge and content – related learning difficulties would initiate teachers in designing tasks which stimulate their thinking and are cognitively appropriate for them.

Thus, the knowledge of children's thinking and responses to it served as significant sources of learning from the classroom context, for the teacher as well as teacher educators.

Implications of tasks for teacher educators

The development and trials of tasks can be aligned with the sub-goals of teacher education in many ways. Tasks can be used by teacher educators to facilitate teachers' learning as well as their own. In order to develop tasks for teachers, teacher educators need to possess a sound knowledge base and personal traits like flexibility, openness, involvement, confidence, etc.; all of which they would like the teachers to possess. The general aim of designing tasks for teachers would be to foster an attitude towards learning while teaching and equipping them to identify sources from their contexts to facilitate learning in students. In general, tasks for teachers focus on three main elements: (a) doing mathematics which involves solving problems, identifying patterns and connections, and classifying mathematical objects; (b) dealing with actual tasks for students, for instance analysing, comparing, solving, extending, generating through lesson planning and explaining; and (c) examining students' thinking by analysing students' responses to a mathematical task or classroom events that reflect students' thinking (Zaslavsky, 2007). The third way has been exemplified in the task developed in the case mentioned above. A step further would be to design tasks that engage teachers to articulate, discuss, and evaluate the curricular propositions vis-a-vis their practices, and related classroom processes (Takker, 2011). However, the decisions on the modes of implementing tasks and the settings (where teachers will be exposed to such tasks) is an open question for the teacher educators.

Carefully designed tasks can be used with teachers to help them learn important mathematical ideas, critically evaluate their own dispositions, and articulate their assumptions about the curriculum, subject-matter, learning and teaching. A reflective attitude gets nurtured in teachers through the use of tasks which encourage them to explore their settings, argue and discuss the ideas learnt or thought, solve a variety of problems, and get involved in the process of learning the subject and its intricacies. The strength of mathematical tasks lies in tracing mathematical contexts, appreciating the linkages between concepts, providing mathematical reasoning, and creating a shared knowledge base. All these provide as means through which the curricular goals can be meaningfully transacted, through effective pedagogies after undergoing critical reflection and planning.

A task-based approach to teaching and learning would involve addressing issues related to content, pedagogy, and resources available by connecting them with teacher's existing knowledge. It is critical to highlight the connections and relationships between mathematical ideas, concepts, etc. such that learning about teaching is a meaningful whole and does not remain constrained to the

departments of distinct content, pedagogy or psychology sessions in a teacher education program. Since all of these operate simultaneously and often in a complex manner in classroom settings, preparedness for situations erupting in the classroom should be used to weave teacher's learning into a coherent whole.

Vision for Teacher Educators

Teacher educators have the task of organising learning spaces and contexts for teachers. The role of teacher educators is crucial for teacher preparation and education. They bring in a broader perspective to education as they are working at the two planes of specific practical engagements of teaching as well as broad theoretical ideas which are envisioned and proposed with the aim of their critical evaluation in practice. Tasks help teacher educators to organise the learning experiences of teachers in ways aligned with the objectives of the larger goal of teacher development and learning. As discussed, teacher education can be conceptualised around three themes: equipping teachers with the content, pedagogy, and epistemology as preparation for teaching. This paper argues that tasks provide meaningful contexts for teacher educators to create rich opportunities for teacher learning as well as their own learning in the process. Teacher educators can engage teachers in task which are purposeful and have direct implications for practice. For this teacher educators need to prepare themselves with tools and qualities which they expect their teachers to acquire.

The design and implementation of tasks for teacher education for enhancing teacher learning is different from taking the tasks from research literature and applying them in practice. The process of making and choosing between different tasks that have different constraints and purposes addressed, teacher educators can plan their engagement with teachers. Teacher educators can create a community where they make a shared understanding of the necessary knowledge and skills that the teacher education programs should provide to prepare teachers for teaching in classrooms. The planning, implementation, and reflection on tasks done with teachers can be shared and discussed. The ideas from research and practice of other educators and researchers in the field can be collated and discussed in a forum like this (RIE conference). The learning of teacher educators from each other and personal trials of tasks would provide enriching experience not only in contributing to developing a practice based literature on tasks but also in knowing more about ways in which diverse teacher communities respond to them. The mutual learning environment created from the use of tasks would enhance the teachers' understanding and knowledge and develops insights into use of tasks by teacher educators with a flavour of concrete reality.

Success in designing effective tasks for teacher education relies on drawing from the synergy between immediate experiences of teachers, classroom practices, and the informed enthusiasm of

the teacher educators. Such a confluence will help in sequencing and structuring learning through carefully designed interconnected tasks and is also a way of ensuring collaborative participation towards making the process of teaching and learning effective and grounded. The larger aim for teacher educators remains to guide teachers and scaffold their transition from active participation in exemplar tasks to encouraging them in harnessing their classroom experiences to construct novel tasks and contribute to the field of teacher learning and development.

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