Developing Cognitive Flexibility

Satyawati Rawool
P. V. D. T. College of Education for Women, Mumbai, India

To represent "content knowledge" in the textbook simple looking, stereotyped, abridged forms are used. These knowledge representations are treated as the "ideal and only correct one" by many teachers and learners. The way teachers learn the mathematics and the way they teach it to pupils lead them to believe that the mathematical knowledge is rigid and rule bound. Consequently for most of the learners, mathematics learning ends in remembering textbook representations. If learners are assisted to make textbook representations meaningful for themselves then mathematics learning may not be drudgery for many of them. It is not possible for any educator to evolve a constructivist-learning environment all of a sudden for helping learners of any level to change their attitude toward mathematics learning. As a teacher one has to make deliberate efforts to create learning experiences that may bring in change in the mathematical activities in the classroom.

Available research findings show that if learners are assisted to represent their thought processes and understanding, using "different contexts", "different media" and "different modes" the learning situation becomes complex and challenges learners to be active. The situations thus evolved forces learners to work in collaboration for making textbook learning meaningful. The learners while revisiting their previous learning are expected to liberate themselves from the way of understanding and create many ways of understanding mathematics. The cognitive flexibility theory is relevant in this respect as it makes specific recommendations about multiple approaches that range from multiple organizational schemes of subject matter for instruction to multiple representations to be organized, taught and procedures and knowledge represented in different ways. One of the available modes for helping learners to act flexibly with respect to mathematical concepts is cognitive apprenticeship. By using this mode it is possible to model the process for learners and coach them to become expert performers. The critical feature of this mode is that the teacher is not supposed to serve as effective or flawless model (with intention). It is assumed that there is no idealized path for teaching or learning. The learners in this situation are expected to experience authentic way of doing mathematics.

This paper is based on my experiences with student teachers. Our learners are student teachers aspiring to become mathematics educators. They equal 'understanding' with 'remembering procedures for getting correct answers to the exercises that are given in the textbook'. They expect pupils to use the writing procedure that is given or rather dictated to them. Though clear instructions are given in the textbook for learners and teachers that they should try to use all possible methods of getting answers to the exercises, most of them think it as needless work. Efforts are made to help them to get experiences in learning mathematics as well as learning to design constructivist-learning environment. I expected to get answers to the following questions.

How far does a constructivist-learning environment help student teachers to change their views about learning in general and mathematics learning in particular?

Do the cognitively flexible environment and the cognitive apprenticeship approach help them become epistemically motivated with respect to subject knowledge and metacognitive aspects of learning?

Teaching and learning activities evolved were mentally engaging and needed relaxed atmosphere. Many learning cycles with emphasis on cognitive flexibility with respect to different mathematical ideas were needed for making student teachers comfortable with cognitively flexible learning environment. Learners appear comfortable with logical inconsistencies but become uncomfortable with flexible learning activi-

ties in the beginning as they feel that these are very complicated. They argue that they are in a position to answer questions related to the logic, as they are graduates but it is not possible with pupils. This opinion is consistent with the opinion of many teacher educators. They forget the fact that learning takes place only when the situation challenges a person. My experience with school children is different. Most of the school children enjoy this type of learning environment. Only few learners worry about important questions. If learner is epistemically motivated then she or he might ask questions related to the knowledge, the way it is represented and its origin. Epistemically motivated learners are 'inquisitive' and 'curious' about every experience they encounter. For example they may be asking questions like how a particular way of representing different mathematical operations has evolved, how much time and effort a particular human culture required to evolve mathematical concepts, are there different number systems with different logic, etc. My efforts as teacher educator did not motivate student teachers to ask these types of questions.

This cognitive apprenticeship did help some student teachers to change their view about learning of mathematics and about mathematics as a subject to some extent. Now they don't restrict their learning and teaching to solving exercises given in the textbook. They are motivated to learn more about subject but they are not yet empowered to question the authority of the textbook knowledge and fail to transfer this learning skill to the learning of other concepts. For example they did not able to apply this learning for studying concept of division or other concepts of this type. Similarly they did not think along these lines with respect to learning geometry. It appears that learners need more time to get attuned with this kind of learning approach. Another aspect was evident through reflective exercises and their narratives about learning experiences. Student teachers did not think that they were learning mathematics and learning about teaching mathematics simultaneously. Their stance was to learn to teach and not learning to learn and teach. Some students mentioned the fact that they don't find any instance to ask epistemological questions. Major hurdle in developing cognitive flexibility is the attitude of teacher educators as well as student teachers. They think that we as teachers of mathematics are there to develop convergent thinking (certainty) and not divergent thinking (uncertainty). Thus getting final correct answer using a particular method or procedure is their sole aim of teaching mathematics.