

Invited Lecture

Professional Development of Mathematics Teachers: Perspectives and Experience from East Africa

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ABSTRACT Teacher professional development is important in order for teachers to effectively address changing contextual realities. Effective professional development builds on teachers' experience and relates to their practice. The paper presents guiding ideas and lessons learnt from teacher development component of a research project that aimed at improving numeracy performance of pupils by focusing on teachers' assessment practices. Based on conclusions, recommendations are made for possible approaches to future PD especially in similar contexts.

Keywords: Pedagogical content knowledge; Professional development; Reflection.

1. Background

Villegas-Reimers (2003) views professional development (PD) as development in one's role as a professional. Mathematics teachers through participation in PD can work towards enhancing their professional competences. Professional development of mathematics teachers should be a continuing process in order to provide support in changing educational contexts. Teachers and their PD are part of the educational reform process but not always in central place (Dachi, 2018). Guskey (2002) maintains that PD should result in change in teachers' classroom practices, beliefs, attitudes, and ultimately influence positively students' learning outcomes. PD that results in change can be viewed as effective since it leads to improvement in professional work. At the same time, Korthagen (2016) contends that successful PD is one that takes into account the person of the teacher and what they value in their practice. Meaningful PD takes into account the experience of teachers in their professional learning process.

This paper will showcase a research project that had an emphasis on mathematics teacher professional development. The priority of the research project was to increase numeracy performance among pupils in selected Tanzanian primary schools by focusing on teachers' classroom assessment practices. The guiding ideas for professional development component will be discussed and also the experience of teachers and teacher educators from the project. Final discussion will be on possible

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recommendations for future mathematics professional development especially in similar contexts.

1.1. Country context

Tanzania is located in East Africa and has a population of over 57 million (National Bureau of Statistics, 2021). Current school system is one year pre-primary, seven years of primary followed by four years of lower secondary and three years of upper secondary (Tanzania Institute of Education, 2019). Education up to end of primary school is mandatory. In 2016, fees were removed from government primary schools, which caused a sudden large influx of pupils and teacher-pupil ratios to increase dramatically. Curriculum reform in Tanzania has been gradually shifting from content-based to a competence-based approach. A competence-based curriculum was first implemented in 2005 and introduced concepts of constructivism and learner-centered strategies. Starting from 2015 the primary school curriculum was reformed to address some emerging challenges and changes implemented in gradual phases (Tanzania Institute of Education, 2019).

A challenge for teacher education is that the complementary initial teacher preparation curriculum is implemented several years after the classroom curriculum and so usually in-service PD is expected to bridge the gap between old and new approaches to learning. Primary school teacher preparation takes two years and admission is after lower secondary school. Primary teachers are generalists in that they are expected to teach all subjects offered at primary level. For standards 1 and 2, each class has one teacher taking all periods and the focus is on basic literacy commonly referred to in the context as the 3R's (reading, writing, arithmetic) (Tanzania Institute of Education, 2019). From standards 3 to 7, there is introduction of separate subjects namely Mathematics, English language, Kiswahili language, Social Studies, Science and Technology, Civics and Moral Education, and Vocational Studies (Tanzania Institute of Education, 2019). Teachers from grades 3 take one or more specific subjects across one or more standards. In some schools there is a tendency to allow teachers to specialize informally by teaching the subjects of their preference but mathematics is generally not a preferred choice for most teachers because it is seen as one of the difficult subjects to teach.

1.2. The AFLA research project

The Assessment for Learning Africa (AFLA) research project aimed to increase numeracy performance among pupils in selected primary schools by focusing on teachers' classroom assessment practices. Another goal was to understand how assessment for learning (AfL) could be used and applied in challenging urban contexts. The research project took place in three sites across two countries, Tanzania and South Africa, with the Oxford University Centre for Educational Assessment (OUCEA)

being the lead. Six primary schools were selected in Tanzania from a district of the largest urban settlement. All schools had large number of pupils per classroom as this was the greatest challenge in schools encountered after the removal of fees with a sudden influx of students before additional resources such as classrooms and teachers could be deployed. Classroom sizes ranged from 85 to 215 pupils. The research project was from 2016 to 2019 and had two major types of activities namely teacher development and specially designed tests to measure students' numeracy levels. This paper will focus on the teacher development activities.

The teacher development in AFLA had two major components. The first was a series of eight (8) workshops spread across one academic year. The second component was lesson observations and mentoring talks that took place between workshops. Tab. 1 shows the dates and activities for the workshops. The first three workshops took place on consecutive days immediately after the official country launch. The workshops planned to enhance teachers' use of AfL while taking into account contextual realities. For example, workshop seven had not been planned to be a joint session with educational leaders at school and ward level but during the formal launch many participants pointed out the importance of having a session for this group of leaders and this was accommodated by having one workshop structured so that some sessions were separately for teachers and a combined session with these leaders. Apart from AfL, the workshops also focused on building teachers' skills in reflection so as to enable them to learn from own practice as they tried out new strategies.

Tab.1. Summary of activities of Teacher Development Workshop (all done in 2017)

Workshop number	Activities, focus areas, notable features	Month, date
One	Setting the scene for AfL	January, 25
Two	Experience of AfL	January, 26
Three	Model class teaching	January, 27
Four	Critical Incident Analysis	April, 11
Five	Questioning	April, 12
Six	Feedback (part 1)	June, 29
Seven	Feedback (part 2) and combined session with leaders	August, 8
Eight	Peer and self-assessment & Reflecting back	September, 1

Lesson observations were planned with teachers of the six case schools who taught the target classes of standard four. The fourth year of primary had been selected because pupils had completed at least three years of mathematics teaching but were still considered lower primary pupils. There was mutual agreement on the date and time for observation between the teacher and the teacher educators who did the observations. All teachers were familiar beforehand with the observation schedule used. A non-participant observation was made of the lessons and after the lesson the mentoring talk began with a teacher self-evaluation (both written and oral) followed by a discussion.

2. Experience about Professional Development from Research Project

The research project was aimed at understanding how AfL could be used and reflection about the experiences of the teacher development component also give insights that could be applied to teacher professional development in the future. The section will present six such experience and also link to achievements of the research project in terms of change to practice and research objectives.

2.1. Listening rather than telling

The approach in all workshops was to listen to teachers rather than telling them what to do. In case a new concept was to be introduced, a series of activities was designed through which participants would eventually arrive at a similar conclusion as intended by facilitators even if sometimes modified to accommodate contextual realities. For example, in order for participants to appreciate the need for AfL, the results of the baseline test both in summary form and sample work was shared with participants. Teachers were then asked to discuss in groups and respond to different questions such as “what can be said about the pupils’ intentions about mathematics?” In their discussions, teachers pointed out that apart from assessment of learning, which is the norm, there needs to be other forms of assessments that can obtain such information since this is crucial. Another example, of listening rather than telling is when teachers were asked during workshop five to state challenges to using questioning in their mathematics lessons and then in groups work on possible solutions. What was achieved was that the emerging techniques were co-constructed between the facilitators and participants and contextually-relevant thus meaningful to the teachers.

2.2. Experiencing novel teaching strategy through new mathematics

The three major areas of teacher knowledge are content knowledge, pedagogical knowledge and pedagogical content knowledge (Shulman, 1986). Through previous experience working on mathematics teachers’ PD it was known that apart from pedagogical knowledge (PK) of new strategies, teachers would also need enhancement of their content knowledge (CK). A design choice of the PD was to embed the new mathematics as part of novel teaching strategy so that teachers could experience the sense of being learners and also feel less threatened by the new content. One example was during workshop six when in response to a query raised by teachers in the previous workshops on how to deal with unexpected responses during questioning, the feedback approach was modeled by asking participants to discuss in groups different questions linking perimeter and area. The choice of the topic was in turn based on lesson observations and awareness that teachers were about to introduce the concept of areas to their learners. Through this combined approach to CK and PK that took place in every workshop, it was possible to address matters of teachers’ conceptual understanding as well as showcasing AfL strategies.

2.3. Acknowledging emerging issues

As stated earlier, the whole research project had the approach of including participants' views. Apart from the inclusion of leaders, another example of acknowledging emerging issues is the choice of material for critical incident analysis in workshop four. During the opening workshops the issue of harsh disciplining had emerged as a possible conflicting matter. The choice of the material for the critical incident analysis introductory session was therefore an education cartoon strip from a well-known school magazine, which highlighted the negative effects of harsh discipline tactics. In later workshops, teachers expressed how they had shifted to alternate forms of behavior management and their realization that the teaching of mathematics was positively impacted by this change. Emerging issues also included teachers' needs that were presented during mentoring talks. For example, the number tray as a concrete tool for visualizing operations and place value was presented at the fifth workshop after some teachers during mentoring talks mentioned their unfamiliarity with this resource. The acknowledgement of emerging issues ensured that the PD addressed contextual realities appropriately and as needed.

2.4. Learning from and with each other

During the workshop's participants were encouraged to share best practices in teaching mathematics and application of AfL strategies. Apart from providing important information to the facilitators for understanding the application of AfL and generally mathematics teaching, the practices shared were then modified during discussions and also adapted as observed in subsequent classroom observations. Discussions during mentoring talks confirmed that the new practice seen was a result of what had been shared during workshops as was the example of allowing pupils to give the name of an animal of their choice to their group. Thereafter, teachers to motivate pupils during group work used the positive characteristics of the chosen animal. Thus, there was a diffusion of some of the best practices across the case schools and classes.

2.5. Adapted reflection for better practice

Another achievement of the research project and its teacher development component was to make explicit reflective practice that was already part of the recommended teaching and learning guidelines in Tanzania. While reflection was part of the lesson plan template, many teachers were not sure on what to write and how to use the information for improving future lessons. The AFLA project introduced a simple four-part template based on critical incident analysis for group reflection but also a self-evaluation form with guided questions that was completed after lessons observed by a mentor. These observed lessons were less than five for the duration of the project but teachers had the option of using some or all of the questions as self-evaluation for other

lessons. While teachers did not use the forms often beyond the required sessions due to large workload, nevertheless, what could be deduced in the final workshop was that ability to reflect had improved since their reflections tended to focus on academic matters and was more critical. In addition, during mentoring talks teachers were able to link proposed future plans to reflections about current observed practices.

2.6. Contextualized change to practice

The teacher development activities were all done in 2017. Two rounds of interviews were conducted, one at the end of 2017 and the second in 2018. Additionally, during the dissemination workshop in 2019, teachers were invited to discuss and validate some of the emerging findings. What could be discerned was that as a result of the PD that there were changes to teachers' practice but these changes depended on what they were doing and what was already in practice. For example, teachers mentioned consciously giving pupils' more opportunity by that in inviting volunteers to the blackboard "teach other pupils" or by telling the intended topic ahead of time so that pupils could then later share about prior or home knowledge. Another example was the improved use of group work. Previously, group work was seen as a means to manage very large class sizes. After PD, teachers mentioned how group work could be used for AfL strategies such as eliciting information about learners' knowledge and feedback through peer assessment. Finally, teachers mentioned that they consulted with other teachers but only in case when they faced specific challenges. The consultation was a positive change since previously the tendency was to see PD and advice as being external only.

3. Conclusions and Recommendations

Reflecting on the experience of the teacher development activities, four conclusions can be drawn. First, involving teachers' experiences and ideas especially with regard to contextual factors and possible solutions ensured that teachers were willing to actively participate in the PD activities. Their willingness was evidenced in opening up their classrooms for observations and new practice observed several months after a given workshop. While it is uncertain how sustained these changes were, these positive shift in practice was probably due to having their experiences respected and included in PD activities. Second, there was win-win situation in combining activities for enhancing teachers' content knowledge and specific tasks related to pedagogical knowledge. The facilitators could demonstrate to teachers how pedagogical content knowledge (PCK) specific to mathematics was applied with the new technique while teachers could to some extent share in their learners' experience ahead of time. The third conclusion is on the importance of adaptation of the PD activities. The process as well as content of the workshops was modified to address emerging issues in order to remain relevant to teachers' needs and realities. While the overall aim was maintained, that is to work teachers' assessment practices so as to improve numeracy outcomes,

other factors as mentioned by teachers was also included in subsequent plans and implementations. The last conclusion is about the importance of both personal and community learning. Individual teachers were encouraged to work on self-evaluation and implementing new learning in personal practices but there was also an element of collaboration both with the mentors and during workshops to develop an improved shared understanding of AfL in mathematics classrooms in context of large classrooms.

Based on these conclusions, four recommendations emerge for professional development especially in similar contexts. First, it would be very important especially when bringing seemingly new innovations to teachers, to start the PD from teachers' experience rather than focusing on deficits. By respectfully listening to teachers there would be an opportunity for all stakeholders to develop professionally. Second, it may be useful to have teachers undergo the experience of being learners and thus reflect back on what it would take to facilitate learning. These opportunities for experiential learning could then build teachers appreciation of the complexities of PCK. In the case of the research project, AfL strategies were the basis for creating these learning opportunities. It may be necessary to research on what could provide similar opportunities for such combined approach and perhaps the use of technology in teaching mathematics could be a possibility. The third recommendation is the need for a flexible approach to accommodate emerging issues in PD. The design of PDs may benefit from having the both content and process not firmly defined so that adaptation to contextual realities can occur when and as needed. The final recommendation is on the importance of developing professional learning contexts that would enable reflections and exchange of ideas for professional growth. PD needs to be a continuing process but in order to achieve this in a feasible manner especially in challenging contexts it is important to shift perceptions about PD as being externally facilitated and done as one off workshops towards the view of professional learning communities. Hopefully, there will be a realization that PD is not for blame nor praise but part of being a teacher.

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