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IMPROVING TEACHER EDUCATION AND CLASSROOM PRACTICES: OPTIONS FOR AFRICA

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ABSTRACT: *This paper is posited on the assumption that in our quest to reform school curriculum to create a knowledge-based society in Africa, the one thing we should not lose sight of is that teachers matter. This is partly due to the fact that the next generation of Africans will need to be well supported by well-trained professional teachers. It is in the light of this that the presentation gives options that could be adopted to improve teacher education and classroom practice. Options discussed in this paper include; use of multimedia/hypermedia technology, problem solving as a pedagogical tool, explicit Institution on heuristics, the use of literature circles, what next after literature cycles, the use of technologies to aid knowledge sharing and transmission.*

KEY WORDS: teaching through problem, problem solving heuristics, literature circles, multimedia systems, internet & computer-related technologies

INTRODUCTION

Research evidence shows that the single most important factor that influences student learning outcomes is the teacher; simply put, teachers matter (see for instance, Begle, 1972; Eisenberg, 1977; Shulman & Quinlan, 1996; and Wilmot, 2009). In fact, no matter the advancements we make in technology, it is an undeniable fact that the next generation of African students will continue to be managed by teachers in their schools. Therefore, in our quest to reform school curriculum to create a knowledge-based society in Africa, the one thing we should not lose sight of is the training of quality teachers.

According to the classical research by the American Educational Sociologist, Dan C. Lortie, on the average students spend about 13, 000 hours in direct contact with classroom teachers by the time they graduate from high school (Lortie, 1975). During this period, students do not have room to ask teachers why they used specific teaching strategies or why they approached answering students questions they way they did. In fact, this period is so long that many pre-service teachers are likely to have formed subjective understanding of what it means to teach a subject like mathematics by imagining why their teachers pursue certain agendas in their classrooms (see Eisenhart, Borko, Underhill, Brown, Jones & Agard, 1993). Research is replete with the fact that these subjective views of teaching affect what pre-service teachers learn from their courses and field experiences (see Lortie, 1975; Fieman-

Nemser, & Buchmann, 1986; Ball, 1988a, 1988b). Consequently, instead of preconceiving teaching in an explicit and analytic manner based on pedagogical principles, there is the tendency for students to preconceive of it in an intuitive and imaginative manner. Even in situations where they are exposed to exemplary teaching, students are not equipped with sufficient theory and ability with which to analyze the actions of their teachers. Lortie, (1975) refers to this long period of exposure to teaching as a form of "apprenticeship of observation" and argues that the effect is so strong that pre-service teachers could have a tendency to dismiss alternative ideas about the teaching of mathematics provided in teacher education as theoretical and unrealistic (Lampert & Ball, 1990). In situations where they do not completely dismiss such alternative ideas, literature is replete with the fact that the initial ideas formed from their long experience as students influence what pre-service teachers in general learn from their courses and field experiences (Bullough, 1997; Anderson & Bird, 1992; Calderhead, 1991; Ball, 1988a & 1988b; Fieman-Nemser, & Buchmann, 1986).

Apart from this, pre-service teacher education has been noted to be fraught with three main tensions that can negatively affect pre-service elementary teachers' attempt at learning to teach various school subjects for understanding (Ball, 1990). The first of these is pre-service elementary teachers' weak understanding of the subject matter of most of the school subjects such as mathematics and the sciences; something that could prove a substantial obstacle to their attempt at learning to teach those subjects for understanding.

The second of these tensions is that the duration of the pedagogy-related courses is invariably too short. According to Wilmot (2008) within a short period of time, only some amounts of students' preconceptions about teaching and subject matter can change. Consequently, though pedagogy courses may have an impact, it is unclear how this impact can help redirect the continuity of pre-service teachers' learning to teach effectively for understanding. In fact, research has been found to provide limited support for concluding that there is potential for pedagogical coursework to contribute to teacher effectiveness (Educational Commission of the States (ECS), 2003).

The third, and perhaps most worrisome of these tensions, is that, according to Ball (1988b) the isolated circumstances and mostly theoretical manner in which the courses are offered in teacher education programmes makes it difficult to effectively challenge the preconceived ideas about mathematics and the teaching of the subject that pre-service teachers bring with them to the college of education. For instance, in most teacher education programmes, pre-service teachers are exposed to college-based content courses, some general or foundations of education courses and a number of pedagogy related courses, among others. My personal read of these arrangements is that in most cases, if not all, these courses are offered theoretically and in isolated circumstances. In addition, in some cases, peer-teaching sessions, under the guidance of experienced professors, are provided to help pre-service teachers put into practice the theories of teaching and learning they have previously been exposed to. Further more, pre-service teachers are attached to schools in a number of semesters for supported internships, with the help of experienced mentors. During the internship, pre-service teachers observe lessons and take lead roles in teaching under the

mentorship of these experienced teachers in their assigned classes or their subject areas, as the case may be, while faculty from the University or Colleges of Education occasionally visit to assess their performance and progress. What many of our teacher education programs offer, can therefore be likened to a process of initially exposing pre-service teachers to 'maps' of the classroom situations under which they would later be working and later, testing their ability to reproduce the maps through the supported teaching in schools, micro-teaching and off-campus teaching practice arrangement. Lampert & Ball (1990) have argued that due to the largely theoretical nature of these maps, many newly trained teachers are left with very few guideposts, if any, to guide them when they arrive at the work situation. New teachers are therefore compelled to invent their own maps; hence the argument sometimes that no matter how much teachers learn during preparation, learning to teach inevitably occurs on the job. Ball (1988b) has argued that due to the lack of connection between the overly theoretical coursework in traditional teacher education courses and the realities of classroom life, the experiences and preconceived assumptions of pre-service mathematics teachers, for the most part, remain unchallenged by conventional teacher education programs; and beginning teachers are likely to teach using the same unproductive methods they are so familiar with.

This paper, therefore, argues that unless the aforementioned weaknesses in the way teachers are trained are overcome, it will be difficult, if not impossible to prepare the right type of teachers needed to create the knowledge-based societies for the next generation of Africans. It is on the basis of this that this paper proposes ways of improving teacher education programmes and classroom practices in Africa.

THE PURPOSE OF THIS PAPER

It is well documented that student performance in African at the pre-tertiary level of the education have largely lagged behind their counterparts in counties such as Singapore, South Korea and other developed countries. For instance, in 2003, a country such as Ghana participated, for the first time, in the Trends in International Mathematics and Science Study (TIMSS) examinations. According to Anamuah-Mensah and Mereku (2005), "the mean mathematics score of the Ghanaian eight graders was 276 . . . compared to the international mean score of 467" p.2. They concluded that "the nature of mathematics experienced by this cohort of JSS2 students [in Ghana] hardly meets requirements that are currently valued globally in school mathematics" p.1. Ghanaian eighth graders did not perform any marked better in their subsequent participations in 2007 and 2011 (see, for example, Buabeng, Owusu, & Ntow, 2014).

Though other African countries, such as South Africa did not perform any better than Ghana in the various TIMSS assessments that they participated in, in South Africa the situation has been more precarious as whites have demonstrated advantages over Africans since the 1990s and beyond (refer to Levy, Cameron, Hoadley, & Naidoo (Eds.), 2018).

In the light of this underperformance among African students at the Basic Education level many African countries such as Ghana have undertaken in recent times undertaken to reform their school curriculum as a way to improve students learning outcomes at the pre-tertiary level. In Ghana, for instance, the previously objective-based curriculum used at the pre-tertiary level of the educational system have since 2017 been reviewed and replaced with a Standards-based curriculum.

Though such curriculum reforms may be warranted, this paper argues that unless care is taken to improve teacher proficiency, student performance the improvement in student learning outcomes will continue to be a mirage in several African Countries. This is the point made in the World Bank Group Flagship Report on Learning (2018) when it stated that "For students to learn, teachers have to teach effectively—but many education systems pay little attention to what teachers know or what they do in the classroom. Focusing on teachers' skills and motivation can pay off" (p. 131).

It is in the light of this that I propose five main options for implementation in teacher educations programme in Africa to prepare the right type of pre- and in-service teachers who can improve student performance in our schools (this is the purpose of the paper):

1. Use of Problem Solving as a pedagogical tool
2. Explicit teaching of heuristics for solving problems
3. Use of multimedia technology
4. Using literature circles
5. Effective use of other forms of Internet & Computer-related Technologies (IC-rTs) in the classroom.

THE PROPOSED OPTIONS

The Use Problem Solving as a Pedagogical Tool

To address the issue of the overly theoretical-based courses and the lack of connection between the college-based courses and reality, I propose the use of problem solving as a method of teaching. This because, research has shown that the most effective way to promote active reflective thought among our students, involve them in mathematics, and enhance their understanding is through problem solving (NCTM, 2000). What does this mean? Does this mean we simply have to teach our students how to solve problems? The point I am making is that though preparing pre-service teachers with the ability to teach their students how to solve problems is good, we need to do more than preparing teachers to be able to teach the heuristics of solving problems. The suggestion is that we need to consider more seriously how to train teachers to be able to use problem solving as a pedagogical tool. This would involve, among other things,

- beginning instruction with problems, dilemmas and questions
- placing the focus of attention on ideas and sense making rather than on teacher directions and rules
- developing the belief that students are capable of learning and making sense of their learning.
- allowing students to wonder why things are, to inquire, to search for solutions and to resolve incongruities
- enacting the exact opposite of teaching by telling whereby the teacher does NOT do the explaining but provides students with opportunities to explore and inquire.

Several approaches to teaching in this manner have been suggested in the literature but one approach which I have found effective is to organize instruction using Van de Walle's (2004) three-part lesson format the "Before, During and After" model

Explicit Teaching of Problem Solving Heuristics

Heuristics are general strategies independent of a particular topic or subject matter that helps problem solvers approach and understand a problem and effectively marshal their resources to solve the problem. Students who have a good repertoire of heuristics will generally be very fluid in the strategies they use in solving problems and not necessarily rely on particular formulas or approaches for solving problems in school. In many African countries there is a general acceptance of problem solving as a cross-cutting issue in school curriculum. However, the curriculum of various school subjects does not explicitly have the teaching of problem solving as a content. As a result, teachers do not teach by introducing their students to generic heuristics that are independent of the various content.

Students therefore learn numerous formulas and ways of solving specific types of questions; a situation that does not allow our students to be fluid in problem solving. In my opinion, this in part, is the reason why our students do not rank well in international competitions such as the Trends in International Mathematics and Science Study (TIMSS). It is also the reason why many students, especially the females, are not taking mathematically related careers.

My argument is that if we really expect students to be good problem solvers then we must teach them to use appropriate heuristics with some degree of seriousness. It also means that school curriculum must make explicit room for the teaching of general strategies for solving problems so that teachers can devote time to teach those general strategies.

Since no one can give what they do not have, it also means that teacher education programmes must expose pre-service teachers not only to a number of heuristics, including those that help students to understand problems up to those that help them solve complex problems without resorting to formulas but also with the ability to teach the appropriate heuristics to students at the various levels of the educational system.

In addition, the type of problems we ask during student assessments, whether in class or at the national examinations would need to change into practical and worthwhile types that do not lend themselves to the direct application of formulas.

Adaptation of the Concept of Literature Cycles

Due to population growth, many elementary school classrooms can be said to be crowded classrooms. This limits the ability of teachers to give Individualised attention to students in an effective manner. One way out is for teachers to do a lot of small group work with their students. Using the small groups as the units of the classes reduces the number of students that must be attended to individually as teachers can focus on a number of them in a group while making it possible for them to support each other's learning. One way of doing this is to adapt the concept of literature circles.

The idea of literature circles was developed by colleagues in the language arts as an approach for enhancing good reading habits and understanding among students using small-group configurations. The approach was first implemented in 1982 by Karen Smith, an elementary school teacher in Phoenix, Arizona. Students are usually put into small groups and given specific roles on a rotational basis to apply in discussing and completing various reading tasks. Though in general, there could be between four to six students in a group, the number of students to put in a group depends on the purpose of assigning the given task and the focus of the class. By taking specific roles, students are made to take responsibility for their learning in ways that get them to enjoy reading any form of text. Furthermore, students develop the ability to discuss, define and explore a text, and they learn to make predictions using prior knowledge or supporting details from it. In the language arts, research has shown that the use of literature circles improves students cognitive and affective ability in positive ways (see for instance, Marshal, 2006; Avci & Yuksel, 2011). Even at the pre-service teacher education level, the use of literature circles in teacher education programmes have been shown to to improve the text-analysis skills, reading desires, and interests of prospective teachers (see, Karatay, 2017). As Karatay puts it, at the end of the study, "the students pointed out that the implementation of this strategy increased their interest and desire for communication, their self-confidence, cooperative learning, critical thinking, reading objectively without bias, and independent reading skills" (p.65). I argue that adapting this approach in all content areas in teacher preparation programmes will not only produce these effects but also improve the teaching proficiency of prospective teachers for better results in our schools.

Examples of roles students can be assigned include:

i. **Passage/Text Master**: His/her job is to find memorable passages/texts to share with your group, indicating why the passages/texts selected are memorable

ii. **Summarizer**: His/ her job is to briefly report the main ideas and events that occurred in the day's reading. How the reading opened and ended and how he/she felt after breading the passage

iii. **Connector**: His/her job is to identify key phrases in the text and discuss how they are connected with other texts, the real world and himself/herself

iv. **Vocabulary Enricher**: Identify new vocabulary and new expressions in the passage, where possible research into their origin, their meaning as used in the passage, and share with the group

v. **Artistic Adventurer (Optional)**: His/her task is to draw a scene or an object from the reading and share with the group. The drawing should contain a puzzle that group members will try to figure out.

Use of Hypermedia Technology

Now let's return to the critique I gave of the weaknesses in the field experiences (or supported teaching in schools) given to pre-service teachers. While it is true that field experiences and supervised internships help pre-service teachers construct practical knowledge that is detailed, concrete, and integrated around problems of practice, it has been argued that such field experiences could have inherent weaknesses in terms of their effectiveness (Buchmann & Schwille, 1982; Shulman, 1987; Masingila & Doerr, 2002). First, in attaching students to schools for field experience or internship purposes pre-service teachers are usually attached individually to particular teachers in their field placements and never together, as a cohort, in the same teacher's classroom. Their individual experiences in this arrangement are, therefore, never the same. Masingila & Doerr (2002), for instance have argued that pre-service teachers' lack of common experience limits their ability to reflect and analyze the teaching and learning process generally with their classmates in a meaningful manner. Second, it is documented that expert teachers have the ability to deviate from their "curriculum scripts" (e.g. Putnam, 1987) and engage in "actions associated with teaching quickly, accurately, flexibly and inventively under several types of constraints" (Leinhardt, 1988, p.120). Unfortunately, even when individual pre-service teachers are placed in the classroom of exemplary teachers, it is doubtful whether they (the pre-service teachers) possess the ability and experience to completely and meaningfully deconstruct what is "good" from simply observing the rapidly changing and complex interactions (both spoken and unspoken) that take place in the classroom (Shulman, 1987). In addition, it is quite difficult, if not completely impossible, for pre-service mathematics teachers to interrupt the classes they are observing and pose questions to their mentors in order to fully understand the actions of their mentors. Their learning in these arrangements could therefore be intuitive, imaginative and in some cases unreflective in nature. Consequently, it is possible that pre-service mathematics teachers draw faulty inferences from their field experiences and internships (Buchmann & Schwille, 1982). Furthermore, in reality, because the number of exemplary reform-based classrooms is few, it is difficult to get sufficient mentors who can help pre-service teachers deal with the disparity between the theoretical

courses they take in college and the reality they face in their field placements (see for instance, Masingila & Doerr, 2002).

This issue of the problems inherent with the type of learning pre-service mathematics teachers engage in during their field placements, have led several mathematics educators to draw attention to the need for intensive practical orientation through the presentation (to pre-service teachers) of experiences that present actual teaching practices and make it possible for them to study or critique those practices (Lampert & Ball, 1990; Merseth & Lacey, 1993; Mousley & Sullivan, 1997; Sullivan, 2002). Sullivan (2002), for instance, has observed that, "studying teaching in simulated or real situations offers considerable potential for stimulating thinking not only about the application of theory to practice but also for creating personal theories for the study of [teaching] practice" (p. 291). To achieve the type of reflective practical orientation suggested here, many educators have advocated for the use of multimedia systems to support pre-service teacher education (e.g. Lampert & Ball, 1990; Merseth & Lacey, 1993; Mousley & Sullivan, 1997; Herrington, Sparrow & Oliver, 1998; Masingila & Doerr, 2002; Sullivan, 2002; Wilmot, E. M. (2015). It is suggested that multimedia systems that capture the complexities of an exemplary teaching "can become sites for investigation, reflection and study by pre-service teachers in ways that are not easily accomplished with actual classroom experience" (Masingila & Doerr, 2002, pp. 236-237).

In this presentation, therefore, I am suggesting that exposing pre-service teachers to teaching in a reflective manner has the potential of effectively challenging the initial ideas they formed from their apprenticeship of observation.

To achieve the type of reflective practical orientation suggested here, many educators have investigated and advocated for the use of multimedia systems to support pre-service teacher education (e.g. Lampert & Ball, 1990; Merseth & Lacey, 1993; Mousley & Sullivan, 1997; Herrington, Sparrow & Oliver, 1998; Masingila & Doerr, 2002; Sullivan, 2002). In the developed countries, many educators have already used multimedia systems to improve teacher education, both in pre-service and continuous teacher education (see for example, Putnam & Borko, 2000; Derry & the STEP Team, 2002; Krainer, 2002; Oonk, Goffree & Verloop, 2003). Unfortunately, developing countries in Africa have not made strides on the use of multimedia systems as tools for reflective teaching in mathematics education yet. It is in the light of this that this paper recommends the use of multimedia systems in pre-service teacher education in Africa.

Using Internet & Computer-Related Technologies (IC-rT)

Burrill, Allison, Breaux, Kastberg, Leatham, and Sanchez (2003), has analysed a number of peer-reviewed publications on the effect of handheld technologies and concluded that, "overall, … the use of handheld technology [in the form of graphing calculators] had a positive impact on student performance" (p. 38). In my personal research (see Wilmot, 2008) I have given mathematics tasks to high school mathematics teachers in a number of states in the US and their counterparts in Ghana. In order to remove the direct advantage of the using of such programmable calculator, I specifically discouraged their use. I found that in

questions like, how many solutions does the equation tanx = 2x have? the majority of the participating Ghanaian teachers attempted to solve the equation from first principles and were unable to complete as they were caught by time. The US participants, on the other hand, simply drew rough sketches of the functions on each side of the equation on the same axes and could thereby answer the equation correctly and within time. I concluded that the affordances of the continuous use of the graphing calculator in their classes made it easier for the US teachers, where necessary, to reason like the programmable calculator and offer fast and accurate solutions as the calculator would have done instead of working from first principles.

From this, the question I ask myself is why do many African countries prevent even high school students from using programmable calculators both in class and for examinations. I challenge experts in this forum to support enactment or implementation of policies that will allow this to happen in our schools.

The situation is more precarious if one considers that even the use simple devices such as the phone is not allowed in a number of Basic School classrooms in many African countries. I challenge colleagues in charge of the various curriculum and assessment centres to change the mind set about the negatives of such devices and allow their use in schools. I argue that African countries can challenge the phone and internet providers to come out with chips that, for instance, allow students to visit libraries and sites that our various ministries of education can place documents to aid teaching and learning in our schools. A device as simple as the phone or tablet developed this way can be of immense academic benefit to our students.

CONCLUSION

In conclusion it is necessary to note that, recent reforms, especially in mathematics education have emphasized a model of mathematics instruction different from what most pre-service teachers have experienced in school. For instance, the NCTM standards propose an emphasis on communication, problem solving, creative thinking and mathematical reasoning. A similar appeal is made in the teaching of mathematics in recent curriculum reform efforts in education in Ghana. The type of teaching that is essential in these situations "is one in which students engage in purposeful activities that grow out of problem situations, requiring reasoning and creative thinking, gathering and applying information, discovering and inventing, communicating ideas, and testing those ideas through critical reflection and argumentation" (Thompson, 1992, p. 128). Therefore, for the current pre-service teachers in Africa to enter the field and be able to teach in the manner emphasized by current reforms, adjustments must be made in the way they are prepared. One way of doing this is to expose pre-service teachers to the terrain of teaching in a manner that enables them to learn about teaching in a reflective manner, as well as tapping the affordances of available technologies. The options proposed in this paper, seek to provide this kind of exposure, when implemented.

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