Dealing with Pedagogy and Mathematical Content

Anass Bayaga
Faculty of Education
School for Initial Teacher Education
University of Fort Hare
East London
South Africa
Office +27 (0) 43 704 7076
Fax: +27 (0) 43 704 7117
Cell 073 789 3367
Email abayaga@ufh.ac.za

Abstract
In this paper I draw on a research in describing and discussing the pedagogy, mathematical content and the reality of teachers' instructional situation- a case study. New styles of teaching have emerged over decades. The recitation still dominates the field of mathematics instruction, as it does for most subjects. More varied pedagogical repertoires are regularly advocated and are beginning to take root; however, these can be characterized as a broad and low trend toward the teacher increasingly assuming the role of facilitator of student learning. No one can learn for someone else, so the teacher creates an environment in which students are able to advance their own knowledge. The methodology involved in this study was largely qualitative for which an exploratory approach was used. The respondents (fifteen learners, five tutors and guardians respectively) were selected according to a purposive non- probability sample method; semi-structured interview with a schedule for each of the respondents (guardians) was used. An inductive form of reasoning was used and concepts, insights and understanding developed from patterns in the data. Responses (likert format questions) that were quantified were transformed into tables where percentages were computed to determine the degree of emphasis. It is hoped that this study will make a worthwhile contribution to the field of Mathematics teaching.

Introduction

The recitation of styles of teaching still dominates the field of mathematics. More varied pedagogical repertoires are regularly advocated and are beginning to take root. Debates over the nature of good mathematics teaching are as old as teaching itself and this is partly because; there is no consensus about what it means to be a mathematically educated adult and partly because of the very nature of teaching and learning. Teachers and learners are individuals with their own backgrounds, personalities and ambitions. Methods, which work well for one teacher sometimes, fail for another. The preferred style of learning for one pupil may be different from that of another. An approach, which works well with most of a class, may fail totally for a significant minority. Thus good teachers cater for the needs of individuals as well as groups by continuously modifying their approaches in response to the feedback they receive from learners.

Moreover, the fact those teachers in many developing countries are in dire need, better content knowledge is often not mentioned. It is worth noting that advocacy is nothing more than a mildly radical interpretation of a prevailing national trend. Simultaneously, some educators and parents urge

teachers to concentrate on children's cognitive capabilities. Inferring from the above, two developments may emerge- the one is the emphasis given to teachers' acquisition of pedagogical knowledge, and second is acquisition of content knowledge. Thus it does not make good sense to make teachers believe that they can make a full-scale assault on mathematics instruction without first acquiring a strong good pedagogical and content knowledge. If there are asked to run before they walk, they will surely fall flat on their faces.

Although we must be cautious about describing the nature of good mathematics teaching because of the limitations expressed above, it is imperative educational researchers endeavour to provide clear evidence from variety of sources about number of features and approaches, which are common to most successful lessons. The above are the contentious issues in this study, noting that if, we ask these questions at all, it points to the fact that the answers are not readily accessible and because philosophical dissatisfaction disappears by seeing more, I can only wish for more as the way ahead.

Pedagogical Paradox

One of the things that one can learn from reflective is examining one's lived experience. One of the decisive signs of increased adult maturity is that the growing individual can, in turn, assume responsibility for children. Langeveld (1979) argues that work is beset with modernist understandings of maturity and self-responsibility. It should not be forgotten, however, that Langeveld (1979) Pedagogy is pedagogy fitting the particulars of his time, his culture and his social sphere. It is quite likely that individuals in our present-post modern age do not experience their relation on their children as being filled with responsibility. If he were still alive, Langeveld would probably say that for many individuals the post-modern conditions might have completely eroded the responsibility of experiencing life pedagogically. In his own time and on the basis of his clinical work with children, Langeveld (1979) proposed that there are certain pedagogical values that emerge from our lives with children. In particular, he has suggested that security; reliability and continuity are fundamental values. Children need to:

- Experience the world as secure
- Be able to regard certain adults as reliable and feel they can depend on them
- Experience a sense of continuity in their relations with those who care for them

How does Langeveld arrive at these ethical values? This, too, is of the controversial aspects of a pedagogical work. He claimed that values could be located in our personal experience with learners (Relative to our historical context). Learners who lack security, who cannot depend on at least one person (teacher) in their lives, who are not permitted to establish long-term relationships with an adult (Teacher), will become a pedagogical concern, claimed Langeveld (1979).

He has been criticized by those who base educational research and theorising on more solid rationalistic foundations (either because they wanted to make the field of pedagogy and educational Policy more scientific and subject to management control, or because they distrusted, on political grounds, the pedagogical values that he articulated). My interest here is not in arguments that have been waged over whether Langeveld was a captive of a particular solid class, a particular culture, or even a somewhat' idealistic' from of phenomenology. I assume that nobody (not even the happy critic of Langeveld) can escape some of the ideological captivity.

We intend to read into the text of others whose preoccupations and tendencies arise from our own societal context and histories. Langeveld (1979) argued that pedagogically, one must often place ethical over rational sense. Rational theorising it by itself is therefore of limited value of pedagogy. In our interaction with learners, we must constantly act, what we do (or not do) is more a matter of appropriateness than a matter of reasoned ground. He repeatedly proposed that in our everyday dealing with learners, our decisions about how to educate them and, more concretely, what to say or do, first of

All involve normative (ethical or more) considerations and, only secondarily, rational ones. While these normative considerations are always relative to adults own cultural and social contexts, they should nevertheless always act in ways that are appropriate. A definition of pedagogy would thus include this active distinct between what is appropriate from what is inappropriate, better from worse, right from wrong, in our daily dealings with learners. In as much as the above may be true, I do not think, the issue has been managed and appreciated fully. The problem, I believe is this: 'Learning' looks in two folds- on one side, it looks towards the teaching transaction, where it indicates that as a result of A's responsible doing, B came by X. Inasmuch as 'learning' is used to the context of teaching, it indicates that A has brought about an understanding in B for which A must take some responsibility.

But learning is not restricted to such contexts, thus not all learning requires teaching. And here, a major focus is on the correctness of what teachers teach (what is learned). Were this is not the case; the concept's point would vanish. Learning is an agent-based concept, which, among other things, reflects an interest in acting effectively in the world, an interest likely to be satisfied only if our ways of understanding the world are realistic. On my part, therefore, there is a presumption that what we have learnt is correct. When I say I learned X, I do not imply that likelihood that I may be wrong (although of cause I may be wrong). In avowing that one has learned something, one is staking one's reputation, putting ones credibility on the line. One is taking responsibility for what one says. The implication in the case of teacher based learning is that the correctness and effectiveness criteria may become separate misunderstanding. However it is very clear from the way in most educational institutions are structured and the methods in which they employ in

teaching that this kind of understanding is given minimal encouragement, or if encouraged is deeply ideological in that the tools of criticism are placed beyond criticism. Learning takes place in social context facilitated and to a large extent structured by the activities and practices of others. Some of the things we learned are picked as a result of our own initiatives, but a good deal of our early life is spent learning from the initiatives of others. The contexts for this vary from fairly informal peer group and family relationships to the formal and highly structured environment of most schools. Within such contexts, what is learned is generally thought of as being taught- whether internationally or otherwise maintained by Polya (1985).

Educational Connotation

More generally our paths have taught us several lessons about learning that are now central to our vision. Like many other teachers, we often overestimated the effectiveness of our efforts. We lacked the sensitivity to understand whether or not students were making sense of what we thought we were teaching. Because we often savoured the educational diet we were offered, we did not fully grasp until we were well into our careers that many students might not have developed the same appetites. We came to realize that we, like all teachers, must seriously enter the student's world if we are to fathom what they know and how they might achieve the educational goals we desire. For that to happen, it is essential to listen to students, to draw them out, to have genuine conversations about their attempts to understand what we want to teach. For such conversations to happen it is necessary to shift the priority from the emphasis on delivery of instruction to one of designing and organizing settings. In such surroundings, students begin to see the importance of their own roles in advancing their own education. In creating such environments, teachers must develop a clear concept of the nature of the learning aims that justify any activity, particularly if it is novel; if they lack such clarity, the work is likely to miss its target and lead to wasted opportunities. But that's not enough: The students also need to be active participants. In activities in which we helped to achieve such a shift of emphasis, or where We saw other teachers do it, we comprehend what many progressive educators had long asserted: Many students have unexpected educational potential that can flower in new learning environments, but that remain undetected in conventional classroom settings.

None of these realisations are remarkable or new. However, they are more salient in current educational discourse than they were at the start of our careers, and they have been the stuff of endless debate, often sadly marked by stereotyping and demonizing of 'progressives' or 'traditionalists'. Our own understanding of these matters has been enriched by opportunities to see many classrooms, talk with many teachers and deliberate in many policymaking bodies. To the extent that our views are penetrating or subtle, they have evolved in such settings. And the most useful lessons to be learned

come from knowledgeable teachers rather than from treatises on pedagogy.

What makes a good mathematics lesson?

Debates over the nature of good mathematics teaching are as old as teaching itself and, in spite of government pronouncements to have found the philosopher's stone of perfect school organisation classroom pedagogy; it is likely to continue for as long as schools exist. This is partly because; there is no consensus about what it means to be a mathematically educated adult and partly because of the very nature of teaching and learning. Teachers and learners are individuals with their own backgrounds, personalities and ambitions. Methods, which work well for one teacher sometimes, fail for another. The preferred style of learning for one pupil may be different from that of another. An approach, which works well with most of a class, may fail totally for a significant minority. Good teachers cater for the needs of individuals as well as groups by continuously modifying their approaches in response to the feedback they are receiving from learners maintained. Although we must be cautious about describing the nature of good mathematics teaching because of the limitations expressed above, educational research should endeavour to provide a clear evidence from variety of different sources about number of features and approaches, which are common to most successful lessons.

Motivating students to engage in mathematical learning activities

Extrinsically motivating students to engage in learning activities is superior to not motivating students at all but inferior to students being intrinsically motivated argued. Students can be intrinsically motivated to do mathematics once they discover the connection between the mathematics and their own needs and interests.

Four points about directions

Teachers who explicitly introduce directions more efficiently and communicate exactly what students are to do during learning activities can take advantage of the following: Students in classes where teachers in mathematics class model business-like attitudes are more likely to efficiently follow directions than those whose teachers seem lackadaisical and less organized argued Barbeau (2000):

- Because giving directions is frequent, teachers can minimize transition time, streamline communication procedures, model the problems attitude and reduce the amount of teacher-talk in classrooms by establishing signals or cues that nearly instantaneously communicate certain recurring expectations to students.
- Students who have learned that their teacher tends to say things only once tend to listen the first time the teachers speak. Sometimes teachers make the mistake of saying "I'm going to say this only once" but then end up repeating themselves, because their initial directions were vague.
- Students are more likely to listen carefully to the directions of teachers who restrict their remarks to exactly what students need to know to successfully engage in the upcoming learning activity contended by Barbeau (2000).
- when teachers are giving directions they are not conducting an inquiry lesson.

Leading students to communicate with mathematics

Leading students to communicate in mathematics may involve a number of issues by:

- Constructing, concepts that lead to definitions
- Discovering relationships leading to statements of propositions
- Proving propositions leading to statements of theorems and presentations of proofs
- Inventing algorithms, which leads to directions for executing step by step procedures
- Addressing problems leading to the articulation of problems and explanations of work on their solutions

In general, doing mathematics creates messages (e.g. definitions, descriptions, arguments, proofs, directions, explanations) that need to be communicated and comprehended. Of course, if mathematic was strictly a solitary activity, as it seemed to be for some eccentrics mathematicians like Pierre de? Fermat in 17th century says Singh (1997), and then maybe, there would be little need to comprehend and communicate mathematical messages (as the above really does not commensurate Hilbert 23 Problems-for many have been solved and**)** but for the vast majority of our history, mathematics is a social endeavour with people collaboratively doing mathematics and sharing their discoveries and inventions with others. Thus, your students need to comprehend and communicate mathematical messages via speaking, writing, reading, listening and observing. Unfortunately, too many people have developed the mistaken belief that all mathematics resides in textbooks. Mathematics resides in our minds and in our environment. Textbooks are used, as one tool for teaching and learning mathematics and teaching students to make use of textbooks is an important aspect of teaching mathematics Maintained Singh (1997), but students also need to comprehend mathematical messages expressed in other media besides textbooks (e.g. video programs, oral presentations, discussions, interactive software, and web-based materials). A particularly engaging source of mathematical messages that you and your students will enjoy and learn from is mathematical trade books.

Problems of learning to use mathematics as a means of communication

The problems of learning to use mathematics as a means of communication are not the same as those of learning one's native language argued Brumbaugh and Rock (2001). Native language provides a means of communication which is in use all time and which, for the great majority of people, 'comes naturally', even though command of language needs to be developed and extended in the classroom. Furthermore, mistakes of grammar or of spelling do not, in general, render unintelligible the message, which is being conveyed. On the other hand, mathematics does not 'come naturally' to most people in the way, which is true of native language. It is not constantly being used; it has to be learned and practiced; mistakes are of greater consequence. Mathematics also conveys information in a much more precise and concentrated way than is usually the case with spoken or written word asserted by Burke, Erickson, Lott, and Obert (2001).

For these reasons many people take a long time not only to become familiar with mathematical skills and ideas, but also to develop such confidence in using them. Those who have been able to develop such confidence with relative ease should not underestimate the difficulties, which many others experience, or the extent of the help, which can be required in order to be able to understand and to use mathematics (Chazzan, 2000; Barbeau (2000).

Educational Implications for teachers

It is imperative to draw attention of those who teach mathematics in schools to what I believe to be the implications of the reason for teaching mathematics, which I have discussed**: Mathematics teacher has the task:**

1. Of enabling each pupil to develop, within his capabilities, the mathematical skills and understanding required for adult life, for employment and for further study and training, while remaining aware of the difficulties which some pupils will experience in trying to gain such an appropriate
2. Of providing each pupil with such mathematics as may be needed for his study of other subjects
3. Of helping each pupil to develop so far as is possible his appreciation and enjoyment of mathematics itself and his realization of the role which it has played and wick continue to play both in the development of science and technology and of our civilization;
4. Above all, of making each pupil aware that mathematics provides him with a powerful means of communication.

Considering the above educational implication, mathematics is a subject, which requires hard work and much practice, whatever one's level of attainment may be. It can be straightforward to understand the solution of a problem which someone else has worked out, it is usually very much more difficult to discover a solution by oneself. Indeed, it is 'getting started' which is often the most difficult part of solving a mathematical problem and it is easy to underestimate the qualities both of determination and of imagination which can be required. One of the reasons why it is difficult to teach mathematics is the fact that attainment and rate of learning vary so greatly from pupil to pupil. If the pace of the teaching is too fast, understanding is not able to develop; on the other hand, if the pace is too slow pupils can become bored and disenchanted.

The amount of ground, which it is appropriate to cover in any one period of work on the same topic, also varies with the attainment of the pupils. Those whose attainment is high are often able to advance a considerable distance at one time but those whose attainment is low need to advance by smaller stages and to return to the topic more frequently. The achievement of a correct balance in those matters requires skilled professional judgment and presents problems to the teacher, which should not be underestimated. Whatever their level of attainment, pupils should not be allowed to experience repeated failure. If this shows signs of occurring, it is an indication that the advance may have continued too far and that a change of topic is needed. Hence educational settings should aim at introducing relevant teaching

programmes enhancing the quality of candidate teachers.

Methodology

The methodology involved in this study was exploratory for which a qualitative approach was used as a case study. The respondents (fifteen learners, five tutors and guardians respectively) were selected according to a purposive non- probability sample method; semi-structured interview with a schedule with each of the respondents (guardians) was used. An inductive form of reasoning was used and concepts, insights and understanding developed from patterns in the data. Responses that were quantified were transformed into tables where percentages were computed to determine the degree of emphasis. It is hoped that this study will make a worthwhile contribution to the field of Mathematics teaching.

Results and Discussion

Mathematicians and mathematics educators all over the years have showed concern over using wrong methods of teaching mathematics that did not enhance learning nor promoted the retention of what was learnt. Therefore the emphasis has been on using the methods of teaching in which the students have hands – on experience by interacting with objects in the environment to develop concepts and principles of mathematics, which requires that concepts and principles of mathematics must be Situational applicable' to enhance proper grip of the subject context. Results of this research indicated that out of a 100% teachers sampled, a discouraging result was that about 18.2% of teachers often used lecture method in teaching mathematics-some given reasons due to lack of enough teaching periods. The lecture method does not provide much opportunity for students to interact with the environment. Barbeau (2000) contends that the lecture method of teaching mathematics and teacher demonstration lesson as a large group of students' instruction do not seem to facilitate the development of the mathematics process skills by students.

Nevertheless the fact that 18.2% used the activity method and 63.6% used problem-solving methods in teaching mathematics meant that all was not lost. As noted above, since teachers are expected to use integrated approaches to teaching mathematics, a unified method of mathematics, which would consider all the teaching methods, would be more appropriate.

Adding up the values of the analysis of 'very often' and 'often' and then arranging them in a hierarchical order, the method from the most frequently used to the least frequently used. Demonstration and discussion methods appeared to be the most popularly used methods (i.e. 100.0% In each case). The other methods used included; activity method (81.9%), lecture method (81.8%), discovery method (85.5%) and problem solving method (63.7%).

Teachers notion about certain aspects of teaching mathematics were also explored. All teachers (100%) regarded students' ability to observe, develop skills as important, also all teachers attached importance to students' ability to participate in mathematics lessons. In addition 81.8% of teachers attached some importance of grouping students for activity. Finally 90.9% teachers considered students' communicating among themselves as important. Although most teachers still relied on traditional methods of teaching such as lecture method and demonstration method often, their notions that students must participate actively in the lessons should give an encouraging signal.

Learning is a highly complex process and has characteristics, which are both social and individual in nature. Mathematical knowledge may often seem to have a highly personal nature as if we had created it for ourselves. However, mathematics is usually taught to a large group of pupils who are asked to arrive to a common understanding of an accepted body of knowledge.

The teacher's creative and demanding role is to mediate between the constructing demands of mathematical knowledge, the individual pupil and the social situation to provide a mathematical education, which will meet the needs of the individual child today and the adult in a future, which we may not know is important. The complex nature of this task requires the exercise of professional judgment and continuous training, on the spot, decision-making form a creative stakeholders in a manner, which may or may not be prescribed. Although teachers rightly exercise a great deal of professional freedom within their classrooms about what and how they teach, they operate within a framework of attainment targets, programmes of study, commercially produced courses and statutory examinations which constrain their choices and focus their attention. This idea is born out of the 'Social learning theory'- of Bandura (1975), which focuses on the learning that occurs within a **social context**. It considers among other things that people learn from one another, including such concepts as observational learning, imitation, and modelling.

Interpretation of findings

A go-getting curriculum is closely tied to more complex teaching, and this presents challenges for teachers of mathematics. The research shows that these challenges call for increased attention to building the capacity of teachers to enhance their mathematics instruction. Both initial preparation and ongoing professional development support. This is critical to the successful implementation of a more ambitious mathematics curriculum argued Barbeau (2000). We need not only to enhance teachers' knowledge of mathematics content and pedagogy but also to provide specific support for their efforts to teach mathematics in better ways in the classroom as the parents emphasise.

Notwithstanding the above, most teachers have had limited experience teaching more ambitious curricula, helping students deal with complex mathematical tasks, or learning complex mathematics themselves in settings in which innovative pedagogy is used. Huetinck and Munshin (2000) argue that teachers often struggle, at least initially, when they use ambitious curricula and cognitively complex mathematics tasks in the classroom. These kinds of tasks require a style of engagement and interaction that is quite different from the pattern of low-level cognitive activity.

Interview with most parents and teachers alike in the study indicated that effective support for teachers to enhance their mathematics instruction can come in many different forms, including collaborating within teacher networks or with knowledgeable persons outside the school; attending short courses; reflecting on one's own experience as a mathematics learner; tying innovations in pedagogy to research-based knowledge of student learning, and linking professional development closely to go-getting curriculum materials supported. Most of these effective approach to professional development address directly/ indirectly the pervasive isolation of mathematics teachers.

The power of professional communities to support instructional innovation in school wide, district wide, and regional improvement efforts is a force to reckon with. Thus, stakeholders (parents) indicate that it is critical that special attention be paid to nurturing and sustaining professional communities in which enhanced practice can be developed and supported. Otherwise, this research suggests that the ambient culture of isolation and resistance to change that typically pervades mathematics departments in schools is likely to inhibit progress.

There is an alarming trend, which may be called the mathematics-avoidance syndrome. With few exceptions, be it in curriculum, or assessment, tend to skirt the importance of pedagogy and content as one parent (Mr. T- pseudonym) indicated. This syndrome is borne out by many of the major developments in mathematics education of the past ten years, which is not driven from sound pedagogical and content knowledge contended by Arzt, and Armour-Thomas (2002). Hence some advocates decide that the way to improve mathematics education is to change pedagogical techniques and make small group learning and the discovery method the centrepiece of mathematics instruction in every classroom supported by Cangelosi (1999).

The fact that teachers in are in dire need, better content knowledge is often not mentioned. It is worth noting that advocacy is nothing more than a mildly radical interpretation of a prevailing national trend asserted by Barbeau (2000). Simultaneously, some educators and parents urge teachers to concentrate on children's cognitive capabilities. Again, that advice ignores the fact that interpreting children's mathematical thinking requires strong content knowledge maintained by Clarke and Hollingsworth

(2002). Inferring from literature review and arguments raised my interviews with parents (Mr. V- pseudonym) two developments may emerge- one is a strong advocacy that lesson-study be the principal activity of the professional development of teachers. The other is the emphasis given to teachers' acquisition of pedagogical content knowledge. The need of a robust content knowledge on the part of the teachers before they can benefit from either form of professional development cannot be suppressed.

Meanwhile Ashlock (2001) contends that pedagogical content knowledge is also a gold standard of teaching. Pedagogical content knowledge is a refinement of content knowledge, and is built on that knowledge. There should be some segments of mathematics education community waking up to the urgency of the need to teach teachers the requisite content knowledge of their profession contends maintained Burke, Erickson, Lott, and Obert, (2001) Therefore it does not make good sense to make. Teachers believe that they can make a full-scale assault on pedagogical content knowledge without first acquiring a strong content knowledge. If there are asked to run before they walk, they will surely fall flat on their faces. Chazzan (2000) explains that the best direct evidence for the lack of appreciation of the centrality of content knowledge in the teaching of mathematics may be seen in some recent case books .In these books, blatant mathematical flaws in many of the lessons are ignored or planed over in the facilitators' comments. Since some of these flaws are sufficiently pronounced to make the lessons border on distortion, one may speculate that only a long tradition of neglecting mathematical content in teaching could have hardened the facilitators to those flaws.

Conclusion

In this fast paced technological (knowledge) age, we have all become learners of mathematics. It is mathematical knowledge that has fuelled the fires of advances and it is those very advances that generate new and more complex mathematics such as the mentioned **Hilbert's 23 Problems together with The Millennium Prize Problems**. The task then of mathematics education becomes one of helping students and those who work with them to understand how to learn mathematics, how to problem solve, and how to acquire the 'automaticity' with skills and procedures necessary for problem solving. Mathematics is best learned in meaningful and memorable contexts. Conceptual and procedural knowledge is best developed when a need for it has been established. Teachers of mathematics need to know the mathematics content itself (this is ever changing), good methodologies, and the pedagogy of mathematics itself. Others who stay or work with students need to know what research says about learning, the importance of inquiry, and need to be aware of the social and economic setting in which the mathematics of today (stocks, mortgage points, arbitrage etc.) and of the future is couched.

To survive socially and economically, it is imperative that ALL of today's mathematics students know, understand, and are able to do complex mathematical operations. With predictions that majority of students will pursue

educational endeavours beyond high school, it is likewise necessary that ALL graduating students be able to access additional education; they must have mathematical backgrounds that will allow them to do this. Our students need to be confident in their mathematical abilities and they need to have the mathematical knowledge necessary to fit them for the future from equipped teachers. It is the mission of the mathematics component of every community (teachers) to aid in endeavors that will help achieve the above-mentioned goals. The mathematics consultant (for instance) may be available at district request to work with the districts on evaluating their mathematics programs, on planning for future progress in mathematics programs, and on discussing standards- based curricula, instruction, and assessment to meet state requirements, district goals, and societal demands.

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