RECONNOITRING ANECDOTES OF TEACHER’S PERCEPTIONS ON THE TEACHING OF PERIODIC TABLES IN THE SENIOR PHASE

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ABSTRACT– This paper explores the teachers’ anecdotes on the teaching of periodic table in the senior phase in some schools in the Vhembe district of the Limpopo province. It was an empirical qualitative study wherein seven teachers from four schools participated. Teachers were interviewed with questions focusing on aspects like scheme of work, lesson planning, and textbooks they use, subject policy and any other related issues to the teaching of the periodic table in the senior phase. The results of the study show that most of the teachers had challenges in teaching the periodic tables. The challenges emanated from the lack of the content knowledge as well as not being specialised in some of the contents of the natural science subject which they are expected to teach. It is recommended that it will be ideal to help teachers with the content knowledge as well as classroom practices on how to teach it

Keywords: Periodic table, primary science teaching, senior phase, CAPS

1. INTRODUCTION

It is the aim of the National curriculum statement (NCS) Grades R-12, to produce learners that are able to think and use science to benefit themselves and those around them (Department of Basic Education (DBE), 2011). This is possible when there are resources for example human resources. In hindsight one of the central human resources is the teacher. As such it is the role of the teacher to teach learners such that they develop the relevant attributes of a scientific literate citizen. However, Danielsson and Warwick (2013); Harlen and Holroyd (1997) also indicate that teachers in the senior phase usually lack confidence of what to teach, lacked competencies and have many misconceptions which are reflected in their learners. It is also important to note that Pine, Messer and John (2001) indicate that children hold many incorrect ideas about science topics which are on the primary curriculum. They also indicate that it is not made explicit how many of the incorrect ideas primary learners have which they do not make implicit or are non-verbal. Yet, Pine et al (2001:79) indicate that it is “the role for the primary school teacher to organise the child’s naïve ideas into coherent concepts which are accurate and explicit”. This again emphasises the critical stage and role in the learning of natural science facilitated by the teacher for the learner. Furthermore, they indicate that these ideas are important as they are the fundamental ideas from which to build new knowledge. It follows then that the teacher is fundamentally very important in the learning of science at primary level of which if it is not done will not enhance the aims of the DBE.

To enhance the teaching and learning field, the curriculum policy has recently been modified (2011-2014) and now has a component called the curriculum and assessment policy statement (CAPS). Yet, the performance in the senior phase ANA (Annual National Assessment) results has been regularly poor. However, from our annotations there has been minimal research in senior phase teaching which should inform the kind of intervention necessary. Consequently, it was necessary to focus on what is happening in the senior phase so that tailor made intervention approaches can be designed. Furthermore, from observations, teachers from Zimbabwe seem to be doing something some of the South African teachers are not doing as the learners they teach usually perform better.
Consequently, one of the community engagement projects was undertaken to understand the classroom practices of natural science teachers in their endeavour to realise the expectations of the DBE and compare those with the classroom practices of Zimbabwean teachers. Based on experiences and observation a topic that is common to both the countries’ curriculum in the senior phase was chosen, which the periodic table is. This should not be misconstrued as an indication that this is the only topic that is common at senior phase. There are other topics that are common for example energy and electricity. But as the project was at its early stages, only one topic, the periodic table was chosen. With the topic chosen it was necessary to first understand the views of the teachers on its teaching. As such this paper will explore the question: what are the teacher’s perceptions on the teaching of periodic tables in the senior phase in some of the schools in the Vhembe district of the Limpopo province? It is hoped that discussions that will be raised within this paper and thereafter will form a fundamental basis for comprehending the classroom practices of teachers. This should in turn inform the kind of intervention strategies that should be adopted after the comparison with the Zimbabwean teachers. Furthermore, the paper should raise or add onto debates on the state of teaching natural sciences in the senior phase.

In order to comprehend the teacher’s perceptions it was necessary that the researcher understand the teaching of science in the senior phase from literature as well as the nature of periodic tables of elements. Some studies (Murphy, Neil and Beggs, 2007; Harlen and Holroyd, 1997) indicate that teachers at primary schools usually have to cope with teaching natural science even if their confidence of teaching is low. It is further indicated that it could be because of inadequacy in comprehending what has to be taught. Consequently, these teachers resort to teaching as little of the subject as possible. Murphy et al (2007:418) also indicate that “there is also evidence to show that some of the science taught at primary school is too difficult for the teachers, never mind the children”. The disadvantage of this, amongst many is that it usually results in the “declining pupil interest in science during the primary school years…” (Murphy et al, 2007:416). Furthermore, it was indicated that they focus more on biology which is life sciences than physical sciences (Murphy et al., 2007; Harlen and Holroyd, 1997). It was also shown that many of these teachers make please that they need somebody to come to their classrooms and show them how to do it. However, it is also cautioned that these please by teachers of being shown how to do it can also be detrimental to their development if not done properly. This is so because they may get used to be told how to do it and take that as a master plan of doing it rather than being creative. It may also stifle their thinking which may hamper leaners opportunity to develop genuine problem solving skills. Yet, for confidence purpose it is also suggested that it will not create harm if a few tried and tested ways of teaching are shown to teachers (Harlen and Holroyd, 1997). Murphy et al (2007) also suggest that it is upon the universities to prepare primary teachers such that they are confident and effective teachers. Moreover, they encourage the development or increase of a partnership with the schools in the endeavour to enhance continuing professional development (CPD) in relation to primary science. This should be done because there is evidence that teachers who are involved in CPD are more confident to teach science than those who were not involved (Murphy et al., 2007).

Then what is the nature of the periodic table? It is very common in a physical science or chemistry classroom to find an ever present wall poster containing the symbols of elements. This poster is very important as a map is to a world traveller. This poster is the periodic table. It originated with discussion amongst chemists about the relative atomic mass (RAM) of an element and its properties. Values given in the periodic table which are derived when one atom of the isotope carbon 12 is taken to be exactly 12,000 units and the average mass of one atom of each of the other elements is then compared with this are called relative atomic masses (RAM). One of the chemists Dobereiner (1780-1849) noticed that there were groups of three elements (Triads) which had very similar chemical properties and in which the RAM of the middle element was almost exactly the average of
the other Triads. For example Lithium, Sodium and potassium; all are soft metals, are highly reactive and have to be stored under oil. Their RAMs are 7, 23 and 39 respectively and 23 is the average of 7 and 39. It was also noticed that some physical properties of the elements such as melting point rise and fall in a regular way as RAM increases. Such a variation is called a periodic variation, because it varies periodically. Lothar Meyer (1830-1895) plotted the atomic volume of elements against RAM and he noticed a periodic pattern in the graph which he linked to the properties of the elements. Newlands (1863) arranged the elements in order of increasing RAM. He noticed that elements with similar properties occurred every eight places; Newlands called this the law of octaves. The only problem was that further along the list it stopped working. This was because some elements had not yet been discovered and Newlands did not realise it. The great breakthrough came when Dimitri Mendeleev (1839-1907) used increasing RAM as well as corresponding chemical properties to arrange elements. Dimitri said that an element would eventually be discovered which would have a RAM and properties that would fit the gap he left. He predicted the properties of missing elements, which eventually happened. Mendeleev is regarded as the father of the periodic table. Yet, it was Moseley who was mainly responsible for its modern form.

2. Methodology
This was a qualitative heuristic interpretative multiple case study, embedded within a community engagement project. We chose an approach within a community project as we intended to integrate research with practice. Tobin (1988) lamented that there is minimal research influencing practice, hence it was our objective that we influence the teacher’s practice based on the research and not perpetuate what has happened before or happening. The community engagement project offered us that latitude. Furthermore, Tobin (1988) indicated that for research to be effective and influence their practice teachers must first appreciate it and accept its usefulness in their practice. As such we did not want to just impose research on teachers and expect them to change their practice and schema. We wanted to develop research from their current practice and then assist them in integrating it in their practices. In a community engagement project researchers identify a problem as we did and then design a methodology to help them into designing an appropriate intervention strategy to counter the identified problem. This is so because Mudau (2013) indicate that there is a need to design a tailored intervention strategy if the teachers are to be assisted maximally and sustainably. As previously alluded, it was the purpose of the project to compare classroom practices of South African teachers and the Zimbabwean teachers. The first stage of the project was to ascertain some of the teachers’ views on how they teach the topic. This was necessary as it is indicated (Tobin, 1988) that teachers’ practice is also influenced by what is in their schema of what works and what does not work. Failure to appreciate that may result in an intervention strategy that is tangent to the needs of the teachers. The how part of teachers’ views focused on the resources they have to teach the topic. The focus was also on the nature of the scheme of work, lesson planning, textbooks they use, subject policy as well as any aspect related to how they teach the topic. It should be noted that this paper will not report on how they taught the topic in the classroom as that was the next phase of the project.

Three provinces in the Republic of South Africa where purposefully chosen for the project. They were chosen based on the contacts the researchers had in the provinces. This was to make excess and choices of schools easier than if it were a province we had not established any contacts with the hierarchy. Furthermore, the process can be a tedious experience to be granted permission to conduct research and especially the kind of research we intended to do. It should not be misconstrued that because it is a community engagement project, the authorities and teachers will be readily available. No, previous endeavours has shown that schools are readily available if one is making a donation in terms of monetary or other resources but become reserved when research is to be conducted. So, the above indicated aspects influenced our choices of the provinces. Yet, even
though we had expected that it will be easier to be granted permission from the three provinces. It was very difficult to receive such permission from the other two. It took us longer than we had anticipated. However, this paper will report on one of the districts of one of the provinces. Four schools were purposefully identified for the study based on the reasons we have already elaborated. Even though we had thought that the process may become easier of being granted permission in the chosen schools, one of the schools chose not to be part of the project when they realised that our intervention will be coupled with research. They did not give reasons but simply ignored us. One of the schools was a primary school where in the focus was on the grade seven teacher. The other three were high schools. They were five in total and had experiences ranging from four years to 35 years. Data was collected through interviews and official documents analysis. The interview questions were piloted in one of the primary schools in the district prior to data collection and the questions that did not elicit the expected responses were removed. Project members also assisted in validating the instruments. Documents that were perused were textbooks, lesson plans, schemes of work and subject policy (this also dependent on their availability). The typology approach was used to analyse data. That is themes and categories were developed which guided the analysis of the interview transcripts and documents collected. Thus the interview transcripts were read with one category in mind and what was relevant in answering the research question was noted. The interpretation of data for meaning was reached by two processes (Hitchcock & Hughes, 1995) namely: direct interpretations of the individual instances and/or aggregation of instances where in an interpretation was reached after aggregating instances.

The participant from the primary school (P) was over 50 years old and had 25 years teaching natural sciences experience which was previously called general sciences when she began her career. She will be called teacher P in this paper. Teacher P had a primary teacher’s diploma and one of her major subjects was general science. School P had about 250 leaners and the atmosphere at the school was conducive to teaching and learning as all the learners were in class and being taught during data collection period. The teacher from school R had over 35 years of experience teaching physical science. In this study he will be identified as Teacher R. He had post initial qualification certificate in physical science. His school had about 700 learners. Teacher R was a senior teacher in the mathematics and science department who was also responsible for assisting new physical science teachers. He was chosen for the study even though he was at the time of data collection teaching the FET phase (grade 10-12) as the researchers viewed him as the person who may provide a different perspective. This was so because the teachers who taught at senior phase refused to be interviewed because they said they are not confident of anything in physical science but only life sciences. He then volunteered to be part of the study as had taught the senior phase before and knew what was happening in his school. Teachers from school M had teaching experiences ranging from 4 to 15 years. The one with the experience of four years had a teaching degree in physical science and was below 30 years old. The other one had an initial teaching diploma in mathematics and life sciences only and was 46 years old. The other teacher the head of department had a secondary teacher’s diploma as well as a further teacher’s diploma (STD) in mathematics and physical science. The fourth teacher had a qualification STD in mathematics and physical science. Their school had just over 1600 leaners crammed in 24 classrooms which also included mobile classes. The school was known as a performing school in terms of grade 12 results. That is their average pass rate in grade 12 was over 75%. As such, even though the atmosphere at the school was conducive to teaching and learning, they had overcrowding challenges. School T also had a challenge with overcrowding as they had more learners than the available classrooms. The natural science teachers from this school had teaching experiences ranging from 5 years to 12 years. The teacher who had a five year experience was 36 years old and had a teaching qualification in life sciences. The other teacher was 44 years old and had a teaching qualification in mathematics.
3. Results
Teacher R indicated that his colleagues in the senior phase (there were two of them) receive pace setters from the circuit level which are aligned with the district pace setters. Pace setters are tools which show teachers what and when to teach a particular topic. Therefore, they cannot teach outside what is expected of them at a particular time. We requested to see their lesson plans but we were told that they do plan but lesson plans are not available. The teacher indicated that the subject policy is available even though he does not know where it was. Teacher R regretted the fact that when students come to grade 10 they have zero knowledge on what a periodic table is. He indicated that it is because teachers in the senior phase at primary and high schools do not have the necessary subject matter knowledge. Teacher R further said that; “Teachers at primary schools concentrate on life sciences and do not teach periodic table...”. Furthermore, he said that “to remedy the situation I wanted to go to the feeder schools and introduce some concepts like the periodic table which are critical in the learning of chemistry...”. However, he said this would be a futile exercise as it will be difficult for him in terms of resources and time. He also pointed out that there is a disjuncture between the senior phase and FET as it is not like the other feeds into the other. Furthermore, at the school, teacher R is the only science teacher and those teaching in the senior phase were just given the subject as he could not teach all the grades. As such they are not doing justice to the learners. “This is because we do not have enough teachers to teach the entire subject as we are affected by the staff establishment” Teacher R elaborated. In terms of the resources for teaching the topic, the teacher indicated that they have challenges and they would really appreciate to have micro kits for safety purpose too. He indicated that even though they do have a laboratory, the chemicals in there have expired and they do not have funds to purchase the new ones. He also indicated that;

I have been teaching for more than 30 years and I am tired of all the changes in the curriculum. I think the changes are not based on the needs but politics... I wish the government had a way of recycling us after some time because things change. I also cannot relate well to the young learners I teach as I am also technophobic and they are techno literate...

Teacher P had the pace setter which she thought was from the national or district office as she was not sure. Teacher P also indicated that they do develop lesson plans and their plans are on a weekly basis than on a daily basis. She also indicated that she belongs to a cluster which does assist in issues related to the curriculum. The teacher did not want to provide evidence of lesson planning or scheme of work. We asked her if she does teach the periodic table. She indicated that she does not teach it as it is not part of the curriculum. She did not want to respond to that. “...I do have problems with some topics and the cluster does assist but not everything...”. She further indicated that she would really appreciate if she can be in-serviced on aspect of subject matter knowledge. Teacher P also indicated that she would really appreciate to have a micro kit as it would assist in her teaching.

In school T there were two natural sciences teachers and the subject is split at the senior phase into life sciences and physical science. The grade 10 physical science teacher also wanted to be part of the discussions we had with the natural science teachers. The grade 10 teacher indicated that they have challenges in terms of the levels of knowledge students bring from senior phase including periodic tables. He said that in the presence of his grade 8 and 9 colleagues to show that he meant it. The teacher also indicated that if they lack in content knowledge of a particular topic they do not have clusters were they can share with other teachers. The grade 8 and 9 teachers indicated that other schools like the top performing school in the Vhembe district have workbooks for their students hence they perform better. They also indicated that they lack micro kits or laboratory. They did not have pace setters as well as lesson plans. School M is known for producing good results at grade 12. In this school there were four teachers teaching natural sciences at the senior phase. Two of the grade 8 teachers refused to be part of the discussions we had about teaching periodic tables.
in the senior phase. The other two teachers indicated that they have split natural sciences at grade 8 and 9 into life sciences and physical sciences. They indicated that they do teach periodic table at these grades. As such the person who teaches grade 10 is able to talk to the chemistry teacher who is teaching grade 8 and 9 and as such close the gaps. The other observations were the overcrowding in the classrooms and the lack of micro kits or a laboratory and all the chemicals they had, had expired. Both our participants did not have either pace setters nor lesson plans. However, the principal also indicated that foreign teachers are good teachers because they are dedicated unlike the South African teachers. He said it has nothing to do with content knowledge but commitment.

4. Discussion

Even though the literature reviewed (Murphy et al, 2007; Harlen and Holroyd, 1997) had shown the kind of challenges in the senior phase like lack of confidence and subject matter knowledge, we did not envisage that it will be the way we found. From all the teachers we had discussions with; all did not have confidence of teaching periodic tables in the senior phase except two from school R and school M. They indicated that it is because they were qualified in either life sciences or not in science at all. This resonated well with what Murphy et al. (2007) found that because of lack of subject matter knowledge, teachers resort to teach as little as possible or not teach the matter at all. According to the literature reviewed for this paper in terms of the ever present poster the subject matter knowledge required of the teacher is not basic but deep in order for the teacher to teach the topic confidently.

At grade 7, teachers are expected to engage learners in the discussion on the origin of the periodic table. In this discussion we will not look at the merits and the demerits of the chronological arrangements of the aspects in terms of periodic table from grade 7 to grade 10. We will only focus on what the teacher is expected to do. From the observation of the aspects they are expected to teach one is made to agree with Murphy et al (2007) that some of the aspects they teach can be difficult to them. Even the focus on life sciences only, was not surprising as it was stated by Murphy et al. (2007) and Harlen & Holroyd (1997). When some of them even refused to participate in the study when we indicated that the focus is on the periodic table we extrapolated that they had challenges in the topic. Yet, as indicated in the introduction of this section we did not expect that the challenges will be of this nature. Moreover, all the teachers we had discussions with had been teaching for some time, so we thought that they would have taught themselves aspects of the periodic table as they should be aware that it is important for their learners after grade 9. Yet, this would also not have yielded maximum results because McDermott (2006) indicates that it does not mean that if a teacher teaches a topic for many years or many times will result in the teacher comprehending that topic.

When one considers the important role the primary teachers (Pine et al, 2001) have and in particular in the teaching of the periodic table, it is a recipe for challenges in terms of chemistry in the FET phase, if it is not taught or not taught properly. This should be true because one of the two of the teachers who teach in the FET phase indicated that learners from the senior phase are inadequately prepared not only in the periodic tables but also in other topics. Yet, one cannot solely blame the teachers taking into cognisance that they are also expected to teach outside of their specialisation. Literature has shown that when the teachers teach outside of their specialisation they focus more on what they know best (Danielsson and Warwick, 2013). They are expected to teacher all the topics and concepts which if one looks at the curriculum documents includes aspects from life science, physical sciences and geography. Even though the teachers indicated that there is some form of inservice training either at the cluster or circuit level, it is not adequate. It is also worth noting that because of that lack of subject matter is some of the strands of the natural science curriculum some teachers tend to think that planet earth and beyond is geography. This is true but it is also a section of astronomical physics. So if a teacher was qualified in physical science should be able to handle the content.
Moreover, the problem of teaching outside of specialisations is not to be solved soon. Because even the new teachers that are coming into the systems some of them are not and will not be adequately qualified to teach natural sciences using an example of one of the universities that produces more than 50% of the new teachers. These pre service or new teachers are expected to take modules in sciences which a pure science student takes. They can only take a maximum of three subjects at first level and two at second level and usually this is in zoology, chemistry and physics. Yet the four strands will not be catered for from this combination. So the higher education institutions especially the one producing a large number of teachers in particular should revise their programmes such that they produce a teacher who is confident to teach the natural sciences content at senior phase level. With the DBE using a formula to allocate posts in schools not all the schools will have the luxury of having specialists in the various strands of the natural sciences. As such the new teachers must be adequately qualified. Some teachers acknowledged that because their schools have a huge roll and as such have more teachers are able to split the natural sciences curriculum where in one teacher teaches life science topics and the other physical science topics.

It is also important to note that most of the teachers did not have lesson plans or pace setters. So it cannot be a matter of the content knowledge only, it has to be the aspect of commitment too. Even the principal of one of the schools indicated that it is not about the subject matter knowledge only but also calls into question issue of commitment. According to him some teachers are not as committed. Moreover, nearly all the teachers were pointing a finger at the lack of resources like the laboratory or micro kits for their dismal competences in teaching periodic table. This should not have been an excuse of excusing their duties diligently and efficiently. This is so because some of their colleagues had all the resources but still confessed that they have challenges in teaching the subject. It is therefore inferred that it could be an aspect of the lack of the know-how of doing practical work. The question is do we fold our arms and let the status quo be? Of course not, it was the purpose of this study to identify challenges as well as possibilities.

5. Conclusion and recommendations
The study revealed that some of the teachers in the senior phase lack the adequate content knowledge to teach the topic periodic table. This was due to some of them not being qualified to teach for example physical science but life sciences. It was also shown in the study that even though they indicated that lack of resources as an excuse of not teaching periodic table, their colleagues who had the resources also pointed other reason like that chemicals are old. So it can be inferred that the genuine reason of not teaching the periodic tables or not confidently teaching the topic could be the lack of the subject matter. One of the teachers who teach at the FET phase from school R indicated that it is his wish to go into the primary schools that feed into his school and train the teachers on how to teach the periodic tables. However, he indicated that it could be time consuming for him and expensive. As such it is our view that to counter the challenge in the teaching of the periodic tables identified it will be necessary to create a forum where all senior phase educators in a particular cluster begin to talk to each other. That is where those who lack the subject matter could also voice their frustrations and challenges.

It is also suggested that there is a need to engage the teachers in terms of the subject matter knowledge in the periodic table as well as how to teach it. Consequently it is suggested that it is of outermost important that a tailor made intervention or in-service training be designed and implemented so that, the confidence of the teachers can be improved which should translate into better preparedness and presentations in the classroom. It is also acknowledged that resources are important but they are not paramount. They should not hamper the practice in the classroom. It is suggested that there is a need to engage teachers on some classroom practices skills for example in the interactions and discourse in the classroom. However, the researcher is conscious of the fact that some researchers think that teachers might get used to be shown how to do things. It is also
important to note what Tobin (1988, 475) indicated that “the majority of the teachers apply their craft in the isolation of their own classroom and teaching strategies are based largely on the well-established schema of what constitutes effective teaching and experience with what works and what does not”. So in assisting the teachers it will be considered that it will not be a smooth ride as what is in their schema has to change. Tobin (1988) further indicated that if research is to influence practice teachers must appreciate that there are some aspects of the classroom practice that can be improved and there is research that can be used to guide that. So it was the objective of this study that based on this research teachers will appreciate its findings and will fully agree as Tobin (1988) indicated and be part of the in-service training which they suggested themselves. Yet, the researcher also shares in the comments of the principal that commitment from the teachers’ side is also important.

6. References


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