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Physics Content and Pedagogical Changes: Ramification of Theory and Practice

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ABSTRACT
The aim of this study was to explore physics teachers' ramification of theory and practices as a result of physics content and pedagogical changes in the Further Education and Training (FET) phase. The researchers adopted the mixed method research approach. The quantitative aspect involved 109 physics teachers and the qualitative approach used ten purposively selected grade 12 physics teachers in two districts in the Eastern Cape Province. Data was analysed via simple descriptive analysis and themes. The findings revealed that irrespective of teaching experience at a stage in the content changed period, physics teachers felt confused regarding what theories and policies are to be practised. It was demonstrated that current CAPS policies and theories are not followed but rather old theories and practices of NATED 550 often dominate in teaching and learning of physics content. The need to ensure science teaching develops active problem-solving learners through current policies, theories and practices in curriculum reformations seems not engulfed by the physics teachers.
Keywords: content changes, curriculum reforms; ramification; policies; theories; pedagogical practices; assessment

INTRODUCTION

Arising from the three main curricula reformations in South Africa's Further Education and Training (FET) phase –National Education Curriculum (NATED 550), National Curriculum Statements (NCS), and Curriculum and Assessment Policy Statements (CAPS)– are different subject content topics and policy instructions which have informed various theories to be applied by teachers in the classroom situation. Curriculum has consistently been linked to have a strong influence on the way subjects are taught and principles that are transmitted to engineer the country to meet international standards (Le Fevre, 2014; Zhu & Engels, 2014; Hoadley & Jansen, 2009; Remillard, 2005). As a result, curriculum planners have over the years used curriculum as a means to convey what content is to be taught in schools, what policy guidelines and theoretical underpinnings to adapt, and how teachers should teach the

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State of the literature

- In the midst of educational curriculum reformation, a large body of international and local research has argued on the importance of presenting excellent national curriculum to meet modern technological advancements, yet few studies look into how the components of the reform such as theories, policies and subject contents are being received and integrated pedagogically by the implementation agents to constitute its success or failure. The case of South Africa basic education sector due to rapid changes of curriculum via policies, theories and subject contents give signal that what is envisaged is not practiced as intended. However, how physics teachers constantly adjust to reform changes in the classroom practices remains under-researched.

Contribution of this paper to the literature

- The primary purpose of presenting and implementing curriculum reformation through content changes, policies and theories is critical to provide adequate knowledge to science learners. Therefore, it is important that curriculum planners work it out concisely and physics teachers ensure precise implementation. This is because at any point that reform fails to achieve its objectives, teachers who are the forefront runners, get the first share of the blame from DBE (Department of Basic Education officials) and in reply, they direct their frustrations to DBE. Whilst DBE perceives teachers to be the cause of the need for further reform, they feel DBE fails to put appropriate components and measures in place to make it work. Physics teachers as curriculum reform implementers require a deeper understanding of the dynamics and play a vital role in the success of any reform in their pedagogical practices. However, DBE needs to understand how physics teachers respond to the changes of reforms in practice. This paper provides holistic descriptions of how envisaged reforms in policies, theories and contents are practiced pedagogically and bridges the gap of confusion which exists between DBE and physics teachers.

subject contents (DBE, 2012; Hall, 2013; DoE, 2002). To this effect, it has been argued that teachers often base their pedagogical practices primarily on the ways the curriculum materials are presented and detailed (Le Fevre, 2014). What constitutes the national curriculum, its contents, policy and theories guidelines, and how teachers are enticed to implement it in relation to classroom instruction are highly important. This is because curriculum reforms via policy instructions and theories lead to innovative means of teaching, learning, improving classroom practices, and fostering greater learner understanding (Ramnarian, 2014; Zhu & Engels, 2014). Yet, the question of whether significant changes of curricula through contents, policies and theories over the years have yielded intended results remains sketchy. In the USA, some science teachers persistently dwell on the traditional form of teaching the content (Banilower & Smith, 2013).

Teaching and learning theories underpin and dictate the pedagogical practices to be exhibited towards a subject's contents. Teachers are expected by the Department of Basic Education (DBE) to make pedagogical practical changes to conform to the required

instructions and theories envisaged in the Departmental policies (DBE, 2012). It is through these pedagogical practices that teachers display their professional act in accordance with Departmental setup instructions during classroom teaching and learning. To teach goes beyond reciting or reading to learners in a classroom situation. It can be said that it involves a teacher's incorporation of instructions, subject matter or content understanding and a great deal of theoretical and pedagogical knowledge. Teaching is basically "a thinking practice", as termed by Lampert's (2001:6). It does not only require mere pedagogical changes but rather the integration of policies, theories, reasoning and knowing with action by teachers. Studies have contended that both cognitive demands such as teachers' knowledge, reasoning, decision-making, reflection and actions including teachers' behaviours are to be combined to effect changes in pedagogy which create opportunities for learners (Raselimo & Wilmot, 2013; Bales & Saffold, 2011; Alexandre, 2009). One has to bear in mind that this can only be successful when teachers stand the chance of being able to switch pedagogical practices as per demand by theories as content and curriculum changes.

The pedagogical practices include: planning and preparation, teaching lessons, assessing, marking, recording and reporting, and moderation. It is through these practices exhibition under a reform that teachers display in their classroom teaching and learning the theoretical underpinnings as envisaged in policy documents. Therefore, this study seeks to explore how current practices in CAPS are informed by its policies and theories in the midst of physics (an aspect of physical science) content changes as a result of curriculum reforms in South Africa's FET phase. The pedagogical practices in relation to current (CAPS) content changed policies and theories, confusion and contradictions existence, as well as whether or not physics teachers have made a complete break with the previous theories and practices are looked into.

RESEARCH BACKGROUND

Pedagogical practices under NATED 550, NCS AND CAPS

Due the three major curriculum reforms, physics teachers have been exposed to numerous content topics, policy instructions and theories. They need the understanding of theories, such as behavioural, constructivism, cognitive and learner-centred, informed by policies since theories underpin effective curriculum implementation through pedagogical practices (Zhu & Engels, 2014). In the South African high school context (grades 10-12), each of the three curriculum reformations (NATED 550, NCS and CAPS) demanded changes in pedagogical practices from teachers and the changes needed to be in line with current policies and theories (DBE, 2012, DoE, 2006). These teaching practices are explained under the three curricula eras to reveal their differences and similarities and how teachers were/are expected to tune to current and relevant policies and theories at any point in time.

Classroom teaching under NATED 550

The mode of teaching in NATED 550 was driven by the behaviourist theory model (Skinner, 1984). The rationale was on ability to gain and recall knowledge which counts in content-led circumstances (Msila, 2007; Hoadley & Jansen, 2009). Teachers were encouraged to simply be banks of knowledge (only source of information) while their learners were limited as recipients of the knowledge during classroom teaching. Therefore, pedagogical practices such as teaching, assessing and reporting (among others) were exhibited towards behaviourist discourse. Classroom teaching mode remained tense and strictly teacher-centred (Hoadley & Jansen, 2009).

Many researchers have attested to this and have reported that teachers' practices during the entire teaching years was content led, of which teaching was drawn directly from textbooks (Msila, 2007; Hoadley & Jansen, 2009). It was further reported that the content taught and teaching in general were not only theoretical but biased and unrelated to most learners' experiences of the real world (Hoadley & Jansen, 2009). One of the reasons argued to have played itself out was that teaching approaches and instruction did not lead to the development of learners' competences to deal with real-world challenges since learners were not involved actively or directly in teaching and learning (Hoadley & Jansen, 2009). Thus, what was taught (knowledge presented verbally) in the classroom was not linked to real-life situations. As a result of lack of better learner preparation under NATED 550, such teaching practices have been regarded as the 'traditional way' and further subjected to tremendous criticism by many authors (Chin, 2007; Msila, 2007; Howie, 2003; Brooks, 2002).

Some of the criticisms included the fact that learners were passive knowledge absorbers of what is said by the teacher, while their natural desire to probe was not taken into consideration (Horn, 2009; Jansen 1998; DoE, 1997). In other words, teachers were directed to adopt a teaching style that concentrates on transmission of knowledge. This has been found to have constricting effects on the curriculum itself at the expense of any form of creativity that could be displayed by any learner (Brooks, 2002). Therefore, there was the need for curriculum reform which envisaged different policies, theories and pedagogical practices in a constructivist nature in delivering content.

Pedagogy in NCS

Teaching as a pedagogical practice under the NCS was opposite to that of the NATED 550. From a theoretical perspective, pedagogical practices such as teaching and its intended approaches as well as instructions were argued to have emanated from Piaget's (1950) learning theory which suggested that learning is developed from self-knowledge (DoE, 2006). The constructivist theory which allows learners to interact with leaning materials to induce learning was adapted (DoE, 2006).

One of the main tenets that attained a prevalent popularity of the NCS inherited from the General and Further Education's (GET) Curriculum 2005 (C2005) as a new aspect of

constructivism was the learner-centered discourse (DoE, 2007). Hansan (2000) defines learner-centeredness as learning where the learner is the sole character in the entire learning process by taking the initiative, controlling the learning process, and actively learning in a socially interactive way. Thus, any kind of teaching and learning put the learner first at the very centre of the entire learning process, allowing them to actively construct their own learning (DoE 2006).

Classroom teaching under the NCS was favoured over NATED 550 and that the responsibility for learning resided increasingly on learners constructing their own understanding rather than "…simply mirror and reflect what they are taught and read" (Glasersfield, 1989;14). For example, research done by Horn (2009) argues that knowledge gained by learners themselves in a familiar, relevant and problem-solving context is better understood and integrated. The teacher's role included selecting of challenging problems and activities relevant to the real world and engaging learners through questioning skills (DoE, 2007a). Nevertheless, while the new image of teacher as facilitator under the NCS was overemphasised by NCS proponents as a means to minimise teacher input and maximise learner participation during teaching and learning, on the contrary it was found that teaching in this era was dominated by administrative practices and less teaching took place (Hegde & Meera, 2012; Chisholm, 2005; Chisholm, Hoadley & Kivilu, 2007; Task Team Committee (DBE), 2009). Based on these issues, amongst others, the need arose for post-modernist constructivist based content teaching and learning where the teacher has more influence in directing the affairs of learning.

Teaching under CAPS

In the case of CAPS, based on critical examination of physical science concise document (DBE, 2011), it can be argued that classroom teaching seems not to differ far from the previous NCS curriculum. Hence, the DBE still endorses the new CAPS as NCS and argues that the former is just an amendment (DBE, 2011). The peculiarity here is the move to relieve teachers of administrative burdens found by many studies and to deal with issues around facilitatorship due to its confusing nature in explicit teaching (Chisholm, 2005; Task Team Committee (DBE), 2009); Review Committee (DoE), 1998). Therefore, there have been some modifications in teachers' teaching roles. This includes the relaxation of facilitator as a teacher's main role; teacher in control of teaching proceedings; demolishing of group sitting, etc. This suggests that teaching in CAPS is posed to deal with concerns that emanated from NATED 550. Dwelling on these modifications, two questions become eminent: (1) What kind of teaching theory should teachers adopt in the new CAPS? (2) What role should they play during teaching and learning under CAPS? Although, the new CAPS policy document (DBE, 2011) remains salient in providing direct answers to these questions, the proponents of CAPS simply categorise classroom teaching under constructivist theory philosophies. If this is so, it can be assumed that teachers under the CAPS are teaching with the learner-centred approach. On the other hand, the greater emphasis of specific contents to teach and textbooks introduction, tracing its root from the NATED 550, can be anticipated that teachers

are signalled to adapt teacher-centeredness underpinnings. Especially considering the detailed allocation of specific timeframes for teaching of the contents, concepts and skills with view of making classroom teaching easier by focusing and directing teachers to be at the same pace across schools and know when and what to teach and assess (UMALUSI, 2014).

By looking into how teaching as a pedagogical practice has evolved as a result of the curricula reforms (and its content changes), it can be argued that confusion may exist in policies, theories and their implementations under the reform eras and that teachers' ability to manage such disparities via pedagogical practices needs to be established.

THEORETICAL FRAMEWORKS

Two theoretical lenses were used to explain and understand physics teachers' pedagogical practices and teaching theories under content changes.

Theory of planned behaviour

Even though Tigehelaar and Korthagen (2004) contested that unconscious behaviour of teachers also exist, in this study teachers' behaviour towards content changes and theory and policy application are assumed to be deliberative and planned rather than fully voluntary (Ajzen, 2005, 1988). Teachers, especially those teaching physics due to the subject nature, have to work under controlled behaviour in order to incorporate any changes in pedagogical practices and execute the required demand of a new curriculum and its content. Chatterton and Wilson (2014) consider behaviour to be diverse and complex and also argue that it can be treated as observable actions. Therefore, as the characteristics of behaviour are revealed in actions, it implies that adoption of attributes of new contents as well as instructions cannot happen instantaneously. The essence is that there ought to be some taught as well as some considerations on implications before a teacher exhibits any action(s). Hence, by linking both Ajzen (2005) and Chatterton and Wilson's (2014) views on behaviour, it can be argued that deliberations and planning on whether curriculum, its content and policy instructions worth taken to be practised or not is shaped by both behaviour and attitude which are determined by intentions that further influence teachers' actions.

Theory of Cognitive Dissonance (TCD)

Festinger (1985) postulates that often feeling uncomfortable tension arises when a person possesses more conflicting thoughts in the mind simultaneously. In the case of physics teachers, content topics and how they are to teach them in relation with policies and theories in their pedagogical practices keep changing due to curriculum renovations; therefore, physics teachers are likely to hold more than one way of teaching a certain topic. Hence, they may decide to apply or eliminate the dissonance. Festinger (1985) and Baker (2003) identified three ways of dealing with cognitive dissonance when it occurs. Presented with information (content topics, new theories and practices) that is dissonant from what a

teacher already knows, the easiest way to deal with this new information is to: (1) ignore or refuse to accept it, or simply avoid that type of information in general; (2) add or create new cognitions, and (3) alter the importance of certain conditions.

By ignoring or refusing cognitive dissonance as a means of reducing or possibly eliminating it, as soon as information or ideas are found to be unattainable they are classified as unworthy (Festinger, 1985; Baker, 2003). In physics teachers' situation, even though a teacher might desire to adopt a certain new practice, his/her inability to understand how it works may lead to criticism of the practice as being boring or irrelevant due to the fact that he/she finds it unattainable. This is done to do away with cognitive dissonance by ignoring or eliminating the dissonant cognitions (Baker, 2003). This allows one to do away with things he/she might otherwise view as wrong or inappropriate and justifiy behaviour, cognition or even decisions by changing the conflicting cognition (Nyborg, 2010; Barker, 2003).

Another way that teachers can eliminate dissonance is that teachers can react to cognitive dissonance by adding or creating new cognitions or behaviours. By creating or emphasising new conditions, teachers can overwhelm the effect of the old cognitions by justifying behaviour or cognition just after adding new cognitions (Lee & Jeyaraj, 2014; Baker, 2003). For example, a teacher may still stick to the old teaching style (teacher-centred) and justify through new cognition that he/she can/will spend more time to explain concepts better to make learners understand and, as a result, reject learner-centeredness if he/she finds it problematic in the view that it allows learners to play in class despite it being the supposed teaching-style as mandated per curriculum and policies.

In the third way of overcoming cognitive dissonance, alteration of the importance (or lack thereof) of certain conditions is done by deciding to overlook the consequences of cognitions to lessen the old cognitions (Baker, 2003). If one of the dissonant cognitions outweighs the other in importance, the mind has less difficulty when dealing with dissonance (Festinger, 1985) and the result means that one can carry on the existing cognition or the new one. Thus, a teacher may change behaviour or cognition by adopting new cognition (and leave the old one) or simply form a new one (adopt new) after taking into consideration the significance of it. For instance, a teacher may accept to respond to new pedagogical changes over the old due to perceived benefits or importance of the new, or still use the old after considering the new as not important in comparison with it. The implication is that the engagement of teachers to either adopt or reduce/eliminate cognitive dissonance if they can has been due to the assumption founded in the TCD that individuals seek consistency between expectations and their reality (Nyoborg, 2010; Festinger, 1985).

Therefore, interactions with cognitive dissonance are done to bring their cognitions and actions in line with one another via creation of uniformity to lessen any form of tension and distress associated with changes. Hence, theoretical and practical ramifications may exist as a result of various curriculum and content reforms. The three curriculum reforms which resulted in three separate content structures serve as dissonance for physics teachers. As the

reforms come with various policy instructions as to how the contents should be taught, learned and assessed (DBE, 2012; DoE, 2006), teachers may have more than one way of dealing with current changes. Therefore, a teacher may decide to adopt the new CAPS principles by ignoring the previous ones; stick to the old (NATED 550 or NCS) by ignoring the new one, or incorporate all three.

RESEARCH QUESTIONS

- How do the changes in theories and pedagogical practices in the three curricula confuse teachers?
- To what extent do previous curricula policies and theories inform current pedagogical practices?
- What pedagogical practices and theories (if any) are performed and employed by physics teachers in current CAPS pedagogy?
- What form of contradictions (if any) exist between teachers' practices and the current theories envisaged by the Department?

METHODOLOGY

This study utilised the mixed method research approach. In the quantitative phase, the use of structured questionnaire successfully enabled the researchers to cover a large number of participants in a more reliable and greater honesty due to anonymity and also to obtain quantifiable data (Cohen, Manion, & Morrison, 2007). After ethical issues were addressed, the structured questionnaires were distributed to physical science teachers during their first district continuous assessment (CASS) moderation in the second term of the 2014 academic year. Out of the 93 (70 plus 23) public physical science schools in the two districts, 109 teachers participated in the study by returning the questionnaires. The physics teachers in the two purposively selected districts (out of 23 districts in Eastern Cape Province) were asked to indicate the extent to which their practices line up with current theories and policies as well as alternate practices adopted as a result of content changes. Thus, the four items in the questionnaire (section E of the main questionnaire which this paper emerged) focused on the ramifications both in theory and practice. Each item comprised of 5-point Likert scale items (strongly agreed, agreed, unsure, disagreed and strongly disagreed).

In order to seek deeper clarification on the research questions, ten teachers (five from each district) selected based on their schools' socio-economic backgrounds were asked to comment on their practices pedagogically in relation to theory (policy requirements) as content changes via face-to-face semi-structured interviews. This type of interviewing allowed the respondents to tell their story regarding alternate practices adopted and sometimes felt free to answer beyond this research question (Cohen et al., 2007). Hence, the depth of explanations guided the probing questions in relation to the objectives of the interviews.

The instruments –questionnaire and interview questions– were subjected to routine editing, allowing experienced and retired teachers to assess their relevance whilst the pilot study was done on non-participatory teachers. These finally paid off and gave rise to valid instruments which yielded quality data for genuine drawn conclusions since validity is premised on the assumption that what is being studied can be measured, proved or captured (Creswell, 2012). To observe confidentiality, respondents were urged not to write their names, schools or districts on the questionnaire and pseudonyms were used for the purpose of data discussion to ensure privacy and strict anonymity of respondents and the research sites with regards to the interviewees.

DATA ANALYSIS

On the basis data analysis, the questionnaire responses were analysed using SPSS version 22. Simple descriptive analysis was employed and percentage frequency responses were used to address the research questions. Additionally, Pearson product-moment correlation coefficient (table not included) was used to test whether a relationship exists between the policy and theory confusion and year of teaching physical science.

The qualitative data was interpreted to give meaning to the findings since interpretations entail consistent understanding, explanations and conceptual frameworks on the systematic observation of the phenomenon in context of the study (Creswell, 2007). Hence, the interview data from was familiarised, induced into themes, coded, elaborated and interpreted and checked based on Creswell (2007).

The interpretation of both quantitative and qualitative data were synthesised to provide an overall representation of the responses according to the research questions and therefore were analysed together, and conclusions regarding practical and theoretical ramifications were drawn.

Demographics

Table 1 shows that most (77%) of the physics teachers (teaching physical science) who were respondents in the two districts were experienced teachers as they have been in the teaching service for over 10 years. Only 6% from the two districts have been in the service for a minimum of five years of teaching experience. It could be assumed that since the majority of the respondents have been teaching and assessing their learners for many years, they are knowledgeable with the practices, policies and underpinned theories of the reforms. It further illustrates that in both districts, majority (56%) of the respondents have been involved in teaching physical science for over ten years (perhaps in the same school). This shows that a significant number of the respondents were familiar with their schools, and have experienced the subject content changes from National Education Curriculum (NATED 550) to National Curriculum Statements (NCS) and to Curriculum and Assessment Policy Statements (CAPS), as well as how practices enfolded over the years.

Table 1. Distribution of respondents by district, teaching experience and the years in teaching the subject in the schools

Service Years	District	< 5 years	5-10 years	10-15 years	> 15 years
Teaching experience	A	4	14	20	42
(Overall)	B	3	4	9	13
Total		**7**	**18**	**29**	**55**
Teaching physical	A	13	23	22	22
Science	B	2	10	8	9
Total		**15**	**33**	**30**	**31**

FINDINGS

The **Table 2**'s items and the interview responses are integrated to answer the four research questions.

Teacher pedagogical confusion on theories and practices under curriculum changes

The question of whether physics teachers had felt confused at one stage of the curriculum reforms and content changes period in terms of what policies and theories were required by the Department to be practiced was investigated. The percentage of the frequency response as indicated in **Table 2** reveals that 51.3% (n=56) agreed to be confused in terms of what constitute theories and policies at this current content changed. The Pearson product-moment correlation coefficient (not included) was utilised to test whether a relationship exists between the policy and theory confusion and year of teaching physical science. The outcome showed that there was a negligible small, positive correlation ($r = .078$, $n = 109$, $p < .001$) between the two variables. This suggests that teaching experiences of physics does not exonerate a teacher from being confused with policies and theories due to curriculum reforms and its content changes. This was not a surprising finding since each curriculum reform and content change advocated for new ways of teaching, new theories and learning directions of physics.

Table 2. Responses on practical and theoretical ramification items on new content topics

Variable	Percentage response				
	SA	A	U	D	SD
Number	**109**	**109**	**109**	**109**	**109**
1) Confusion existence in theory and pedagogical practices	17.4	33.9	7.3	31.2	10.1
2) Old practices are displayed in teaching new contents	36.7	35.8	15.6	8.3	3.7
3) During teaching, adoption of theory in practice is a problem	22.0	37.6	11.9	22.9	5.5
4) Existence of contradictions between theories and policies and practices	20.2	35.8	13.8	24.8	5.5

The integration of the teacher interviews confirmed the questionnaire responses and further revealed some of the reasons behind teacher confusion. Six of the interview respondents admitted that they have felt confused regarding how contents are to be taught in relation to theories. Respondent BFT6 stated:

> *"The physics topics, the theories, the policies, the styles of teaching keep changing here and there so we teachers get confused sometimes. Because in class you can't really know how to teach the topic because NCS said this, NATED said that, now CAPS is saying another."*

This notion was felt by urban school teachers. For instance, AUT5 said, "*Too many changes in policies, theories, methods –you name them– confuse teachers [more] than anything. The more you follow the more you get confused*". According to the DBE (2011), altering policies and how teaching enfolds in new curriculum bring about quality and serve as a means of ensuring transformation. Drawing from the DBE's arguments, policies informed theories which when followed by teachers in their teaching practices improves learners' academic performances and therefore cause greater curriculum impact, yet to the classroom teachers, this leads to teaching confusion.

Although teachers seem worried about too many changes within a short space in time, there were respondents who generally welcomed the content changes from NCS to CAPS based on misconceptions. This was explained by respondent AIT3 as follows:

> *"I don't think teachers were stuck at all in NCS learner-centred thing. I think we are happier to go back to CAPS which is teacher-centred. It is the same as how we used to teach in NATED 550 where you know you get the textbook, the content and you teach it."*

This suggests that some physics teachers were not interested in the NCS theoretical underpinning as its structure required constructivist, learner-centred and inquiry-based pedagogy but undermined content to be taught in a behaviourist, teacher-centred manner. Linking NATED 550 behaviourist theoretical stand to CAPS constructivist, learner-centred but greater teacher influence theory perspective signals teacher misconception and policy misinterpretations. This seems to be another source of confusion as physics teachers appear to view CAPS theory and pedagogy as the same as that of NATED 550 and hence welcome it. This is surprising as despite the content and textbook emphasis in the CAPS policy documents, teachers are urged to adapt constructive, inquiry-based and learner-centred teaching approach (DBE, 2012). This indicates teachers' misinterpretation of policies. In support, respondent BFT6 who also seemed a bit relieved added:

> *"I think CAPS is helping [more] than the NCS since it's got content like we used to have in NATED and we will teach only the content without worrying about constructivism and learner-centred learning which waste time…".*

The teaching under NCS was based on context, focused on learners' own constructive learning and demanded teachers to create their own teaching and learning space, of which some of the respondents may have found it problematic. Hence, the teaching theory in the new CAPS remained behaviourist, traditional style and not based on constructivist principles and direction as envisaged by the DBE but based on the NATED 550 mode of teaching.

Old theory and pedagogical practices versus new practices in current teaching

Over two-thirds (72.5%, n=79) strongly agreed (and agreed) that old practices are still displayed during teaching, learning and assessing of the new contents. Both qualitative data and themes from the interviews indicate that there are pedagogical practices and theories which are inherited from NATED 550 curriculum and content teaching in the new CAPS classroom. For example, AIT3 revealed: *"I don't see any new ways of teaching or new theories in the classroom because of CAPS that is being done now and to new topics. Those new changes are just on paper but not in the classroom".* Despite the content changes requiring adoption of modern practices, nothing new is exhibited in the classroom content teaching. Respondent BFT6 shared:

> *"I don't think any of those teachers I know teach with special strategies or change theories or something here and then. I still teach as I used to do in NATED, its chalk and talk because I have to teach the students. Look, some when you ask them they will say all what they don't do in class. They won't tell you the truth. So I think our teaching approach, assessment style and other things are the same."*

The point is modern physics content teaching should take cognisance of learners' real experiences and lead teachers to exploit that, yet as revealed by the findings, some of the old practices employed in NATED 550 such as 'talk and chalk' teaching, 'lifting' of questions directly from textbooks as assessment tasks, assessments as once-off high stake tasks, lack of planning as teaching is dictated by textbooks, passive learning and lack of participation, etc. are still alive in the current CAPS physics classroom. An excerpt from ATT4 revealed that "*…as teachers we know how to teach learners the new content topics. The Department cannot insist on 'centre' whether we teach with teacher-centred or learner-centred*". The classroom teachers who need to adopt the theoretical stand, new strategies, instructions, and directions in current physics content teaching and learning appear to be content with the ingrained known ones. According to respondent BUT10, "*Theories and policies in CAPS to me are not different from the NATED one. So why not use it. The way of teaching physics in NATED is good for learner understanding so I use it*". The findings indicate that irrespective of the school location and district, teachers find out ways and style of teaching effectively.

Despite the importance of modern physics content teaching over the old/traditional mode teaching, old pedagogical practices and theories are preferred. Le Ferve (2014) and Zhu and Engels (2014) are of the view that modern curriculum conveys what and how content are to be taught, learned and assessed and they are designed based on modern

philosophies. This means that teachers need to implement modern curriculum with current ideologies, interpretation skills, strategies and approaches. Yet, in this study it was shown that old practices are still dominant and displayed during physics content teaching and learning. As a result, pedagogy in CAPS is based on old theoretical background instead of current approved theory and practices.

Pedagogical practices and policies disparities

With reference to practical teaching, 59.6% (n=65) of the respondents agreed that adopting the required theory into practice to address the new content changes has been problematic. Lack of shift in the spheres of teachers' classroom lives towards new curriculum affect pedagogical practices such as teaching, planning and assessment related practices (setting of tasks, assessment administration, marking, recording, moderation, reporting, etc.). Some physics teachers fail to plan, ignore what current policies underpin on content aspects/topics, teach content based on previous aspects, and teach to examinations. According to respondent AUT5, *"I think the teachers find preparation towards content by using documents difficult and time wasting. So it is not counted as part of learning processes so they ignore and relax"*. This finding is strange as the CAPS policy document places more emphasis on teacher planning as part of the pedagogical practices. Therefore, misrepresentation of policy document prevails.

Pedagogical practice like assessments according to policy documents are to be employed with full consideration to policy guidelines and cognitive level descriptors (DBE, 2012). The data shows that marking and reporting were strictly applied to formal assessment tasks and that informal assessments were not marked nor reported on in the new CAPS. An account given by respondent AIT3 revealed that *"…in the informal assessments teachers do not do them, they focus on the CASS which is formal ones. Even marking, it's not applicable to mark any informal"*. Therefore, the focus on formal assessment at the expense of informal assessment undermines holistic development of learners in physics content teaching and understanding (Hall, 2013; Tan, 2011; DBE, 2011). Even when it comes to marking, as indicated by majority of respondents, teachers select and mark only the formal ones. Hence, teachers' classroom assessment practices are not tailored towards new CAPS policy requirements even though holistic usage of formal and informal assessment have the power to unlock intrinsic understanding of learners' physics content.

The findings further revealed that teaching time is used to do assessment tasks due to learners' inability to do work on time. This was highlighted by respondent AIT3:

> *"in assessment you give a task and when it's the due date few submit and the rest have not done it and then CASS comes so you allow learners to do the task in class at the expense of the usual teaching time. That challenge is there because the learners are lazy".*

This may means that despite CAPS's stipulation of the type and time for assessment tasks to be administered, teachers do not stick to such arrangements.

Assessment becomes complete when it is properly moderated (DBE, 2011; Harlen, 2007), yet moderation as practiced is not done according to new policy and theoretical requirements. Respondent BIT3 disclosed:

> *"The CASS moderation takes the teacher away from teaching yet it is more effective. Teachers struggle to get work from learners and also it's time wasting not even time consuming nowadays because we just moderate others' work with no policy or guidelines in mind."*

The challenges faced by teachers with regard to moderation, such as preparation (task administering, marking, recording, etc.), time spent at meetings, and the battle to acquire tasks from learners, signal that these practices are performed without policy considerations. A study done by Reyneke, Meyer, and Nel (2010) partly supports this finding that moderation meetings are perceived as workload. This implies that despite the time taken to prepare for moderation, the practices as enfolded therein (districts moderations) do not match the preparation and time taken out of the classroom.

Based on the findings in this study, it can be argued that disparity between pedagogical practices and theories and policies exist which hamper appropriate physics content teaching and learner information receiving. Especially as contents taught are expected to be planned, assessed in totality based on both formal and informal assessments, and be moderated efficiently (DBE, 2011), teachers find it difficult to tune their pedagogical practices towards DBE policies in physics content teaching and learning.

Theory and practices contradictions

From **Table 1**, 56% (majority) believe contradictions exist in theory and practice in current physics teaching. The contradictions based on the interview data indicate that lack of policy clarity on practices from the DBE and also ingrained traditional ways of practising by the teachers exist. It was noted by respondent ART2 that "…*with policy and even the theory it is not really clear what the Department want – one contradicts the other and sometimes they are the same. I'm not really sure what is required that is different from NCS and CAPS*". The physics teachers find it difficult to distinguish the kind of changes to be made in policies, theories and therefore practices in the classroom content teaching situation. This is supported by the Task Team Committees (DBE, 2009) that confusion exists on what constitute requirements and official instructions of NCS reform and content change due to rapid changes. It appears what constitutes current policies and theories as well as what adjustments required to be made during pedagogy towards theory is difficult to identify by physics teachers. The lack of pinpointing what exactly is to be done in the CAPS classroom situation which differs from the previous physics content teaching and learning by the teachers seems to exacerbate the instructional conflict. Respondent AIT3 said, "*Teachers are not clear about the policy so teachers*

do not read them…You know this policy and theory thing are not a problem because we know how to teach". Failure to read policies means no interactions exist. Therefore, teachers may ignore current theory principles and stick to the old/known theory in their practices. Hence, they will dwell on behaviourist teaching philosophies as was the case in NATED 550 where the knowledge transmission mode of teaching physics content was rampant (Chisholm, 2005; Tisani, 2006).

Respondent BRT7 mentioned that *"… they (DBE) have forgotten that most of us are old educators from NATED and its difficult to follow these changes".* With the contents, measures, pedagogy, policies and theories fluctuating, teachers fail to keep changing their behaviours accordingly. Similarly, respondent ATT4 believes that *"…the policies are there on policy document but are not surely for teaching".* Physics teachers view policy as statements which have no link with their classroom pedagogy. This finding is surprising as they need guidelines from the policy documents in order to execute their duties effectively. Respondent BRT7 explained that:

> *"It's not practical to stick to policies and theories as they change curriculum. That is why sometimes I blame the planners who should know better. These things don't work in class…I think it's good we also ignore them and teach the topics our own way."*

The teachers view Departmental policy documents on teaching as ambiguous, contradictory and inapplicable to current physics teaching and hence they prefer to stick to their traditional way of teaching irrespective of the curriculum reforms and content changes.

DISCUSSION

Physics teachers have always been expected to make changes in pedagogical practices, theories and policies to conform to instructions mandated through new curriculum. To do so they have to be familiar with latest theories and practices in order to adjust pedagogy which suit the newly demanded practice (DBE, 2011). However, based on the findings, it was clear that due to the various curriculum reforms via content, policy, theory and pedagogical practices alterations, confusion exists among physics teachers regardless of teaching experiences and school locations. In the Task Team report (DBE, 2009), confusion exists on what constitute official requirements and instructions of NCS reform.

In NATED 550, teaching was solely driven by the behaviourist theory model advocated by Skinner (1984). On the contrary, in the NCS the theory was constructivist (DoE, 2006). In the new CAPS, teaching remains constructivist, but the teachers take responsibility in pedagogy (DBE, 2011). Yet, physics teachers had not changed their theory and teach in a manner that allowed the learners to be custodians of content taught during pedagogy so that they would not only be receivers of information but the discoverers of knowledge (DoE, 2006). Physics teachers fail to adjust to new theories in the form of constructivist with much teacher influence as envisaged by current policies in their pedagogical practices (DBE, 2012).

The DBE's (DBE, 2012; DBE, 2011) reintroduction of contents per subject and greater emphasis on textbook usage in the new CAPS physics appears to make teachers associate CAPS to be similar to NATED 550 in terms of content structure and how teaching and learning must enfold. This appears to be the distinction drawn by teachers when comparing the NATED 550 and CAPS curriculum. Hence, practices towards content teaching, learning and assessing emanate from the teachers' own ingrained philosophies inherited from the old dispensation than by current Departmental mandate. These findings also contradict several authors advocating for modern methods and philosophies in science teaching and learning (Ramnarian & Schuster, 2014; Le Fevre, 2014; Hegde & Meera, 2012; DBE, 2011). Through adoption of new theories, such as learner-centeredness under constructivist discourse, learners can be incorporated in the process of pedagogical practices exhibition (Le Ferve, 2014; Ramnarian, 2014; DBE, 2012).

Brooks (2002) and DBE (2012) view pedagogical practices such as planning as a step to quality content teaching because policies are consulted to identify all the aspects of the contents to be taught and assess and resources needed for learner understanding. Yet, planning appears to be excluded in the pedagogical processes. Previous studies reported that in the NCS planning contributed greatly to the administrative burdens of the teachers (Chisholm, 2005; DBE, 2009; Jansen & Christie, 1999), but the current study points out that planning in CAPS is not regarded as an essential practice by the teachers to constitute administrative burdens.

Formal and informal assessments as pedagogical practices differ from the new CAPS assessment policy. Assessment practices are essential for teachers to be able to diagnose whether or not learners understand the content taught (DBE, 2012; Wiliams, 2008). The CAPS policy (DBE, 2011: 143) insists on marking some of the informal tasks to provide feedback and interventions to learners in the form of continuous assessment (CASS). Meanwhile, ignoring informal assessment in the classroom pedagogy was criticised by Kanje and Sayed (2013) and Howie (2012) due to its ability to enhance learners' learning processes which involve content, concepts and skills acquisitions and self-assessments. Bayaga and Wadesango (2013) argue that including learners in self-assessment enable them to judge themselves and their work effectively which is "an important life skill as well as an academic one" (p. 6). The formal assessment is to accumulate marks (25% CASS) for learners as part of final examination, whilst the informal assessment serves as a guide to monitor learning (DBE, 2012; DBE, 2009). Old practices are performed at the expense of modern or current practices which include appropriate planning, asking of questions to induce critical thinking skills, setting tasks based on cognitive levels, and effective moderations, amongst others (Kanje & Sayed, 2013; Wiliam, 2008).

In literature, a study done by Horn (2009) linked learners' own acquired knowledge through active learning to problem-solving abilities. Thus, learners gain better understanding of the acquired content knowledge and can easily integrate it based on the informed theory. In the new CAPS, active participation in pedagogy is envisaged for them to

understand science content and exhibit their natural desire of inquiring and discovering (DBE, 2011; DoE, 2006; Brooks, 2002). However, as majority of physics teachers find theory and practices to be contradictory in the classroom circumstance may mean that current theory is not put into practice for the learners' benefit.

As a result, their intentions and attitudes as explained by the TPB have been negative towards modern theories, policies and pedagogical practices which in the long run affects how learners are taught, learn and assessed in physics classroom. Also, their adoption of theories and polices to inform pedagogical practices have been deliberate, carefully thought of and that prediction of later behaviour is based on stable circumstances (Filho et al., 2012). Similarly, drawing from TCD, teachers do not want to struggle due to content changes and entire reforms, therefore they avoid new policies, theories and practices which could bring dissonance or uneasiness (Bohlmann & Weinstein, 2013).

CONCLUSION AND RECOMMENDATION

Effective content teaching and learning is governed by appropriate theoretical-based curriculum which dictate pedagogical practices (Hoadley & Jansen, 2009, Hall, 2013). Hence, with reference to research questions, it can be concluded that confusion in theory and practice exist in the new CAPS due to various reforms. Old/traditional practices often criticised in previous studies (Chisholm, 2005; Jansen, 1998), and behaviourist theory principles are still prevalent in the new CAPS instead of constructivist underpinnings where adequate learning opportunities to discover knowledge in problem-solving contexts are mandatory. Policies and theories adoption is a challenge and often pedagogical practices contradict what is envisaged as theories and policies.

The current study suggests that the DBE has to endeavour to maintain a stable educational system where teachers can make behavioural predictions towards modern practices and at the same time avoid or deal with dissonance by not incorporating new dispensational underpinnings. Nevertheless, there is the need for greater teacher capacitating.

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