Implementation of the new FET Physical Science Curriculum: Teachers views

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South African physical science teachers are currently implementing the new FET curriculum. This paper reports on the views of 59 physical science teachers currently teaching Grade 10 and 11 learners. Data from questionnaires and focus group interviews showed that even though the teachers generally held positive views about the new FET physical science curriculum, they had concerns about the content overload, their capability of teaching, resources available and the level of support given as well as the quality of training. The perspectives of these teachers were used to determine the level of implementation of the new curriculum. Their views were compared with a theory of curriculum implementation with particular reference to developing countries.

Background and Introduction

The South African Department of Education introduced a new curriculum with a different philosophy after 1994. This curriculum is modelled on outcome-based education principles, incorporates learner-centeredness and continuous, performance-based assessment. Grade 1 learners experienced the new curriculum in 1998 and from there the new outcomes based curriculum were gradually phased in year after year. In 2006, the physical science teachers had to implement the new curriculum for the first time in Grade 10 while implementation followed in 2007 for Grade 11 and the Grade 12 learners will write a "new" examination towards the end of 2008.

Curriculum changes place new demands on teachers. For example, the FET teachers are required to address three learning outcomes (LO's) that have been formulated for Physical Science namely, practical scientific inquiry and problem solving skills, constructing and applying scientific knowledge and the nature of science and its relationships to technology, society and the environment (DOE, 2003).

Concomitant to this, the use of a spiral approach is been recommended to enable conceptual progression and conceptual coherence (DOE, 2006). Conceptual progression refers to introducing a concept in a particular grade and then revisits that concept in later grades while conceptual coherence is about highlighting links among topics in a grade. For example the topic mechanics has been moved from grade 11 to grade 10, while kinematics is been used in some instances to analyse the motion of a pulse (Smith et al., 2005). In addition, new topics such as electronics, compulsory practical work as well as assessment standards have been included.

Therefore, teachers' responses and views about their readiness and preparedness to deal with such changes are important. To determine how far the process of implementation is, we used these responses and compared it against a theory of curriculum implementation that was designed for developing countries.

Curriculum implementation theory

Rogan and Grayson (2003) published the start of a process to develop a theory of curriculum implementation with particular reference to science education in developing countries. To implement

a curriculum is no easy process and their main aim was to develop indicators to determine to what degree the implementation of a curriculum process is. The theory consists of three constructs: Profile of implementation, Capacity to support innovation and Support from outside agencies. Each construct comprises four levels. The beginning levels encompass the period of becoming aware of and preparing to implement the new curriculum, followed by mechanical and routine use levels. The final levels are when the teacher begins to take ownership of the curriculum and may enrich it by making major modifications. Since the theory has been proposed for developing countries, we will use it as a reference for our results.

Sample

Data was collected during the first three months of 2007 at meetings of three clusters of the Tswane North District of the Gauteng region that represent a combination of urban and township schools and a rural cluster in the North West Province. A total number of 59 teachers participated in the research with 9, 14, 19 and 17 teachers respectively in the four groups.

Data collection

Focus group interviews and questionnaires were used to obtain information from teachers who taught the new curriculum to grade 10's during the first implementation year 2006 and to grade 11's at the beginning of 2007. The objective was not to design the interviews and questionnaires as a test for the implementation theory mentioned above. The aim was to allow a free flow of ideas and comments from teachers, especially during the interviews and then evaluate their comments against the indicators and levels proposed in the theory.

Findings

The responses of the teachers to the questions put to them in the questionnaire were analysed and classified as well as the transcribed interviews. The six themes that emerged were curriculum, resources, learners, support, practical work and affective. The last theme was chosen to capture data that expressed the teachers' feelings towards the implementation of the new curriculum.

Curriculum

Almost half of the responses had to do with the curriculum. A third of the teachers found the curriculum challenging and engaging for themselves and their learners. Since almost half of the responses had to do with the curriculum, we had a careful look at this theme and identified five sub-themes sequenced according to priority.

1. *Amount of content and time constraints: S*ome of the teachers indicated that it was a positive experience to teach especially the new content; however, 35% of the comments were about the perception that there is too much content in the new curriculum.
2. *Nature of the content:* This was the second most common concern (27%). Teachers commented mostly about the fact that they do not have experience in teaching the new content.
3. *Level of the content:* Almost all comments referred to the content as too difficult and too challenging for learners in grade 10.
4. *Assessment:* This was also an important aspect of the new curriculum (24%). Teachers found it time consuming to evaluate each learner according to the leaning outcomes (LO's) and assessment standards (AS's).
5. *Progression between grades:* Some teachers indicated that learners in grade 10 struggled with the amount of work, because they are not used to so much work coming from grade 9.

Learners

The second highest category found was about learners (30%). The positive comments about the learners were focussed on learner involvement. The most frequent negative comment about the

learners was that learners enter grade 10 without the necessary skills that they ought to have developed in lower grades, especially grades 8 and 9.

Practical work

Practical work featured third (15%). Some teachers indicated that learners understand better when doing experimental work, but they felt constraint here due to a lack of equipment. Others wanted prescribed practical work. A third group wanted more time to do experimental work and rubrics that are standardised at national level for this aspect of the curriculum.

Resources

A third of the comments indicated that resources are a problem: 54% of these were complaints about a lack of equipment to do experimental work or demonstrations, 25% about the overcrowding in classrooms and 21% about problems with textbooks.

Support

Support did not feature prominently, but when asked what is needed to successfully teach physical science, 82% of those that indicated some form of support were needed, felt that more training is required. All the comments about training were negative.

Affective aspects

Teachers' comments on the influence of C2005 on their teaching ranged from very negative ("I'm fed up") to mostly positive ("See it as a challenge to improve"). The impact of teaching the new curriculum in an outcome based way seems to affect teachers most in terms of the time and the effort that need to be spend on lesson preparation. Teachers seem to be conscious about the learning outcomes and specifically mentioned LO3. They are positive about the curriculum being related to the real world.

Biographic features

There seems to be gender dominated views about assessment and the overload of content and the time associated with it. All male teachers made responses on assessment. The female teachers on the other hand made comments on the learning program that is too long, and that they found it difficult to fit in all aspects of the curriculum and finish on time. When asked about what would be needed to be a successful teacher, again it was mostly female participants that indicated concerns about time management, while male participants were more focussed on the content itself.

Teachers with diploma qualifications only, were in relation much more concerned about training, workshops and practical work than teachers with degrees qualifications. They felt that they were not adequately trained and all the changes affected negatively on teaching as a career.

Teacher recommendations

Half of the teachers would want to reduce the amount of content. They realise that they have to focus on concept development, but feel constrained by the large amount of content that needs to be covered during one year. They once more emphasised the influence of the time constraints within which they have to operate. Some wanted specific time allocations for each topic and others wanted the content to be rearranged. Another group are even of the opinion that they should have fixed work schemes, that everybody should teach the same content and in the same sequence.

Degree of implementation

We compared the teachers' views as reported above with the levels and indicators of the three constructs of the implementation theory (Rogan & Grayson, 2003). This evaluation is limited by the nature of our interviews and questionnaire that were structured in such a way that we wanted the teachers to comment spontaneously.

Profile of Implementation

The construct Profile of Implementation specifically focuses on what is happening in the classroom. All the dimensions, classroom interaction (teacher and learner), science practical work, science in society and assessment were addressed by the teachers. Our data do not demonstrate all the indicators at the various levels, since our questions did not for example include “does the teacher probe learners’ prior knowledge?” (level 3) or “does learners take responsibility for their own learning?” (level 4). Issues like these were not spontaneously addressed by the teachers. They struggle to present content in a well organised and sequenced manner (level 1) because they find it difficult to determine the extent and depth to which they should teach most topics in the new curriculum.

The dimension assessment featured prominently in the teachers’ responses. A chapter devoted to assessment in the NCS (DOE, 2003) includes topics such as the types and methods of assessment. Therefore the level 3 criteria of the Profile of Implementation that state “assessment is based on more than written tests” should be familiar to teachers. In addition, level 4 indicates that learners have to compile portfolios. A teacher however requested “guidelines for portfolios so that one can have an idea of what an investigation must entail”. Other comments included difficulties to “evaluate each learner according to the assessment standards” and concerns about the “drawing of rubrics for each assessment criterion or learning task”. The new curriculum puts a high demand on teachers to operate at level 3 or 4, but according to our data the teachers in our sample are not there yet. A variety of reasons featured such as “no guidelines for assessments” and “difficulty with constructing rubrics”.

Capacity to support innovation

This construct relates to the capacity of a specific school to innovate. The four dimensions, physical resources, teacher factors, learner factors and the school ecology and management did not all emerge. Mainly teacher factors were pointed out. The biographic information revealed 1.6 qualifications on average per teacher. These qualifications varied from one teacher with a PhD in Physics to the majority of teachers with four-year teaching diplomas. One would expect that level 3 of this construct, a “teacher is qualified for the position and has a sound understanding of subject matter” would be applicable, but many of the interviewed teachers have difficulties with the content they have to teach. One teacher indicated “I have to improve my knowledge of Physical Science content” and another “I need assistance on the new chapters, especially chemical systems". The need to be “empowered” and “attend more workshops on Physics” would not be stated if teachers had a sound understanding of the subject matter.

The teachers’ years of teaching experience averaged to nine years. It has been shown that students of experienced teachers achieved better than students with inexperienced teachers (Rivkin, et al., 2005). An inexperienced teacher is considered as a person with one to three years of teaching experience. Although we were interviewing experienced teachers, they still indicated that they do not feel confident enough to do their work.

Support from outside agencies

This construct intends to describe the kinds of actions undertaken by outside organizations such as departments of education and NGO's. Our study can only reflect on the “types of encouragement and support” and then again, not in detail. However, it is clear that the support provided by the department of education is inadequate (see section on support). Comments such as "we need to be trained by professionals and experts of the NCS”, “more support from responsible bodies” and “better leadership (government)” were conveyed by the teachers.

Recommendations

Considering the teachers' perspectives about what they are currently experiencing with the implementation of C2005, the following are suggested. At the National Department of Education level the amount of content could be reconsidered. We support the principle of "less is more". Less content that is properly dealt with, will add much more value to the education of our FET learners, especially with a view of them advancing to scientific, technical or engineering studies and careers.

At the Provincial Department of Education level, serious thought should be given to the nature, duration and timing of training provided to teachers. It seems that the intension is fine, but the implementation lacking. Resources and/or the lack of resources provided by departments for teaching Physical Science are a serious concern to most teachers. Although efforts are made to supply schools with equipment, Physical Science teachers are not confident to use and manage it. This implies appropriate training once more. University departments involved in the training of our future and in-service FET Physical Science teachers should urgently align their training with the desired objectives and outcomes of the new curriculum. The major concerns here are with the FET content, the level and nature of the content and the applications in terms of practical work and projects.

The authors of the theory of curriculum implementation invited contributions and modifications to the theory, particularly from developing countries (Rogan & Grayson, 2003). The ultimate goal with this theory is for a school to achieve level four on all dimensions of each of the three constructs. Considering the complexity of the current South African education landscape and from the perspectives of the teachers, a simplification of the theory might be worthwhile. The three constructs seem to be adequate to base a theory of implementation on, but we view the four levels within each construct to be too elaborate and extended. Given the current views of teachers and realities of the implementation situation, it seems that it will take too long for most schools and support agencies to live up to the expectations of such a theory. It would be more attainable to set targets of implementation if a measurement could be made based on fewer levels. A three-level system is proposed based on a "baseline", an "intermediate" and an "excellent" level. Arguably most schools would start off at the baseline level. The objective would be to support and motivate schools to reach the intermediate level within five years. With reference to developing countries that could be considered a "successful" implementation. Targets should then be extended to achieve the excellence level in the subsequent five years.

Concluding remarks

Determining teachers' responses about the new FET physical science curriculum helped to identify difficulties, deficiencies and gaps that there are in the curriculum delivery. It also provided some information about what needs to be done in order to sustain the ideals of the new curriculum. The teachers interviewed generally held positive views about C2005. This positive attitude gradually disappeared when they expressed their concerns about the content overload, their own adequacy of teaching, the learning resources and the level of support they were given as well as the quality of training they were exposed to.

Our aim was to create an awareness of the perspectives of physical science teachers while they are midst in the implementation process. ".. one of the basic reasons why planning fails is that planners or decision-makers of change are unaware of the situations that potential implementers are facing. They introduce changes without providing a means to identify and confront the situational constraints and without attempting to understand the values, ideas and experiences of those who are essential for implementing any changes" (Fullan, 1991:96).

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