Student teachers' views: what is an interesting Life Sciences curriculum?

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In South Africa, the Grade 12 'classes of 2008 and 2009' were the first to write examinations under the revised Life Sciences (Biology) curriculum which focuses on outcomes-based education (OBE). This paper presents an exploration of what students (as learners) considered to be difficult and interesting in Grades 10–12 Life Sciences curricula in the Further Education and Training (FET) phase. A sample of 125 first year, pre-service Life Sciences and Natural Sciences teachers from a university responded to a questionnaire in regard to their experiences with the newly implemented FET Life Sciences curricula. The responses to the questions were analysed qualitatively and/or quantitatively. Friedman tests were used to compare the mean rankings of the four different content knowledge areas within each curriculum, and to make cross-curricular comparisons of the mean rankings of the same content knowledge area for all three curricula. All four content areas of Grade 12 were considered as being more interesting than the other two grades. In terms of difficulty, the students found the Grade 10 curriculum themes the most difficult, followed by the Grade 12 and the Grade 11 curricula. Most of the students found the themes under the content area Diversity, change and continuity *(Grades 10–12) more difficult to learn than the other three content areas. It is recommended that more emphasis needs to be placed on what learners are interested in, and on having this incorporated into Life Sciences curricula.*

Keywords: curriculum; difficulty; interesting; Life Sciences; students; teachers

Introduction

The Organisation for Economic Co-operation and Development (OECD) Global Science Forum (2006) reported that the declining enrolment of students in the sciences is often attributed to the uninteresting curriculum of science courses. Spall, Barrwett, Stannisstreet, Dickson and Boyes (2003) cited Watson, McEwen and Dawson (1994), who asserted that science-related subjects are also seen by learners as offering less freedom of expression than non-science subjects and as being more difficult.

The Grade 12 'classes of 2008 and 2009' were the first to write exams under the revised Life Sciences curriculum which focuses on outcomes- based education (OBE). The majority of participants in curriculum-based research studies involved teachers, politicians, teacher unions, non-governmental organizations (NGOs) and academics at teacher-training institutions and universities. Currently, little (if any) research has been done on learners' first-hand experiences of the newly implemented Life Sciences curricula. The purpose of this study is to analyse, from the point of view of the learners, the level of cognitive difficulty of the themes under each content knowledge area in the Grades 10–12 Life Sciences curricula, to rank the

themes and content areas in each curriculum according to interest, and finally, to make cross-curricular comparisons.

Background

It had already been recommended by Armstrong in 1973 that learners should be involved in choosing their curriculum topics. Today, more than 30 years later, curriculum design is still based on adult notions of what is of interest to themselves, and not to the learners. Particularly noteworthy is that, interest, goals, and motivation have been identified as important for learning and academic performance (Hidi & Harachiewicz, 2000). Studies have shown that interest-triggered learning activity leads to a higher degree of deep-level learning (Krapp, 2002). According to Baram-Tsabari and Yarden (2005), 'interest' is often defined in reference to the teachers, rather than from the learners' view. Wade (2001:245) described the word 'interest' as "specific, develops over time, is relatively stable, and is associated with personal significance, positive emotions, high value, and increased knowledge". Uitto, Juuti, Lavonen and Meisalo (2006) contend that 'interest' is a relationship between an individual and an object. In relation to the curriculum, an 'interesting curriculum' would therefore be one that arouses a feeling of interest in the learner or teacher (Kidman, 2010). This last author suggests that students' interests still need to have greater prominence in the design of science curricula. To enhance student interest in science, Christidou (2006:1184) advises the careful selection of topics: "A revised science curriculum should emphasize those topics that are of interest to the students, and encourage activities that are familiar and readily adopted by them". Studies have indicated that a better fit between students' interests and curricula could lead to better affective and cognitive outcomes in the sciences, as well as increased enrolments in the sciences (Trumper, 2006). The study of Osborne and Collins (2001), cited in Kidman (2008, 2010), highlighted that learners' decreasing interest in science was due to the lack of discussion of topics of interest, the alienation of science from society, the absence of creative expression opportunities and the prevalence of isolated subjects. These learners were dissatisfied with science contexts that did not meet their interests. The study of Kidman (2010) found learners withdrawing from Biology courses in post-compulsory settings due to lack of interest and perceived lack of relevance of the course.

Curriculum reform in South Africa

After South Africa's first national democratic elections in 1994, the need for educational reform was widely recognised when this government came into power. According to Chisholm (2003, 2005) curriculum revision in South Africa was undertaken in three main stages: firstly, the 'cleansing' of the curriculum of its racist and sexist elements and purging of the most controversial and outdated content.

Secondly, the most ambitious and comprehensive of these reforms was the implementation of outcomes-based education through a new curriculum, Curriculum 2005 (C2005) (1997). This drastic step was taken because the Department of Education considered the existing curriculum as narrow and outdated and with little focus on Africa (Gadebe, 2005). The Minister of Education launched C2005 in Cape Town on 24 March 1997, with implementation in Grade 1 scheduled for 1998, and Grade 7 in 1999. This curriculum was thus to be phased in progressively so that it would cover all sectors of schooling by 2005 (Harley & Wedekind, 2004). The intention was to introduce this curriculum for Grade 10 learners (pupils) in 2003, for Grade 11 learners in 2004 and for Grade 12 learners in 2005, but the curricula for these

grades were not developed in time for implementation (Velupillai, Harding & Engelbrecht, 2008). Rogan & Grayson (2003), as well as Rogan (2004) identified the problem that too often the energies and attention of politicians and policy-makers are focused on the 'what' of desired educational change, neglecting the 'how'. They argued that developing countries emphasize curriculum adoption and neglect implementation (De Waal, 2005; Rogan, 2004). Aldous (2004) described the curriculum as complex and warned that it would be open to misinterpretation. The emphasis in OBE shifts to what learners can do with their knowledge and, in particular, whether they can use what they know to meet the specified outcomes (Hattingh, Rogan, Aldous, Howie & Venter, 2005).

The third stage involved the review and revision of C2005 (up to Grade 9) in the light of recommendations made by a Ministerial Review Committee appointed in 2000. This Review Committee recommended a major revision of the curriculum in order to make it more understandable in the classroom (Chisholm, 2003; 2005). C2005 was reworked into the Revised National Curriculum Statement (RNCS), which was introduced into Grades 1 to 3 in 2004, 4 to 6 in 2005, 7 and 10 in 2006, 8 and 11 in 2007, 9 and 12 in 2008 (Velupillai *et al.*, 2008). The NCS became official policy in 2002.

Implementing of the new Life Sciences curricula

In South Africa, three different curricula have been used for Life Sciences in the Further Education and Training (FET) phase. Till 1995, the 'apartheid' curriculum directed teaching; during the period 1995–2006 the Interim Curriculum (IC) was used; and in 2006 the National Curriculum Statement (NCS) for Grades 10–12 (the final years of secondary schooling) was implemented. Since 2006, the subject Life Sciences has replaced the subject known as Biology in Grades 10–12 in the FET phase. Four content knowledge areas were created for each curriculum. The content knowledge areas include:

• *Tissues, cells and molecular studies*;
• *Structures and control of processes in basic life systems*;
• *Environmental studies*; and
• *Diversity, change and continuity*.

Several Botany, Zoology and/or human Biology related themes or topics were grouped under each content area (Department of Education, 2003). The findings of Johnson (2009) provided evidence that there has been an improvement in the re-contextualisation of Life Sciences as a hierarchical knowledge structure in the Life Sciences curricula implemented since 1995. Pandor (2006:2) described the newly implemented Life Sciences curricula as "modern and up to date" and "it starts our children on the road to understanding new scientific knowledge …". How did the learners experience these 'modern' curricula?

Objectives of the study

Based on the above rationale, the following research questions were asked in the study:

1. Which themes and content knowledge areas in the new Grades 10–12 Life Sciences curricula did first year students (as learners) find the least and most interesting?
2. Which themes and content knowledge areas in these curricula did they find difficult?
3. Is there a correlation between the grade of cognitive difficulty and level of interest in regard to the Life Sciences curricula themes?

Research methodology

Sample and participants

In this study, the sample was purposively selected. A sample of 125 Bachelor of Education (BEd), pre-service Life Sciences and Natural Sciences teachers at a single, semi-urban university participated in this study. Only students enrolled for the courses Zoology and Botany or General Sciences were involved in this empirical study. The study ran over two years (2009 and 2010). All the students in the sample population were exposed to C2005. Only students who matriculated in 2008 or 2009 and who wrote the Grades 10–12 Life Sciences examinations participated in the study. The 2008 and 2009 Grade 12 classes were the first cohort to enter the FET phase under the Revised National Curriculum Statement (RNCS) in Grade 10. They were also the first two Grade 12 classes to complete the new Life Sciences curriculum which focuses on outcomes-based education (OBE). These participants obtained the National Senior Certificate (NSC) in 2008 or 2009, respectively.

Instrument

The questionnaire was approved by the Faculty Research Ethical Committee. The research complied with the ethical guidelines laid down by the university for educational research, including voluntary participation, informed consent, confidentiality, anonymity, trust and safety in participation. The questionnaire contained both open-ended and closed questions, which elicited responses in regard to individual experiences and opinions. The responses yielded demographic data as well as information on students' personal experiences of and opinions toward the Grades 10–12 Life Sciences curricula. The students were also asked to critically analyse the Grades 10–12 Life Sciences curricula mainly in terms of interesting themes. The demographic items had bearing on Grades 10–12 Life Sciences symbols, gender and area of specialisation. One section of the questionnaire dealt with the ranking of four content areas and its themes *separately*, for example, the Grade 10 curriculum (12 themes), Grade 11 curriculum (13 themes) and the Grade 12 curriculum (12 themes). These content areas and themes were obtained from the National Curriculum Statement Life Sciences FET (Department of Education, 2003). In each case the students were required to separately rank the themes of each curriculum according to interest and difficulty.

Data collection strategies

Information was collected by means of a single questionnaire, which students completed during routine classes. Students of one Zoology class and one General Science class were involved in the study. Participation was voluntary and participants did have a choice as to whether they wanted to submit the completed questionnaire or a blank form. The questionnaire took about 45 minutes to complete.

Data analysis procedure

The responses to the open-ended questions were analysed both qualitatively and quantitatively. The responses to the closed questions were analysed only quantitatively. Statistical analysis (summary statistics, two-way tables) of the survey data was used to elaborate and enhance the discussion. Friedman tests (ANOVA) were used to compare the mean rankings of the four different content areas in each curriculum. The same test was also used to make cross-grade comparisons of the mean rankings of the same content area for all three curricula. Results are presented as percentages rounded to whole numbers.

Validity and reliability

The questionnaire's content validity was face-validated by experts in the field of Life Sciences, who are competent to judge whether the questionnaire reflects the content domain of the study. The questionnaire was pilot-tested with second year Zoology and Botany students. Based on the feedback of the pilot study and from the experts, the questionnaire was revised. Redundancies and ambiguities were removed to improve the clarity in the formulation of certain items in the questionnaire. Reliability is not applicable to the data because 'forced ranking' was used in the questionnaire.

Results

Biographical information

One hundred and twenty-five prospective student teachers completed the questionnaires. Ninety-four (75%) were Zoology and Botany students and the other 31 (25%) were General Sciences students. Of these, 49 matriculated in 2008 while 76 matriculated in 2009. All the students were first year students. The majority of students (72%) were female. The majority (41%) passed Life Sciences with a percentage between 60 and 69%, followed by 70 to 79% (30% of the students), 80% or more (14% of the students), 50 to 59% (13% of the students) and 40 to 49% (2% of the students).

Popularity of the Life Sciences curricula

In response to the statement "Write down in order of preference which curriculum did you like the most", the majority of the students (60%) liked the Grade 12 Life Sciences curriculum the most. Grade 11 was chosen by 31% while only 9% of the students indicated the Grade 10 curriculum as being the most liked. A high percentage (41%) of students indicated that their preference of curricula was in the following order of sequence: Grade 12, followed by Grade 11 and Grade 10. In summary, the data revealed that the Grade 12 Life Sciences curriculum is more popular than the other two curricula.

Ranking of the Grade 10 Life Sciences themes

Table 1 shows the ranking of all the Grade 10 Life Sciences curriculum themes from the most to the least interesting. The results indicated that the theme 'Cell structure' is the most interesting theme ($\bar{x}$ = 4.12; *SD* = 3.18) and 'Significance and value of biodiversity to ecosystem function and human survival' the least ($\bar{x}$ = 8.50; *SD* = 2.97) interesting theme in the Grade 10 Life Sciences curriculum. The four content areas are ranked from most to least interesting as follows: *Tissues, cells and molecular study* (themes 1 to 3), *Structure and control of processes in basic life systems* (themes 4 to 7), *Environmental studies* (themes 8 and 9), and *Diversity, change and continuity* (themes 10 to 12). The mean scores indicate that there are no significant differences between the themes within each content area.

The majority of students found the two themes under the content area *Environmental Studies* more difficult to learn than the other three content areas. Fewer found the three themes under the content area *Tissues, cells and molecular study* to be difficult. The results indicate that the easiest theme for them to learn was: Digestive system, human nutrition and related diseases, classified under the content area *Tissues, cells and molecular study*.

Table 1   Ranking of themes of the Grade 10 Life Sciences curriculum

	Most to least interesting themes	Content area	$\bar{x}$	SD
1.	Cell structure	TCM	4.12	3.18
2.	Cell division	TCM	4.53	3.26
3.	Tissues and related diseases	TCM	5.01	3.09
4.	Digestive system, human nutrition and related diseases	SPL	5.18	3.16
5.	Food production e.g. photosynthesis	SPL	5.91	2.96
6.	Respiratory system, gaseous exchange and related diseases	SPL	6.00	3.12
7.	Energy release e.g. aerobic and anaerobic respiration	SPL	6.64	3.14
8.	Living and non-living resources, nutrient cycles and energy flow within an environment	ES	7.71	3.07
9.	Biospheres, biomes and ecosystems	ES	7.75	3.25
10.	Biodiversity of plants and animals and their conservation	DCC	7.98	3.19
11.	Threats of biodiversity	DCC	8.25	3.05
12.	Significance and value of biodiversity to ecosystem function and human survival	DCC	8.50	2.97

TCM = Tissues, cells and molecular study; SPL = Structure and control of processes in basic life systems; ES = Environmental studies; DCC = Diversity, change and continuity

Table 2   Ranking of themes of the Grade 11 Life Sciences curriculum

	Most to least interesting themes	Content area	$\bar{x}$	SD
1.	Support e.g. skeleton	SPL	4.68	3.66
2.	Transport e.g cardiovascular system	SPL	5.36	3.62
3.	Excretion e.g. urinary system	SPL	5.39	3.25
4.	Nervous system	SPL	5.40	3.52
5.	Micro-organisms	TCM	6.43	3.96
6.	Endocrine system	SPL	6.38	3.17
7.	Human influences on the environment	ES	7.31	3.43
8.	Related diseases of systems	SPL	7.63	3.05
9.	Sustaining our environment	ES	7.74	3.40
10.	Air, land and water borne diseases	ES	7.97	3.00
11.	Social behaviour – predation, competition	DCC	8.16	3.71
12.	Population studies	DCC	8.84	3.64
13.	Managing populations	DCC	9.52	3.51

TCM = Tissues, cells and molecular study; SPL = Structure and control of processes in basic life systems; ES = Environmental studies; DCC = Diversity, change and continuity

Ranking of Grade 11 Life Sciences themes

Table 2 shows the ranking of all the Grade 11 Life Sciences curriculum themes from the most to the least interesting. The results indicated that the theme 'Support' is the most interesting theme ($\bar{x} = 4.68$; $SD = 3.66$) and 'Managing populations' the least ($\bar{x} = 9.52$; $SD = 3.51$) interesting theme in the Grade 11 Life Sciences curriculum. The four content areas are ranked

from most to least interesting as follows: *Structure and control of processes in basic life systems* (themes 1 to 4, and 6), *Tissues, cells and molecular study* (theme 5), *Environmental studies* (themes 7, 9 and 10), and *Diversity, change and continuity* (themes 11 to 13). The mean scores indicate that there are statistically significant differences between the themes 'Support' and 'Endocrine system' within the content area *Structure and control of processes in basic life systems*. There are few differences between the standard deviation ranges (SD = 3.00–3.96) of the thirteen themes (see Table 2).

The majority of students found the three themes under the content area *Environmental Studies* easier to learn than the other three content areas. More found the themes 'Micro-organisms and their diseases' and 'Population studies' under the content areas *Tissues, cells and molecular study* and *Diversity, change and continuity,* respectively, to be difficult.

Ranking of Grade 12 Life Sciences themes

Table 3 shows the ranking of all the Grade 12 Life Sciences curriculum themes from the most to the least interesting. The results indicated that the theme 'Genes, inheritance, genetic diseases' is the most interesting theme ($\bar{x}$ = 3.49; SD = 2.68) and 'Fundamental aspects of fossil studies' the least ($\bar{x}$ = 8.48; SD = 2.68) interesting theme in the Grade 12 Life Sciences curriculum. The four content areas are ranked from most to least interesting as follows: *Tissues, cells and molecular study* (themes 1 to 3), *Structure and control of processes in basic life systems* (theme 4), *Environmental studies* (themes 5 and 7), and *Diversity, change and continuity* (themes 6 and 8 to 12). The mean scores indicate that there are no significant differences between the themes within each content area. There are a few differences between the standard deviation ranges (SD = 2.54–2.93) of eleven of the twelve themes (see Table 3).

Table 3   Ranking of themes of the Grade 12 Life Sciences curriculum

	Most to least interesting themes	Content area	$\bar{x}$	SD
1.	Genes, inheritance, genetic diseases	TCM	3.49	2.68
2.	DNA, protein synthesis	TCM	3.55	2.80
3.	Chromosomes, meiosis, production of cells, diseases	TCM	3.64	2.68
4.	Reproduction and related diseases	SPL	3.91	2.81
5.	Effect of pollutants on human physiology and health	ES	6.96	2.86
6.	Origin of species	DCC	7.26	2.93
7.	Local environmental issues	ES	7.30	3.10
8.	Evolution theories, mutation, natural selection, macro evolution, speciation	DCC	7.81	2.78
9.	Cradle of mankind	DCC	8.35	2.79
10.	Biological evidence of evolution of populations	DCC	8.35	2.54
11.	Popular theories of mass extinction	DCC	8.39	2.85
12.	Fundamental aspects of fossil studies	DCC	8.48	2.68

TCM = Tissues, cells and molecular study; SPL = Structure and control of processes in basic life systems; ES = Environmental studies; DCC = Diversity, change and continuity

The majority of students found the six themes under the content area *Diversity, change and continuity* more difficult to learn than the other three content areas. Fewer found the three

themes under the content area *Tissues, cells and molecular study* to be difficult. The results indicate that the easiest theme for them to learn was: 'Reproduction and related diseases', classified under the content area Structure and control of processes in basic life systems.

Cross-grade comparisons of the mean rankings for each content knowledge area

Table 4 shows the cross-grade comparisons of the mean rankings of the same content area for all three (Grades 10–12) Life Sciences curricula. The mean value ($\bar{x}$) and standard deviation (*SD*) were obtained for each content area to examine the internal consistency of the students' responses of some questions. All the mean values of the content area *Tissues, cells, and molecular study* differ significantly for all three grades. The students found this Grade 12 content area more interesting than the other two. There are no significant mean score differences between the Grades 10 and 11 content area *Structure and control of processes in basic life systems*. Again, the results show that this Grade 12 content area is the most interesting. Friedman's test (ANOVA) indicates no significant mean score difference between the same content area *Diversity, change and continuity* for Grades 10 and 12. The relatively low standard deviation (*SD* = 1.65) suggests that students were quite consistent in relation to what they perceived to be interesting. The students also experienced this Grade 12 content area as the most interesting. In summary, all four content areas of Grade 12 are considered to be more interesting than the other two grades. Statistical analysis of the content area *Environmental studies* shows that it was not significant at the 0.05 probability level ($p = 0.3324$), but the other three were ($p = 0.0000$; $p = 0.0006$). Comparing the rank of interesting content areas of all three grades, *Tissues, cells and molecular study* (Grade 12) has the lowest mean score (3.55) which indicates the most interesting content area. In contrast, *Diversity, change and continuity* (Grade 11) shows the highest mean score (8.87) which indicates the least interesting content area.

Table 4 Results of Friedman's ANOVA comparing the content areas for Grades 10–12 in terms of interest

Content areas	Grade 10		Grade 11		Grade 12		*p*
	$\bar{x}$	*SD*	$\bar{x}$	*SD*	$\bar{x}$	*SD*	
Tissues, cells and molecular study	4.61	2.20	6.38	2.35	3.55	2.20	0.0000*
Structure and control of processes in basic life systems	5.94	1.98	5.78	3.94	3.92	2.76	0.0000*
Environmental studies	7.77	2.70	7.74	2.85	7.21	2.74	0.3324
Diversity, change and continuity	8.24	2.53	8.87	3.08	8.15	1.65	0.0006*

 * $p < 0.05$

Comparison of the mean rankings for the four content knowledge areas within each curriculum

Friedman's tests were used to compare the four different content areas in each curriculum. The

content areas are ranked according to interest for each grade (Table 5). The participants found the themes of the content area *Tissues, cells and molecular study* in Grades 10 and 12 the most interesting, followed by *Structure and control of processes in basic life systems*, *Environmental studies*, and lastly, *Diversity, change and continuity*. The ranking of content areas is slightly different for Grade 11 — most participants indicated that *Structure and control of processes in basic life systems* is more interesting than their second choice, *Tissues, cells and molecular study*. Friedman's test indicates no significant mean score difference between the same content areas, e.g. *Environmental studies* and *Diversity, change and continuity* (Grade 10, 11 and 12); *Tissues, cells and molecular study* and *Structure and control of processes in basic life systems* (Grade 11 and 12); and *Tissues, cells and molecular study* and *Environmental studies* (Grade 11). Statistical analysis of the content areas in each curriculum show that it was significant at the 0.05 probability level ($p = 0.0000$).

Table 5 Results of Friedman's ANOVA comparing the four different content areas in each curriculum in terms of interest

Content areas	Grade 10			Grade 11			Grade 12		
	$\bar{x}$	SD	R	$\bar{x}$	SD	R	$\bar{x}$	SD	R
Tissues, cells and molecular study	4.61	2.20	1	6.38	2.35	2	3.55	2.20	1
Structure and control of processes in basic life systems	5.94	1.98	2	5.78	3.94	1	3.92	2.76	2
Environmental studies	7.77	2.70	3	7.74	2.85	3	7.21	2.74	3
Diversity, change and continuity	8.24	2.53	4	8.87	3.08	4	8.15	1.65	4
	$p = 0.0000*$			$p = 0.0000*$			$p = 0.0000*$		

R = ranking;   * $p < 0.05$

Discussion

Despite the small number of participants in this study, the information can be used to raise issues and possibly initiate some debate in terms of Life Sciences curricula and the challenges facing educators and curriculum designers when designing new curricula.

Educators (teachers, principals, academics) see the 2008 and 2009 Grade 12 classes as guinea-pigs of the system because it was essentially tested on them, was modified several times, and taught by teachers with little experience of the system. On the other hand, the Department of Basic Education sees the 2008 matriculants as trend-setters who will be remembered as the first faces of a new chapter in education. Most of the participants do not see themselves as guinea-pigs. They were asked to comment on the following question: "Did you consider yourself as a guinea-pig when implementing the new Life Sciences curricula?" Their responses were classified as yes (31%) and no (69%).

Although the NCS Grade 12 Life Sciences curriculum is clearly less conceptually demanding than those for both Higher Grade and Standard Grade National Educational Curricula

(NATED 550 old curricula) at Grade 12 level (Umalusi, 2009c), the overall national pass rate for Life Sciences in 2009 was 66%. This was down from 71% recorded in 2008 (Thutong, 2010). The participants of this study were part of these statistics and the results indicated that 44% of them passed Life Sciences with 70% or more. This percentage (44%) is much higher than the NCS 2008 (12%) and 2009 (12%) national results.

Life Sciences as a discipline generally involves understanding of life and difficult levels of organisation. Cognitive difficulty may be engendered by sequence of content in the Life Sciences curriculum (Dempster & Hugo, 2006). Sequence of content in the NCS curriculum is not aligned with the knowledge structure of Life Sciences. The implication is that learners may not achieve vertical development of disciplinary knowledge. In general, in terms of difficulty, the students found the Grade 10 curriculum themes the most difficult, followed by the Grade 12 and then the Grade 11 curricula. Some difficult topics (e.g. photosynthesis, cellular respiration, and homeostasis) previously taught in NATED 550 Grade 12 are now taught in NCS Grade 10 (Umalusi, 2009c). There is less difficult content in Grade 12 of the NCS curriculum than there was at the same level in the NATED 550 curriculum (Umalusi, 2009b; 2009c). The majority of students in this study also found the six evolution themes under the Grade 12 content area *Diversity, change and continuity* more difficult to learn than the other three content areas. It correlates with the findings of the Umalusi Report (2009a:42) which highlights specific questions in which Grade 12 candidates performed poorly and points out that "the performance was poor in 'genetics' and 'evolution and computation' questions". Interestingly, the participants experienced genetics as less difficult but more interesting than evolution. The Grades 10–12 content areas were experienced in order, from the least to the most difficult, as follows: Tissues, cells and molecular study the least difficult, followed by *Structure and control of processes in basic life systems*, *Environmental studies*, and lastly, *Diversity, change and continuity*. The author suggests improved restructuring of content in the Grades 10–12 Life Sciences curricula. The distribution of difficult (and less interesting) topics across Grades 10, 11 and 12 is uneven and one of the difficult topics taught in Grade 10 (e.g. photosynthesis, cellular respiration or homeostasis) should rather be placed in Grade 11 which has only one difficult topic (nervous and chemical coordination). The NCS documents are strongly framed in relation to general pedagogy, but weakly framed with regard to approaches specific to the Life Sciences. The activity-based pedagogy in the NCS curriculum is aligned with the content, aims and age groups of learners studying Life Sciences. OBE, however, needs competent, well-qualified teachers and well-resourced schools for its success (Umalusi, 2009b).

In terms of interest and content, the NCS Grade 12 includes very little plant Biology, and no animal Biology, other than human Biology. It includes evolution, biotechnology, environmental issues, a number of social issues, and indigenous knowledge, all of which were absent in the previous NATED 550 curriculum. The content specified in the Life Sciences curricula is very context-sensitive. Most students liked the Grade 12 curriculum more because they found it more interesting, useful and informative. Comparing the three FET curricula, almost two-thirds (60%) of the students indicated the Grade 12 curriculum as their first choice, followed by Grade 11 as their second choice (23%) and Grade 10 as the third choice (17%). The results show that the themes of all four content areas of the Grade 12 curriculum are the most interesting; and the Grade 10 themes the least interesting. Learners' interests may often have been influenced by the way the content was presented by teachers. The Life Sciences curricula are fraught with concepts and terminology that can be misunderstood and mis-

interpreted by teachers. According to Rogan (1999) cited in Onwu & Mogari (2004:162) "most schools include many teachers who often have little experience, meagre training, and are operating in under-resourced, large classes with teachers who speak a variety of home languages". Despite these constraints, they are expected to implement a very complicated curriculum. The majority of the students (82%) indicated that they experienced many problems with the Grade 10 curriculum, followed by the Grade 11 curriculum (74%) and Grade 12 curriculum (66%). The main problem for the students in Grade 10 was their Life Sciences teachers, followed by textbooks and terminology used in Life Sciences. Teachers, textbooks and practicals were listed as significant problems in Grade 11. More than a third (34%) of the students indicated that the theme 'evolution' in the Grade 12 curriculum should be replaced. The students described their Grades 10–12 Life Sciences teachers as unmotivated, uninvolved, lazy, incompetent, often absent from class, unqualified, having no work ethics and using poor teaching methods. Many schools had a shortage of textbooks; some did not use any textbooks. They also described their textbooks as outdated and having many errors.

If the difficult content was well taught, the interest would be higher. Not only in Grade 12, but also with regard to the other two grades, the Content areas were experienced in order, from the most to the least interesting, as follows: *Tissues, cells and molecular study* the most interesting, followed by *Structure and control of processes in basic life systems*, *Environmental studies*, and lastly, *Diversity, change and continuity*. The study shows that there is a correlation between the grade of difficulty and the level of interest in regard to the content knowledge areas. In general, the students found the easiest curricula themes and content knowledge areas more interesting.

The content specified in the NCS curriculum is far more context-sensitive than that in the NATED 550 curricula. Many NCS topics in all three school grades lend themselves to adaptation in different teaching and learning contexts. Other topics (e.g. evolution and reproduction) need to be taught with great sensitivity on the part of the teachers. Although the students experienced fewer problems with the Grade 12 Life Sciences curriculum than with the other two curricula, the most negative responses included the evolution category. In spite of different religions and backgrounds, the students and teachers were, respectively, forced to learn and teach this controversial theme. Studies done locally indicate that some of the learners and teachers who have deeply entrenched religious beliefs find it hard to accept evolution (Chinsamy & Plaganyi, 2007; Sanders, 2010). Umalusi (2009c) reported that the volume of content decreases across Grades 10, 11 and 12 in the Life Sciences curricula. There is also a smaller volume of content in Grade 12 of the NCS curriculum than there was at the same level in the NATED 550 curricula. In this study, only a low percentage [Grade 10 (12%), Grade 11 (17%), and Grade 12 (14%)] of the students pointed out that the volume of work was too much and the tempo of concluding the work too fast.

Conclusion

New knowledge in the Life Sciences has mushroomed (Cheeseman, Frence, Cheeseman, Swails & Thomas, 2007) and this mushrooming will continue. Against this background of expanding knowledge comes the increasingly difficult task of training learners in this field. Complex questions arise regarding what Grades 10–12 learners should know and what the appropriate content should be. Participants in this study were able to articulate what was of interest and what was difficult to them in relation to FET Life Sciences curricula. The study shows that there is a correlation between the grade of difficulty and the level of interest in

regard to the curricula themes and content knowledge areas. The distribution of difficult and less interesting topics across Grades 10, 11 and 12 is uneven. The findings of this research could aid teachers in the Grades 10–12 curricula, as well as policy makers, curriculum developers, and academics at tertiary institutions. Curriculum designers, politicians and academics should be encouraged to determine the learners' interests and to relate these interests to subject matter to provide a base for new knowledge. The interest learners show in terms of key ideas should contribute to the pedagogical thinking of those who plan curricula for the learners. Guinea-pigs, trend-setters or pioneers — it doesn't matter how we refer to the 2008 and 2009 Grade 12 classes; they opened the way for new curricula that are more in line with the demands of the modern world.

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