

THE OPINIONS OF PHYSICS TEACHERS ON THE NATURE OF THE CONTENT OF PHYSICS SENIOR SECONDARY SYLLABI AND RESOURCES

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Abstract. *The purpose of this study was to find out the opinions of physics teachers on the nature of BGCSE physics syllabi in Single Science, Double Science and Pure Science in the areas of their: (i) content (ii) objectives (iii) teaching methods (iv) differentiation teaching (v) assessment (vi) teaching orientation (viii) availability of computers (ix) student projects (x) laboratory facilities (xi) duration of the programme and (xii) laboratory assistants. A 38-item open-ended questionnaire was completed by 22 senior secondary school physics teachers. The results showed the need to revise the content, and assessment practices and those teachers were trying to promote learner-centered approach, even though they were faced with problems.*

Key words: *the content of physics syllabi and resources.*

Introduction

Science educators and curriculum theorists agree that mathematics, science and technology education should be such that learners are equipped not only with relevant knowledge, but with attitudes and skill for a healthy life style, social-economic survival, self-reliance and self-sustenance. The challenges lie in the identification and integration of appropriate content (Mulemwa, 2004). This should be reflected in relevant curricula and materials for acquiring basic skills, especially in the areas of skills for life and knowledge in such areas as gender, health, nutrition, HIV/AIDS prevention and peace. The school curricula content should be student-centred, non-discriminatory, standards-based, contextualized, and relevant and provide life skills (UNICEF, 2000).

According to Yandila (1999), this was not the case with the old Cambridge Overseas School Certificate (COSC) Science Syllabi that Botswana inherited at the time of obtaining independence in 1966. Its major emphasis was to provide learners with assumed body of knowledge deemed necessary for tertiary education and technical fields. Its content was not differentiated to accommodate wide-ability students and had not been updated in the light of curricular changes in the world. Its teaching method was teacher-centred, and students were not encouraged to acquire process skills through performing practical work. Empirical topics were taught by demonstrations followed by class discussions. This did not provide students with hands-on experience. Its assessment was formative. Only in exceptional cases did students handle equipments, though they had to take practical examinations at the end of secondary education. For these reasons, COSC Science Syllabi were considered irrelevant and needed to be replaced by new ones that would reflect the aspirations of the people of Botswana and contribute significantly to the country's human resources development that could compete positively to the technological world (Pendaeli, et al 1993).

The desire to change COSC syllabi was expressed soon after obtaining independence and reported in National Commission on Education of 1976, Education for Kagisano of 1977, National Commission on Education of 1993, Revised National Policy on Education of 1994 and several official documents. Though the change was delayed in coming, when it took place it was very comprehensive and included the philosophy, rationale, programme features, programme aims and objectives, programme content and structure, teaching methods and orientation and assessment. The change was made in stages, the Pure Science Syllabus (Biology, Chemistry, Physics) were

introduced in 1997 and Single Science and Double Science in 2000. Each of these three types of syllabi insists on learner-centred teaching approach as stipulated in the Curriculum Blueprint (1997).

Curricula innovations in Botswana followed the guidelines set up in the National Curriculum Blueprint (1997). These were consistent with a hybridized curriculum models of Bayona (1995), Kelly (1989), Miller and Sellar (1985), Ogunniyi (1984, 1993), Print (1988), Tyler (1949), and Wheeler (1967). Commissioned needs assessment studies were carried out by Pendaeli, et al. (1993). It involved all stakeholders-teachers, students, parents, tertiary institutions and some potential employers and consultations held with relevant institutions outside the country. The findings of this study were published as recommendations in the National Commission on Education (1993), and passed by an act of Parliament as contained in the Second National Policy on Education (1994). The principles and guidelines for the construction of the new syllabi were published in Curriculum Blueprint (1997). Thereafter, a 14-man physics task force was appointed to design the new syllabi. It consisted of four secondary school teachers, four curriculum development and evaluation officers, two university lecturers, two colleges of education lecturers, one officer from the Department of Teacher Training and Development, and one officer from Regional In-service Department. One consultant from IGCSE of UK served as a resource person. The task force was asked to follow closely the guidelines set out in the Curriculum Blueprint and to consult the Botswana Junior Secondary School, the current COSC and IGCSE syllabi of UK. The constructed syllabi were sent to schools for the input of physics teachers (Yandila, 1999).

The final draft of the syllabi was submitted to the Ministry of Education for approval, which was then sent to schools for implementation. Before they were introduced to schools, representative teachers from every senior secondary school attended workshops on how to implement them in schools. After they were implemented, several studies have been carried out to determine their acceptability among students, parents and teachers. Their results are expected to form part of the overall evaluation of the new syllabi and guide in their revision.

As a result of syllabi innovations outlined above, Botswana General Certificate of Secondary Education Syllabi replaced the Cambridge Overseas School Certificate Syllabi in different subjects in 1998. The new syllabi in physics introduced major changes in (i) content, (ii) objectives, (iii) assessment, (iv) teaching methods, (v) organization of the syllabus, (vi) teaching orientation (viii) utilization of laboratory resources, (ix) computer utilization and (x) student project. One wonders whether physics teachers are satisfied with the syllabi and implementing them as prescribed. It is necessary to investigate the two matters because a few recent studies have indicated that physics teachers are dissatisfied with some aspects of the syllabi (Mogapi and Yandila, 2001; Phethego, 2004; Rummung, 2000; and Yandila, 1999).

Research methodology

Purpose of the study

The purpose of this study was to seek the opinions of physics teachers about the nature of BGCSE physics syllabi in Single Science, Double Science and Pure Science in the areas of their: (i) content (ii) objectives (iii) teaching methods (iv) differentiation teaching (v) assessment (vi) teaching orientation (viii) availability of computers (ix) student projects (x) laboratory facilities (xi) duration of the programme and (xii) laboratory assistants.

Population and sample selection

The population of the study consisted of 99 physics teachers in all the 27 government and government-assisted senior secondary schools in Botswana. It was important that such teachers constituted the population because they had the experience of teaching both COSC and BGCSE syllabi and therefore, expected to make informed recommendations on the suitability or otherwise of the new syllabi for the Botswana context.

Copies of the questionnaires were mailed to heads of science departments in 27 government and government-assisted senior secondary schools. They were requested to administer the questionnaires to all physics teachers in their departments and return completed ones to the researchers within two months of receiving them. After reminding the heads of department several times by mail and phone calls, 22 duly completed questionnaires were received from teachers. This represented 22.2% of 99 physics teachers in the schools. They constituted the sample of the study of which 90% were Batswana and 10% non-Batswana, 60% males and 40% females, of ages ranging from 35 to over 55 years with majority falling within the 35-41 range, and of teaching experience of between 10-34 years. They were all graduate teachers who had taught both COSC and BGCSE physics syllabi and were involved in supervising student teachers on teaching practice assignment.

The questionnaire

An open-ended type purposeful questionnaire was developed by the investigators. Its questions were derived from the nature, philosophy and rationale of the syllabi and the Curriculum Blueprint (1997) and addressed problem areas identified in previous studies of Modise (2001), Rammung (2000) and Yandila (1999). The draft questionnaire was face-validated by three senior science educators in the Department of Mathematics and Science Education of the University of Botswana who were asked to establish whether its items were addressing appropriate areas of the new biology syllabi and teachers' concerns established in previous studies. Thereafter, the questionnaire was revised and reproduced for administration. This method of validation of the questionnaire for a qualitative study such as this one is consistent with the views of Maxwell (1992) and Brinberg and McGrath (1985) who assert that: "*Validity is not a commodity that can be purchased with techniques.... Rather validity is like integrity, character and quality, to be assessed relative to purposes and circumstances*" (p. 13). To Maxwell (1992), "*validity of an account should be seen as inherent, not in the procedures used to produce and validate it, but in its relationship to those things that it is intended to be an account of*" (p. 281).

The questionnaire was administered to 8 physics teachers who were not part of the sample in order to ensure that the respondents would be able to provide appropriate answers to the questions. Following their input, corrections were made and a final questionnaire produced. It was a 10-page instrument consisting of Section A made up of eight questions requesting information about the respondents' age, gender, qualifications, teaching experience, title held at school, nationality, teaching subjects and involvement in teaching practice supervision. Section B was made up of 38 open-ended questions in which respondents were requested to express themselves on each of the 12 items related to the physics syllabi: (i) content (ii) objectives (iii) teaching methods (iv) differentiation teaching (v) assessment (vi) teaching orientation (viii) availability of computers (ix) student projects (x) laboratory facilities (xi) duration of the programme and (xii) laboratory assistants. Respondents were also assured of confidentiality of the information they would provide.

Results and discussions

The responses to Section A of the questionnaire were counted and percentages computed on respondents' age, gender, qualifications, teaching experience, title held at school, nationality,

teaching subjects and involvement in teaching practice supervision. They were used to describe the characteristics of the sample presented above. The responses to questions 1-38 of Section B were first read carefully in order to understand each answer then grouped according to their similarities and dissimilarities in meaning. This method of treating written responses is in conformity with what research literature recommends (Geertz, 1973; Maxwell, 1992). For example, Geertz, (1973, p.17) states that “description is the foundation upon which qualitative research is built.” And Wolcott (1990a) adds that “whatever I engage in fieldwork, I try to record as accurately as possible and in precisely their words, what I judge to be important of what people do and say” (p. 128). Statements in each group were then counted, percentages computed and entered in tables as shown below. These percentages were used for discussing the results.

Content of the syllabi

The topics for physics syllabi include length and time, motion, mass, weight and centre of mass, density, forces (a) effects on shape and size, (b) effects on motion, (c) turning effects of forces, scalars and vectors, energy, work and power (a) energy, (b) work, (c) power, pressure, simple kinetic molecular model of matter, thermal expansion of matter, measurement of temperature, heat capacity, melting and boiling, transfer of thermal energy, general wave properties, light, electromagnetic spectrum, sound, magnetism, electricity, practical electric circuitry, electromagnetic effects, introductory electronics, electronic systems, radioactivity. Table 1 shows the topics that the respondents suggested should be removed and reasons they gave.

Table 1. Topics that teachers to be removed from the syllabi and the reasons given (%).

Syllabus	Topics to be removed	Percentage	Reasons for removal
All Three	All topics are necessary	47.6	All the topics are very important and necessary
Pure Science	measurement of length	4.8	They are included in Junior Secondary Integrated Science
	using metre rule	4.8	They are included in Junior Secondary Integrated Science
	measurement of mass and density	9.5	Too advanced for students & there is little practical work related to it
	thermal expansion	9.5	It is above the cognitive of the students & they do not interact with any of those things in their everyday life.
Double & Single Sciences	electronic system		
	Motion	4.8	Objectives not clearly stated
	Energy	4.8	They are included in Junior Secondary Integrated Science
	thermal physics	4.8	They are included in Junior Secondary Integrated Science
	radioactivity	9.5	Too advanced for students & there is little practical work related to it

It is our view that removing the suggested topics would reduce the content of the syllabi drastically and students may not be adequately prepared for physics courses at tertiary level. All the

topics that the respondents suggested to be removed are conceptually important for students to learn. We wonder what effect their removal would have on the conceptual hierarchy of the topics in each syllabus.

The reason given for removing the topics of measurement of length using metre rule, measurement of mass and density, energy, and thermal physics from the syllabi is that they are taught at junior secondary school level. A closer examination of each of their specific objectives reveals that they are at more advanced level than those at the junior level. This goes to demonstrate the spiral nature of the topics and should therefore, not be removed at senior secondary school level.

The reason for suggesting the removal of the topics of electronic system and thermal expansion, is that they are too advanced for students to learn at senior secondary school level. Perhaps a better reason might be that students lack pre-requisite knowledge. The solution may lie in the production of supplementary information for use by physics teachers on each topic so that they know how far to cover each. Such information could include prerequisite knowledge of what Ausubel (1963) calls Sub-summers or Advance Organizer. This is important because at the moment, there is no single physics prescribed book that covers the majority of the topics in the syllabi.

Objectives of the Syllabi

Table 2 shows the percentages of the respondents who would like certain objectives removed from the syllabi and the reasons they gave. About 68.18% said that all the physics objectives in the Pure, Double and Single Science syllabi were necessary and should be retained. About 13.63% said that some of the objectives on energy should be removed, 9.09% said that one objective should be removed on the topic of motion, 4.5% said that one objective should be removed in the topic of energy source and another 4.5% said that five objectives should be removed on the topic of sound in Double Science.

Table 2. Objectives to be removed from the syllabi and reasons given (%).

Responses	Percentages	Reasons given for removal
None to be removed	68.18	All are necessary and important and should not be removed
Energy -Sources of energy -Kinetic theory of matter -Arrangement of particles in solid, liquid & gas -Brownian motion (diffusion) Change of state of matter (melting & boiling)	13.63	They are adequately treated in Integrated Science
-Socio-economic impact of each energy source both locally and globally	4.5	It is not a physics concept. It is best explained in Geography.
Motion -Using acceleration due to forces of gravity in solving problems of motion in Single Science	9.09	It is not stated in the syllabus that students should be familiar with the equations of motion but then they are expected to use acceleration in solving problems of motion
Double Science: Motion -Estimate the accuracy of a given instrument	4.5	Though it is necessary to be accurate but it is not easy to quantify and estimate it. One has to have some idea about it, which is not easy

<ul style="list-style-type: none"> -Describe factors that influence the quality of sound waves -Describe the effect of multiple reflections of sound waves on quality of sound. -Describe electric field as a region in which. . . -State the direction of lines of some and describe the patterns 		<p>either. Quality of sound is relevant in advanced studies of sound. Although it is an easy concept to understand, it is not useful at this level of education.</p> <p>The concept of electric field is an abstract, which students at this level can avoid.</p>
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Duration of the Programme

The school structure in Botswana is made up of 10 years of Basic Education (7 years of Primary Education and 3 years of Junior Secondary Education) and 2 years of Senior Secondary Education and this is similar to most Southern African Development Community countries (Revised Policy on Education, 1994). It is stipulated in BGCSE Syllabus (1997) that the Senior Secondary School Science is a two-year programme designed for learners who have completed three-year Junior Secondary education. It is designed to provide learners with scientific knowledge, skills and attitudes needed for understanding and responsible participation in society. The results show that 30.8% of the respondents accepted the two-year duration of the programme, 53.8% did not, arguing that the duration was short for the syllabi to be covered and 15.4% made no comment. Assuming that the absence of comments was indicative of the respondents' acceptance, then it may be concluded that a total of 46.2% accepted the 2-year duration of the syllabi. Those who said that 2-year duration was inadequate made several suggestions including the following:

- Increase the number of periods per week to 6 for each Pure Sciences, 12 for Double Science and 6 for Single Science.
- Reduce the number of specific objectives in Triple Science (biology, chemistry, physics) and Double Science (two-thirds each of biology, chemistry, physics).
- Examinations, Research and Testing Division should consider revising time allocation for each science syllabus.
- Reduce the physics content by removing the topics that are covered in Integrated Science of Forms 1-3.
- Increase the duration of senior secondary education to three years so that the BGCSE science syllabuses are adequately covered.

Experience has shown that of the six school terms allocated for covering the two-year syllabi, real teaching/learning takes place in about four terms. Students start Form 4 in the middle of the first term of senior secondary school. The last school term of senior secondary school is usually used for summarizing the course, preparation of and sitting for final examinations. As a result, teachers tend to teach the syllabi for examinations rather than for students' comprehension.

In order to increase the duration of the programme from presently two to three years either secondary education should be increased from five to six years or the junior secondary education should be reduced from presently three to two years. The former would cost the Ministry of Education a lot of money by keeping thousands of students one extra year in school and the latter, would put pressure on teachers to cover the current three-year junior secondary school syllabus in two years. This may encourage rote learning in students. But if the content of the junior secondary school science syllabus is correspondingly reduced so that it can be covered in two years, then students who proceed to senior secondary may not have acquired all prerequisite knowledge and skills for the next level. The second option is still feasible if the overlap certain topics between junior secondary and senior secondary school syllabi are eliminated and career guidance is taken

seriously at junior secondary school level. This requires greater consultation between junior and senior secondary curriculum development Task Forces.

Differentiation Teaching

The new BGCSE syllabi stipulate that students be differentiated into taking Triple Science, Double Science and Single Science on the basis of their performance at Junior Secondary Education and that in each subject they be differentiated into taking Core objectives only and taking additional Extension objectives (Botswana, 1997). This is a common practice in countries that adopted International General Certificate of Secondary Education syllabi such as Namibia. The results show that 54.54% of the respondents were in favour of differentiating students into Pure, Double and Single Science, 36.36% did not attempt the question and 9.09% were not in favour. Reasons given for favouring the status quo included the following:

- It allows students to receive instructions according to their capabilities of acquiring and using Science skills.
- It is a good teaching orientation because it takes care of differentiated students in a given class.
- It is likely to help mixed ability students to understand the assigned content.
- Not every student at senior secondary school level will follow a Science or Science-related career.
- Students are only examined on their ability without unnecessary demands on them.

Reasons given for not favouring the status quo included the following:

- Different schools have different ways of teaching and some students end up sitting for Junior Certificate examinations before completing the syllabus.
- Some students may not have taken their studies seriously while doing Junior Certificate and so performed below their capabilities. Most of them take their studies seriously from Form 4.
- Some students are wrongly placed in subjects and it is difficult to change them later, because of the groupings of optional subjects, which seems to be rigid.
- Some students may not have done well in Junior Certificate due to factors beyond their control and may be denied the chance of doing what they are capable of.

About 50% of the respondents agreed with the system of differentiating students into Pure, Double and Single Science on the basis of their performance in Form 3 final examinations, 27.27% disagreed and 22.73% gave no response. Reasons given for agreeing with the system included the following:

- There is no other better way of efficiently selecting students even though it might be imperfect.
- It is fair though later it may be improved upon or supplemented by having students take admission or aptitude tests.
- The Form 3 final examinations are standardized and have established reliability and validity and are used to for both certification and progression into senior secondary school level.
- It is the easiest way out of the problem of differentiating students academically.

Reasons given for disagreeing with the system included the following:

- The Integrated Science taken in Forms 1-3 is very shallow and is not a true reflection of the students.
- Some students perform badly in Form 3 examinations due to some circumstances beyond their control such as social problems, not being aware of the advantages of passing Integrated Science, being immature to make well-informed career choices, panic while sitting for Form 3 final examinations.

- The students may be misplaced due to teachers' lack of knowledge on how much prerequisite knowledge and skills they mastered in Integrated Science.

About 45.5% of the respondents indicated that their students understood the effect of doing core alone and core plus extended objectives in choosing their science career after leaving school but 54.5% indicated that their students did not.

Process skills

The new BGCSE syllabus (1997) stipulates that in the course, students should be given opportunities to perform four process skills of (i) using and organizing techniques, apparatus and materials, (ii) observing, measuring and recording, (iii) handling experimental observations and data and (iv) planning investigations. About 70% of the respondents said that it was realistic to expect students to learn the four process skills in two years, 30% said that it was not realistic. Reasons for saying that it was realistic included the following:

- Students come across the four process skills in everyday life.
- Regardless of the complexity of the experiments, the skills are basic for learning Science at secondary and tertiary institutions of learning and in Science-related careers.
- Since in Integrated Science students learn the four process skills theoretically, it is very important that they learn them empirically in BGCSE syllabus.
- The four process skills are important for learner-centered approach to be used fully.

In addition to the four process skills the respondents suggested inclusion of the skill of presentation, as it would improve the students' confidence in organizing and time management skills.

Reasons for saying that it was not realistic to expect students to learn the four process skills in two years included the following:

- The physics syllabus contained a lot of content to be covered in a limited time.
- Given that students were already having problem in understanding basic concepts, they would not be able to apply what they did not understand.
- Students were too young to master the four process skills.
- Most students are reluctant to undertake individual work, but always relying on the teacher.
- The physics laboratory facilities and equipment were either inadequate or disrepair, shortage of apparatus, chemicals and specimen.

Of those who said it was realistic to expect students to learn the four process skills in two years, 6.01% said that the four process skills were important for learner-centered approach to be used fully. About 12.01% each said they were important for students who intended to follow science-oriented careers, and were important also in life situation.

Teaching Methods

Table 3 shows the percentages of the respondents employing different teaching methods in class. About 27.27% use general class discussion and about 9% each use group discussion and class presentation by group representatives, practical work, questioning, and assignment worksheet for performing experiments, giving students research questions to be investigated, textbooks to solve problems and performing demonstration in front of the class. The general class discussion is a method by which every member of the class is given opportunity to contribute to a discussion on a particular topic. The discussion may be prompted by a problem raised by either the teacher or

students or it may arise from a principle or concept that has been presented to the class by the teacher. A group discussion and class presentation is a method by which the class is divided into smaller groups of say, 5-8 students to discuss a problem, results of an experiment or demonstration and at the end of which one member of the group presents to the rest of the class. Practical work ranges from individual investigation to small group investigation by a variety of experimentation. Questioning is a method, which involves question, and answer raised and responded to by teachers and students. It can be done in small groups or entire class. Assignment is a method by which the teacher gives out homework, which students have to complete in and outside the class. After the work has been marked, the teacher may go over it with the entire class. The worksheet method is one in which the teacher gives written or oral guidelines to students to carry out an investigation, at the end of which they present their findings in plenary sessions.

Although the results in this study do not show whether the above-mentioned teaching methods were used exclusively, the researchers assumed that transcending each one of them is some form of lecture method that teachers use to communicate the aims and objectives of the lessons to the class.

Table 3. Use of different teaching methods in learner-centred approach (%).

Teaching methods	Percentage
General class discussion	27.27
Group discussion and class presentation	9.09
Practical work (individual/group)	9.09
Questioning (question/answer)	9.09
Assignment (class and home work)	9.09
Worksheet-guidelines for performing experiments	9.09
Research questions to be investigated.	9.09
Use of textbooks to solve problems.	9.09
Performing demonstration in front of the class.	9.09

The results on Table 4 show that most of the respondents were experiencing difficulties in implementing learner-centered teaching approach. They attributed this to different factors. About 36.36% each of the respondents cited inadequate time to cover the syllabus and lack of teaching materials resources, apparatus, chemical, and laboratories; 18.18% cited lack of confidence in students, and 9.09% cited teaching large classes. Similar results were reported by Maluke (2001), Modise (2001) and Yandila et. al (2002, 2003, 2004). The major problem in schools is the conditions of science laboratories. Yandila et al (2003) found three types of conditions of laboratories: (i) those that were relatively new and well designed with required equipment and materials for use by students, (ii) those that were old but well maintained with required equipment and materials for use by students, and (iii) those that were old, run-down with inadequate required equipment and materials for use by students. About 70% of the laboratories were in-group three. We hope that their conditions will soon be improved.

Table 4. Factors hindering learner-centered teaching approach (%).

Problem faced by teachers	Percentage
Inadequate time to cover the syllabus	36.36
Lack of resources, apparatus, chemical, laboratories	36.36
Students lacking confidence	18.18
Teaching large classes	9.09

Assessment

About 36.36% of the respondents agreed that it was fair for students doing core alone to earn a maximum of grade 'C' while those doing core plus extended to earn up to a maximum grade of 'A'; 54.54% said that it was not fair and 9.09% expressed no opinion on the matter. The reasons for not supporting the assessment system were that: (i) the grade of 'C' was too low for a student who consistently got 100% in core only and (ii) the grading system disadvantages students who do core alone. The reasons for supporting the assessment system were that: (i) there is more work in core plus extended than in core alone, so more work should be rewarded with more credits, and (ii) the process is fair, if the certificates are to be recognized worldwide.

With respect to Form 5 subject mark that students would earn, 36.36% of the respondents were comfortable with the ratio of 80% final examination to 20% continuous assessment, 54.54% were not comfortable and 9.09% made no comments. Those who considered the mode of assessment of project, practical, tests, assignments and final examination to be fair said that: (i) examinations are standardized, so that all students are examined at the same level, and (ii) the life of a student should not dependent upon one paper. Those who considered the assessment to be unfair said that: (i) in Single Science some questions that feature in the examination are not in the teaching syllabus and (ii) science teachers can easily ruin the future of the students due to subjective awarding of continuous assessment grades for work done. But what they overlooked is that continuous assessment is moderated both internally and externally.

Table 5 shows five suggestions on improving the ratio of continuous assessment to final examinations. Those who were uncomfortable with the ratio suggested the ratios 50% : 50%, 70% : 30%, 60% : 40%, or 40% : 60%. One respondent suggested that continuous assessment should be abolished altogether.

Table 5. Suggested ratios of final examination to continuous assessment (%).

Suggestions of ratio of Exams: CA	Percentage respondent in support
50% Final Examinations to 50% Continuous Assessment	9.09
70% Final Examinations to 30% Continuous Assessment	18.18
60% Final Examinations to 40% Continuous Assessment	9.09
40% Final Examinations to 60% Continuous Assessment	9.09
Continuous Assessment should be abolished altogether	9.09

About 30.30% of the respondents said that continuous assessment began in Form 4; 3.03% said in Form 5 and 60.67% gave no response. The high percentage of no response can be attributed to the fact that course work assessment has not been introduced in all senior secondary schools in the country. It is still being piloted in only three schools (Phethego, 2004).

About 63.64% of the respondents agreed that the syllabi should clearly indicate when the continuous assessment should be included in students' overall performance in Forms 4 or 5; 12.12% did not agree and 24.24% did not express any opinion. About 27.27% suggested two years and 36.30% suggested one year. The reasons for suggesting that the syllabi should clearly state that continuous assessment should be taken in one year were that: (i) in first year students would be settling down in the new school environment and the teacher can use the first year to cover the basic principles and concepts. The reasons for suggesting two years were that students would be encouraged to take their science seriously and two years' work would give a true reflection of their work.

Availability of Computers

According to the Department of Secondary Education, every senior secondary school has a computer laboratory where students take computer awareness courses. Each department is expected to have one or two computers to be used by teachers for word processing, computation and record keeping of student work. One wonders whether this is the case in every school.

Table 6 shows that 40.90% of the respondents indicated that their physics departments had functional computers, 36.36% said they did not have and 22.72% gave no response. It also reveals that 68.73 % of the respondents were able to work on spreadsheets, 22.72% were unable and 9.09% gave no response. The table also shows that 50% of the respondents are able to carry out simple calculations such as mean, percentage and standard deviation on the computers, 31.81% were not able to and 18.18% gave no response. Finally, the table shows that 40.90% were interested to take a special computer course on word processing and computation, 22.72% were not and 36.36% gave no response. This is one of the most encouraging news that most respondents had the necessary computer skills to compute the continuous assessment. So it is hoped that at least the appropriate department in the Ministry of Education or In-service function in the University of Botswana can be praised for achieving some of the goals they had set for themselves.

Table 6. Availability and use of computers in physics (%).

Questions	Percentages		
	Yes	No	No response
Are you able to work on spreadsheet such as entering marks on Excel table?	68.18	9.09	22.72
Are you able to carry out simple calculation such as mean, percentage, and standard deviation on the computer?	50.00	31.81	18.18
Does Physics have its own functional computers available to teachers?	40.90	36.36	22.72
Would you be interested in attending a special computer course designed to equip you with basic computer skills (word processing and computation)?	40.90	22.72	36.36

With respect to suitable time of taking a special computer course, table 7 shows that 27.27% of the respondents suggested during school holidays, 13.63% suggested during the weekend, 36.36% suggested in the afternoon, 13.63% suggested organized workshops, and 9.09% suggested during free school periods.

Table 7. Proposed time for attending computer course (%).

Suggestions	Percentage response in support
Afternoon	36.36
School holidays	27.27
Weekend	13.63
Workshop	13.63
Free periods	9.09

Student Projects

In the new Science Syllabi, students are required to carry out supervised projects during their two-year programme of study (Curriculum Blueprint, 1997). This is because science educators and teachers have recognized the fact that for science to play the vital role of transforming Botswana's economy, science subjects had to be well assimilated by the learners. The National Commission on Education (1993) recommended that "intensified measures should be taken to popularize science amongst students and to develop an interest and positive attitude towards science and technology ...through science and mathematics fairs ..." (Botswana, 1993:180-181). Students are required to be assisted by their teachers in identifying a problem to be investigated, reviewing literature, defining research questions, carrying out the investigation, collecting and analyzing data and writing the report.

About 30.30% of the respondents said that it was possible for a student to be taught about project and do it but 36.36% said that it was impossible because projects need more time to be done. With a congested physics syllabus, it is impossible unless the students were doing physics only. Finally, 33.33% made no comment.

Appropriate Laboratory Facilities and Laboratory Assistants

The table 8 shows the responses of teachers on the conditions of the laboratories in their schools. About 69.2% of the respondents found the laboratories as having a shortage of materials for all students to use and having no trained laboratory assistants. Only 30.8 % of the respondents were positive with the conditions of the laboratories and 69.2% were negative. These results are similar to those reported by Yandila (1999) and Rammung (2000), of poorer conditions of Science laboratories. The results show that a large percentage of the respondents saw laboratories as poor places where it is difficult for students to perform practical work due to lack of manpower. Some of them suggested that there should be in-service training of teachers and some suggested that Junior Certificate and Cambridge School Leavers should be trained as laboratory assistants to fill up that gap. Teachers are faced with the problem of shortage of time for preparing for practical work and hence work during their spare times, such as during the afternoons, after school, and even at night. This is not commendable. No wonder most Science teachers complain of being overworked.

Table 8. Responses of teachers on the conditions of Science Laboratories (%)

Percentage of those who were positive	Percentage of those who were negative	Reasons	Means of survival	Improvement
30.8	69.2	Materials not enough Laboratories not ready for use Arrangement of furniture not good for teacher- student interactions	Planning in advance Teachers work during spare time, afternoons, after school, at night All chemistry teachers work together to reduce the load	Provide in-service training Train Junior Certificate and Cambridge leavers

Conclusions

The study suggests the reduction of physics topics and objectives in each of the three physics syllabi. The two-year duration of the programme should be increased to three years to ensure that the content is covered adequately. The students should be placed into Pure, Double and Single Science on the basis of their performance in Form 3 examinations. Most physics teachers considered it realistic to expect students to acquire the four process skills of: (i) using and organizing techniques, apparatus and materials, (ii) observing, measuring and recording, (iii) handling experimental observations and data and (iv) planning investigations in two years. The commonly employed teaching methods included class discussion, group discussion and class presentation, practical work (individual/group), questioning (question/answer), assignment (class and home work), and worksheet-guidelines for performing experiments. Some physics teachers favoured the assessment system in which students' final course grade is based on the ratio of 20% continuous assessment to 80% final examinations. Though most physics teachers are computer literate, their departments are not adequately equipped with functional computers for use in word processing and record keeping. Most physics teachers were of the opinion that it was possible for students to do projects in two years. Most physics teachers said that their physics laboratories were inadequately equipped with facilities to enable students to carry out individual practical work. They lacked trained technicians to assist teachers in setting up and running practical sessions.

Recommendations

The study recommends that the Department of Curriculum Development and Evaluation should take into consideration the findings of this study when revising the BGCSE physics syllabi. It also recommends that all physics teachers should receive the necessary in-service training in teaching and assessing of the new BGCSE physics syllabi. Finally, physics laboratories should be staffed by trained technicians.

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Резюме

МНЕНИЯ УЧИТЕЛЕЙ ФИЗИКИ ОТНОСИТЕЛЬНО СОДЕРЖАНИЯ ПРОГРАММ И РЕСУРСОВ ФИЗИКИ

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Цель этого исследования было установить мнения учителей физики о разных программах физики в Республике Ботсвана (Африка). Исследование предлагает сокращение тем физики и целей в каждой из трех программ физики. Двухлетняя продолжительность программы должна быть увеличена до трех лет, чтобы гарантировать, что содержание распределено соответственно.

Большинство преподавателей физики считало реалистичным ожидать, что учащиеся приобретут основные навыки:

- использовать разные аппараты и материалы;
- проводить наблюдение, измерение и регистрацию данных;
- осуществить обработку экспериментальных наблюдений и данных;
- планировать исследования.

Хотя большинство преподавателей физики – грамотные по использованию компьютера, их отделы не соответственно снабжены функциональными компьютерами для использования в обработке текстов и проведения других важных работ. Большинство преподавателей физики имело мнение, что было бы возможно для учащихся сделать проекты через два года.

Большинство преподавателей физики сказала, что их лаборатории физики были неадекватно снабжены средствами обслуживания, чтобы позволить учащимся выполнить индивидуальную практическую работу. Они испытывали недостаток в технике.

Результаты показали потребность пересмотреть содержание, и методы обучения физики. Авторы делают вывод, что лаборатории физики должны быть укомплектованы необходимой техникой. В свою очередь, учителя физики должны соответственно повышать свою профессиональную квалификацию.

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