

CHAPTER 1

CRITICAL EXAMINATION OF THE SCHOOL CERTIFICATE SYLLABI IN CHEMISTRY

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Objectives

At the end of this chapter, students should be able to:

1. State the differences between syllabus and the curriculum.
2. State the purposes of different examination syllabi in chemistry.
3. Discuss the structures of the different examination syllabi in chemistry.
4. Highlight and explain the skills and abilities measured in the examination syllabi.

Introduction

The term *curriculum* comes from the Latin word *currere*, which means "to run or to run a course". Curriculum has a holistic meaning that encompasses not only subjects, but also the connections between subjects, teaching methods and all aspects of schooling that result in the educational experience the learner receives.

However, experts view *curriculum* from different perspectives other than as the course of study definitions.

Curriculum is a structured series of intended learning outcomes.

Curriculum is an organized set of formal educational or training intentions.

Curriculum is a deliberate, systematic and planned attempt undertaken by the school to modify or change the behaviours of the citizens of a particular society.

Several other definitions from Oliva (1997) are that curriculum is:

- That which is taught in schools
- A set of subjects.
- Content.
- A programme of studies.
- A set of materials.
- A sequence of courses.
- A set of performance objectives.
- A course of study.
- Curriculum as everything that goes on within the school, including extra-class activities, guidance, and interpersonal relationships.
- Everything that is planned by school personnels.
- A series of experiences undergone by learners in a school.
- That which an individual learner experiences as a result of schooling.

In defining the curriculum, it is clear that there is a programme which schools must run in order to properly educate the students. It is therefore a plan, a statement of purpose with specific contents and methods, built with the capacity for evaluation to determine whether or not the purpose has been achieved.

These programmes which the schools must follow include:

Programme of Studies: the subjects taught in schools such as: Chemistry, Physics, Biology, Mathematics, English, History, Geography, Economics, etc.

Programme of Activities: planned, organized and out-of-classroom teaching activities which include getting students to join various clubs and societies in the schools (sports, historical clubs, debating clubs, dramatic society, etc).

Programme of Guidance: a programme of care for the well-being of the students. In this programme, professionally-trained helpers are employed to assist the learners achieve self-understanding and self-direction necessary for adjustment to school, home and the larger society.

In this chapter, emphasis will be placed on programme of studies with particular reference to the chemistry curriculum as a core-curriculum. The official curriculum has all the details of the theoretical policy formulations of the nation. However, since Nigeria runs an examination-oriented education system. Examination bodies (WAEC, NECO, NABTEB and JAMB) present to schools what should be focused-on; in the form of syllabus and the required skills that must be developed and utilized. Once the schools satisfy the requirements of these examination bodies they have indirectly implemented the curriculum.

The curriculum and syllabus have been used interchangeably in some educational documents. The two do not mean the same thing. The syllabus is a macro element of curriculum and can be seen basically as a prescribed content of what should be studied in the school in terms of subjects listed for a particular course. Curriculum is more than listed subjects- it includes other elements including syllabus (Olorundare, 2014).

An Overview of the Chemistry Curriculum

The chemistry curriculum was adapted and revised from the 1985 editions developed by Comparative Education Study and Adaptation Centre (CESAC). According to the Educational Research and Development Council [NERDC] (2009), the objectives of this curriculum have been derived from the national policy on education, and the main objectives are: "to prepare students with the basic knowledge in chemical concepts and principles through efficient selection of contents and sequencing; to acquire the ability to apply scientific knowledge to everyday life in matters of personal and societal needs, among others" (p. iv).

In the pursuit of the aforementioned objectives, the contents and contexts of the curriculum place emphasis on guided discovery; laboratory techniques and skills along with conceptual thinking; and anticipate imbuing into the learners the spirit of inquiry. In selecting the contents, three major issues-globalization; information and communication technology and entrepreneurship, shaping the development of nations worldwide, necessitated the organization of the contents around four themes of: (i) the chemical world; (ii) chemistry and environment; (iii) chemistry and industry; and (iv) chemistry and life. Table 1 presents the summary of the Nigerian senior school chemistry curriculum, which includes the topics to be taught and the thematic approaches adopted in implementing the curriculum (Oloruntegbe & Agbayewa, 2013).

Table 1

Summary of the Nigerian Senior School 1-3 Chemistry Curriculum

Theme/Year	SS1	SS2	SS3
Chemistry and Industry	Chemistry and Industries	Periodic table, Chemical reactions, Mass-volume Relationship	Quantitative and qualitative analysis
The Chemical World	Introduction to chemistry, Particulate nature of matter, Symbols, formulae and equations, Chemical combination, Gas laws	Acid-base reactions, Water, Air, Hydrogen, Oxygen, Halogens, Nitrogen, Sulphur	Petroleum, Metal and their compound iron Ethical, legal and social issues
Chemistry and Environment	Standard separation techniques for mixtures, Acid, bases and salt, Water	Oxidation-reduction (redox) Reaction, Ionic theory, Electrolysis	Fats and oil, Soap and detergent, Giants molecules
The Chemistry of Life	Carbon and its Compounds	Hydrocarbons, Alkanols	

Source. Adapted from Oloruntegbe and Agbayewa (2013).

In planning the revised chemistry curriculum, curriculum developers adopted a spiral approach to sequence chemical concepts. For instance, the concepts to be taught are arranged in such a way that they run throughout the three years of senior school education, with the concepts being discussed in greater depths as the course progresses (see Table 1).

Structure of the Examination Syllabi in Chemistry

Science plays a major role in the evolution of knowledge. It empowers us with creative and independent approaches to problem solving. It arouses our natural curiosity and enables us to meet diverse and ever-expanding challenges. Science enhances our ability to inquire, seek answers, research and interpret data. These skills lead to the construction of theories and laws that help to explain natural phenomena and exercise control over the environment. Thus, science is an integral component of a balanced education.

The most important natural resource of any nation is its people. If Nigeria is to play an important role in the new global village and survive economically, a sustained development of the scientific and technological resources of its citizens is essential.

The examination syllabus is, therefore, designed to provide a coherent course of study which addresses, in addition to a specific knowledge base, and the

development of related skills and attitudes. The syllabus takes into account the requirements for tertiary education at national and international (West African sub-region) institutions. The syllabus is structured in such a way as to ensure that students become aware of their moral, social, and ethical responsibilities, as well as the intrinsic benefits to the practical application of scientific knowledge to careers in the scientific field.

Chemical principles are currently applied to societal concerns, such as; birth control, communicable diseases, environmental pollution and depletion of natural resources. As such, chemistry is a major area of scientific study which impinges on and influences every facet of our daily lives—the food we eat, the clothes we wear, our health, environment and recreational activities. Therefore, chemistry is a fundamental science whose inclusion in science education cannot be over-emphasized.

The organization of each of the examination syllabi discussed in this chapter varies slightly. For instance, the NECO chemistry syllabus listed chemistry topics and grouped them under the chemical concepts of energy, periodicity and structure. Whereas for WAEC and NECO, topics or contents are not necessarily arranged around concepts or themes, or in the order in which they should be taught. The specific objectives that indicate the scope of the contents, and practical work, on which examination will be based were included. From the syllabi, unfamiliar situations may be presented as stimulus material in questions.

Explanatory notes were also provided together with some specific objectives. These notes provide further guidance to teachers and students as to the level of detail required in their preparations for examinations.

The chemistry topics/contents syllabi are arranged independently, but together they form a coherent course of study which should prepare candidates for the world of work and studies at the tertiary level.

A Critical Analysis of the Chemistry Syllabi of Public Examinations in Nigeria

In all the examination bodies discussed in the chapter, and as stipulated in the national policy on education, chemistry is one of the non-vocational elective subjects offered at the senior secondary school level, and in which students are examined (Federal Republic of Nigeria, 2004). The structure of the examination questions are designed by the Examination Boards on the basis of the objectives and contents of the chemistry curriculum; teaching and examination syllabi.

The West African Examinations Council (WAEC)

One of the foremost summative assessments science students enrol for towards the end of their senior secondary education in Nigeria, is the West African Senior School Certificate Examination (WASSCE) conducted by the West African Examinations Council (WAEC). The WASSCE is a qualitative and reliable examination in West Africa that has a strong influence on learning, teaching of; and assessment in chemistry.

The result from this examination is the first requirement for students to progress to their next stage of education. The combined results of WASSCE and Unified Tertiary Matriculation Examinations (UTME) are used by universities to make external judgment about students, performance, and to offer admissions to

students into courses or programmes for which they are considered adequate enough to cope with.

The National Examinations Council (NECO)

The National Examinations Council (NECO) came into existence in April 1999, when the Nigeria government directed that the National Board for Educational Measurement (NBEM) should be transformed into a new examination outfit, and to be known as NECO. The Federal Government also saddled the new council with the responsibility to conduct Senior School Certificate Examination in Nigeria starting from the year 2000.

The need for the establishment of NECO was connected to the fact that all countries of the world determine their educational objectives, which are in line with their national aspirations. It is important to note that, there are no two countries that have same educational objectives, though, they maybe similar. This is because national interest and aspiration differs from country to country. Since education has been regarded as a potent tool to attain national set goals, it becomes imperative for nations to set up their assessment outfits for the realization of such goals.

The Unified Tertiary Matriculation Examination (UTME)

The decree No. 2 of 1978 established the Joint Admissions and Matriculation Board (JAMB), and empowers it to conduct matriculation examinations, formally referred to as Universities Matriculation Examination (UME) and the Monotechnics, Polytechnics and Colleges of Education Matriculation Examination (MPCEME), as well as place suitably qualified candidates into the tertiary institutions in Nigeria. These two examinations used to be organized and conducted at two different periods in a year. However, as part of effort to widen the doors of opportunities to tertiary education, the UME and MPCEME were merged into one as Unified Tertiary Matriculation Examination (UTME) in 2010.

One of the purposes of the UTME is to reduce the cost and time preparation for examination administration, processing of candidates' admissions and the cost of registration for parents who will now have to pay for one examination instead of two. Other purposes were to remove the dichotomy that existed between universities and polytechnics graduates and to increase enrolment for polytechnics and colleges of education. By its nature, the matriculation examination is a selective examination. The scores obtained in this examination form the bases for decision making by institutions with respect to applicants' admissions.

For candidates' whose subject combination include chemistry, there are other three subjects they must sit for, these include: English Language (which is compulsory for every candidate irrespective of choice of anticipated course of study in the tertiary institution) and any other two science subjects. The format of examination for all subjects is a multiple-choice format.

Aims and Objectives of the Examination Syllabi

The examination syllabi in chemistry have similar and general aims to prepare candidates to satisfy requirements of the senior secondary school programme and to provide knowledge in chemistry adequate for students who: (i) will end their study of chemistry at the senior secondary school level; (ii) require application of chemistry in their vocational studies; and (iii) wish to continue the study of chemistry at tertiary institutions.

The objectives of the syllabi are closely related. The overall objectives are to:

- (i) Build upon the knowledge acquired in Integrated Science or General Science at the J.S.S. level;
- (ii) Provide students with basic knowledge in chemical concepts and principles through efficient selection of content;
- (iii) Enable students to appreciate the scientific method which involves experimentation, accurate observation, recording, deduction, and interpretation of scientific data
- (iv) Enables students to develop laboratory skills, including an awareness of hazards in laboratory and the safety measure required to prevent them;
- (v) Create an awareness of the interrelationship between chemistry and other disciplines; and
- (vi) Show chemistry and its link with the industry and the environment, and everyday life, in terms of benefits and hazards (WAEC, 2005).

Format for Senior School Certificate Examinations for WAEC and NECO

In the SSCE chemistry syllabi for WAEC and NECO, there are three Papers – Paper 1, Paper 2 and Paper 3. Candidates are usually required to take either Papers 1 and 2 or Papers 1 and 3 only. Paper 2 is a two-hour practical test and is taken by school candidates only. The paper contains three questions which carry 50 marks that forms 25% of the total marks for the external examination (West African Examinations Council [WAEC], 2005). The candidates are required to answer all the three questions. Two of the questions are quantitative and qualitative analysis while the third question tests candidates' familiarity with practical activities.

Paper 3 is a three-hour theory paper that covers the entire curriculum and carries a total of 150 marks, i.e, 75% of the total marks of the external examination. The paper has two parts; Part A and Part B. Paper A contains fifty multiple choice tests where candidates are required to answer all the questions within 60 minutes for 50 marks. Part B contains three sections: Sections I, II and III. Section I contains four essay questions for candidates in all the member countries. Candidates are required to answer any three of the questions. Each of the questions carries 25 marks (WAEC, 2005).

Skills and Abilities Assessed by the Examination Syllabi

The relevant skills that students are expected to have developed on the conclusion of the examination syllabi can be grouped under two main headings, namely:

- (i) Cognitive process skills
- (ii) Practical/Experimental skills

The revised cognitive process skills of Bloom's (1956) taxonomy which have six categories of: remember, understand, apply, analyze, evaluate, create (Krathwohl, 2002) were measured by the syllabi. The six categories are discussed below:

Remember. The ability to identify, remember and grasps the meaning of basic facts, concepts and principles.

Understand. The ability to select appropriate ideas, match, compare, and cite examples and principles in familiar situations.

Apply. The ability to use facts, concepts, principles, and procedures in familiar and novel situations; transform data accurately and appropriately; use formulae accurately for computational purposes.

Analyze. The ability to identify and recognize the component part of a whole and interpret the relationship among those parts; identify causal factors and show how they interact with each other; infer, predicts and draw conclusions; make necessary and accurate calculations and recognize the limitations and assumptions involved.

Evaluate. The ability to make reasonable judgments and recommendations based on the value of ideas and information and their implications.

Create. The ability to combine component part to form a new and meaningful whole; and make predicts and solve problems.

Practical/Experimental Skills

Observation, Recording and Reporting. The ability to use the sense organs to perceive objects and events accurately; record the results of a measurement accurately; select and use appropriate format and presentations, such as tables, graphs and diagrams; organize and present a complete report in a clear and logical form using spelling, punctuation and grammar with an acceptable degree of accuracy; report accurately and concisely.

Manipulation and Measurement. The ability to handle chemicals carefully and use them economically; appropriately prepare materials for observation or investigation; assemble and use simple apparatus and measuring instruments.

Planning and Designing. The ability to recognize the problem and formulate valid hypothesis; choose appropriate experimental methods and sampling techniques; choose appropriate apparatus; plan and execute experimental procedures in a logical and sequential form within the time allocated; use control where appropriate; modify experimental methods after initial work or unexpected outcomes.

Conclusion

The examination syllabi in chemistry are designed to test students' achievement of the subject's objectives and to improve their performance. The syllabi analyzed in this chapter have been adequately developed to measure students' knowledge and understanding, and also skills in creative thinking, inquiry and problem solving, which could help students perform well and prepare for the next stage of their education.

Review Questions

1. Explain the differences between syllabus and curriculum?
2. Explain the structure of any syllabus of your choice as discussed in this chapter?
3. Briefly state the purposes of each of the different syllabi in chemistry?
4. Briefly discuss the skills and abilities expected of students who have completed the requirements for preparation in examination?

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