Curriculum reform – Does it provide the divide between developed and developing countries?

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Abstract. Globalisation is an inevitable and inescapable phenomenal reality. Global imperatives dictate the level of growth and development in various emerging economies across the globe. Over the years, many countries embarked upon educational reforms to serve as catalysts for economic development. Given this scenario, this article provides a comparative analysis of secondary education Physics curricula in selected countries with a view to meaningfully evaluate the level of depth up to which each curriculum extends. Analysis of secondary education Physics curricula of selected countries reveals striking distinctive features that serve to provide the structural differentiation with regard to these curricula. In addition, further detailed elucidation on the nature and structural coherence of each curriculum is subsequently provided in order to make sense of any correlation that couldbe possible between curriculum reform and economic growth of selected countries.

Introduction

Curriculum reform has been a key area of concern for both developed and developing countries in a bid to consolidate the structural imperatives that characterise their education systems.While most countries have made substantial progress in overhauling their education systems, secondary education in particular remains a weak link in the education chain in many countries [1]. It is against this background that this article unpacks the secondary education Physics curricula of selected countries as its primary focus in order to provide a comparative analysis in terms of distinctive and distinguishing features.

Secondary education reform

Secondary education in the Asia-Pacific region has been characterized by rapid expansion in response to an increasing demand for skilled manpower, economic growth and strong private requirements[1]. Consequently, some of the varied approaches adopted by different countries in this region in developing the structure of secondary education included diversifying the curriculum, financing institutions and student support and assessing student-learning performance.Curriculum reform was the major driving force in the improvement of the quality of secondary education in the Asia-Pacific region. Some of the detailed strategies that were developed to adequately address curriculum reform include the improvement of the quality and scope of vocational education, strengthening science and technology education, developing competence in information technology skills by introducing or expanding the use of information technology in the classroom, as well as focusing on the teaching of a wide range of cognitive, social and personality skills so as to develop the capacity for flexibility, problem-solving, creativity, initiative and life-long learning [2].

While secondary education reform process in Eastern Europe was largely influenced by political and economic factors, the rules of the game that resulted in good educational outcomes under Communism are changing [3]. In the main, educational change in this region can be described in terms of four key characteristics [4]: (a) depolarization of education (i.e., the end of the ideological control of the system); (b) breaking down of the state monopoly in education by allowing private and denominational schools to be established; (c) increased choices in schooling options; and (d) decentralization in the management and administration of the education system (in particular the emergence of school autonomy).

Although the education systems in Latin America and the Caribbean were characterised by relatively high enrolment rates at the primary and secondary levels during the latter part of the 20th century, there were significant problems with regard to quality and relevance of instruction [5]. In fact, the system was bedevilled by a bimodal distribution of enrolment[6], which provided a skewed picture in terms of both school and university attendance and completion. The revamping of secondary education in this region primarily focused on aspects such as curriculum structure, teacher training, student evaluation, development of technological infrastructure and management [7].

Arab States also undertook a series of educational reforms to overhaul their education systems. While educational reform in the Arab States was previously aimed at the elimination of high illiteracy rate, the education reform policies have of late been geared towards quality and equity in education [8]. In addition, educational reforms in this region reflected different sources of funding for education [9]. This scenario is in stark contrast with educational reform initiatives in other countries.

Secondary education reform in Sub-Saharan Africa has also been an area of increased focus over many years.The quality of education in this region was eroded by a skewed provision of resources in favour of basic and higher education at the expense of secondary education [10]. In response to this predicament, several African countries embarked on secondary education reforms and South Africa is no exception.Suffice to say that substantial growth in secondary education in this region was characterized by a general shift in emphasis from vocational training to general secondary education [11].

Theoretical framework

Analysis of secondary education Physics curricula of selected countries in this article is underpinned by a Product-Process Framework [12] provided in Figure 1 below. This framework consists of three continuums. The first continuum,[Product (Dimension 1): Broad conceptual content versus Descriptive factual content], is used to identify the organisation of content. The second continuum, [Product (Dimension 2): Pure content versus Socially applied content], is used to identify the nature of Physics content. The third continuum, [Process dimension: Intellectual process skills versus Practical process skills], is used to identify the skills valued in the Physics curricula.

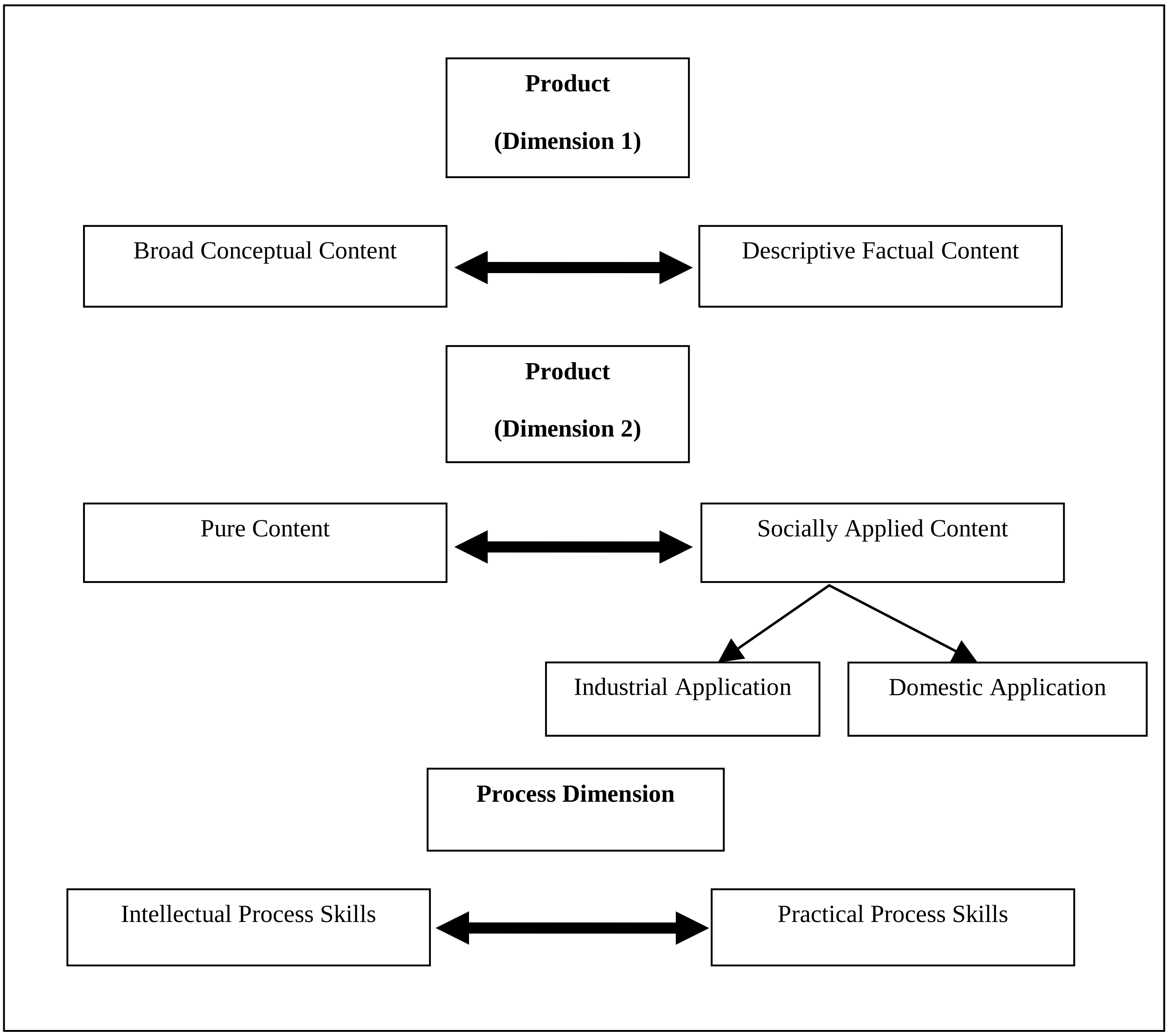

Figure 1: Bailey's (1978) Product-Process Framework

Focus on the analysis of secondary education Physics curricula of selected countries

The countries selected for comparative analysis of secondary education Physics curriculum are India, Ghana and South Africa. Ghana represents in this particular context West African countries which have historically embraced the British A Level and O Level Physics curricula. The structure of the syllabus pertaining to the Indian secondary education Physics curriculum is illustrated in Table 1 below. In terms of broad conceptual content, the curriculum provides more emphasis on basic conceptual understanding of the content through detailed description of factual content. Furthermore, the curriculum exposes the learners to different processes used in Physics-related industrial and technological applications (Industrial Application). The Domestic Application component of the curriculum is not clearly articulated though. The curriculum provides opportunities for Intellectual Process Skills as it promotes the development of process-skills and experimental, observational, manipulative, decision makingand investigatory skills in the learners. In terms of Practical

Process Skills, every learner is afforded the opportunity to perform 10 experiments (5 from each section) and 8 activities (4 from each section) during the academic year. In addition, two demonstration experiments must be performed by the teacher with participation of learners with learners maintaining a record of these demonstration experiments.This is augmented by a Practical Examination based on a clearly defined evaluation scheme. The striking characteristic feature with regard to the Indian secondary education Physics curriculum is that Physics and Chemistry are treated as two separate components and this is in stark contrast to the South African secondary education Physical Sciences curriculum.On close scrutiny, the level of depth of the Indian secondary education Physics curriculum reveals that Physics topics taught at university in South Africa are covered at secondary school in India.

Table 1: The structure of the syllabus: Indian secondary education Physics curriculum

STRUCTURE OF THE SYLLABUS: INDIAN SECONDARY EDUCATION PHYSICS CURRICULUM	
CLASS XI (THEORY)	**CLASS XII (THEORY)**
Physical World and Measurement Kinematics Laws of Motion Work, Energy and Power Motion of System of particles and Rigid Body Gravitation Properties of Bulk Matter Thermodynamics Behaviour of Perfect Gas and Kinetic Theory of gases Oscillations and Waves	Electrostatics Current Electricity Magnetic effect of current and Magnetism Electromagnetic Induction and Alternating current Electromagnetic Waves Optics Dual Nature of Matter Atoms and Nuclei Electronic Devices Communication Systems

The structure of the syllabus pertaining to the A Level and O Level Physics curricula is provided in Table 2 below. It is appropriate to indicate at the outset that the A Level and O Level Physics curricula make provision for a Practical Assessment (Practical Process Skills) designed to assess the learner's competence in those practical skills which can realistically be assessed within the context of a formal test of limited duration. The learners pursue a comprehensive course in practical Physics throughout the time during which they are being taught the theoretical content.In line with broad conceptual content imperatives, the curriculum provides a thorough introduction to the study of Physics and scientific methods through detailed description of factual content. In addressing the need for Intellectual Process Skills, these curricula make provision for the development of skills (such as accuracy and precision, objectivity, integrity, the skills of inquiry, initiative and inventiveness) and abilities that are relevant to the safe practice of science and to everyday life (Domestic Application).In addition, these curricula also strive to enable learners to become confident citizens in a technological world (Industrial Application) and to take an informedinterest in matters of scientific importance such as the promotion of the use of Information Technology (IT) as an aid to experiments and as a tool for the interpretation of experimental andtheoretical results(Practical Process Skills). The A Level and O Level Physics curricula cover the curriculum content in sufficient depth far superior than the South African secondary education Physical Sciences curriculum does. As is the case with the Indian secondary education Physics curriculum, the A Level and O Level Physics curricula make provision for Physics and Chemistry to be taught as two separate components.

Table 2:The structure of the syllabus: A Level Physics and O Level Physics

STRUCTURE OF THE SYLLABUS: A LEVEL PHYSICS AND O LEVEL PHYSICS	
A LEVEL PHYSICS	**O LEVEL PHYSICS**
General Physics Newtonian mechanics Matter Oscillations and waves Electricity and magnetism Modern Physics Gathering and communicating information	General Physics Newtonian mechanics Mass, Weight and Density Turning Effect of Forces Deformation Pressure ENERGY AND THERMAL PHYSICS Temperature Thermal Properties of Matter Kinetic Model of Matter WAVES Light Electromagnetic Spectrum Sound ELECTRICITY AND MAGNETISM Magnetism and Electromagnetism Static Electricity Current Electricity D.C. Circuits Practical Electricity Electromagnetism Electromagnetic Induction Introductory Electronics Electronic Systems ATOMIC PHYSICS Radioactivity The Nuclear Atom

The structure of the curriculum content in relation to the South African secondary education Physical Sciences curriculum is depicted in Table 3 below.The South African Physical Sciences curriculum seeks to prepare learners for future learning, specialist learning, employment, citizenship, holistic development, socio-economic development and environmental management by developing competences in the following three focus areas: scientific inquiry and problem solving in a variety of scientific, technological, socio-economic and environmental contexts (Intellectual Process Skills); the construction and application of scientific and technological knowledge(Practical Process Skills); andthe nature of science and its relationship to technology, society and the environment (Industrial Applicationand Domestic Application) [13].

Table 3: The structure of the syllabus: South African secondary education Physical Sciences curriculum

STRUCTURE OF THE SYLLABUS: SOUTH AFRICAN SECONDARY EDUCATION PHYSICAL SCIENCES CURRICULUM
GRADE 11 AND GRADE 12
Mechanics Waves, Sound and Light Electricity and Magnetism Matter and Materials Systems Chemistry Change Chemistry

The South African Physical Sciences curriculum is characterised by six core knowledge areas: two with a Chemistry focus – Systems and Change; three with a Physics focus – Mechanics; Waves, Sound and Light; Electricity and Magnetism; andone with an integrated focus – Matter and Materials [13].A major structural deficiency of the South African secondary education Physical Sciences curriculum is that it does not make provision for Physics and Chemistry to be taught as separate components despite repeated calls to do so. While the curriculum provides opportunities for learners to perform practical work, this is not augmented as a logical imperative by a clear practical assessment process to evaluate the practical skills acquired by the learners.

Economic growth levels of selected countries

Economic considerations paint a rather interesting picture with regard to the countries selected. More specifically, India's average quarterly gross domestic product (GDP) growth rate stood at 7.45% during the period 2000-2011 [14]. In addition, the per capita GDP growth rate doubled from 3.7% (1980-1991) to the current 7.3% [15]. India's real GDP growth averaged 7.3% per annum between 2000-2001 and 2007-2008 [16]. Another remarkable feature is that India's annual average GDP growth stood at 6.6% during the period 1990-2010 [16]. Ghana posted an average annual GDP growth rate of 5% over the past ten years [17]. South Africa's average quarterly GDP growth rate stood at 3.32% during the period 1993-2011 while its average annual GDP growth rate was 3.26% during the period 1994-2011 [14]. The average real GDP growth rate was 3.0% during the period 1995-2004 [18]. Clearly, South Africa's economic performance was far below par during the period under review as compared to India and Ghana. South Africa faces a real challenge to generate acceptable levels of economic growth as an integral part of the global community of nations. Can South Africa overcome this critical challenge without making significant reforms to curriculum particularly the Physical Sciences National Curriculum Statement? There appears to be a healthy correlation between economic growth level and the structure of the secondary education Physics curricula in India and Ghana and it is indeed imperative for South Africa to follow suit.

Conclusion

All things considered, South Africa has a moral obligation to harness its potential in order to develop and strengthen its competitive edge in the global arena. This can possibly be accomplished through epoch-making and crucial steps such as undertaking significant and far-reaching curriculum reforms in a bid to develop the much needed human capital for meaningful competitive advantage. Efforts at beneficiation of available mineral resources in South Africa can hardly yield any positive results given the nature of the curriculum particularly the inherently shallow secondary education Physical Sciences National Curriculum Statement when viewed against similar curricula elsewhere.

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