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

Sam Ramaila, Padmanabhan Nair, Leelakrishna Reddy

Physics Department

University of Johannesburg

Johannesburg, South Africa

E-mail: samr@uj.ac.za

**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 could be 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 developed and developing 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 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. Data was sourced from policy documents characterising education reforms in the respective countries involved in this inquiry.

**Product**

**(Dimension 1)**

Broad Conceptual Content

Descriptive Factual Content

**Product**

**(Dimension 2)**

Pure Content

Socially Applied Content

Industrial Application

Domestic Application

**Process Dimension**

Intellectual Process Skills

Practical Process Skills

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

**Analysis of secondary education Physics curricula of selected countries**

The countries selected for comparative analysis of secondary education Physics curriculum are India (Asia- Pacific), Ghana and South Africa (Sub-Saharan Africa). This comparative analysis is motivated by the fact that both India and Ghana made significant strides in terms of sustainable economic growth and overall development.

**South Africa**

Pr

The structure of the curriculum content in relation to the South African secondary education Physical Sciences curriculum [13] is depicted in Table 1 below.

**Table 1: South African secondary education Physical Sciences curriculum**

|  |
| --- |
| **sTRUCTURE OF THE SYLLABUS: South African secondary education Physical Sciences curriculum** |
| **gRADE 11 AND gRADE 12** |
| MechanicsWaves, Sound and LightElectricity and MagnetismMatter and MaterialsSystems ChemistryChange Chemistry |

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); and the nature of science and its relationship to technology, society and the environment (Industrial Application and Domestic Application) [13].

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; and one 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.

**India**

The structure of the syllabus pertaining to the Indian secondary education Physics curriculum [14] is illustrated in Table 2 below.

**Table 2: Indian secondary education Physics curriculum**

|  |
| --- |
| **sTRUCTURE OF THE SYLLABUS: Indian secondary EDUCATION Physics curriculum** |
| **Class XI (Theory)** | **Class XII (Theory)** |
|  Physical World and MeasurementKinematics  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  |

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 making and 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.

**Ghana**

Ghana represents in this particular context West African countries which have historically embraced the British A Level and O Level Physics curricula [15]. The structure of the syllabus pertaining to the A Level and O Level Physics curricula is provided in Table 3 below.

**Table 3: A Level Physics and O Level Physics**

|  |
| --- |
| **sTRUCTURE OF THE SYLLABUS** |
| **A Level PHYSICS**  | **o LEVEL PHYSICS**  |
| General PhysicsNewtonian mechanics  Matter Oscillations and waves Electricity and magnetism Modern Physics Gathering and communicatinginformation | General PhysicsNewtonian mechanics Mass, Weight and DensityTurning Effect of ForcesDeformationPressureENERGY AND THERMAL PHYSICSTemperatureThermal Properties of MatterKinetic Model of MatterWAVESLightElectromagnetic SpectrumSoundELECTRICITY AND MAGNETISMMagnetism and ElectromagnetismStatic ElectricityCurrent ElectricityD.C. CircuitsPractical ElectricityElectromagnetismElectromagnetic InductionIntroductory ElectronicsElectronic SystemsATOMIC PHYSICSRadioactivityThe Nuclear Atom |

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 informed interest 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 and theoretical 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.

**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 [16]. In addition, the per capita GDP growth rate doubled from 3.7% (1980-1991) to the current 7.3% [17]. India’s real GDP growth averaged 7.3% per annum between 2000-2001 and 2007-2008 [18]. Another remarkable feature is that India’s annual average GDP growth stood at 6.6% during the period 1990-2010 [18]. Ghana posted an average annual GDP growth rate of 5% over the past ten years [19]. 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 [16]. The average real GDP growth rate was 3.0% during the period 1995-2004 [20]. 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.

**Recommendations**

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.

**Conclusion**

The level of development in the countries involved in this inquiry appears to be a function of the quality of education reforms. It is imperative for South Africa in particular to consolidate its education reforms in order to realise meaningful human capital development.

**Acknowledgements**

The authors would like to express sincere gratitude to colleagues in the Physics Department at the University of Johannesburg for providing assistance during the course of this undertaking.

**References**

[1] National Institute for Educational Research (NIER). (1995). *Reorienting Secondary Education in Asia and the Pacific*. Report of a regional seminar.

[2] Byron, I. (1999). *An Overview of Country reports on Curriculum Development in South and South-East* Asia. Available: <http://www.ibe.unesco.org/National/China/chicoune.htm>.

[3] World Bank. (2000). *Improving Education and Reforming Education Systems in Central and Eastern Europe and the Commonwealth of Independent States*. Available: <http://www.worldbank.org/eca/eca.nsf>.

[4] Cerych, L. (1997). Educational reforms in central and Eastern Europe: Processes and outcomes. *European Journal of Education*, **32**(1), 75-96.

[5] Torres, C.A. & Puiggrόs, A. (1995). The state and public education in Latin America. *Comparative Education Review*, **39** (1), 1-27.

[6] Arnove, R.F., Torres, A., Franz, S., & Morse, K. (1997). A political sociology of education and development in Latin America.In Y.W. Bradshaw. (Ed.), *Education in Comparative Perspective*. New York: E.J. Brill.

[7] Inter-American Development Bank (IDB). (2000). *Reforming Primary and Secondary Education in Latin America and the Caribbean: An IDB Strategy*.

[8] Eeghen, W. (2000). *Education and Economic Growth in Middle, East and North Africa.* Available: <http://www.worldbank.org/wbi/mdf/mdf1/edecmen.htm>.

[9] World Bank. (1997). *World Development Report*. Washington, DC: World Bank.

[10] UNESCO. (1999). *Reforming Secondary Education Consortium*. Available: <http://www.unesco.org>.

[11] World Bank. (2000). *World Education Report 2000*. Available: <http://www.worldbank.org>.

[12] Bailey, R.F. (1978). *A Study of Secondary School Chemistry Courses in Victoria, 1932 – 1972*. Unpublished M.Ed Thesis, Monash University, Melbourne.

[13] Department of Education (DoE). (2003). *National Curriculum Statement Grades 10-12 (General) Physical Sciences.* Government Printer: Pretoria.

[14] **Department** of School **Education** & Literacy. (2012. *Schools Curriculum*. India

[15] Cambridge International Examinations. *University of Cambridge syllabi for A-Level and O-Level Physics*. Cambridge, United Kingdom

[16] http://[www.tradingeconomics.com](http://www.tradingeconomics.com)

[17] http://[www.OECD.org](http://www.OECD.org)

[18] http://[www.Eastasiaforum.org](http://www.Eastasiaforum.org)

[19] http://[www.Ghanaembassy.org](http://www.Ghanaembassy.org)

[20] http://[www.ber.ac.za](http://www.ber.ac.za)