Highlights of Astronomy, Vol. 13
International Astronomical Union, 2003
O. Engvold, ed.

Astronomy Curriculum for Developing Countries

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1. Introduction

After the democratization of South African society it became clear that there was a need to develop a new curriculum. This process started in the early 1990's and the implementation of a new curriculum began in 1998. The South African experience also gives an indication of how best astronomers, and other scientists, can intervene to maximize their impact.

2. Background

Prior to 1994 there was no national curriculum in South Africa; individual population groups had their own schools with differing facilities, resources and teaching capacity. In developing a new curriculum, the South African Department of Education consulted curriculum developers from New Zealand, Australia, Scotland, the USA, Canada and the Netherlands. The resulting curriculum was an Outcomes Based Education (OBE) structure, similar to that used in Australia and New Zealand and was known as "Curriculum 2005" (C2005). It was a complex document using a structure and language that was unfamiliar to most educators.

C2005 was implemented in 1998 and shortly afterwards it became clear that C2005 needed to be reviewed. This was done and resulted in the new Revised National Curriculum Statement and this is currently being implemented.

3. Curriculum 2005

This is an OBE curriculum which has two bands: the General Education and Training, GET, band (Grades R - 9) and the Further Education and Training, FET, band (Grades 10 - 12). The FET band will be implemented in 2006 and so the focus will be on the GET band. Here the traditional 'subjects' have been replaced by eight 'Learning Areas' (LA's): Language and Literacy, Mathematics and Mathematical Literacy, Arts and Culture, Natural Sciences, Human and Social Sciences, Technology, Life Orientation, and Economic and Management Sciences. The GET band is divided into three phases: Foundation (Gr R - 3), Intermediate (Gr 4 - 6) and Senior (Gr 7 - 9

The Natural Sciences LA is sub-divided into four 'Themes', one of which, Earth and Beyond, was originally further divided into Beneath the Earth, On the

Earth, Above the Earth and Beyond the Earth. Here the 'Beyond' component was of course "astronomy" and covers the topics such as lunar phases, seasons, time and time zones, eclipses, the solar system, stars, galaxies and the evolution of the Universe.

There are many positives to this new curriculum: it is a National Curriculum. It is learner oriented: the emphasis is on the learner "doing things" rather than "rote learning" as was the case in the past. Assessment is more varied and multifaceted: learners are expected to "show" understanding in project and other work, and is continuously assessed.

4. Comments on C2005 and some South African solutions

When such a large paradigm shift takes place there are bound to be implementation problems. These are exacerbated because many teachers, who are poorly trained and under qualified are now expected to deal with totally different lesson and assessment strategies, in addition to using new text books and other learning materials.

There are specific problems when a totally new subject/topic such as astronomy is added to the curriculum. It now meant that teachers would need training; relevant and appropriate resources needed to be developed and supplied. Teachers were already under strain attending workshops in learning how to cope with C2005 and there was some resistance as astronomy was perceived to be difficult and had to be done at night. It was a 'specialist' subject suitable only for experts.

5. Alternative Strategies

Comparing the South African change with that of Zimbabwe in 1994, after 14 years of independence, shows that evolutionary change is better than revolutionary change: the latter was better in all respects and consistently produced better results at all levels.

The strategy should be to keep what does not need changing, especially in maths and science, but to change the curricula of subjects such as language, history and the social aspects of geography. Where change was needed in other subjects it must be done in an incremental way. Teachers should be consulted in the process. They will be empowered by involvement: make them part of the process, make it their curriculum. It would probably be a good idea to start by looking at the assessment process as we have found that this impacts critically on the development of the curriculum.

6. Intervention by Scientists

Few scientists are also educators, particularly at school level. To optimize the use of this vast pool of expertise, the South African experience has shown that it is best for scientists to:

- assist curriculum developers with content and ideas,
- collaborate with textbooks authors,

- work with teachers in developing resources,
- work with teachers at training institutions, and
- liaise with local education departments and officials.

Other interventions are possible even where no curriculum change is taking place. In any existing chemistry, physics and maths curriculum there is ample material that can be used, either as illustrative examples or as 'add-ons' in topics such as: the inverse square law, spectroscopy, optics, gravitation, nuclear physics, magnitudes, graphs etc.

Additional interventions are possible by supplying data and ideas to repeat simple experiments and to give support material for project work.

7. Resources

The Internet is not a resource that is readily available to many people in developing countries. It is either unavailable, or when available, expensive. Sometimes it is available in a limited way: one computer per school with a telephone line with a 54k modem. Much material is written from a 'northern perspective', uses complex language and often sites contain poor or bad material which local teachers are unable to identify.

There is a "digital divide" and it is widening. Developing countries experience problems with bandwidth, hardware, software, support and maintenance and servers.

The Internet does have its place, but it is not the magic solution: it is the Internet AND other resources, especially tactile ones. What is important in a developing country is that the resources are cheap, easily reproducible and use readily available materials.

8. Conclusion

In creating a new school curriculum in a developing country it is worthwhile to consider the following:

- see what other developing countries have done
- the context in which the new curriculum is being developed,
- to use local, appropriate and relevant material,
- new material, including textbooks, will need to be created/written
- work closely with teachers and local education authorities,
- the process starts on COMPLETION of the new curriculum!

The school curriculum is important and scientists, especially astronomers, should be contributing to curricula, especially in the teacher training colleges. But irrespective of the curriculum, if teachers know that astronomy can be used as a "vehicle for science education" then they can use astronomy in their teaching of science and maths.

In South Africa we have what we call "Ubuntu", or "Motho ke Motho ka Batho": "I am because we are, and because we are (therefore) I am". Education is about human interaction: computers, textbooks etc are tools used by people; by themselves they have limited value.