

## **Section 2: The Current Situation in Astronomy Education**

## Astronomy Education: The Current Status in Zambia

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**Abstract.** There are many interlocking factors determining the introduction of astronomy education in Zambia. The process of infusing this new subject into an education system so centralised as that of Zambia is extremely complex. At school level the process is more complex than at university level, as all syllabuses are developed by a central body, Curriculum Development Centre (CDC) whose priorities are determined by perceived social and economic needs of the country. The prevailing notion in Zambia is that astronomy has no direct bearing on future employment needs. It is therefore not surprising that astronomy is at the bottom of the priority list among school subjects. The recent upsurge of interest in astronomy at the University of Zambia opens up the necessary background for developing astronomy in both school and university curricula. The University has recently formed the Astronomical Society and the Working Group on Space Science in Zambia. Coupled to this are exchange visits and collaborative work between the Physics Department of the University of Zambia and the South-African Astronomical Observatory. In this paper we present a review of the current activities in space science in Zambia and how they relate to the development of astronomy education.

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### 1. Introduction

Astronomy is fundamentally an ancient science, which has played an important role in the general development of modern science and technology. At the XII IAU General Assembly held in Hamburg in 1964, Commission 46 (Teaching of Astronomy) was created (Blaauw 1994). The creation of this new commission made astronomy an educational tool, which has to date, found its way into the curricula of many universities worldwide. It is rather disappointing to note that such a treasured and developed science is non-existent in the curriculum of our University. What therefore is the missing link? Does it mean that astronomy has no direct relevance to the development of science and technology in Zambia or is it simply an unexciting science? An attempt (Munyeme 1997) to trace the many

factors determining the missing link requires a detailed and lengthy analysis of the several factors claiming to influence the innovation of the physics/science curriculum in Zambia. It is not the intention of this paper to make this analysis, however we can easily point to the fact that science and technology are social phenomena which must be included in the social transformation and organization of a country. Both developed and developing countries follow this path, but with different degrees of success. In order to derive success in the application of science for social and economic development, the teaching of science must be broad-based. This has not been the case in Zambia, the emphasis on science and technology subjects has always been determined by: (1) the government, (2) the external agents, and (3) the interest of individuals or groups of scientists and teachers.

The above three factors have had strong influence on the past and present status of astronomy education in Zambia. We will address the combination of these factors with the current activities in space science in Zambia to explain their influence on the development of astronomy education.

## **2. Curriculum Development**

Zambia's educational practices are based on conceptions of education and science derived from colonial experience. Our history of colonial rule, combined with the post-independence government policy on science education and research has unfortunately resulted in low levels of scientific and technological progress (Kelly 1991, Goodson 1983). A central body currently known as Curriculum Development Centre (CDC) has always developed the school curriculum during both colonial and post colonial eras. CDC is a government body and its approach to curriculum development is largely determined by government policy on the social and economic needs of the country. CDC is responsible for developing curricula for all primary and secondary schools, pre-schools and preservice primary-school teacher-training programs.

### **2.1. Space science in the school curriculum**

Unfortunately, the centralized arrangement of developing the school curriculum makes it difficult to infuse new curricular materials and often leads to a very narrow selection of science topics. The current school curriculum addresses some elements of basic space science. A topic known as Universe I is taught in grade 5 of the primary-school syllabus. This topic introduces simple ideas of the solar system and features of the night sky. In grade 8 of the secondary-school syllabus is taught Universe II, which is a further study of the solar system and the position of the Earth in the universe. The contents include planets, comparison of Mars and Earth, stars, galaxies and the universe. Universe II marks the end of space-science topics at school level.

The great weakness of the school curriculum in Zambia involves assumptions that some kinds of areas of knowledge are more important than others and space science is among the less emphasized. Though appearing on the school curriculum, space-science topics have often been omitted by most of the schoolteachers. The common notion is that these topics have no direct bearing on the future career prospects of an ordinary Zambian. Space science is viewed by most of

the schoolteachers as a subject for developed countries with capabilities in space technology (Stobie 1998). In our opinion the large percentage of teachers with inadequate understanding of space science contributes to the omission of these topics in their lessons. The findings of informal interviews conducted with some of the students admitted to the Physics Department of the University of Zambia show that at least 30% of the school leavers have not studied the Universe topics. We later discovered that these topics have been excluded from the school science-examination questions. The combination of this and the fact that space science is a non-career subject provides enough ground for pupils and teachers to shun it. The shunning of space science at school level has a detrimental effect on the promotion of astronomy education. It means that a lot of effort must be put into reversing the negative attitude that students and teachers have about space science.

## 2.2. The university curriculum

Schools and departments of the University have the statutory authority to formulate their own syllabuses. However there are many setbacks for the introduction of new material and courses into the existing curriculum. The constraints are mostly attributed to low funding levels and difficulties in securing high-level academic personnel. Recently the University of Zambia witnessed the emergence of new courses dictated by the rapidly changing world-wide educational system. The advent of the free market and democracy has brought in educational values that prepare young people for induction into today's competitive economy. Successfully introduced at the University of Zambia in preference to traditional courses are courses in human rights, democracy, computer studies, energy and environmental studies etc. The broadening of University curriculum reflects changes that can be made when suitable conditions are met.

## 3. Towards Astronomy Education

Having provided a general overview of curriculum development in Zambia, we shall now focus on the feasibility of developing astronomy education under the prevailing education conditions. From what has been said it might appear that there is no room for astronomy in the current educational system in Zambia. The question we must ask ourselves is: What type of instruments and methods do we have at our disposal to make astronomy compete favourably with courses dictated by the economic climate of Zambia? The answer to this question lies in the recent upsurge of interest in astronomy at the University of Zambia. There are three major initiatives in the Department of Physics, which are aimed at promoting astronomy in Zambia. These initiatives offer the necessary background and opportunity for infusing astronomy into both school and University curricula. In addition to this there are dedicated members of the Physics Department who are available and willing to spend a considerable part of their time and thought in organizing these activities. The three initiatives are:

1. The formation of the Astronomical Society of Zambia.
2. The formation of the Working Group on Space Science in Zambia.

3. The participation of the physics department in exchange visits and collaborative work with the South African Astronomical Observatory.

### **3.1. The Zambia Astronomical Society (ZAS)**

The Zambia Astronomical Society was created in 1998 with the sole purpose of promoting the study of astronomy in Zambia. In its constitution, it is clearly stated that ZAS will provide the platform for popularizing astronomy among educational institutions and the general public through;

- Public lectures, seminars and exhibitions. ZAS will collect material like books, magazines, slides, movies, journals, etc. on astronomy and make them available to interested parties.
- Assisting the promotion and introduction of astronomy courses and activities in the school, college and university curricula.
- Encouraging co-ordinated research programmes and exchange visits between institutions within and outside Zambia.

Though different categories of membership were open to all those interested in the field of astronomy and other sciences, ZAS failed to command good membership. This did not come as a surprise to the organizers, since Zambia has no astronomical heritage and education. To many Zambians astronomy is a new vocabulary implying a new science in the history of Zambia. Fortunately a spectacular achievement of changing the image of astronomy was later facilitated by the formation of the Working Group on Space Sciences in Africa (WGSSA).

### **3.2. Working Group on Space Sciences in Zambia (WGSSZ)**

The Working Group on Space Science in Zambia was formed on 27th May, 1999 as an affiliate of the Working Group on Space Sciences in Africa (WGSSA). African delegates to the 6th UN/ESA Workshop on Basic Space Science held in Bonn in 1996 founded WGSSA. It is an international and non-governmental organization whose long-term objective is to make possible the creation of an African Institute for Space Science. The immediate strategic objectives of the Working Group is to promote education in (a) astronomy and astrophysics (b) solar-terrestrial interaction and its influence on terrestrial climate (c) planetary and atmospheric studies and (d) the origin of life and exobiology.

In 1999 the Physics Department of the University of Zambia launched a membership drive for the WGSSA. The membership drive involved the distribution of the WGSSA membership forms obtained by the Department from the WGSSA co-ordinator Dr. Peter Martinez of the South-African Astronomical Observatory. The forms were distributed to various institutions involved in space science of one kind or another. The response was quite encouraging, a total of 38 members were registered and the Department forwarded their forms to the WGSSA co-ordinator. It was motivating for registered members to have received individual letters of acknowledgment from the co-ordinator of the WGSSA, urging them to support the WGSSA activities and its publication, *African Skies*, by contributing articles and communication news of developments in space science.

### 3.3. International cooperation

Zambia has no experience of astronomy education. In order to succeed effectively in introducing astronomy education, it is necessary to establish strong links with external institutions and individual scientists with wide experience of astronomy education and research. The links will promote skills which Zambian scientists are lacking and this will be beneficial to the general development of astronomy. The Physics Department of the University of Zambia has already established a link with the South-African Astronomical Observatory (SAAO). Two members of the department have visited South Africa and participated in the SAAO organized summer schools. In 1999, Dr. Peter Martinez of SAAO, who is the current coordinator of the WGSSA, visited Zambia during the inauguration of the Working Group on Space Sciences in Zambia. His visit was a landmark in the promotion of space science in Zambia and has strengthened the image of the Working Group in Zambia. Besides the SAAO link, the Physics Department has links with individual scientists who have assisted in the provision of materials such as journals, slides and bulletins.

## 4. Suggestions for the Way Forward

As already mentioned, the prime factors that influence curriculum change in Zambia are (a) the government (b) the external agents (donors) and (c) the interest of individuals or groups of scientists and teachers. The interplay of these factors is now possible through the current space-science activities at the University of Zambia. First and foremost, it is necessary to strengthen the existing structures. Either the Astronomical Society or the Working Group should be made to function thoroughly and efficiently so that it can be easier to advance the interests of promoting space science in Zambia. There is need to convince the government (in this case CDC), the teachers and the funding agencies that curricular changes responding to the needs of astronomy education should be introduced. However we should realize that the promotion of astronomy in Zambia is taking place against a background of social and economic change. This means that a systematic approach requiring dedication from the organizers is necessary for achieving the end results. The association should initiate programs aimed at:

- Influencing the integration of curriculum reform with an initial training of a small number of school teachers in space science. These teachers will transfer the acquired knowledge with enthusiasm to other teachers in schools and can reduce the shunning of the Universe topics at school level. The training can be accomplished through a series of workshops or summer schools.
- Circulation of information on space science through public lectures, slides, videos and newsletter.
- Initiation of a program of exchange of scientists for collaborative training and for R&D programs with Institutions like SAAO. This will enable high-level access for Zambian scientists to astronomical facilities.

- Establishing liaison between national institutions dealing with the components of space sciences.
- Assisting, where possible, the learning institutions to lobby funds for acquisition of equipment and facilities necessary for teaching astronomy. As an example, in 1998 Prof. Donat Wentzel offered the University of Zambia U.S. \$500 for the purchase of a telescope. Though a telescope costing this amount was found in the U.S.A., the Physics Department of the University of Zambia failed to meet the cost of transporting it from America. This would have been possible if there was a program dedicated to the acquisition of such instruments.

From the preceding discussions, it can be observed that the Physics Department of the University of Zambia has great interest in promoting and coordinating space-science activities in Zambia. The success of introducing astronomy in the physics curriculum of the University of Zambia is therefore very high. The constraints are attributed to lack of funding and difficulties in securing high-level academic personnel. In 1999 a proposal for the introduction of an undergraduate course in astronomy was written and circulated by the Physics Department to potential funding agencies. The project addressed among other things the need for capacity building in astronomy and international cooperation particularly with SAAO. Unfortunately the project has failed to attract positive response from potential funders. It is our feeling that funding will be hard to come by and other ways should be sought. The easiest is to fuse and to expand some astrophysics topics into the existing courses. In this case the Department can adopt the approach, and some contents, of the booklet *Astrophysics for University Physics Courses*, written by Prof. Donat Wentzel for the United Nations Office for Outer Space Affairs. The booklet presents an array of astrophysical problems, which can be selected and used within the existing physics courses. It covers topics on elementary mechanics, heat and radiation, kinetic theory, electrical currents etc. The other option is to look for volunteer scientists, particularly retired professors of astronomy, to assist in establishing the course for at least a year. Under this arrangement it is possible for the University of Zambia to arrange accommodation and local salary for the visiting scientist.

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## Discussion

Orchiston asked if Zambian astronomers had joined with other scientists in their country to lobby for the establishment of a National Science Centre, which could lead to greater public interest in astronomy and thus to more interest among both high-school and university students.

Chambliss asked what plans the Zambian government had to enlighten its populace on the solar eclipse of 2001. In the past, in some countries (e.g. Indonesia) the emphasis seems to have been on dissuading people from observing an eclipse rather than on telling them how to look at it safely. Munyeme replied that the Physics Department of the University of Zambia had set up a Working Group in connection with the eclipse which they hoped would receive funds to work with the Zambia National Tourist Board on arrangements for accommodation and transport of visitors. This Group is also in touch with Jay Pasachoff. Pasachoff remarked that the IAU Working Group on Eclipses (Commissions 10 and 12) and the Program Group on the Public Understanding of Science (Commission 46) was in touch with Peter Kalebwe (Munyeme's co-author) and providing educational material, including instructions on how to observe the eclipse safely and describing how exciting a total eclipse is. Kalebwe plans to join Pasachoff and his students in observing the eclipse. Pasachoff also pointed out that convincing local authorities to advise the public correctly about eclipses is often difficult – and not only in developing countries. Finally, he mentioned that Zambians would see not only the total eclipse of June 2001 but also partial phases of the eclipse of December 2002. (*Editor's note*; see also the paper by Pasachoff on pp. 101-7 and the poster by Podmore on pp. 369-70.)