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Towards design and technology in partnership with science and other related subjects in the primary schools of Botswana

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Abstract
Botswana, as a developing country, needs a well structured education system. We are aware that education is the foundation which a developing country could use as a platform to maintain a sustainable economy. We need therefore to develop young brains educationally by introducing technological and creative skills and also working out the modalities of how such topics may operate in partnership with other related areas in the school curriculum. Therefore the paramount aims of this paper are to explore the feasibility of introducing Design and Technology as a subject to be taught in the primary schools of Botswana and also to consider the prospects of introducing the subject in partnership with Science and other related subjects such as Art. The paper concludes that the scheme would be not only feasible but also desirable.

Introduction: The Subject of Primary Design and Technology
The purpose of this paper is to consider the feasibility of introducing Design and Technology as a subject in primary schools in Botswana. It involves an approach which seeks to contradict those people who believe that Design and Technology is a subject only for less able students.

Design and Technology is the intellectual process which brings ideas into effect or practice. It is a human activity of identifying problems and needs and establishing critical priorities. It involves research, data collection, organisation of ideas and rational analysis.

Design is the area of human experiences, skill and knowledge which is concerned with man’s ability to mould his environment, to suit his material and spiritual needs. (Eggleston 1992; p.17)

It draws upon knowledge and resources while dealing with issues in society and the economy. Design and Technology is more than the sum of the two terms defined separately. When the two concepts are put together, they mean the ability to use the mind and hands in order to solve a problem: designing, making, testing and, finally, evaluating. Eggleston (1992; p.13) sees Design and Technology as:

...a subject directly concerned with individual capacity to design and make, to solve problems with the use of materials and to understand the significance of technology.

Design and Technology, if introduced at primary schools, would contribute towards the creation of a balanced curriculum.

The Context of Primary Technology Education in Botswana
Design and Technology is not taught in primary schools in Botswana. The subject is introduced to pupils when they reach junior secondary level, typically from thirteen to sixteen. From 1996, the subject is being taught to all students as a core subject with an allocation of six to eight periods a week. This ranks the subject at the same level as Science, Mathematics and English. This is indeed a good move, but it will further widen the gap between primary and secondary schools regarding Design and Technology.

At Senior Secondary School, students are offered a chance of proceeding with the subject or they may choose other optional subjects depending on ability and interest.

The subject is taught to those who want to become teachers of Design and Technology...
at the Molepolole College of Education and the University of Botswana faculty of Engineering and Technology (formerly the Botswana Polytechnic), where programmes prepare students to become teachers of Design and Technology at Junior and Senior Secondary schools respectively.

Since the introduction of universal primary education in Botswana, there has been no serious consideration of the introduction of Design and Technology as a subject at primary level. Perhaps the subject is too new in the education system of Botswana or perhaps people associate the subject with less able students. However, one wonders why so much emphasis has been geared towards introducing the subject at secondary and tertiary level, leaving stranded students at primary schools without even a slight knowledge of what Design and Technology is all about. Primary School children might well be enriched with a better balanced acquisition of skills and knowledge by including Design and Technology. It is stated in Education for Kagisano (1977; p.53) that

Irrespective of its condition, primary education is the most important of all stages of education. This is true in several senses. In contemporary Botswana there are ten times as many primary school pupils as secondary, and the primary schools reach out into communities which are as much as 200 miles from the nearest secondary school. Primary education is the foundation on which further learning is based and opens up to the young person a range of opportunities for further studies and work which are closed to the uneducated. It is in the primary school years, influenced to an important degree by school itself, that the child’s character and abilities take shape and many of the habits and attitudes of life time are formed.

It is evident that primary education is the basis in which a child’s intellectual and moral ability develops, and the omission of the excitement of Design and Technology with its opportunity for value judgement development is regrettable.

Benefits Expected from Primary Design and Technology in Botswana

First, the introduction of the subject to primary schools would assist pupils to cope with scientific and technological developments from a young age, especially those students who will not be lucky enough to proceed beyond junior secondary level. At present about 68% of the junior certificate leavers do not proceed directly to further education or training. Primary education goes as far as the age of 12 in Botswana. The omission of a technological education for children aged 12 in the United Kingdom National Curriculum would have raised serious questions.

A second point is that the subject at primary level aids broadening the pupils’ intellectual capacities through real life situations, unlike Science where replication of experiments to confirm formulae and concepts is the order of the day. Design and Technology involves the pupils with creative and critical thinking as they undertake a design process ranging through identifying the situation, generating possible solutions, research and realization up to testing of the end product to confirm the project’s workability. The idea of introducing the subject at primary level is not to overload children’s intellectual faculties with complex factual knowledge in Design and Technology, but rather to develop capability so that they enter junior secondary with confidence and experience in Design and Technology skills and be able to integrate it logically with other related subjects.

The third issue concerns the everyday nature of Design and Technology. The problem is that, as we undertake various problem solving activities, we are not aware that we are using a design activity approach. An early start in encouraging clear, rigorous thinking in everyday issues is desirable. We are involved in design and technology as we undertake problem solving activities although we may not follow a formal pattern or design process.

Finally I regard it as essential to introduce Design and Technology to pupils at a young
age because young children enjoy learning the creative process of Design and Technology.

**Design and Technology with other practical subjects**

Banks (1994) cites an example in which a group of pupils were making a prototype of containers in which to grow cress for sale to parents. Apparently the pupils were in a Design and Technology lesson but they ended up working on an experiment: selecting a range of materials to form into container shapes and test them for water permeability.

In this regard, there was an element of science which still suits the Design and Technology lesson. The two subjects are intertwined, and pupils in Botswana primary schools miss the excitement of exploiting the two subjects concurrently as they have not been exposed to Design and Technology.

Furthermore, Cross (1994) emphasises the imperativeness of introducing Design and Technology at lower and middle levels as follows:

> Technological education should form an integral component of the educational experience of all young people aged five to nineteen years. As consequence of this experience and that obtained in other subject areas, students will be better prepared to develop an awareness and an appreciation of the world, its culture and the influence of the past, present and future technological challenge. (p.4)

The report of the National Commission on Education of 1993 (Botswana) recommended that practical subjects be included in the National Development Plan 7. This is not enough; more attention has to be drawn to Design and Technology.

The questions are which practical subjects are most beneficial and what criteria would be used to prioritise the subjects? Design and Technology is a flexible subject which may overlap with almost all subjects taught in primary schools, although the degree of integration would differ from one subject to the other. It does not necessarily require a separate existence.

Makiya and Rogers (1992, p.1) support the idea:

> The incorporation of design and technology in the national curriculum is one of the most exciting developments in primary education in recent years. Pupils thrive on the types of activities that are involved, and the impact of this involvement and excitement is quick to reach home, as a parent commented when a school organised a Design and Technology workshop evening for parents: Sharon never talks about what she does in school, now all I hear is Design and Technology this and Design and Technology that. Do they do anything else at school, and what is the design and technology.

This quotation brings to the surface the fact that children cannot hide the excitement and enjoyment which they get from the subject, it enriches them with a variety of practical problem solving skills.

It is evident that children best engage their intellectual capabilities if Design and Technology is introduced to them through a familiar context. It is also an advantage if they are provided with the opportunity to experience their own design ideas through a range of materials in order to create a positive and stimulating environment for them to work in. Pupils should be encouraged to find a solution to problems they encounter in real life situations; they should work collaboratively within a group and promote safe and healthy work practice. Through participation in design and technology types of activities, pupils manage to foster confidence and self-esteem. By not offering children an opportunity to pursue Design and Technology programmes at primary level, we are denying them the opportunity of exploiting the technological world at a young age and thus becoming technologists and scientists of tomorrow.

**Primary Design and Technology and Science**

Throughout the argument of this paper, it is clear that Design and Technology and Science
integrate well and hence the two could be taught to pupils concurrently in order to create a positive and stimulating environment.

Science can help students to understand Design and Technology; Design and Technology can assist the pupils to cope with Science and relate it to factual concepts.

The industrial practice of technology depends to a certain extent on applying scientific knowledge and it may use scientific processes. This is also the case with school situations whereby a technology project would need some support from Science. Let me cite an example in which a group of Junior Secondary pupils designed and made a motor operated crane. For their project to work, they needed some scientific knowledge. They considered the speed of the motor and then chose gears and pulleys and worked out ratios in order to control the speed of the crane. They had to decide whether to use the mains or battery cells to power their project. If they opted for the mains, they were to use an adaptor in order to step down the voltage. Although they were designing a crane for lifting objects, they have also dealt with electricity and mechanisms from Science.

Design and Technology within a Science approach explores those areas of technological expertise which may help the students to understand Science better. We are quite aware that the scientific processes are performed through discovery and mainly by controlled experimentation, while design and technology processes are carried out through design, investigation, realisation and evaluation. Design and Technology within a Science approach is about using technological artifacts in a scientific context. There is at present mismatch between science and technology subjects taught in schools, and the realities of the scientific and technological world outside.

**Primary Design and Technology and Art**

This paper would not be complete if the relationship between Design and Technology and Art were not considered. The focus will now base on Art, the subject that shares many of the activities of Design and Technology as Science does. In primary, secondary and tertiary levels in Botswana, Art is taught as an independent subject, in some cases as an option. Some of the topics of Art overlap with some activities of Design and Technology and some areas of Design and Technology integrate with Art. In areas of Art such as design, graphics, printing, weaving and dying, Design and Technology may be exploited in order to enhance the teaching of Art.

Some topics of Art such as screen printing may be taught in a Design and Technology department while Design and Technology topics like graphics may be performed in the Art department. The two departments are always next to each other in schools in Botswana. Art adds an important aesthetic dimension to Design and Technology.

After looking at how Design and Technology integrates with other subjects in primary schools there is now need to consider the advantages of establishing Design and Technology in primary schools of Botswana.

**Primary Design and Technology in Practice**

Establishing the subject at primary schools has a number of advantages, not only to Design and Technology but also to other subjects which integrate with it. Cross (from the Centre for Primary Education at the University of Manchester) confirms that establishing Design and Technology at primary school has greater advantages:

- society needs a technologically literate population, girls and boys who can operate in the technological world.
- Design and Technology, encourages team spirit and the creation of a safe and healthy working environment. Another advantage of this subject is that it enriches pupils with a balanced acquisition of skills and knowledge, broadens their academic abilities and confronts them with real life situations. Cross further stated that “education is about educating the whole person”. Jarvis (1993) argues that:
  
  By encouraging children to take an increasing role in decision making, technology provides the opportunity to help children to become independent,
thinking adults who are more likely to cope with problems and failure, and who regard difficult tasks more as challenge than barriers. (p.3)

Primary Design and Technology also prepares pupils for Junior Secondary education where the subject is taught at a higher level. In this the introduction of Design and Technology in primary schools of Botswana will assist by avoiding replication of facts. That is, topics which sometimes appear in two different subjects may be restructured and taught under Design and Technology as one topic, using a thematic, rather than a subject approach. My argument is not for the introduction of a new named subject, but the efficient use of primary children’s time and the laying of sound foundations.

Conclusion
As part of the conclusion, this paper must address the following question: who lays the golden eggs of economic national prosperity? Is it science or technology?

Some people may say Science, others would settle for Technology. I suggest that both subjects lay golden eggs. Provided we are aware of the context in which the subjects operate, then we are sure of the eggs.

Page 82 of the Report of the National Commission on Education (1993) (Botswana), indicated that a review of the national curriculum in primary schools should be conducted in order to incorporate practical subjects. I would suggest that Design and Technology be the first subject to be considered as the pupils would benefit more if such a move could be instigated with the first few years of National Development Plan 7.

The government would benefit much from this plan if the local context approach is used (as has been done in the new junior secondary curriculum) and a close relationship between Design and Technology and other subjects is maintained. It will be an advantage to operate Design and Technology in partnership with these subjects so as to provide a balanced curriculum.

There should be a clear link between Design and Technology as a subject taught at primary level and the junior secondary school Design and Technology syllabus so as to create a smooth transition. However, primary school Design and Technology is not a transfer of elements of Junior Secondary Design and Technology to a younger age. It is an experience to be designed which is totally appropriate to primary school children, intended for their stage of development.

The subject should be made compulsory to all primary schools in Botswana including those privately owned. This will maintain a fair acquisition of Design and Technology skills and knowledge across the board.

I would also recommend that the subject be allocated a contact period equivalent to other subjects.

I am aware that primary teachers might be nervous to teach the subject as it is not their area of speciality. However they may develop confidence by attending INSET courses and seminars during school vacations. The subject may be incorporated in course work during initial training so that they acquire the basic skills. Botswana’s local primary school teachers are generalists. Importantly, many primary teachers now teach the skills required, but without any planned scheme.

Initially ordinary classrooms may be used for teaching the subject. Basic equipment, some of which already exists in such departments as Science, Agriculture, Art and Home Economics may be used in order to make the programme cheap and allow all schools to enrol.

Formation of a primary Science and Technology Teachers Association and attending exhibitions and seminars would assist both teachers and parents (as well as pupils) to understand the subject better.

Cross (1994) has an explicit model on how Design and Technology operates in partnership with Science and other related subjects in terms of sharing topics. He has prioritised topics which he considers basic
when dealing with Design and Technology at primary level.

Educational systems do not transfer across cultures easily without considerable adaptation. The idea of including Cross’s (1994) models of education in primary schools is not to suggest that this is the most suitable for my country, but to highlight that comprehensive and very interesting models do exist.

References