Pupils' Attitude Toward Technology-Botswana

by

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PUPILS' ATTITUDE TOWARD TECHNOLOGY IN BOTSWANA

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(Abstract)

Pupils' Attitude Toward Technology (PATT) research began in Botswana in 1993. The research was designed to study pupils attitudes toward technology through the use of an instrument that has shown to be effective in measuring affective/behavior and cognitive attitude dimensions. The instrument used was an (English) adaptation of one created at the University of Technology Eindhoven, The Netherlands, by Drs. Jan Raat and Marc de Vries in 1984. Since that time, versions of the Dutch instrument have been used to assess the pupils' attitude toward technology in over 20 countries worldwide.

One of the aims of this *ex post facto* study was to produce a descriptive profile of the student population based on a sample of 800 Form 5 pupils. The model employed a comparative framework controlling for differences in demographic characteristics that included GENDER, LEVEL OF TECHNOLOGICAL STUDY, and URBAN/RURAL BACKGROUND. The identification of these variables was seen as important in terms of their social significance within a changing traditional culture. Interest in comparing the findings from male and female students living in diverse rural traditional and modern urban environments, was the rationale for the investigation. Another aim was to compare responses from pupils with a technological background in school to pupils with no prior technology course work. Another aspect of the research was to encourage

opportunities to share the findings in cross-cultural comparisons with research in other African countries.

The Botswana instrument was modified from a study conducted in the USA (Bame, de Vries, and Dugger) and re-designed for Form 5 pupils (ages 16-21). The modified instrument was field tested during October-November, 1993, with 800 pupils in eight schools (four rural, four urban) across the nation.

The instrument contains four basic parts. The first part asks pupils for a short description of what the student thinks technology is. The second part consists of 14 questions to gather demographic data about the respondents, and a survey of the technical subjects a pupil may have studied. In the third part, 58 statements were included to assess the respondent's *attitude* toward technology. In the fourth part, 31 items assess the pupils' *concept* of technology.

The findings revealed that gender was a factor that affected students' attitude toward technology, as was the level of technology pupils studied in school. To a lesser extent, but still an important factor, the urban/rural backgrounds of pupils was found to combine with other variables, and thus contribute toward pupils' attitudes and concepts of technology. The findings also showed that in general, a positive correlation was determined to exist between pupils' concept of technology and their attitudes toward it. However this relationship, while observed significant, was in magnitude, not notably strong.

The contributions of PATT Research in Botswana offer both educators and program planners an instrument to assess the needs of particular pupil populations. Government and local planners need a means of monitoring formal educational efforts. As a curriculum development tool, the design offers a responsive solution to the needs of assessment and evaluation.

Dedication

Jan Raat
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and
The Republic of Botswana

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CHAPTER ONE

The Proposal for PATT Research in Botswana

Introduction

Technology is an important component of a nation's cultural, social, economic and political life, and often shapes the ways in which humans interact with one another. For traditional societies, induced innovations brought on by development and technology transfer accelerate the pace of modernization but often create abrupt divisions in the life styles, working habits and forms of leisure activities people seek. Rapid modernization and urban growth can produce unevenly distributed levels of exposure to technology among various sub-groups within a society.

It is important that technology educators understand how the nature of technology is viewed relative to the needs and interests of students. Children learn about technology in school, at home, and from the world around them. They gain their concept of technology from culture, from the books they read, from the movies and pictures they see, and from watching others work and apply technologies in a wide range of activities both modern and traditional. In terms of their own lives, these kinds of experiences help pupils formulate meaning and feelings about the role of technology. Also, in terms of their own cultural awareness, pupils will be forced to interpret various forms of imported technology based on the norms and values of their own society.

In fairly recent studies on technology and pupils, evidence revealed that a relationship was found to exist between attitudes and concepts. It is possible that the attitude may be influenced via the concept (Bame and Dugger, 1989). If the level of technological exposure among pupils varies, one might expect that so too, a pupil's concept of it would vary.

Education has the capacity to raise levels of technological exposure. A positive attitude for a subject is helpful in producing motivation for pupils to learn. The studies mentioned above have indicated that a child's concept of technology influences his/her attitude. Herein lies the opportunity for education and the curriculum to build a balanced concept of technology that in turn, is tied to the educational needs and interests of students.

The following study is an examination of pupils' attitudes toward technology. Justification for this study is in response to the steps Botswana has taken to improve the quality of technological education in schools. It involves administering a tool that will provide Botswana educators with a clear picture of pupils' attitudes toward technology that may serve as a valuable benchmark on which further educational goals can be based. The aim of the study is to produce findings related to student attitudes that are of importance to technology educators in Botswana. The study is designed to give educators a current descriptive profile of a particular pupil cohort. The profile is expected to reveal levels of interest, concepts, and attitudes toward technology that prevail among Form 5 male and female pupils with different levels of technology education backgrounds and from urban and rural areas in Botswana.

The Need for PATT Research in Botswana

In 1966 the British Government returned sovereignty back to the people of Bechuanaland and a new nation was born. Accounts of the levels of development at the time of Independence reflected the neglect given the Protectorate during the period of British administration. Apart from a railroad constructed across the nation's eastern edge, very little else added to the modern infrustructure. There were no tarred roads outside the few that were in certain towns. There was almost no industry, and electricity was not even produced within the country. When Seretse Khama became the new president, Bechuanaland became Botswana- one of the least developed nations in the world.

Minerals discovered soon after Independence created the means for Government to finance development and expand the economy. Government formulated the development philosophy of *Kgaisano* (social harmony) and since has followed a charted course toward rapid modernization of the economy and one that would lead toward the reduction in poverty through formal sector growth, and raise standards in health and education for Batswana (Ministry of Finance and Development Planning, 1985).

Growth in the economy for the first nearly quarter of a century took place at a pace that averaged thirteen percent. With such a change in the economy, the ways of life for Batswana who tried to keep pace with modernization took on some drastic changes of their own. Perhaps the most noticeable consequences of modernization in Botswana and indeed in other developing countries, are brought about through urbanization. The effects of urbanization on traditional societies often create sharp socio/economic distinctions between urban and rural communities. Population segments which have retained mostly traditional ways of living face growing challenges brought on by modernization and interactions with modern technology. New patterns of employment, new ways of doing things and new values associated with modern urban living alter the cultural composition of traditional societies bound together in traditionalism and maintained for centuries by technologies that appropriately fit the conditions.

These challenges are particularly important given that technological innovations which have occurred in Botswana almost always involved technologies produced and developed in nations already industrialized. The implications of adopting foreign technologies and drafting development policies dependent on the transfer of technology may have serious impacts on social and economic activities that utilize traditional technologies. As observed in Botswana's schools, children often express a preferred taste for imported toys and gadgets when these items are discussed in comparison to home-made (wire) toys and traditional craft equivalents. In this example the challenge represents a real concern for the value of indigenous technologies and the continuance of traditionally valued livelihoods among young people if attitudes are not sufficiently positive to preserve and promote these cultural aspects.

General differences in attitudes and behaviors toward technology are often seen across age groups within Botswana's present society. Frequently older persons are more likely willing to plough using draft animals than say, a middle-aged farmer who may prefer sharing a tractor through a cooperative system. Again, a young person might be more inclined than the other two to live in a rural community, but drive in and out of a nearby city to work a white-collar job instead of pursuing a traditional occupation all together. These examples begin to show how generations may react differently to innovations and economic changes brought on by rapid modernization and technology transfer.

To consider the role of technology within Botswana, one must examine the nature of lifestyles and technologies that existed before modernization began as these characteristics coexist within society today. The economy and ways of life for most living in Bechuanaland and roughly one third in Botswana today, has been tied to subsistence farming and livestock rearing. Traditionally, education for boys and girls up to adulthood was imparted through the exercise of leadership of chiefs, headmen and elders over the community as a whole (Coles, 1985). Lessons about culture, history and social responsibility as well as important vocational skills were taught informally with the guidance of parents and relatives. The technologies that were used over the centuries to produce food and shelter, and provide transportation etc. was indigenous to the region and to the culture. If it is found that there are technological gaps between generations of Batswana, or if attitudes prevent young people from acquiring technological knowledge that encompasses historically cultural forms of indigenous, as well as the new (foreign) technologies, then perhaps the role of technology is no longer in sync with social values.

The vital role of new technology within Botswana's modern economy is highly recognized by leaders in Government. The importance of new technology is evident in the nation's policy formation and planning where education and strategic manpower targets are discussed. In the National Development Plan 6 (1985-1991), technology plays a major role in achieving the following goals:

1. to strengthen the capabilities [technologically] of Botswana's human resources;
2. to accelerate the pace of localization in technology related employment fields; and
3. to contribute overall to national self-reliance.

In combined efforts to support these goals the Ministry of Education has placed great emphasis on curriculum development of vocational and technological subjects and programs that assist in providing Batswana skills that are valuable in the formal sector.

Botswana's actions are reflective of steps taken toward vocational and technological education in other developing African countries like Zimbabwe, Zambia and Malawi (UNESCO, 1984). Governments in these countries also recognize that rapid modernization requires an expanding technologically competent society.

However the aspect of competency sometimes overlooks the formal recognition of the entire technological spectrum of new and traditional technologies. Often greater emphasis is directed toward policies that prioritize programs tied to goals that bring modernization. Because levels of technology and education within nations engaged in different stages of development are so characteristically diverse, technology education becomes an essential part of the preparation for living and adapting in a society (and region) marked by transition. In this view technology education can serve as the school subject which teaches about how we as humans apply knowledge, and resources to create a technological world that is culturally and environmentally sound. Education programs designed to provide a balanced view of technology within its cultural contexts has the potential to avoid reinforcing the effects of either traditional or modern technological development at the expense of the other.

The results of ongoing research in Pupil's Attitudes Toward Technology (PATT) has offered limited findings within developing countries. Of the more than twenty nations in which PATT research has been conducted, most was carried out in industrial countries. Nations where PATT research has been initiated in the developing world include: China, India, Kenya, Mexico, Nigeria, Zimbabwe. Other countries that have been involved in this area of research include: Australia, Belgium, Canada, Denmark, Finland, France, Hungary, Italy, Poland, Portugal, Spain, Sweden, United Kingdom and the United States.

PATT research in Kenya, Nigeria, Zimbabwe and recently South Africa has led the focus on Africa. It is important from an educational point of view, to extend PATT research across regions where cultural similarities exist but different models of education are in place. From a social point of view, studies that can investigate issues related to modernization and technology among those who share a traditional, regional, cultural identity influenced by colonial and political conditions, is particularly valuable for gaining an understanding of the unique set of development issues that have evolved in this part of the world.

The PATT research instrument developed at Eindhoven University in the Netherlands by Raat and de Vries (1986) can be adapted to provide researchers with a valid and reliable tool to compare pupils' attitudes toward technology. This has been shown in each of the countries studied so far. Experiences of researchers show that wide cultural differences require changes in the instrument prior to its execution (Kapiyo and Otieno, 1985). These changes could be based on language differences or educational differences for example. After modifying and revalidating the PATT instrument, its results can be used to interpret the factors that influence pupil attitudes toward technology. Generating carefully selected country-specific factors prior to the execution stage is one way to critically increase the validity and reliability of findings.

One of the specific aims of this study is to compare the attitudes of pupils toward technology from the perspective of locational characteristics. Kapiyo (1988) noted that in Kenya the role of technology within the cultural context reflected a *rural-urban* division. He also observed that upper income urban populations were more exposed to "modern" technology than were lower income groups. He defined the condition whereby rural and poor urban populations were "problem-pushed" into developing "survival technology" - a process he found requiring creative and adaptive solutions to solve problems. Restated, the question might be asked whether or not attitudinal perceptions toward technology vary with respect to rural and urban population groups.

If pupil responses to attitudinal questions show significant urban-rural differences toward technology in dual sector economies then it follows that greater attention in curriculum planning should be given to the relationship between school and community. Technology education taught as a pre-vocational subject or as a general discipline should provide a positive relationship between activities in the classroom and the realities within the immediate community and beyond. It is not enough for a democratic system of education to present rural-based technology education to rural children and urban based technology education to only urban pupils. Neither is it effective to design a universal curriculum that falls short in matching levels of technology across a broader spectrum of local and cultural conditions. Appropriate systems of technology must be addressed in classrooms to allow the contributions of pupils to meet the manpower demands of their own immediate communities as well as those of the nation. In addition, pupils must not be limited in their decisions to contribute effectively in either modern or traditional segments of the economy. The important contributions of each sector clearly raise issues that affect concepts of national unity and self-reliance. It would appear that an investigation into the views of technology among urban and rural dwellers could provide valuable information for curriculum planners and those involved with national development planning.

Statement of Problem

The accelerated pace of industrial and urban development in Botswana has expanded the need for an up-to-date workforce and a citizenry with high levels of technological literacy in the modern formal sector. In the rural sector, traditional technologies need assistance to co-exist with new forms of technology being introduced from outside. In this regard, modern and traditional sectors are separate yet they are often forced to act interdependently. The primary role of the modern sector in Botswana's development has been to produce capital. The primary role of the rural sector has traditionally contributed toward agricultural employment. From a social perspective these two sectors illustrate patterns of behavior that often function in contrast to one another. Hence, this dual society is an area of special significance in the role of development and of interest in terms of social harmony.

Technology education as a discipline is responsive to issues that emerge as technology and modernization impact the lives of Batswana in every community. Educators and officials need to utilize the means to study and share information about technology, how it is perceived, how it is adopted/adapted, and what its consequences are in terms of development and social harmony.

In addition, developing countries like Botswana have the opportunity to thwart many of the environmental problems seen throughout the world where modernization and industrialization have occurred. By encouraging young people to express their attitudes toward technology, educators become the vehicle for empowering pupils to shape the directions of future technological development. Therefore, it becomes crucial that educators assess, develop, and direct current technology education programs. In this respect, the PATT-Botswana study can be viewed as an effort to create an important tool for educators and those in development planning in Botswana.

The Research Question

The main research question is stated as follows:

What is the attitude toward technology of Form 5 level pupils in Botswana and what is their concept of it?

The Sub-questions

The main research question will be answered by formulating and testing the following sub-questions:

1. What is the relationship of gender with the pupil's attitude and concept? Do males have a more positive attitude toward technology than females? A greater concept of technology?
2. What is the relationship of technology education with the pupils' attitude and concept? Do pupils who have studied technology in school (ie. Woodwork, Metalwork, Technical Drawing, Technical Studies, Design and Technology) have a more positive attitude toward technology than those who

have not studied technology? A greater concept of technology?

3. What is the relationship of the technological climate at home which is assumed to differ in rural and urban locales, with a pupils' attitude toward technology? Do urban pupils have a more positive attitude than rural pupils toward technology? A greater concept of technology?
4. What is the relationship of the concept of technology with the attitude toward technology? Do pupils who have a greater concept of technology have a more positive attitude toward technology?

The sub-questions will be answered by formulating and testing four assumptions relating to the four research variables. The assumptions are based on literature reviewed in Chapter Two.

1. Boys have a more positive attitude toward technology than do girls. Boys have greater knowledge about technology than girls. (variable: GENDER)
2. Pupils who study technology in school have a greater concept of technology than pupils who do not have a technological education background.(variable: EDUCATION)
3. Pupils in technologically diverse urban locales have a greater concept of technology than do rural pupils. (variable: LOCALE)

4. Pupils possessing a higher concepts of technology have a more positive attitude toward technology. (variable CONCEPT)

Assumptions

The following assumptions were made with regard to this study:

1. The Affective/Behavior (A/B) and Cognitive (C) attitude scale instruments used in PATT research can be employed effectively in this cross-cultural setting. Field testing the instrument after it has been modified will test to validate this assumption. So far this has shown to be true in at least twenty internationally conducted studies.
2. An attitude has three components: cognitive, affective and conative (intentions). The instrument used to carry out the research is assumed to enable the analysis to compare each of these three components.
3. The levels of English proficiency known to exist among Form 5 pupils in Botswana makes the English version of the PATT instrument used in the United States, a suitable instrument for this target population.

Limitations

There were four limitations considered in this study.

1. The lack of standardized instruments pertinent to this study necessitated the modification and validation of a similar instrument.
2. The results cannot be expected to be generalizable for all developed or developing countries.
3. The results of this study are limited to the relative differences or similarities in attitudes toward technology among cohorts enrolled in Form 5

4. limitations will occur in the power of this analysis to draw conclusions based on gender to measure the influence of prior technical education programs. The low numbers of girls enrolled, historically in technical programs, makes a comparison with boys unreliable.

Delimitations

Four delimitations were imposed on this study due to financial and time constraints:

1. The study was confined to the senior secondary school level of Form 5 pupils in Botswana.
2. The sample was drawn from pupils living in five of the seven districts that provide senior secondary schools. These schools include four in urban communities and four in rural communities.
3. The length of time devoted to administration of the questionnaire was a period of ten weeks.
4. The length of time devoted to carry out the entire study was roughly four and one half years.

Definitions

The Definition of "Technology".

Offered is a description of technology as rendered by one of the founding PATT researchers, Marc de Vries. It should be mentioned that de Vries as he presented "technology" was not referring to technology as a school subject, but as a social phenomenon. This description contains within it five characteristics:

1. Technology is a specifically human activity. Implications are:

- technology is for women as well as men;
- the view of humanity determines the way technology is looked upon;
- and technology has developed the way humanity has developed.

2. The three 'pillars of technology' are: *matter, energy* and *information*. In the course of history the accent has been shifted from the first to the second, and from there to the third pillar. Yet all of them still play a part in modern technology.

3. Technology is closely linked to natural sciences, especially physics. Originally technology was independent of science, but in the course of time an interaction and mutual influence came into existence.

4. Skills in technology are: designing, practical technical skills and handling technical products.

5. Technology thoroughly intervenes all aspects of society: economy, labor and social relations. Technology assessment, as a separate subject, is concerned with the possible consequences of technological applications. (1986)

It is from this general perspective of technology that attitudes were defined. The reference of technology as a social phenomenon expresses the theme of the inquiry.

The Definition of "Attitude".

PATT researcher Falco de Klerk Wolters concludes "...attitudes are more than reflections of affective dispositions. Attitudes also comprise elements of knowledge and behavior. Affection (feeling), cognition (knowledge) and conation (intention) are the three generally accepted sub-concepts of attitude" (1989, p. 14).

From this meaning it becomes apparent that any significant measurement of attitude takes into account these three intervening variables or sub-concepts. Therefore, results on a technology attitude scale must reflect not only how pupils feel and behave toward the subject but also what each knows about it. Further elaboration on measurement scaling is included in Chapter Two.

The Definition of "Form 5".

The reference of Form 5 is directed toward the population of interest. Educators familiar with Botswana's system of education may recognize the term. In the United States, one would relate this level of education to that of the *high school senior class*. In Botswana graduation from senior secondary school coincides with the completion of the Cambridge Overseas Certificate Examination.

The system creates three distinct tracks or academic streams of students within the Form 5 class. Students are typically streamed into one of the three following academic streams: *Pure Science*, *Combined Science* or, *Practical Science*. Students involved in a Pure Science track do not generally take technology or practical subjects but, instead, follow a more academically rigorous, college prep curriculum. The Combined Science track engages students in intermediate math and/or science classes and includes some practical coursework. Practical subjects include the following courses: Woodwork, Metal Work, Technical Drawing, Technical Studies, Design and Technology, and Home Economics. The Practical Science curriculum engages students in core academic subjects with an additional concentration in practical coursework. Hence, the system of tracking stratifies the Form 5 student body into three distinct groups.

The Definition of "Rural Community".

An official definition of "rural communities" offered by the Ministry of Finance and Development Planning in its *National Development Plan 7,* (1991) is not straightforward in its presentation. Instead, the parameters for *urban settlements* (see definition of urban community) are outlined.

A description excerpted from the National Settlement Policy is that of the *tertiary* settlement. This type of settlement is one that functions to bridge the gap between agricultural needs of each family to live on its own land areas and farm, and the need to bring people together to provide them with services. (Government of Botswana, 1991)

It may also be useful to present descriptions of rural communities found in unofficial sources. Silitshena reports that others have written about the *agro-town* as a settlement that reflects a timeless, traditional way of life. The distinction that agro-towns or even smaller settlements (ie tertiary settlements), are not industrial and not commercial centers is emphasized. (1994. p.254)

The Definition of "Urban Communities".

The *National Development Plan 7,* published by the Ministry of Finance and Development Planning, defines urban settlements as follows:

> - Urban settlements are defined by Botswana's population census as those settlements with populations of 5,000 or more inhabitants, and with at least 75% of the working population engaged in non-agricultural employment..."
> - Also included in the definition of "urban" settlements are those settlements which have formally been declared townships by the Minister of Local Government and Lands under the Township Act. Such towns include Botswana's most conspicuously urban settlements (Gaborone, Francistown, and Lobatse) and the mining townships (Jwaneng, Selebi-Phikwe and Sowa, and the "closed" town of Orapa), but also, for historic reasons, Ghanzi and Kasane. (1991, p.405)

Summary

The impacts brought on by rapid modernization and growing urbanization in Botswana create a number of challenges for society, officials, educators and researchers. The changes that affect the traditional values and lifestyles of people within a nation that only three decades ago was ranked among the least developed in the entire world, have created ever widening gaps between those in society who are able to access and utilize the available new technologies and adapt to new ways of doing things, and those who are not in a position to keep up with the changes. Other challenges arise through the implementation of national policies aimed at transforming a traditional, agricultural-based economy into a thriving, diverse modern economy reliant on sophisticated technological capabilities of its manpower resources. Educators are called upon to help children living in modern, rural and transitioning settlements gain a perception about how the rapid changes brought on by active efforts to modernize the nation will require that their generation must be technologically literate in ways that their parents were not. Lastly, researchers challenged by these issues are needed in Botswana to provide the models that spawn local research endeavors and add to the knowledge we already have about the attitudes toward technology among boys and girls in Botswana and to the body of knowledge that was initially started by Raat and de Vries.

CHAPTER TWO

A Review of the Literature

Introduction

This chapter provides a review of literature organized into four major themes: Characteristics of Botswana; Education; Attitudinal Research; and PATT.

The Characteristics of Botswana theme encompasses the following five sections: Selected Demographic Characteristics; Government and Balanced Development; The Urban Sector; The Rural Sector; and the Form 5 Level Population.

The second theme, Education, relates to seven sections: Access to Education in Botswana; Actual and Forecasted Issues related to Employment and Manpower; Issues, Strategies, and Recent Changes in Botswana's Educational Structure; The Development of Technology Education in Botswana; Vocational/Technical Education and Training in Botswana; Education and Gender; and Non-Formal Education in Botswana. Note that the body of literature in the area of education is too great to include the spectrum of Botswana's educational system in its entirety. However, an attempt was made to characterize some of the major aspects and programs.

The third theme, Attitudinal Research, regards information on the science of attitudinal measurement. Three sections are part of this theme: Attitudinal Research; Scaling Methods Used to Measure Attitudes; and The PATT Instrument.

Previous PATT Research is the final theme. It encompasses the following three sections: Previous PATT Research; PATT-Kenya; and PATT-USA.

Selected Demographic Characteristics

This section examines selected demographic characteristics including ethnic groups, population size, subgroups within the population, growth rate, etc.

The population of Botswana contains several ethnic groups. The nation's people are collectively known as Batswana (singular = Motswana). Nearly half are from ethnic groups having Tswana origins. A variety of other ethnic groups make up roughly 40 percent of the population; while whites and others form the remaining 10 percent (Barclays, 1987).

The National Development Plan 6 (1985-1991) provided a useful listing of the nation's main population characteristics.

> The main features of Botswana's population are that:
> - it is small relative to the size of the country;
> - it is growing very rapidly as a result of a high fertility rate and declining mortality and emigration;
> - there is consequently a high proportion of children and young people;
> - infant mortality is declining and life expectancy is increasing, although there is still much scope for further improvement;
> - a high proportion (25 percent in 1981) of men aged 20-40 years are working abroad;
> - consistently, women predominate among young adults as heads of households;
> - the pattern of settlement is changing rapidly. (1985, p. 8)

Looking more closely into the total composite, the national demography takes on some notable features. Children under the age of 15 make up 48 percent of the nation. At the time of this report, females headed one third of all households in urban areas and nearly half of those in rural communities. This information suggests that women alone are largely responsible for the care and upbringing of a population of children currently growing at 3.6 percent per annum (Ministry of Finance and Development Planning, 1985). (See Table A-1 in Appendix A).

Regarding the growth rate of the overall population, recent figures showed that Botswana's (1.3 million inhabitants) growth rate will declined from 3.4 percent in 1988 to an average of 2.6 percent through the end of this century (World Bank, 1990). The Central Statistics Office estimated that growth rates in 1991 have declined three tenths of a percent to 3.1 (Ministry of Finance and Development Planning, 1985). Given this trend, Botswana's population can expect to double within the next 20-22 years. These projections do not account for possible fluctuations caused by the impact of the AIDS virus.

Government and Balanced Development

This section describes the challenge faced by the Government to promote balanced development throughout the nation. Settlement patterns are examined, along with the national settlement policy and a complex set of economic conditions which affect this policy.

Under the constitution, Botswana has maintained a non-racial, multi-party democracy. The constitution also guarantees citizens' equal rights which include freedom of speech, freedom of the press and freedom of association (Ministry of Finance and Development Planning, 1985). Since independence in 1966, Botswana is one of a few countries in Africa to have enjoyed a quarter-century of unbroken electoral democracy (Holm, 1988).

In addition to the theme of "Kagisano" (peace) which has long served as the philosophical foundation for development planning, four primary objectives are clearly embedded in Government's policy and development strategy. These objectives are rapid economic growth, social justice, economic independence and sustained development.

Population density varies greatly throughout the country. The heaviest concentration is in the eastern portion of the country where land and water resources are best. Population pressures in these areas are making it increasingly difficult to manage limited land and water resources. The effect on Botswana's traditionally agrarian society has induced rates of urbanization above 8 percent annually (World Bank, 1990).

The national settlement policy was aimed to ensure balanced development between urban and rural areas. The government has been concerned that inordinate growth of the country's capitol, Gaborone could upset the entire balance of development to the detriment of other urban centers and rural villages (Barclays, 1987).

The national settlement policy was reported to provide investment guidelines within a three tier framework: primary centers, secondary centers and tertiary centers. Primary centers provide the infrastructure within the four largest towns and six largest villages to attract modern sector and manufacturing activities. Secondary centers incorporate the two mining communities, together with other large district service centers, and have the infrastructure to support smaller scale services than those in the primary centers. The tertiary centers serve to support cottage-based industries, agricultural activities, and development to service the majority of Botswana's citizenry (Barclays, 1987).

The Government's attempt to promote aggregate national development and a more equitable distribution of income through this plan have been affected by a complex set of economic conditions. These conditions were outlined in an assessment report by the Botswana Education and Human Resources Sector:

- Dual economic bases of mining and agriculture. Mining is the driving force for aggregate economic growth and the accumulation of foreign reserves, and agriculture is the provider of livelihood for an estimated three quarters of the population.

- Interdependence of the traditional and modern sectors. Extended family arrangements allow a majority of Botswana workers to benefit from both family agriculture and wage employment. Sectoral interdependence is also evident in a macro-social context wherein the agriculture sector is dependent on the mining sector specifically, and the modern sector generally, to provide the resources for improvement in access to and use of land, irrigation, training and technology. The modern sector is dependent on the traditional sector to ease the employment burden which would result from mass urban migration.
- Environmental fragility. Periodic drought and the fact that 75 percent of the country's water needs are supplied by subterranean water sources, dramatically affects the 5 percent of land area suitable for cultivation.
- External dependence. There is external dependence upon the ports of other southern African countries for export of minerals and beef, for repatriated payments and reduced employment pressures at home, for demand for its products, for foreign assistance to finance development expenditures, and especially for professional and technical expatriate personnel in both public and private sectors.
- Manpower imbalances. There is a gross surplus of workers relative to jobs while there are simultaneous shortages in trade, technical, scientific, and managerial skills.
- Political stability and conservative fiscal management. A surplus of receipts over expenditures resulted throughout the 1970's and in 1990 there was sufficient foreign reserves to cover 24 months of imports.

(1984) (Economist Intelligence Unit #3, 1991)

Subsequent sections examine issues specific to the each the urban and the rural sector.

The Urban Sector

This section provides information on the growth of Gaborone, the nation's capital; sources of economic growth that have fueled modernization; the range of technology associated with an urban standard of living; and some problems associated with the transformation from rural to urban.

Urban development could be said to have started in Botswana with the construction of its new capital, Gaborone, when the country was one of the poorest in Africa. Then a village, Gaborone was selected as the capitol site for several reasons. Primarily it lay within the most developed region of the country which had access to water and rail connections.

When construction began in 1964, Gaborone was planned to expand to a community of some 20,000 inhabitants. Today, the city has a population of over 130,000 people and it is still growing rapidly (Middleton, 1990). Gaborone is now among Africa's fastest growing centers.

Any analysis of the sectoral composition of urban centers must include an examination of the sources of economic growth. Here, the literature pointed out that the mining sector has been the catalyst for the country's infrastructure development and social achievements (Ministry of Finance and Development Planning, 1984). This has created a rapid expansion in Botswana's export economy. In doing so modernization and technological diffusion have occurred primarily in the urban and mining communities.

The impact of modernization and technological development has given urban centers a character uniquely different than that which is found in most provincial settings. First and foremost, the literature shows that urban centers are non-agricultural enclaves. This is reflected in the high concentration of wage earning activities involved with manufacturing, construction, transportation, communications, trade, commerce, tourism and a host of service and other growing industries (Ministry of Commerce and Industry, 1988).

With this relative economic diversification occurring in urban centers, the range of technological diffusion is interwoven closely with standards of living for urban dwellers. The literature shows how modernization has contributed to the needs of urban households as follows:

- •97 percent of households had piped water in urban areas ;
- •70 percent of households had either pit latrines or flush toilets;
- •15 percent of households had access to electricity for lighting or cooking;
- •49 percent of all households used either wood or charcoal for cooking. (Ministry of Finance and Development Planning, 1985)

The rapid growth of urban settlements has abruptly created changes within agricultural communities (see Tables A-2, through A-4 and Figure A-1, in Appendix A). As modernization takes place, rural settlements beginning to face challenges that are related not only to transformations in the economy but also to changes in customs. Urbanizing settlements often shift from agriculture-based activities toward economic activities where people may find that small-farm technologies do not carry over well into the environment created by modern consumerism. In addition, the introduction of wage earning may cause considerable changes in the patterns of behavior many have lived with. In the face of land and environmental pressures, the uncertainty and often declining real earnings of subsistence farmers and livestock producers will force many Batswana to seek formal sector occupations.

Given the relatively short timeline involved in rural to urban transformation, one can understand the disturbing social realization of those caught in the midst of cultural change in their rural communities over the last two decades. In addition, Rapid urbanization has created some of the constraints described in the previous section, specifically: manpower imbalances (i.e. surplus labor and unmet demand) and the external dependence on expatriate technical and managerial personnel. Educational programming, specifically vocational/technical education and training, has tried to respond to the numbers of Batswana who are unqualified in the most strategic career fields.

What then are the attitudes toward technology among younger generations of Batswana who have grown up being exposed to these social and technological transformations within their urban environment? One cannot be certain from a review of the literature whether the type of technology education taught in schools is particularly useful to these pupils. Perhaps more importantly, the literature does not inform us as to whether young people in these communities are being exposed to technology that empowers them to choose between pursuing a successful career in either the urban or rural environment.

The Rural Sector

In contrast to the previous section, information is provided here on the characteristics of rural households and rural communities including physical, social, and economic characteristics. Factors that affect the livelihoods of rural people, and the importance of rural communities are included. Finally, this section describes the tendency for young people to leave the rural areas.

The National Development Plan 6 (1985-1991) estimated that the average rural household is made up of roughly six persons. This averages slightly two persons higher than urban households. In rural settlements of 1000 people or more, only 20 percent of households have access to piped water. Electricity in rural homes reaches a little over 1 percent of families. Also, more than 90 percent of rural families use either wood or charcoal for cooking (Ministry of Finance and Development Planning, 1985).

Government estimates show that three quarters of Batswana live in rural areas. The greatest percentage of rural dwellers resides in communities of 5000 inhabitants or less. The literature describes a dramatic increase in villages of a size smaller than 500 people over the past twenty years. The National Development Plan 6 reports several reasons for this trend: increased prosperity in the country; availability of transport and improved roads; availability of extension workers in animal husbandry and farming to extend their services to more remote parts of the country, availability of increased financial services to help farmers develop bore holes (wells), etc. (Ministry of Finance and Development Planning, 1985).

A study of economic activity shows that most people in the rural areas are engaged in agricultural activities. Crop and livestock production forms a unique three-site system of farming. This system results in patterns of annual migration from the village where families usually live together during June through November, to the "lands" where women and girls farm crops, and to the "cattle post" where men and boys look after their livestock (Ministry of Finance and Development Planning, 1984). The National Development Plan 7 reports that while still in existence this system of farming is declining (Ministry of Finance and Development Planning, 1991). Due to this change in the traditional farming system along with migration and the developments that have made it possible to settle more remote areas, a challenging demand has been created for government to provide services and education to those scattered throughout the less developed regions.

Factors that affect the livelihoods of people in rural areas are conditions such as rain, soil, land availability, suitable grazing areas, wood for fuel, clean water, medical service, accessible markets and other needs basic to their ways of existence. Use of the natural resources is culturally viewed as an inherited right. For example, entitlement to build homes and plough, to freely collect firewood, building materials, wild food, and medicinal plants, and the right to herd cattle are all guaranteed through citizenship (Middleton, 1990).

There are pressures brought onto the environment by population, drought, deforestation, and overgrazing. For example, the soil conditions of Botswana's savanna makes it more suitable for grazing than crop production. However, overgrazing on communal pastures is now a serious threat. Also, reports show that the pressure on woodlands to provide firewood is increasing deforestation at an alarming rate. Combining these pressures in the more populated areas compounds the effects of environmental degradation making these areas less productive over time (Middleton, 1990).

The literature also described some social characteristics that adversely impact the lives of families within rural populations. Households headed by women (roughly half) are constrained by often not owning draft animals or not having the aid of males to help plough fields in order to plant crops (Ministry of Finance and Development Planning, 1985). This suggests that young children within the household will be affected. In addition, many of the mobile and better educated young adults are opting to migrate out of rural communities in favor of urban occupations. Thus, the literature presented some serious hardships faced by families whose livelihoods depend on food production.

On a national scale, low production of staple food crops such as maize and sorghum requires heavy importation from neighboring countries to off-set the domestic shortage (Ministry of Finance and Development Planning, 1984). The inability of the agricultural sector to respond to market demands and the associated dependency on imports is contributed to by capital constraints that prevent improved methods of production. In short, the types of labor-saving agricultural solutions within industrialized countries cannot be assumed within the rural context of Botswana. In fact, the nature of agriculture in Botswana ensures that individual household incomes are usually not sufficient to invest in new technologies or capital goods that might increase outputs.

Even when research provides technological solutions to local agricultural problems, the benefits tend to favor large farmers and those who can afford the capital outlay (De Janvry, 1987). Consequently, the nature of such innovation is often mixed with labor saving rather than employment generating technologies. This type of agricultural development, if continued, may produce serious consequences for the society. After all, the successes that have allowed rural communities to contribute to Gross Domestic Product earnings (roughly 12 percent), as well as jobs for three quarters of the population, have traditionally been tied to labor intensive modes of production (Ministry of Finance and Development Planning, 1984).

Rural communities have kept traditional values alive while making contributions to a modern economy. In the face of environmental fragility, rural people have proved to be poor, but efficient farmers and skilled herdsmen. There is balance, a sense of belonging, kinship and social harmony found within rural communities. Adapting technologies that lead to an erosion within the social fabric and the important employment generating role of this sector could create uncertain social as well as political instabilities within the nation.

The literature gave evidence that migrating numbers of young people leaving the rural areas are increasing (Ministry of Finance and Development Planning, 1985). This continues even though manpower imbalances contribute to higher annual unemployment figures in urban areas. This seemingly counter-intuitive condition has inspired a great deal of research into this phenomenon. Harris and Todaro (1969) explained in their studies that in dual societies, finding a job in the rural sector is ensured. The decision to find work in urban centers is largely based on two factors: the expectation of higher wages, and, the probability of finding a job once a person gets there. However, the literature does not specifically include attitudes toward technology which may influence the decision to migrate towards modernized enclaves.

It would seem that there is a vital interest at stake in assessing the attitudes toward technology from the distinct perspectives of this young, rural population. Also, the literature does not reveal whether the concept of technology is similar among rural and urban dwellers. The researcher hopes that the contributions of PATT-Botswana might provide information useful to educators and rural planners in their rural developments efforts.

The Form 5 Level Population

Form 5, the final year of senior secondary school, culminates in the Cambridge Overseas School or 'O' level examination. Passing this examination, pupils receive the Cambridge Overseas School Certificate. Senior secondary school provides both higher academic education and further specialization in general subjects. By completing Form 5, pupils are considered among the top ranks of pupils qualified for public and private employment and higher education. In terms of national objectives, a growing number of better educated young adults are being prepared to meet the nation's manpower requirements.

According to the 1993 report from the National Commission on Education, the 1991 Form 5 population included approximately 6041 students. There is a steady increase of pupils accessing senior secondary education. It was proposed that by 1992, a minimum of 12 percent of those leaving junior secondary school will have access to senior secondary education. This is an eight percent increase over the numbers accepted in 1983 (Ministry of Finance and Development Planning, 1984). This steady increase is expected to continue well into the 1990's (Ministry of Finance and Development Planning, 1991).

The relatively higher education Form 5 pupils receive provides them with a significant advantage over the majority of school leavers looking for work in the formal sector. Assuming that most of those pupils leaving Form 5 will seek wage employment, important information is likely to be gained from inquiries about students' attitudes in regard to employment decisions. Results that contribute toward a better understanding of the attitudes about career decisions and the role that technology plays in helping to shape pupils' choices, may also lead to a greater understanding about the complex issues associated with urban migration. If attitudes toward technology can be strengthened to challenge better educated young adults to become successful by utilizing innovative technology in the traditional sector, their example may help improve conditions in rural communities and contribute significantly to our understanding of migration in many developing countries.

Access to Education in Botswana

This section provides a background on Botswana's efforts to increase access to education, focusing primarily on the primary-junior secondary-senior secondary school setup, and touching upon the issue of "missing children." Illiteracy problems described in this section lead to limited coverage of non-formal education programs. The bulk of information about non-formal education programs is included in a another section "Non-formal Education in Botswana."

The literature identified the 1970's as an era of educational reform across much of Africa. Nations sought qualitative improvements in formal curricula. Science and mathematics programs occupied central positions in curriculum reforms. Particularly, vocational training and models of pre-vocational technology education were expanded throughout the polytechnic secondary schools, technical teacher training colleges, and post-secondary institutes of technology (Dyasi and Tlou, 1987).

The early problems with education in Botswana were centered on access and equity. For decades following independence, most of the nation's children missed opportunities to complete even primary school. The problem of equity in education was officially addressed in 1977 when the first National Commission on Education was directed to study such conditions in the country and presented a plan based on its findings. Information from this study is presented in greater detail in subsequent sections. Government has since responded steadfastly through numerous projects undertaken during the strategic planning periods of NDP 5 (1979-85), NDP 6 (1985-91), and currently NDP 7 (1991-97).

Universal Primary Education (UPE) was declared a goal of the NDP 5 (1979-1985). UPE was a step towards the eventual plan of providing nine years of basic formal education for all Batswana. The strategies outlined in NDP 6 (1985-1991) to achieve UPE targets, and outlined in NDP 7 (1991-1997) to make progress toward universal access to a nine year basic education (the inclusion of secondary school), include plans for the construction of several hundred new school facilities and a massive effort to supply a cadre of qualified new teachers. The Boipelego Education Project Unit implemented the Community Junior Secondary School (CJSS) Construction Program. Between 1985 and 1991 the program was responsible for constructing 131 new schools and expanding an additional 24.

Government's aim to achieve an 80 percent enrollment target by the year 2000 has been met for primary education. Progress toward nine years of basic formal education for all pupils is evident in the continuation rates from primary to junior secondary school (See Tables B-1, B-2, and B-3, and Figures B-1, B-2, and B-3 in Appendix B). The targeted 1991 intake of 70 percent was met by an actual intake of 65 percent. Despite the shortfall this was an increase of 27 percent from 1985. The total number of pupils enrolled between 1989 and 1990 in all grade levels (primary + junior secondary + senior secondary) was 326,000. Government exceeded its targeted 1989 primary student enrollment of 260,910 by roughly 7000 pupils. Enrollment totals within Junior Secondary Education for 1990 exceeded the targeted figure by 1,187 for a total enrollment of 40,747 pupils. The total enrollment of pupils in Senior Secondary Education for 1990 stood at 17,048. (Ministry of Finance and Development Planning, 1991).

In 1988, a 7 primary + 2 junior secondary + 3 senior secondary structure was introduced as a transitional step to a 6+3+3 structure. However, a report from the National Commission on Education later called for the re-introduction of the 7+3+2 structure in 1995 (Ministry of Education, 1993). With the restructuring in 1988, a Junior Certification (JC) Examination was introduced at the end of the second year (Form 2) of junior secondary school. The JC Examination scores are used as the basis for promotion into senior secondary school. Completion of Senior Secondary Education is marked by the Cambridge Overseas Certificate Examination which leads to the Cambridge Overseas School Certificate. (Ministry of Finance and Development Planning, 1984).

Despite the noted improvements in student enrollment figures, inconsistencies appeared between the estimated school aged population and education enrollment statistics. A 1989 follow-up confirmed that enrollment figures showed 17 percent of the 7-13 age group were not enrolled in school (National Commission on Education, 1993). A study identified this group as the "missing children". It was found that the missing children were exceptionally disadvantaged either geographically, or through gender, ethnic origin, or disability, or a combination of these conditions. The existing hardships of the children were compounded by not attending school. Particularly, not only were youngsters missing an education, but many who would have benefited from the government lunch program were unable to attend. Cases of abuse had also surfaced at schools and hostels where children of the minority Basarwa group and other people living in the Kalahari desert had tried to attend school but eventually volunteered to leave. Reports such as these presented grounds for Government to improve conditions.

Government reacted with measures to help overcome the disparity. The measures included building more schools for the disabled and in remote settlements, sensitizing teachers to cultural differences and improving supervision for boarding pupils, financial assistance programs, and the use of unqualified teachers where qualified teachers were not available. Government stopped short of enacting compulsory education legislation preferring instead to encourage parents to send their children to schools. (National Commission on Education, 1993)

Despite the recent improvements in access to education described above, illiteracy remains a problem in Botswana's rural and remote areas. It is also a problem for many urban and peri-urban adults who had little opportunity to attend or complete school because they chose to work (in the mines, tending livestock, etc.) or look after families. Illiteracy nationwide has been reported at 31 percent for adult women and 29 percent for men (World Bank, 1990).

The Adult Basic Education Program and National Literacy Program are aimed directly toward the segment of adults who need remedial and basic educational services. Various other non-formal Government programs aimed toward providing adults with other skills are detailed in the "Non-formal Education in Botswana" section.

Actual and Forecasted Issues Related to Employment and Manpower

This section introduces problems in Botswana related to employment and manpower, and provides a list of forecasted trends related to this subject. Because educational goals are linked in part to to employment, the information presented here is also emphasized and further detailed in other sections.

The need to employ non-citizens in key areas has continued to challenge leaders in Government, education and training. Skilled technical and managerial positions have been reported to account for approximately five percent of the demand for formal sector personnel. These jobs are concentrated in occupations with the highest skill requirements (Ministry of Finance and Development Planning, 1984). The absolute number of employed non-citizens rose from 4000 in 1978 to 4800 in 1981 (Ministry of Finance and Development Planning, 1985). After experiencing a short decline, the number of jobs held by expatriates rose steadily. A later report announced that the total figure in 1992 topped 11,000. The bulk of foreign workers (9,194) occupied jobs in the parastatal and private sectors, and Government was responsible for hiring 2,187 non-citizens (Department of Technical and Vocational Education, 1992).

Literature suggested that Botswana's ability to meet its needs for skilled labor in key areas will not come from local manpower supplies. The Botswana Education and Human Resources Sector Assessment forecasted that occupations in technical fields would continue to force both public and private sectors to depend on expatriate labor through the 1990's (1984).

A report by the National Commission on Education contained forecasted trends related to employment and manpower in Botswana including the following:

- A general decline in significance of the traditional agriculture sector is expected.
- The near future shall show growth in both the industrial and commercial sectors.
- Increases in formal sector employment will emerge (ie. service, financial, and tourism).
- The future economy will be characterized by a more skill-intensive stage of industrialization.
- Competition from other nations will force Botswana's workers to find ways of reaching higher levels of scientific and technical skills. (1993)

Issues, Strategies, and Recent Changes in Botswana's Education Structure

A broad array of issues, strategies, and changes that have affected the educational structure in Botswana are included throughout this section. Highlights from the significant 1993 report from the National Commission on Education are included. Issues of historical significance are discussed relative to the impact each may have had in generating policy guidelines for future performance. Information on Government's responsiveness to problems and the processes of finding prospects for the future is included. Note that, although touched upon in this section, technology education as well as technical/vocational education and training are both subjects of subsequent sections.

In 1992, the National Commission on Education embarked on education development efforts which would contribute significantly to changes in Botswana's national education policies. These efforts were directed toward the development of Botswana's education and training system over the next twenty five year period. A report was generated which upholds the original guiding principles for education first published in *Education for Kagisano* in 1977. The current report, *Report of the National Commission on Education: 1993,* reflects the fundamental assumption that Botswana's major resource is its people; therefore investment in their education and training is a necessary condition of national development.

Proposed strategies and plans included in the report take into account social conditions forecasted for the 21st century; emphasize the social value of an educational system that is responsive to the evolving needs of the economy; and recognize the potential benefits of stronger cooperation within the tripartite structure linking education, business, and labor.

The report emphasizes the future "vocationalization" of the curriculum and proposes policies defining the role of the school as a pre-vocational experience. Hence, the school experience was seen to provide both sound basic education for the future and a bridge to the world of work in the 21st century.

The following excerpts from the report written by the National Commission on Education help summarize its position.

> ...the rationale for educational development is not to be found solely in its contribution to the economy. Access to basic education is a fundamental human right. Education must respond not only to the changes in the economy but also to those in society...The humanistic aims of education continue to be the promotion of the all-round development of the individual, in order to foster intellectual growth and creativity and enable everyone to reach their full potential. The Commission believes that education must develop moral and social values, cultural identity and self-esteem, citizenship and democracy. Its proposals for the future development of education have therefore been based on a vision of society in the 21st century. (1993, p.19).
>
> The Commission's view is that a common general education and pre-employment training approach will provide the best preparation for young people whether they enter the formal or informal sector initially. (1993, p.22)
>
> Consequently, the Commission has adopted the concept of 'pre-vocational preparation' to summarize the role of the school in relation to the economy. (1993, p.23)
>
> The issue (of the relationship between education, training and work) is contained in the following Terms of Reference:
> 2. To...recommend a system that will guarantee universal access to basic education, whilst consolidating vocationalizing the curriculum content at this level.
> 3. To advise on an education system that is sensitive and responsive to the ...manpower requirements of the country.
> 4. To study various possible methods of student streaming into vocational and academic groups at senior secondary level. (1993, p. 20)

> ...Three central elements of the Commission's strategy namely:
> a) The adoption of a pre-vocational orientation in the school system and the emphasis on sound general education as the essential basis for training and work.
> b) The strengthening of post-school vocational and technical training.
> c) The emphasis on Science, Mathematics and Technology education. (1993, p. 22)

By in large Government has responded positively to the Commission's report. A number of recommendations that emerged as a result of the Commission's study have been acted upon. This has led to an overall revised national policy regarding education. In 1994 the government announced its plans in *The Revised National Policy on Education* which spelled out the rationale, strategy, and changes that would affect the structure of education and lead the way forward into the new millennium. The initiatives were backed up by funding expected to reach 22 percent of the nation's total annual budget. (The Botswana National Assembly, 1994)

The revised policy prescribed large scale changes that affected not only curriculum but also teacher training and development, facilities planning and improvement, and the system's core structure. The Commission was in favor of initiating a science and technology policy. Its recommendation specified that school children should receive a "sound Science and Technology base" (The National Commission on Education, 1993, p. 25). The Commission also considered making the junior secondary (optional) course called Design and Technology (D&T) a core subject. This initiative called for planning to begin for future classrooms and equipment as well as immediate teacher training preparation in anticipation of the increased enrollment pressure placed on Design and Technology facilities and its teachers.

Government was then already faced with an overwhelming expansion of its junior secondary schools because of an approved recommendation to change the 7+2+3+4 (primary + junior secondary + senior secondary + university) structure to a 7+3+2+4 structure. Addition of an extra year to the junior secondary system required an all out expansion to those school facilities. (The National Commission for Education, 1993).

Government upheld the Commission's view that present investments in education would lead to effective savings in the future. To help offset anticipated spending increases, several plans emerged. The general thrust of the overall strategy to finance changes in education came in two-parts. The first involved a plan to increase overall cost-effectiveness. The second part planned to create a cost-sharing structure that was targeted to include the private sector.

Measures to improve cost effectiveness were directed at internal and external efficiency. Here, several initiatives were planned in the hopes of reducing the level of unit costs in education. First, school facilities were expected to serve a more multipurpose role in the community. Plans for night, weekend and school vacation periods were explored to help meet the needs of many adults and others who were reported as having educational deficiencies (the 1991 census reported that 31 percent of the population above the age of fifteen had no schooling while roughly another 30 percent had only partial primary education), and to help achieve greater internal efficiency. To try and bring about greater external efficiency in education, the concept of pre-vocational preparation was stressed in an attempt to better link schools with the world of work and the demands from labor. Lastly, the Commission hoped to further reduce unit costs by continuing efforts to reduce the need for expatriate teachers (The National Commission for Education, 1993).

The Commission's approach to increased cost-sharing from the private sector was to ask for contributions from the beneficiaries of education. Where appropriate, the Commission and Government sought to build strategies of cost-recovery into programs that benefited employers, communities and individuals. In general, the focus of these strategies was leveled at boarding students, vocational training, and tertiary programs. Although introduction of school fees was not planned for basic education (primary + junior secondary), explorations were made to assess the feasibility of introducing school fees in other areas (The National Commission for Education, 1993).

In 1991, it was expected that about one third of all pupils entering the (nine year) basic education structure would be promoted to senior secondary school. Under the Commission's revised plan, one year was added to the basic education structure. This plan provided for an additional 20 percent of pupils to be promoted into senior secondary schools. The concern for those in the percentage not promoted or accepted into senior secondary school is a growing issue. The data in Tables B-4 and B-5 (See Appendix B) illustrated the scope and the magnitude of the problem facing Government.

Government's accelerated expansion of secondary education through programs during the 1980's helped to meet some manpower shortages. However, the programs have not reduced the persistent problem of unskilled manpower surpluses. The manpower problem may have been compounded by the rise in numbers of children newly gaining access to schools. This in turn produced a much larger turn out in the numbers of school leavers than previous generations had known. The fortunate generation of young people, who after great effort and expense to the Government, completed nine years of basic education, and were seen as educated candidates for employment. Unfortunately for the accelerated numbers of graduates, jobs did not keep pace.

This condition was clearly revealed in the 1993 report from the Commission on Education. It was hoped that Government would invest in an expanded vocational training infrastructure to continually upgrade the quality of the formal workforce. Also, by creating incentives for increased participation from the private sector, it was hoped that companies would benefit along with employees through on-the-job training schemes and apprenticeship programs. The Commission hoped its plan would come to the aid of the formal sector by reducing unemployment, improving the quality of the workforce, providing more out-of-school opportunities to larger numbers of school leavers, and easing public dissatisfaction over the annually increasing number of basic education completers who cannot find needed work.

Literature showed that the structure of the education and training system for 1995 and beyond included plans to reconstruct and expand both the general education system and the out-of-school vocational programs. (See Figure B-6 in Appendix B) The figure shows that the minimum age to begin employment starts at sixteen years. Completion of junior secondary school also signifies completion of a child's guaranteed free education. Progression into senior secondary education, vocational training and other options is highly competitive and often requires fees.

The next two sections focus respectively on technology education and vocational/technical education and training.

The Development of Technology Education in Botswana

Recent developments in technological education in Botswana as well as the factors which significantly influenced these developments are examined in this section.

Technology education in the school system had traditionally encompassed such optional courses as Woodwork, Metalwork, and Technical Drawing for boys; while girls typically opted for Home Economics. These courses were uniquely part of the junior and senior secondary school curricula and not offered during primary school. In the late 1980's, a transitional course known as Technical Studies came to form an integrated replacement for the three previous technology courses, and in 1989 the program name Design and Technology replaced the Technical Studies title.

These changes were brought about by several factors. First, The costs associated with equipping and staffing each of the newly constructed junior secondary schools were high. This was particularly true in terms of unit costs for optional practical subjects. Secondly, there was internal pressure to ..."downplay the vocational nature of the curriculum and align the programme more closely with the changing trend to Technology Education that was occurring internationally" (Robb, et. al., 1989, p.135). Finally, Design and Technology was tailored to meet the reform-minded *Aims of the Nine Year Curriculum* that developed from instructional improvement projects throughout the mid-eighty's.

Development of Botswana's nine year, basic education curriculum was part of a larger international project called Efficiency of Educational Systems (IEES) Project. In Botswana, the United States Agency for International Development (USAID) joined Government to implement two instructional improvement projects, the Junior Secondary Education Improvement Project (JSEIP) and the Primary Education Improvement Project (PEIP). These projects resulted in the *Aims of the Nine Year Curriculum* paper and the *Aims: Design and Technology Application/Relevance* paper by Walton (1989). Both are presented in Appendix C.

The Design and Technology course (optional through 1994) was designed to keep pace with the changing technological environment and thus teach all pupils about relevant technologies that are useful at home, in the community, and at work. The subject developed around the problem-solving approach and reflected a culturally appropriate use of materials through the application of skills and abilities to develop an understanding and appreciation of technology as it relates to student's present and future lives. (Walton, 1989).

The rationale for introducing a course that was not intensely material-based, but rather, one that offered a broad-based approach to technology, ("technology" as a force of social and economic development) presented a significant shift within the paradigm for teaching technical subjects at school. Proponents of the new program placed emphasis on the need to stimulate interests in career choices that involved the use of technology; but felt that providing pupils with job skills was not the school's mission. There was also sentiment that girls, who traditionally remained apart from subjects like Woodwork, Metalwork, Technical Drawing and even Technical Studies, should now be encouraged to participate more actively in technology classes (Robb, et. al., 1989).

The 1993 Commission on Education report highlighted the value of school programs aimed to expand knowledge and awareness in areas such as computers, science, and technology. Goals that were expected to accompany other outcomes of the Commission's proposed three year junior secondary curriculum are listed below:

- computer literacy;
- an understanding of scientific concepts;
- critical thinking and problem-solving ability;
- appreciation of technology and the acquisition of basic skills in handling tools and materials;
- and readiness for the world of work.

A period of pilot testing for Design and Technology began in the 1989-1990 academic year and ended in 1992. In 1993, the Ministry of Education had decided to implement the program throughout the entire junior secondary system. Plans were also being made to begin developing senior secondary level Design and Technology programs to provide continuity for cohorts who would progress beyond the junior secondary curriculum.

The Commission's assessment on seeing Design and Technology positioned within the scope of a pre-vocational curriculum was favorable. In their report, the Commission identified Design and Technology as a subject that should be considered part of every child's basic education. In 1994, the Government approved the Commission's recommendation to included Design and Technology among the eight core subjects specified in the future three year junior secondary curriculum.

Vocational/Technical Education and Training in Botswana

An overview of vocational/technical education and training in Botswana needs to begin with an important distinction between vocational education and technical education. "Vocational education is considered as training which is oriented toward craft skill development whereas technical education consists of academic and occupational training aimed at higher order skills, usually involving integration of several technical skills." (Ministry of Finance and development Planning, 1984, p. 8-1). Formal training programs are divided into two subcategories:

1. those in institutions with the sole purpose of providing training, and
2. those that are part of the various ministries or parastatals (Ministry of Finance and development Planning, 1984 p. 8-5).

The Government's commitment to technical education has been well spelled out within the strategy for national development. National Development Plans 5, 6, and 7 (1979-1997), specifically identified technical education among the nation's top educational priorities:

NDP 5

- Improve the quality of and access to primary education;
- Develop technical education to meet the country's needs;
- And increase the numbers of Form 5 secondary school leavers who are well qualified in mathematics and science. (Ministry of Finance and Development Planning, 1979).

NDP 6

- Achievement of universal access to primary education during the plan period;
- Increase access to post-primary education, in particular secondary and vocational/technical;
- Growth of university enrollments related to the nation's manpower needs;
- And expansion of non-formal education activities to complement formal education.

(Ministry of Finance and Development Planning, 1985)

NDP 7

- Promote industrial and rural development;
- Develop new local training programs;
- Use students' vocational aptitudes to develop their intellectual abilities;
- Increase the participation of women;
- Continue with instructor training for localization.

(Ministry of Finance and Development Planning, 1991)

Across the nation, public and private agencies are active in vocational and technical education. Collectively they offer training opportunities to more than 10,000 trainees annually at roughly 70 different centers. Within the public sector, Government provides the greatest share of training through institutions such as the University of Botswana, Botswana Polytechnic, the Botswana Institute of Administration and Commerce, the National Health Institute, the Roads Training School, the Police College, Prisons, and the Brigades. Various government departments have facilities to satisfy their own needs and of these, Co-operative Development, the Unified Local Government Services, and the Central Transport Organization are foremost (Ministry of Finance and Development Planning, 1985).

Technical education within Botswana's public schools has historically provided a pre-vocational bridge for pupils to access further vocational/technical training in one or more of the country's adult education facilities. Tables D-1 and D-2 in Appendix D list the entry requirements for several formal vocational and technical training institutes.

Enrollments, in most cases, showed that vocational training is favored over technology education. The 1984 National Education and Human Resources Sector Assessment described a nearly four to one preference among pupils to develop craft skills over general technology skills. As an explanation, the report cited that "Botswana's workplace requires this heavy emphasis on vocational training, and may depend on it as a foundation for more advanced technical training." This, however, adds to the constraint of satisfying the demand for high-level technical personnel (Ministry of Finance and Development Planning, 1984, p. 8-58).

Further constraints have effectively reduced the numbers of potential pupils from entering technology education and pre-vocational technical subjects. Programs in junior and senior secondary schools that have traditionally concentrated on subject-centered disciplines like Woodwork, Metalwork, Technical Drawing, Plastics, etc., are forced to compete with other elective courses like Art, Home Economics, Moral and Religious Education, and college prep Math and Science courses for enrollment.

In addition, the status of technology-related subjects in schools has been such that girls have often been encouraged (by limited opportunities for females in certain technical programs and careers) to avoid taking these courses (Ministry of Finance and Development Planning, 1984). Combined, these conditions have historically restricted the potential for obtaining larger numbers of high-level technicians needed to meet the economy's changing demands.

With this in mind, the literature revealed that government has established a formal education strategy to eliminate some of these constraints. Many of these initiatives called for closer institutional links. Others have been more directly involved with identifying student needs. These initiatives include: career counseling for secondary and post-secondary pupils, improving the quality of local instructor training, incorporating more job-related training in vocational/technical program curricula, making greater efforts to enroll females, and expanding access to vocational/technical education programs through revised entrance requirements (Ministry of Finance and Development Planning, 1984).

One specific recommendation made by Ministry of Trade and Commerce called for the establishment of a labor market information service as an integral part of the national manpower survey. In the proposal, the labor market service would provide an official channel through which business and industry's interest would be represented (Ministry of Finance and Development Planning, 1984).

In recent times Government has placed growing emphasis on creating Vocational Training Centers (VTCs) for artisan training, and Vocational Teacher Training Centers (VTTCs) for staffing of primary and secondary schools. The diagram titled "The Structure of the Education System" (Figure D-1 in Appendix D) represents a particularly useful visual road map of vocational training destinations.

Government has also created legislation that promotes private and parastatal training programs (Apprenticeship and Industrial Training Programme, Rural Industries Innovation Center, etc.) and has established a coordinated network of monitoring and planning boards. Some of these boards are:

- Committee for National Manpower Development Planning (Ministry of Finance and Development Planning);
- Technical Education Department (Ministry of Education);
- National Advisory Board for Apprenticeship and Industrial Training (Ministry of Home Affairs, Labour Department);
- Industrial Training and Trades Testing Center (Ministry of Home Affairs, Labour Department);
- Employment Services Unit (Ministry of Home Affairs, Labour Department);
- National Industrial Training and Technical Education Council (NITTEC);
- Transportation Committee of Government, Employers, and Employees;

- Botswana Confederation of Commerce, Industry and Manpower (BOCCIM);
- National Brigades Coordinating Committee (NBCC); and,
- National Advisory Board for Vocational Education and Training (NABVET).

During the early 1990's, several studies were conducted that had resounding implications for policy matters where technical and vocational education was concerned. The Ministry of Education received two reports concerning the vocational education and training system. These were the *Mansell Report* in 1991, which stated what actions were required to optimize the system's effectiveness and the *Greinert/Biermann Report* in 1992, which attempted to investigate how implementation might occur. The combined effect of these two reports inspired the Department of Technical and Vocational Education to draft a white paper which set new guidelines for the future of manpower development. The Ministry of Finance and Development Planning (MFDP) released its *Revised National Policy on Incomes, Employment, Prices and Profits* which emphasized the complex relationship between employment, education, and the standard of living. It also outlined the goals of a revised strategy which included the following:

- Government will assume responsibility for identifying training domains for human resource development and for general training as a whole.
- Reliance on expatiate manpower will be reduced by encouraging employers and citizens to become actively involved in more on-the-job training and apprenticeship programs.
- Parents and youths should become better informed about opportunities and needs of the economy so as to match their aspirations will jobs and professions (Department of Technical and Vocational Education, 1992).

The Mansell report dealt with the whole of the education system but highlighted concern in the context of Vocational Education and Training and the goals stated in the *Revised National Policy on Incomes, Employment, Prices and Profits* . Mansell's report offered the following strategic goals:

- Improve general education and introduce pre-vocational education within the general education curriculum.
- Develop staff.
- Improve the structure and organization of Vocational Education and Training especially through the foundation of a national agency for Vocational Education and Training.
- Design a structure of vocational awards

(Department of Technical and Vocational Education, 1992, p.169).

Part of the Mansell Report contained an assessment of training standards. The report considered distinctions in levels of trained personnel ranging from semi-skilled and skilled tradesmen to the technician class and engineers. Mansell's proposal effectively replaced the existing set of standards with a new five-level National Vocational Awards scheme. The proposed scheme was supported by the Department of Technical Education in 1992. The Table 1.0 is an example of the proposed structure.

Table 1.0

A Possible Structure of National Vocational Awards		
Vocational Qualification	**Level of Competence**	**Academic Qualification**
Diploma-and degree-level/Ph.D.	Competence in executive leadership and highest professional performance; substantial personal autonomy, responsibility and accountability for planning, execution and evaluation. **LEVEL 5**	**Diploma-and degree-level/Ph.D.**
Technician National Diploma, Master Craftsman	Competence in a broad range of complex technical or professional work activities performed in a variety of contexts with full accountability. **LEVEL 4**	**'A' level**
National Craft Certificate NCC	Competence to perform difficult and non-routine occupations on a level requiring full apprenticeship or equivalent training **LEVEL 3**	**COSC**
VTC and Brigade two-year full-time courses and Trade Test B	Competence to perform various activities, some of which are complex or non-routine, under normal and difficult conditions. **LEVEL 2**	**GCE**
Trade Test C Proposed Basic Vocational Year	Competence to perform a range of various work activities, most of which may be routine and predictable. **LEVEL 1**	**Junior Certificate**

Source: The Ministry of Education, 1992

The Ministry of Education partially supported the National Vocational Awards scheme. It complied with certification levels 1-3 roughly equated with established standards guidelines. It also responded by implementing a number of new changes and showed support for wide reaching policy shifts. Overseeing the routes to certification through the institutional structure was the charge of a newly created organization called the Botswana Training Authority. It would monitor and coordinate efforts to align skills training programs and see that private programs would design courses that would meet accreditation prerequisites.

The National Commission on Education approach to certification included a basic vocational training supplemented with competency-based modular skills training programs. The C level certification was achievable upon completion of a general, broad-based vocational training (basic) program. Those primarily eligible to receive this award fall into two groups: those who have not completed their Junior Certificate level (JC) education but have gone through fundamental training in one of the Brigades or apprenticeship through employment; and those who had passed their JC exam and also completed one year at one of the nation's vocational training centers. The general objectives for the Brigades was to provide practical training to many who have not had the opportunity to complete basic education. The focus of these training programs has historically emphasized rural vocational skills that were meant to benefit those in the informal sector (Ministry of Finance and Development Planning, 1991). Certification in levels 2 and 3 combine full-time institutional training and industrial attachment (diploma programs) or apprenticeship.

The Ministry of Education also responded to the series of 1990 reports by taking an active role in supporting new legislation. One legislative plan expanded funds during the next planing period (NDP 8, 1997-2003) for a second Polytechnic (NDP 7, 1991) and several new Vocational Training Centers (VTCs) and Vocational Teacher Training Centers (VTTCs). Other plans included sponsoring legislation to enact a National Training Act that would provide for all aspects of the skills training system (Ministry of Education, 1994). Administration of the entire vocational education and training system was to be the responsibility of the National Advisory Board for Vocational Education and Training (NABVET). The Figure D-2 entitled *A System of Vocational Education and Training for Botswana* in Appendix D represents a particularly useful diagram of vocational training and academic options.

One proposal that was highlighted during the 1992 Conference on Vocational Education and Training in Botswana was the suggestion of inserting a year of basic vocational training targeted toward the junior community school leaver. The "Basic Vocation Year" (BVY) was designed to further strengthen the bridge between a pre-vocational education and employment. The BVY plan included early streaming at Junior Secondary levels by career and guidance counseling staff, expanded access to VTCs, a BVY curriculum that was shaped by the basic skills demanded by employers in the formal sector, opportunities for senior students to enter at later stages, and opportunities for the brightest in the Brigades to enter into VTC programs (Department of Technical and Vocational Education, 1992).

Opponents to the Ministry of Education's BVY (like the National Commission on Education) won out. Their argument centered on three points: (1) The rationale for major expansion in vocational training was seated in social responsibility more than in the labor market demand. Therefore rather than increasing prospects of employment, the BVY would merely post pone the school leaver problem by one year; (2) The scale and pace of expansion for the program was unrealistic. Facilities, staffing and curricula were not achievable within any immediate time frame; (3) The nature of the curriculum was obscure. Many questioned a program that could meet the pre-determined goals in one year. Although any immediate plans for BVY were put aside, the Commission and the Ministry of

Education shared views for the merits of long range development toward the BVY structure and its aims (National Commission on Education, 1993).

Other significant reactions by Government to recent reports and issues in vocational training have led to proposals that call for the restructuring of the VET structure itself. Figure D-3 in Appendix D shows how one Department of Vocational Education committee envisions the future structure of its department. Another suggestion hoped to create a position for an Assistant Minister for Technical Education to be responsible for strengthening and developing the department.

One last initiative that will be mentioned here is that of the creation of the National Advisory Board for Vocational Education and Training (NABVET) under the Chairmanship of the Assistant Minister of Education. The creation of this board was in reaction to the fragmented condition of the system as described in the Mansell report (Ministry of Education, 1992). The board was to serve as a unifying administrative regulatory body with the job of improving the structure and organization of Vocational Education and Training. Three existing panels joined to form the NABVET. These were the National Advisory Board for Apprenticeship and Industrial Training (NABAIT), the National Industrial Training and Education Council (NITTEC), and the National Brigades Coordinating Committee.

One way to further increase pupils' interests toward vocational/technical education may be derived from studies investigating their attitudes and concepts toward technology-related career fields. Examining the responses of pupils within the formal education system may provide a valuable contribution to the labor market and those charged with responsibilities to strengthen the capacity of the present manpower supply.

Education and Gender

This section is limited primarily to a review of literature on women/girls in vocational and technology programs. Vocational training and technology education programs are traditionally labeled as "male domain" subjects. The exceptions are in areas such as nursing, secretarial and office programs, and teaching vocations. Historically, the roles of women in Botswana have not been seen to play a major part of technology and vocational programs. This has been so much the case that the need to address it has been brought out fairly strongly in recent years.

Class composition and enrollment statistics gathered during the period of NDP 6 (1985-1991) helped to provide the base for continued investigation into gender issues in education. The goal of achieving universal access to primary education led to monitoring enrollment, census, and other data used to uncover the "missing children." A later follow-up study contained in "The Girl Child in Botswana: Educational Constraints and Prospects," revealed that "disparities between girls and boys in access, performance, and quality, continued to exist from the colonial to the current period" (National Commission on Education, 1993, p. 35).

A summary of this study showed that in Mathematics, Science, and Design and Technology subjects, boys performed better than girls. Table 2.0 shows the 1990 pass rates for pupils across the three subjects. The report also claimed that educational institutions upheld cultural stereotype of females which actually contributed to lower expectations for girls. Enrollment figures in Woodwork and Food and Nutrition classes were compared to illustrate the point that girls make up the largest percentage of school drop outs. In 1990, 77 percent of secondary school dropouts were girls (National Commission on Education, 1993, p. 35).

Table 2.0
Selected Junior Certificate Pass Rate Results, 1990:

Gender	Mathematics	Integrated Science	Design and Technology
Boys	75%	81%	80%
Girls	68%	66%	57%

Table 2.0 continued
1990, COSC Exam Participants

Gender	Woodwork	Food and Nutrition
Boys	580 (96%)	11 (1.5%)
Girls	24 (4%)	690 (98.5%)

Source: Ramahobo, L. *"The Girl child in Botswana: Educational Constrains and Prospects"*. Gaborone, Botswana: UNICEF, 1992. p. 34.

The disadvantages for girls in school appear to be numerous. Low expectations coupled with under performance and the chance for becoming pregnant lead to lower participation in many areas of post-school education and training. Table E-1 and Figure E-1 in Appendix E provide information that reveals drop out rates and enrollment of females at various levels.

This condition motivated the Ministry of Education to launch a modest campaign designed to encourage greater female participation in wider fields of education and employment opportunities. One public awareness measure created school posters that portrayed women in science and technology jobs. This campaign may illustrate an awareness of the disadvantages experienced by girls in school. However the lack of strong policy recommendations in the National Development Plan 7 related to issues such as access to school and educational opportunities for females may indicate that these issues were not of highest priority.

There is a limited focus on gender-specific issues in the 1993 report from the National Commission on Education that could lead to new educational opportunities for female students. The Commission's strategy for a 'Science and Technology Policy' specifically targeted females. The Commission recommended that the Science and Technology Policy should develop guidelines "to promote greater participation by females in Science, Mathematics and Technology at every level" (National Commission on Education, 1993, p. 27).

In schools, the Commission recommended changes in the composition of classes traditionally 'felt' to be male only. Design and Technology is the best example of Government's commitment toward equity and access for all pupils to gain an education about technology.

Non-Formal Education in Botswana

This section includes information on non-formal education in Botswana, including: a general description of the types of technical education programs offered; the rationale for these programs; and limitations and constraints to the nation as a whole with respect to technical education in non-formal program areas.

Non-formal education in Botswana was described within the literature as "any learning activity outside the structure of the formal education system that is consciously aimed at meeting specific learning needs of particular subgroups in the community, be they children, youths or adults" (Ministry of Finance and Development Planning, 1985).

Non-formal educational activities grew out of the need to provide basic social services to the traditional population segment. Vocational/technical programs are not specific to the role of non-formal education, although the types of programs offered to citizens may include such training. Extension services originally focused on agricultural activities, but were eventually expanded throughout almost all ministerial branches of the government producing extension programs in health, education, rural and community development, small business, etc. This has created a multi-level system of non-formal educational management and administration within Government. Nearly each ministerial branch maintains a national extension system intended to promote coordination and cooperation among the various entities (Ministry of Finance and Development Planning, 1984). Improved communication and cooperation between district offices and ministry headquarters is the goal of plans to decentralize non-formal education during the planning period of NDP 7

As an integral part of the education system, non-formal education has become a complement to formal education with two major purposes:

1. to initiate and implement innovative programs that promote individual and community development; and
2. to provide second chance education of a more structured nature (Ministry of Finance and Development Planning, 1984).

Among the Ministry of Education programs continued during NDP 6, the Distance Learning Programme expanded its target group to provide wider access for Batswana who did not complete Basic Education. The National Literacy Programme continues to address the literacy needs of Batswana and introduce English as a Second Language (ESL). In addition, training and supervision programmes continue to produce non-formal education officers.

Under the Ministry of Education, is a national service program called Tirelo Setshaba for Form 5 graduates. During their national service, these young adults volunteer their time under the supervision of community leaders to provide additional assistance in the public service areas. Many assist schools in the education of primary children. In some cases Tirelo Setshaba participants might be called on to teach adults as is the case with the National Literacy Program (Barclays, 1987).

Participants in Tirelo Setshaba are generally required to commit themselves for the entire year between leaving school and going on to employment or higher education. Earning a National Service certificate has become an additional prerequisite for entry into many higher education institutions including the teacher training colleges (Ministry of Finance and Development Planning, 1985).

The Ministry of Commerce and Industry is responsible for promoting rural manufacturing and retail activities under its extension program. The Rural Industries Innovation Center (RIIC) provides training and extension within this system. RIIC's efforts are jointly guided by a closely related non-governmental organization that focuses on rural industries (Ministry of Finance and Development Planning, 1984).

Attitudinal Research

For this section, literature surrounding attitudinal measurement relevant to PATT research was examined. The information included here focuses primarily on the three-component model of an attitude, and relates this model to PATT research methodologies.

A definition in Chapter 1 presented the three domains comprising "attitude:" the affective, the cognitive and the conative. Therefore, attitudes can be describe in terms of these sub-concepts. Attitudes are formed when persons have positive or negative feelings associated with objects or stimuli (affective domain). In addition, attitudes are formed when concepts on the basis of knowledge and experience are present (cognitive domain). And lastly, attitudes are evidenced by reactive intentions or inclinations (behavior) towards an object or stimuli (conative domain). All three of these domains invariably interact with the introduced stimulus and contribute to the formation of persons' attitudes.

This view of attitude is supported by a number of authors of the reviewed literature. Fishbein (1975) stated that the notion of response consistency throughout the bulk of attitudinal research largely emphasized the affective domain. That is, most studies have tended to focus on the commonly accepted attitude-measurement procedures designed to index "this general evaluation of feeling of favorableness or unfavorableness toward the object in question" (Fishbein, 1975, p. 11). But, he argued that conceptual distinctions that include cognition and conation in addition to affect are justifiably necessary for an adequate understanding of the attitude area (Fishbein, 1975).

Some researchers in the field of social psychology stress that the intensity in a person's otherwise stable affective response is influenced by beliefs held toward a particular object or stimulus. In Rosenberg's assessment: "When a person has a relatively stable tendency to respond to a given object with either positive or negative affect, such a tendency is accompanied by a *cognitive structure* made up of beliefs about the potentialities of that object for attaining or blocking the realization of valued states" (Rosenberg, 1956, p. 367).

Additional work has been carried out to identify a behavioral component within the attitude area. In their article, Triandis and Triandis (1960, 1962) expand upon this distinction of the behavioral relation described earlier by Katz and Scotland (1959) (Bogardus, et. al., 1925). Their argument was that measuring the attitude construct should include more than simply effective evaluation. Measurement should also account for the belief (cognitive) and behavioral components. By approaching the methodology of attitude research with a design to isolate the behavioral component they noted several advantages: "it permits clearer analysis, and hence, better understanding of the theoretical construct (of the attitude); it permits explicit measurement of the dimensions defining the construct, through a few items which are relatively 'pure' or independent of each other; and it suggests that when behaviors that are closely related to a particular dimension are to be predicted from attitude measures, it is desirable to give more weight to the other dimensions of the behavioral component of attitudes" (Triandis, 1964, p. 420).

PATT research methodology has acknowledged the three-component attitude model. Throughout the early formulation of the research, Raat focused on a measurement technique that could be applied to each distinct component within the attitude construct (Raat, de Vries et. al.,1986). The pilot studies included a single measurement instrument designed to test the validity and reliability of specifically:

1. the concept of technology, and
2. attitude toward technology.

To operationalize the measurement of attitudes with respect to the three-component model, a system was designed to improve upon the results of these pilot tests.

The steps taken to develop a method have been based on valid and reliable techniques of attitude measurement in other areas of social and behavioral science. The cognitive component stands to be measured by self-ratings of belief or disbelief or by the amount of knowledge which a person has about some topic (technology). The affective domain can be measured by means of physiological responses or verbal statements of like and dislike. The behavioral relation has thus shown to be measured by direct observations of how a person behaves in particular stimulus settings. The rationale to combine affective and behavior components under a single scale is explained in the PATT literature. De Klerk Wolters concluded "It is meaningful to represent the behavioral component in attitude measure towards technology too. This increases the relevance of the results. We see no reason why this should necessarily be done by means of observation. Attitude statements usually contain examples that refer to behavior" (1989, p. 23).

In his own definition of attitude de Klerk Wolters offered a useful disclosure: "The attitude toward technology could be a certain feeling with reference to technology, based on a certain concept of technology, and that carries with it an intention to behavior in favor of or against technology" (1989, p. 15). Perhaps a further distinction can be reached in defining behavior and behavioral intentions. If so, the statement above may be viewed to make more sense of combining conation with affect. Fishbein suggested that attitude can be subdivided into four components: "affect (feelings, evaluations), cognition (opinions, beliefs), conation (behavioral intentions), and behavior (observed overt acts)" (1975, p. 12).

In many respects the results of attitude research (PATT included) is not designed to predict overt behavior as much as it is concerned with predispositions to behave. Therefore, the intensity of an intention is indicated by a person's subjective *probability* that one will perform the behavior in question. Clarification here serves to support the inclusion of conation with affect, combined under one scale rather than to confound the improbability of measuring behavior per se, in conjunction with an internalized emotional evaluation.

Scaling Methods Used to Measure Attitudes

Before proceeding further into PATT related research it was important to review some of the various scaling methods used by researchers to measure attitude. The four most common of these, developed by Thurstone, Likert, Guttman and Osgood, are described in this section.

Thurstone's method of equal-appearing intervals or psychophysical (rational) scale was developed in 1929 in his study of attitudes toward religion. The *a priori* scale which developed is fundamentally a test founded on logic rather than empirical considerations. Thurstone used this type of logic in assuming that an attitude holds differing degrees of affect for an object. Thurstone believed that if a person was presented with several statements of opinion about a particular issue one could rationally order each statement in rank according to the degree of favorable or unfavorable reaction. Thurstone believed that it was possible to use this method to study the degree of favor or disfavor among subjects in a population toward social issues (Zimbardo, et. al., 1977).

The initial weakness of Thurstone's original method has been the distance or discriminable difference between statements. Subsequent refinements produced the method of equal-appearing intervals. The procedure for constructing such scales has been well laid out by Thurstone, Chave and Peterson (1929, 1933). The steps require a considerable number of judges to assemble a wide range of opinion statements and calculate the scale values (Fishbein, 1967). Then, the remaining statement can be administered as an *a priori* list to produce sound results.

Likert (1932-1933) has shown that a variation of the simple *a priori* method of scaling can be produced which avoids Thurstone's more complex procedures (Fishbein, 1967). This is done by allowing the subject to rate opinion statements on a five-point scale. A person's attitude score is the sum of all the ratings given to each statement. Typically the Likert scale is distributed from 1 to 5 with affirmative ratings given toward the lowest values of the spectrum. This makes some logic as we commonly associate affirmation with numerical position such as first place, striving to be "number one," losers finish last, etc. Therefore, statements in which person's may strongly agree would be coded as a 1 while statements expressing disfavor or strong disagreement would be coded a 5 (Remmers, 1954).

It is quite possible that the Likert scale can measure the ordering of peoples' attitudes on a continuum, yet fail to indicate the spread of individuals' different attitudes. For example, there is little to help us determine the distance between a response of "strongly agree" and "agree". Therefore, the Likert scale is limited to helping the researcher differentiate between sample subjects with the highest and lowest scores.

However, in comparing the Likert and Thurstone methods, the literature makes an important distinction. It has been supported (Fishbein, 1967, and German, 1988, et. al.) that scales constructed using the Likert method yield higher reliability coefficients with fewer items than scales constructed by the Thurstone method.

Guttman's scalogram is a technique based on the assumption that a single unidimensional trait can be measured by a set of statements that are ordered along a continuum of difficulty of acceptance. In effect, such a set of statements forms a cumulative scale under which there is a range that is easy for most to accept. Beyond this threshold there are statements that few would endorse (Zimbardo, et. al., 1977).

A basic assumption of this cumulative scale forces both the researcher and subject to evaluate the generated response pattern. Since the statements are ordered along a continuum of difficulty such properties assume that subjects eventually reach a maximum level of acceptance. In so doing it is logical to imply that subjects must reconfirm acceptance of all statements of lesser magnitude.

The dimension between the maximum scale score and the performance score produces a relationship between the persons location and the probability that he/she will pass a given item. This is referred to as a traceline. Fishbein (1975) adds that it is important to note that with Guttman's method "the relation between total score and the responses to any given item is not linear; rather, it is step-shaped (See Figure 1.0). High correlations between total score and single-item responses should not be expected since a correlation coefficient is an index of the degree of linear relationship" (1975, p. 66). The traceline then reflects the probability of the degree of favorableness or unfavorableness that is implied. This scale can therefore, be assumed to measure the attitude toward the object and, thus, exhibit the affective domain.

The foundation of Osgood's semantic differential method comes from the behavioral sciences. His study of overt responses has contributed to the literature in attitudinal research by introducing a unique solution to the problem of measuring meaning. Osgood's technique focuses on verbal responses to the object or concept. The semantic differential method can be used to differentiate between concepts and the measure of their meaning. This technique involves having respondents judge a particular concept on a set of semantic bi-polar scales. In each case, a profile of ratings can be obtained and compared to the degree with which other profiles are similar; thus, demonstrating the degree to which concept may hold similar meaning (Fishbein, 1975).

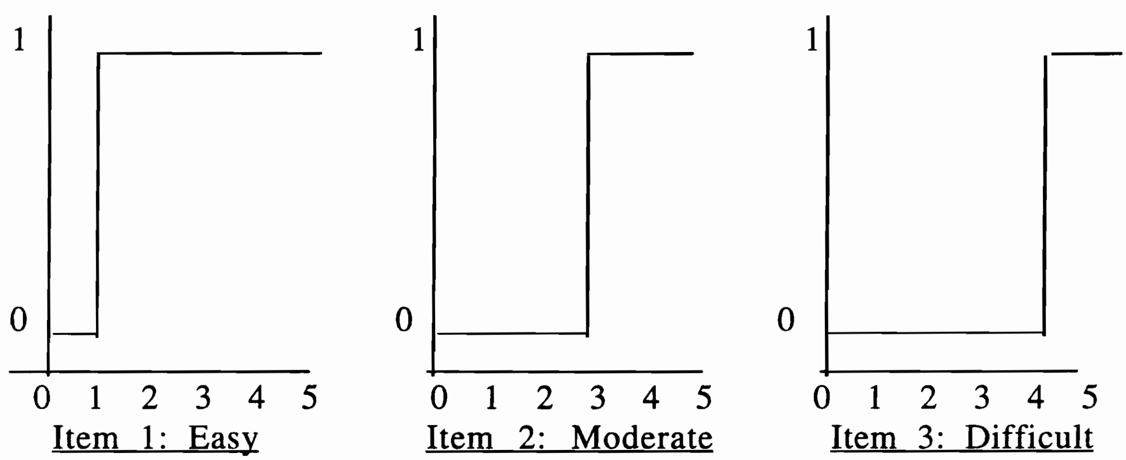


Figure 1.0 The traceline showing the relation between total score and the responses to any given item.
Source: Fishbein, M. *Belief, Attitude, Intention and Behavior.* London: Addison-Wesley, 1975, p.66.

His own research led Osgood to determine that there are three dominant, independent dimensions underlying semantic differential ratings: the evaluative factor (good-bad); the potency factor (strong-weak); and the activity factor (active-passive). In view of attitudinal research, this method can be used to determine conceptual conformity, but this does not lead to identifying meaning of any given concept without further applying factor analysis to summarize the interrelationship among a larger set of scales (Zimbardo, et. al., 1977).

Having briefly explored a variety of measures employed for attitudes among these four classic methods a few summary notes should be made. The literature points out that in each technique the resultant attitude score represents an individual's location on a bi-polar evaluative dimension vis-a-vis a given object. Where nonperformance of behavior is treated as equivalent to agreement (disagreement) with a belief or intentional statement, scaling methods can be used to analyze behavior. These various methods of scaling can be designed to identify either a set of beliefs or intentional attributes which measurably serve to index attitudes. These methods also require respondents to indicate their strength of beliefs and intentions in order to ascertain a certain associated attribute evaluation (Fishbein, 1975). Table F-1 in Appendix F indicates some of the differences between scales in terms of characteristics and properties of attitude scores.

Consistent with previous definitions of attitude, the literature shows that techniques are available to measure all three components. The next section now turn to the rationale for selecting scaling techniques that fit within the conceptual framework of the PATT-Botswana study.

The PATT Instrument

This section provides information on the development of PATT, describes the PATT instrument, and provides a rationale for the utilization of Likert and Guttman scaling techniques. It also provides a list of guidelines for construction of a valid and reliable questionnaire.

The developmental phase of PATT research began in the Netherlands as early as 1985 with investigations into the differences in attitudes between boys and girls toward physics and technology. The international interest that emerged led to the search for a valid and reliable technique to measure cross-cultural differences in attitudes toward technology among pupils in other nations. (Raat, de Vries, 1986)

A number of reasons why this type of research was needed have been well documented in the early literature on PATT's foundation. Mottier (1986) reported that the project grew out of the following need to:

- respond to the international interest for this subject;
- help researchers in their own country's show the importance of PATT research;
- compare differences in concept of and attitude toward technology;
- understand peoples' attitudes toward technology;
- confront others; e.g., experts with pupils' views of technology;
- motivate learning among pupils in science, math, and technology;
- contribute to curriculum development;
- sensitize people in developed countries to the implications of this type of research in the developing world;

The aim was to initially devise an attitude-measurement instrument which could be used internationally. Several countries reacted positively toward a proposal to initiate a series of pilot studies (Australia, Belgium, Canada, France, Hungary, Kenya, Nigeria, Poland, Sweden, United Kingdom and United States). In each case, the project addressed the main research question: What is the concept of technology that pupils in secondary general education have and what is their attitude toward it? (Raat, de Vries, et. al., 1986)

Such a project requires an operational methodology that can reflect not only pupils' concepts of technology, but also their attitude (affect and conation) toward it. The instrument used must also provide reliable and valid results. Thus, de Klerk Wolters wrote "According to Zimbardo, et. al., (1970) the effective component can be measured by means of physiological responses or verbal statements of like and dislike, while the cognitive component should be measured by self-ratings of belief or disbelief or by the amount of knowledge which a person has about some topic" (de Klerk Wolters, 1989, p. 23).

The model devised by the PATT Research Group (Raat, de Vries, de Klerk Wolters, 1986) to conduct the international project combined the utility of Likert and Guttman scales in the methodology. In accordance with their conceptual framework, a Likert scale is fundamentally incorporated within the instrument to measure affect and conation. A Guttman version of scaling is used in connection with a single open-ended question (What do you think technology is?) to measure the pupils' concept of technology (de Klerk Wolters, 1989). These Guttman and Likert techniques, combined with an essay question formed the basic model of instrumentation. In practice, pupils' attitudes toward technology and their concept of it are typically analyzed in relation to independent characteristics such as mothers' and fathers' occupation, age and gender (Raat, de Vries, et. al., 1986).

The Affective/Behavior (A/B) element of the PATT instrument is made up of six Likert sub-scales: interest in technology (Interest), technology as an activity for both girls and boys (Role Pattern, Gender), consequences of technology in society (Consequences), perception of the difficulty of technology (Difficult), technology in the school curriculum (School, Curriculum), and ideas about technological careers (Careers). In the 1988 version of the PATT instrument, 60 items total these six scales (de Vries et. al., 1988). From studies, Moore (1987) showed that the strongest correlations were found between interest, school and career. The relationships of the scales' consequences and difficulty with other scales were weak, but positive. The scale gender was found to correlate negatively (Moore, 1987).

The concept measurement element in the PATT instrument deals with four concept scales and an essay assignment. First, the development of the concept scales was based on an *a priori* determined group of questions that operationalize a characteristic of technology. Among the characteristics noted there are five: technology is directed and controlled by man and intervenes in all parts of society (Society); the difference between technology and the natural sciences and their mutual influence (Science); designing, which is creative and practical skills are part of technology (Skills); and there are three dimensions or pillars in technology: matter, energy, and information (Pillars). The relationship between technology and humans is the fifth characteristic. This is combined with Society (de Klerk Wolters, et. al., 1989). Each of the four scales were originally constructed using a Guttman design.

In addition to the questionnaire, pupils write an essay on what they think about technology. The essays are later read and compared with responses in other scales both for validation of the instrument and for finding additional information not appearing in other sections of the questionnaire. The A/B , concept, and essay elements form the basis of the model used in PATT research.

The rationale for selecting the Likert method to measure affect and conation was weighed heavily upon its reliability factor. Yielding higher reliability with fewer items is an obvious benefit. Additionally the PATT literature supported the notion that Likert scales are more easily constructed than those of the Thurstone method (de Klerk Wolters, 1989). While some researchers (Fishbein, 1967) arguably question this point, it is not an issue that is likely to alter the results so long as careful steps are taken to eliminate defective items.

The rational for employing Guttman's method to measure the cognitive component appeared to also be largely based on its inherent ability to ascertain reliability and validity. In principle, the value of this technique can readily be judged by researchers with respect to its reproduction coefficient (Mokken, 1970). Thus, the self-rating scale incorporated in the measurement instrument is devised to act with the open-ended question method to reflect the amount of knowledge or concept of technology among pupils.

The literature states how the Likert scales and attitude scales were formulated. Gardner's (1975) conclusion presented a rationale for following a set of guidelines as the methodological choice for construction of questionnaires that would prove valid and reliable. A list of these guidelines appears below:

- The specification should avoid confusion between different theoretical constructs. If more than one construct is to be included in a single instrument, each should be identified and separately scored;
- There should be elimination of defective items such as those that combine two or more different perceptions;
- there should be some means of filtering out influences of respondent knowledge (of technology) from attitudes towards it;
- refinement of the instrument should be directed toward obtaining reasonable internal consistency;
- instrument stability should be established through a test-retest technique;
- factor analysis should be used to validate the scales.

Previous PATT Research

Chapter 1, as well as previous sections of this literature review, has emphasized the importance of PATT research in education; in the study of attitudes toward technology; and in the context of the national development of emerging countries such as Botswana. These elements have today remained the driving force that has carried PATT research to nearly every continent on earth. The global interest that continues to motivate commitment in PATT research is evidence that serves as justification for our need to better understand the attitudes and beliefs of young people toward technology. This section presents an overview of the PATT project as it developed from the early stages in 1985 to the international status it now receives.

During the period between 1985 and 1987 the PATT attitude study emerged from the Department of Physics Education at the Faculty of Technical Physics of the Eindhoven University of Technology. The project was the creation of two members of the department, Dr. J. H. Raat and Dr. M. J. de Vries. The aim of their work was focused on developing content material for secondary level physics education coursework. One aspect of their curriculum proposal endorsed integrating technology. To achieve this, de Vries investigated the concept and attitudes of pupils who were not exposed to technology education, and also the experiences of those with reference to the course material (de Klerk Wolters, 1989).

The two researchers found that the implications for attitude research in this area extended widely beyond curriculum development. Their investigation showed that pupils (age 13) held vague concepts of technology. It also showed that girls primarily had a negative attitude toward technology when compared with boys. In addition, the investigation appeared to indicate that technology education provided pupils with a better concept of technology (de Vries, 1988). Judged to exhibit good statistical properties, the initial attitude questionnaire was offered at two international conferences (1985) to begin attitudinal research at an international level (de Klerk Wolters, 1989).

As noted in the previous section, researchers from several countries accepted the proposal to pilot-test the questionnaire. The first PATT conference was held in 1986 and explored the possibility of developing a single international instrument with unidimensional scales to measure the attitude toward technology. The results of the physics and technology pilot-studies laid out a useful framework for the initial discussion. The English version of the test instrument was confirmed valid and reliable by the empirical analysis conducted in the studies. Modifications to the design of the test instrument included a separate "concept" component based on the definition of technology put forth by de Vries which, with regard to international applications, raised the level of cultural sensitivity expressed in the instrument (Raat and de Vries, 1986). The results of the initial studies (PATT-1 and PATT-2, 1985, 1987) focused mainly on the research and development of an instrument suitable for international and cross-cultural comparisons.

The 1987 PATT conference included the results of several studies and an evaluation of the instrument. Of the original 13 researchers, all rated the instrument with a positive evaluation, only minor improvements were made to the attitude questionnaire. Since this conference, the instrument has not been changed (de Klerk Wolters, 1989).

The scores based on the attitude questionnaire, the concept questionnaire and essays offered these general findings:

- Pupils' have a fairly positive attitude toward technology;
- pupils' have problems with the concept of technology with respect to technology and society, technology and Pillars and Technology and Science (relatively low scores). Pupils see the relationship between technology and skills fairly well (relatively high scores);
- gender appears to be the most important explanatory variable for the scores on the scales. Girls have a less positive attitude toward technology than boys and their concept of technology is not as good as that of boys.
- from the essays it appears that pupils from different cultures, in spite of several similarities such as the productive side of technology, have different ideas of technology.
- in several west European countries (researchers) found a significantly positive correlation between the concept of technology and the attitude towards it.

(de Klerk Wolters, 1989)

By 1988, support for PATT research had taken shape in new directions. There was development of the Technology Attitude Scale (TAS), a shortened classroom instrument. There was an initiative carried out to start a new project called **ME**isjes, **N**atuurkunde en **T**echniek (MENT), or Girls, Physics, and Technology (in English). The MENT Project was led by Raat to specifically make technology and physics more attractive to girls (Raat, de Vries, et. al, 1989). There was also action toward large scale studies in India, Kenya, Nigeria and the United States. For a complete summary of the analysis of international findings, one has been prepared by de Vries, Bame and Dugger (1990), and is included in Appendix G.

To date, the continued PATT research and contributions from PATT researchers have helped to further our understanding of the role of technology. Specific themes of PATT conferences have annually generated and promoted interest in technology education. From *Basic Principles of School Technology* (1988) to *Teacher Education for School Technology* (1989) to *Technology and School* (1990) to *Technology Education and the Links with Industry* (1991) and others, technology education substance has taken shape from what originally started as justifications for a student-centered approach to teaching physics.

The role of technology in society is complex and pervasive. The implications of PATT research have become important to us as educators not simply because it has a sound scientific basis, but because it is tied to a subject area likely to become central to the existence of mankind.

When one looks at the literature involving PATT research in developing countries, there are limitations. The bulk of research is conducted and reported within countries exhibiting industrialized levels of technological development. The balance is made up primarily of middle income or less developed European nations. The weight of literature related to developing countries is in many ways an admission that PATT research is not being conducted in less developed parts of the world.

Indeed the needs to improve living conditions for these populations is critical. While the role of technology in developing countries may take on different characteristics than those in the west, one must consider that in principle the roles are the same. The role of education to respond to pupils' needs is the foundation behind much of the original PATT project. Educators in developing countries can learn a great deal from further research in this area. In turn, it is the pupil who will benefit most from this endeavor.

The study conducted by Kapiyo and Otieno, one of the few PATT studies conducted in a developing African country, will be the focus of the next section.

PATT-Kenya

This section focuses primarily on the PATT study conducted in Kenya, and examines its relevance to PATT-Botswana. Raphael J. A. Kapiyo and Fredric O. Otieno were among the first researchers in Kenya to apply PATT research toward their own unique cultural context. Kenya's array of technological forms and experiences typifies many of the conditions found among sub-Saharan African societies.

Central to this researcher's interests, the Kenyan team noted that the social geography accounted for the total population being made up of at least two distinct subgroups, i.e., "urban" and "rural." The characteristics of these two groups differed substantially enough to warrant the distinction of pupils from different areas as an "essential" consideration for in-depth attitudinal study (Kapiyo and Otieno, 1986).

At the onset of their pilot-study the two researchers observed that the urban-rural dichotomy, if unaddressed, would lead to incomplete results in their attempt to make an accurate evaluation of pupils' attitudes throughout the mixed sample. The researchers noted that omission of a rural-urban contextual factor suggested "threats to reliability and validity" (Kapiyo and Otieno, 1986).

To re-emphasize an earlier distinction, Kapiyo explained in a later report that:

> ...problems and prospects" for consideration in the development of technology education in developing countries lies within the cultural contents, different forms of technological practices and experiences (e.g., indigenous technology, technology in the informal sector, appropriate technology, and modern technology) and shifts in educational practice might have a different response to technology in schools.
>
> Although school technology is an attractive educational option in curriculum terms, especially with regard to national development, indigenous technological capability and the vocational element it entails change; educational and attitudinal. How PATT research results can link with actual practice of existing technological curriculum in Africa to effect this change remains the challenge" (Kapiyo, 1988, p. 272).

Otieno in a description of the rural areas states:

> Kenya like most African countries, has mainly a rural based population, with over 70 per cent living in rural areas. This rural population is also mainly involved in peasantry type agriculture, producing food for mainly subsistence purposes. There are few large scale farms in Kenya run for export and commercial purposes. One other disadvantage about the rural parts of Kenya is that because only a small part of the land is arable there is on the whole congestion which on many occasions leads to negative environmental effects (Otieno, 1986, p. 214).

These passages show there are clear similarities in the Kenyan and Botswana examples. With respect to the technological order, social economies, and issues of environmental concern, African educators are faced with the challenge of presenting pupils with a technical education curriculum that must be applicable in a wide range of community settings across an equally broad technical spectrum.

Other Kenyan writers and educators have strongly advocated the development of meaningful technical education curriculum planning. Muthama (1990) recommended the introduction of technology education at all levels of schooling. The curriculum should be aimed at important principles with reality and value for the learners. He emphasizes that educators and planners should be equally concerned with content as well as the "attitudes" which the learner forms toward such content (Muthama, 1990).

Obura (1990) emphasized the need to shift the focus of the technological debate away from the "product" toward the "total living environment" (home). To achieve this he stressed "that understanding specific community contexts is crucial for successful school learning in the domain of technology and that careful identification and analysis of social group technology will assist in an important way the development of relevant and appropriate technology curricula" (Obura, 1990, p. 10).

One can conclude from this review that certain parallels can be drawn from conditions in Kenya to conditions of similar reference in Botswana. These similarities overlap with social, environmental, and technological concerns. In direct reference to PATT and related attitude research this review of literature demonstrates that there is strong justification to operationalize the urban-rural dichotomy as a specific variable when measuring constructs such as attitude and concepts of technology. Lastly, there appears in the readings, significant value for this type of research when applied toward curriculum planning and national development.

PATT-USA

In the following review the procedures used in PATT-USA are examined as a model for instrument modification and revalidation. The researcher believes this procedure to be appropriate for the proposed study in Botswana. The information gathered comes from the PATT Research Plan of the Department of Technology Education, Virginia Polytechnic Institute and State University.

The PATT-USA research team initiated their study in 1987. Dr. W. E. Dugger and Dr. E. A. Bame worked with Dr. M. de Vries (from Eindhoven University and author of the original PATT instrument) to develop a procedure to modify and validate the original instrument so that it could be used in America. This procedure is an important and critical phase of every PATT pilot study. To accomplish this the team spent roughly three months modifying, field testing, and analyzing the results found from the instrument. It was with kind permission that Drs. Dugger and Bame shared an overview of their method for the purpose of having their proceedures replicated in the Botswana study.

The timeline used by the team is presented below:

- Field testing of the original PATT instrument, March - April 1988;
- Analysis of the results and modification of the instrument, May 1988;
- Revision of the questionnaire June 1988.

(Dugger, Bame, de Vries, 1988)

The exploratory research conducted throughout this period took on the following description:

1. The original questionnaire was assessed to meet standards of American-English readability. Some minor adjustments were necessary.

2. Procedures were undertaken with a sample of 200 pupils in grades 6 and 7 from five schools within various regions of Virginia to field test the Likert questionnaire. To field-test the open-ended essay ("What I think of technology"), an additional 100 pupils were selected from the same sampling frame. Researchers also observed teachers deliver instructions to detect problems with the method of administration. In four out of five schools, this step was carried out. Essays were written later and mailed to Virginia Tech.
3. Results collected from the field-test were analyzed. This procedure comprised the following steps: a frequency analysis of all measurable variables, a factor analysis of the attitude items, a reliability analysis for the attitude and concept items, t-tests on the attitude and concept scale scores with subgroups based on gender, age, grade, rural or urban school area, parents' profession, technological climate at home, and quality of a definition of technology given by the students in the questionnaire. (de Vries, 1988)

The experience of pilot-testing the original instrument provided information to the research group that enabled the team to modify the original instrument and gain several related benefits. The analysis identified items with low or nonexistent correlational value. These items were eliminated. Modifying the questionnaire in this manner effectively increased the validity and reliability within the new instrument. Changing or deleting items also produced a more culturally specific questionnaire.

The aim of the factor analysis was to get further confirmation of the attitude sub-scales (de Vries, 1988). The research analysis suggested that it was possible to construct better scales than those found in two original attitude questionnaires. However, for the sake of compatibility with data collected from other PATT studies, the decision among the USA team was to preserve the original scales.

Other modifications included the replacement of the standard printed questionnaire with optical scanning forms. A copy of the new instrument is included in Appendix K.

The implications brought out by the researchers' treatment of this exploratory stage hold practical and valuable reference to the proposed study in Botswana. In their procedural design, the Virginia Tech-Eindhoven team offers a practical and innovative approach to the problem of modifying and revalidating an existing PATT instrument. Since no truly universal instrument is available, PATT-Botswana will require the modification of an existing instrument. The contributions made by PATT-USA within the literature offers interested researchers a model to follow.

Summary of the Literature Review

In this Chapter a review of literature introduced four major themes. Each is relevant to the study planned for Botswana.

In the first segment the review of the literature highlighted distinctive characteristics within Botswana's social, political, and economic composition. Beginning with a description of the general population, the literature describes particular subgroups based on statistical descriptions, characteristic economic activity and the nature of the socio/technological order. The subgroups presented here are: the urban sector, the rural sector and the Form 5 level population. With respect to the first two groups, it is noted that a strong interdependent relationship exists. In reference to the later group, the population of interest, it is emphasized that this group maintained an educational "edge" over others seeking employment. The literature also provides information as to the different levels of technological exposure pupils might posses living in the nation's various rural and urban areas. This suggested the presence of a rural-urban dichotomy.

Education was the second major theme of the literature review. The role of education in Botswana’s social and economic development is significant, and the literature offered a definitive description of the various complementary systems of training and education in the overall educational thrust. The function of education to serve the nation's manpower needs and interests of individuals and communities is presented within this section. The limitations of the scale of this study are introduced as a rational for excluding non-formal populations from the sampling frame.

The last two themes of this Chapter focus on attitudinal and related PATT research. Information on attitudinal research examines various scaling techniques. Reviewing the development of PATT and its underlying foundation provides the rationale for the study in Botswana. The two case studies (PATT-Kenya and PATT-USA) provide an orientation to the problems and prospects for replicating this type of research within the context of Botswana.

CHAPTER THREE

The Design and Method of the Study

Introduction

This chapter describes the design and methods of the study including the scope, the subjects, the timeline, the process of modification and revalidation of the instrument, general procedures and analysis of the data.

Scope of the Study

This study was the first to introduce PATT research in Botswana. The focus of the study included a segment of the population that represented a strong national concern. One outcome of the study hopefully presented others with the motivation to continue this type of research in expanded areas. In comparison to other PATT projects, this was a medium scale study of approximately 800 subjects.

The main research question was to determine: What is the attitude toward technology of Form 5 level pupils in Botswana and what is their concept of it?

The design of the study allowed for the results of the main research question to be based on the formulation and testing of a set of secondary questions:

- What is the impact of gender on the pupils' attitude and concept? Do boys have a more positive attitude toward technology than girls?
- What differences in attitude and concept are there between pupils who have had formal technical education and those

who have not? Do pupils who have studied technology in school have a better understanding of technology?, a more positive attitude toward technology?

- Is there a difference in attitude toward and concept of technology between rural and urban pupils? Is the technological climate at home the same for rural and urban pupils?
- What is the impact of the concept of technology on the attitude toward technology?

The steps describing the procedures followed before the actual research began is presented:

1. Governmental and official approval to conduct the proposed research was obtained. Funding for the support of this research was the responsibility of the researcher and no outside source of additional funding was obtained.
2. The (English) language used in the PATT-USA version was assessed and modified slightly to meet local standards of readability and understanding among Form 5 pupils.
3. A series of trial tests using the modified instrument were conducted to assess procedural and administrative performance and to identify unforeseen problems that might later cause problems.

The steps describing the procedures carried out during the actual research is presented:

1. The questionnaire was pilot-tested with a sample of approximately 800 pupils in the Form 5 grade level. Eight schools were used for pilot-testing: four in urban settlements and four in rural settlement. In each school, roughly 100 pupils participated by responding to the questionnaire and accompanying essay.

2. The data collected during the pilot phase was analyzed to determine the validity and reliability of the modified instrument.
3. The results of the analysis were then used to draw conclusions and provide information about the pupils' attitudes and concepts of technology.

Replicating the ex post facto design in the study of pupils' attitudes toward technology allowed the researcher to find answers to questions through analysis of variable relationships. In this case, the researcher was interested in the differences expressed toward technology among subcategories of pupils identifiably male or female, urban or rural, possessing prior technological education or a combination of categorical descriptors (or independent variables) uniformly preserved in PATT research. The goal was not to manipulate outcomes, but to expand our knowledge and perceptions of pupils who have reached the highest level of secondary education; and are seen as students who have successfully attained academic recognition within a highly competitive educational system. Also the goal is to contribute to the global understanding of pupils' attitudes toward technology. Through a series of replications this design has provided researchers with valid and reliable descriptions of pupils' attitudes and concepts toward technology. To this end, many curriculum developers have found the means to improve the learning outcomes for pupils.

In reference to the goals of this design, it is important to mention two criteria for evaluating the validity of any experimental design. The first criterion is *internal validity*. "Internal validity refers to the validity of assertions regarding the effects of the independent variable(s) on the dependent variable(s)" (Pedhazur, and Schmelkin, 1991, p. 224). As defined by Campbell and Stanley (1963), an experiment has internal validity when the independent variables are manipulated such that an actual effect on the dependent variable is observed. With regard to the design of this study, it is not assumed that a causal relationship exists. The aim of PATT-Botswana, and PATT projects in general, is to determine which of the independent variables (if any) exhibit an association with certain attitudinal and concept responses. In this research, we are interested more in "determinants" and less in "predictors."

One of the limitations of an ex post facto design is that by eliminating the treatment variable, cause and effect cannot be ascertained. On the other hand, it is quite possible to categorically describe differences in scores related to the dependent variable (attitude, concept) according to subgroup identification, i.e., boys, girls, urban, rural, technologically educated, etc. In doing so, the researcher must recognize that the information retrieved from the analysis cannot be considered isolated from exogenous variables.

The other criterion, *external validity* "refers to the generalizability of findings *to* or *across* target populations, settings, times and the like" (Pedhazur and Schmelkin, 1991, p. 229). The key terms *to* and *across* exemplify generalizing results from a sample "to" a population and "across" subgroups, i.e., race, gender, etc. What is looked for in the correlational analysis is statistical relevance in strengths (or weaknesses) of variables associated with Affective/Behavior (A/B) and Cognitive (C) Attitude scales. In that the conclusions reached throughout the bulk of PATT studies reports characteristically higher percentages of boys with "greater interest" (See Appendix G) toward technology than girls, these statements are thought to be statistically representative of attitudes rather than predictive. It is also important to state that the researcher recognizes that profiles among pupils the same age for example, will undoubtedly vary over time and location. Therefore, without aiming at completeness, research into the attitudes toward technology provide investigators a feasible method of analyzing past or existing conditions to study causation in a broad sense.

Population and Sampling

One step toward ensuring accurate representation within a population was to make every effort to design a system of sampling that is representative of the target population (Fowler, 1988). This entails rather complex analysis of demographic characteristics, population size, etc.

Probability sampling provides us with the most statistically sound method to estimate the precision of sampling estimates (Kalton, 1983). The goal of this study was not to base its conclusions within a predictive framework, but rather to associate findings within the Affective/Behavior (A/B) and Cognitive (C) Attitude scales to the broader interaction of categorical descriptions of those participating in the study. This aspect does not, however, preclude the notion that the sample must represent the target population. The choice of a sampling strategy rests in part on feasibility and cost, but to a larger extent on the accuracy given to select a representative sample.

It is common for researchers to employ sampling strategies that stratify populations when studying groups dispersed over wide geographic areas (Fowler, 1988). National samples can be divided according to regions, ethnic composition and other related variable characteristics. When it is required, each stratum can be allocated proportionally to approximate representation of a larger total population (Pedhazur and Schmelkin, 1991). It is possible, therefore, to treat each stratum as an independent sample. By organizing the independent variables carefully to define stratification the researcher can create a relatively homogeneous strata with respect to the dependent variable of interest. This in turn, increases the precision of estimates of variables to which the stratification variables are related.

Cluster sampling is a relatively efficient and inexpensive method of selecting a sample of individuals. It will not be necessary to sample pupils from every secondary school in Botswana when in terms of pupils' background the researcher is interested in the more general distinction of urban and rural origins. This method affords the researcher the opportunity to select samples or *clusters* from within a widely scattered distribution to represent the population (Best and Kahn, 1989). In effect, this variation of simple random sampling allows the researcher to select at random schools (in this case) which offer Form 5 education; then, from these schools again randomly select class samples to represent pupils in Form 5 education from Botswana. Simply stated, cluster sampling assumes that individual clusters can be utilized to represent widely distributed individuals from within the greater population. Thus, the benefits of cluster sampling reduce the need for a universal listing of all students enrolled in Form 5, as would be required in a simple random sample, and a reduction in time and expense in collecting data (if such a list were obtainable).

The precise methodology employed with regard to these two techniques does require that execution is carried out cautiously. First, constructing a method to weigh stratification according to variables requires careful objective consideration on the part of the researcher to recognize that boundaries are not simply limited to the variables of interest. Extraneous variables and specific regional differences may emerge that were unanticipated. Cluster sampling also requires some method of categorization. The disadvantage of combining both methods may produce biases in the ways used to establish subjects (Pedhazur and Schmelkin, 1991).

Before discussing the method of sampling used in this study, a word or two must be said about sample size. Issues concerning sample size in experimental research is germane to both random selection and random assignment. In practice, researchers who seek inferential conclusions are concerned with the type of estimators, effect size, Type I and Type II errors and the complex relations among these elements and sample size (Pedhazur and Schmelkin, 1991).

To perform the analysis, the researcher is concerned with obtaining a sample size large enough to produce reliable results. As part of the sampling strategy, the need to provide a minimum of 30 subjects within cells has determined the total number of pupils. The analysis stage matrix (Table 3.0) required 8 cells. The minimum sample size is 240 subjects (Howell, 1987). Here, increasing the sample total to 800 subjects would allow equal sample sizes of 100 pupils from eight schools at an increased cost within budget limits.

Table 3.0
<u>The Analysis Stage Matrix</u>

	Studied Technology in School		**Did Not Study Technology in School**	
	Urban	Rural	Urban	Rural
Boys	100	100	100	100
Girls	100	100	100	100

The numbers in the cells represent the estimated maximum numbers of pupils in the sample consisting of 800 Form 5 pupils.

These aspects help to form the sampling strategy. The model to be used to select pupils will combine both stratification and cluster sampling. Considerations for stratification will be drawn heavily toward a representative urban and rural composition. Once every community having a Form 5 schools is identified, each school will be classified as either rural or urban. Classification will be based in accordance with definitions of rural and urban communities discussed in Chapter 2. Table 4.0 is an illustration showing the preliminary stratification of all communities expected to have a Form 5 school by 1993 (Ministry of Education, 1992).

The second phase in sample selection is to randomly select four schools from each stratum. The preliminary classification shows that:

- Urban communities account for 7 schools;
- Rural communities account for 16 schools.

The issue of proportional allocation is not a determinant to sample selection. In this phase of sample selection, the researcher determined to increase the precision of estimates based on relatively equal proportions of regional attributes. Therefore, samples representative of social, economic and technological characteristics, (i.e., the degree of urban or rural influence), will be critical to the scope of the study.

The final phase in sample selection will be to select nearly 100 Form 5 pupils from each school. Secondary students are commonly distinguished according to the type of curriculum each follows ie. Pure Science, Combined Science, and Practical Science tracks. Selection procedures included sampling equal numbers of pupils from each academic track. The method of random selection of class sets accomplished the goal of achieving a balanced and representative sample.

In reference to Table 3.0, it is possible to visualize how the sampling strategy is to be used to facilitate the analysis. This concludes the discussion on population and sampling.

Table 4.0

Preliminary Stratification of All Communities Expected to Have a Form 5 School in 1993

School	Location	Stratification
Letlhakane	Letlhakane	Rural
Lotsane	Palapye	Rural
Madiba	Mahalapye	Rural*
Matshekge Hill	Bobonong	Rural
Moeng	Moeng	Rural
Shashe River	Shashe	Rural
Swaneng Hill	Serowe	Rural*
Tutume Comm.	Tutume	Rural
Francistown	Francistown	Urban
Mater Spei	Francistown	Urban
Gaborone	Gaborone	Urban
Naledi	Gaborone	Urban
St. Joseph's	Gaborone	Urban
Matsha	Kang	Rural
Molefi	Mochudi	Rural*
Kgari Sechele	Molepolole	Rural
Lobatse	Lobatse	Urban
Maun	Maun	Rural*
Kagiso	Ramotswa*	Rural*
Moeding	Otse	Rural
Moshupa	Moshupa	Rural
Seepapitso	Kanye	Rural
Selebi Phikwe	Selebi Phikwe	Urban

* Settlements expected to attain urban status during the period of NDP 7. (Ministry of Education, 1992)

Research Timeline

The structure of the timeline has been developed to extend over a period of 30 months. Some of the considerations are purely logistical constraints related to resettlement in Botswana, while others described in this segment deal more directly with the stages of research.

A timeline (see Appendix H) is presented in outline form to serve as much as a guideline as it was intended to illustrate the developmental procedure involved in the PATT-Botswana study:

I. The Conceptual Stage

The Proposal for PATT-Botswana:

A. The proposal was created within the Department of Technology Education at Virginia Polytechnic Institute and State University during December 1991 - January 1992.

B. Support for the proposal and official permission to conduct the study will be undertaken in Botswana. The timelines for these two interrelated procedures overlap during the course of the first 12 months. Support for the proposal takes two different directions.

1. A search for financial support for PATT-Botswana was conducted through private, non-governmental and Ministerial channels throughout 1992 (unsuccessfully).
2. Direct governmental approval for the study required the researcher to seek support from several institutions and offices within various levels of government. This took place from October - November 1992. The parties involved included:
   a. The Ministry of Education - the offices of the Permanent Secretary and Chief Technical Education Officer; and

b. The University of Botswana - The National Institute for Research.

II. The Instrument Modification Stage

Modification and Revalidation of the Instrument:

A. Assessment began in February 1992 to appraise the level of readability in the American (English) version of the PATT instrument.

B. Modifications to the instrument were carried out during August to October 1992.

III. The Testing Stage

Trial Testing and Pilot Testing the Modified Instrument

A. Administrative trial test simulations took place during April, 1993. Participants included two class sets of First-year teaching candidates.

B. Two senior secondary schools were selected to test the modified PATT instrument under true pilot test conditions during October 1993.

C. Local personnel involved in the trial tests were contacted in September to schedule a time period when parties could conduct the pilot test.

D. Six schools were selected to participate in the study during September 1993.

E. Local school administrators and personnel were contacted to develop a time table between September and December 1993 for the study to be carried out in their schools.

IV. The Analysis Stage

A. The period between January and September 1994 was utilized to transfer the data collected on the questionnaires to a personal computer using Fastat Statistical software; to conduct a frequency analysis on all measurable variables; and to initiate the cross comparison analysis on the demographic data.

B. The months between January 1995 and September 1995 were set aside for a return to residence at Virginia Polytechnic Institute and State University.

C. Statistical analyses including factor analysis (Principle Components) on the A/B scale items, factorial analysis of variance (ANOVA model) between the Independent variables and the A/B and C sub-scale scores, a reliability analysis on all A/B and C sub-scales, and a simple correlation analysis on the C scale scores with the A/B sub-scale scores, were conducted between September 1995 and March 1996.

D. Findings of the analysis were compiled and a final presentation prepared during the month of April 1996.

V. The Reporting Stage

The Findings:

A. An oral report of the preliminary findings will be submitted to the board of Graduate Student's Advisory Committee, presented at Virginia Tech in May 1996.

B. A similar written report will be presented to the Government of Botswana in June 1996.

Modification of Instrument

A review of the literature described the procedures used by the USA team to revalidate and modify the original Dutch version of the PATT instrument. This procedural model demonstrated practical and efficient guidelines for others. The implications of utilizing an optically "read" format was identified by the researcher as one direct advantage for following their methods. Another was the detailed timeline documented in their report. Adapting the USA model for instrument modification and revalidation to the design stage in this study contributed valuable guidelines and efficiency in the method.

The procedural framework was structured closely to that described in the USA model. However, developing country-specific items related to the context of Botswana entailed heavy emphasis not only on the language, but with the content of the instrument. The prime concern was to increase the face validity of the questionnaire. Therefore, much effort was directed to enlist the aid of local experts to assess the construct and cultural validity of each item. It was viewed that a close association with institutions such as the University of Botswana, National Institute of Research, Botswana Polytechnic, Botswana Technology Center, Rural Industries Innovation Center, Ministry of Education, Design Technology teachers and others could play a beneficial role in helping to achieve this goal. With the aid of members from these various organizations, several of the items in the USA questionnaire were modified to fit Botswana's cultural setting.

The structural model used throughout the design and test stages is presented below:

1. The USA questionnaire was assessed to meet Botswana standards in readability. Interestingly, some of the efforts to "Americanize" the original English version of the questionnaire were reversed to meet the British equivalent within the context of Botswana.
2. Procedures were undertaken to trial test the modified instrument with a sample of pupils in Form 5 education. Two schools were selected from communities determined to be primarily urban and primarily rural.
3. The data collected from the pilot test was put into analysis. This procedure was comprised of the following steps: a frequency analysis of all measurable variables including the essay responses, a factor analysis of the attitude items, a reliability analysis for the attitude and concept items, and a factorial analysis of variance (ANOVA) on the A/B and C scale scores with subgroups based on GENDER, LOCALE,

EDUCATION, and CONCEPT. The tests used to determine the validity and reliability of the adapted questionnaire will be applied toward the A/B and C scales. For the reliability assessment, Cronbach's alpha is to be used. For validation, factor analysis (Principle Components) was employed with varimax-rotation. To add with the assessment of reliability and content validity in the concept scale, essay analysis to identify key words and compared frequency responses with items contained in the questionnaire. A careful investigation of the independent variables in relation to the responses generated in the A/B and C scales were conducted to identify those that serve as useful parameters.

4. The results of the analysis of the pilot-test will lead to adaptation and validation of the PATT-Botswana instrument. This instrument can be reprinted on optical scanning forms in preparation for further replication in Botswana.

Data Collection and Response Data Sought

Administration of the PATT-Botswana instrument was conducted by the researcher at each school site. It was felt that the number of participating schools posed minimal logistical constraints if administration was conducted over a timeframe that included two to three months. The researcher has selected September to December 1993 for this purpose. The underlying rationale was formulated on the outlook that by minimizing possible threats during the administration stage the researcher could control the element of reliability at this level. Therefore, instructional delivery and data gathering was under the control of the primary investigator (researcher).

Individual instruments were coded with a school and pupil identification number. Pupils' responses to the questionnaire were compiled manually. The raw data was entered into a Macintosh computer whereby a preliminary spreadsheet of the data was produced using the *Fastat Statistical software* (Bjerknes, 1989), and later analysis was made possible using *SPSS* (Norusis, 1994).

The essay component was treated separately. Each of the essays was reconstructed and entered into the word processing software tool *MicrosoftWORD* (Cobb,1989) for follow-up analysis.

Analysis of the Data

This stage of the study required a series of investigative data analysis procedures to formulate conclusions. The researcher employed the use of two computer software packages to perform the necessary operations: *Fastat Statistical software* (Bjerknes, 1989), and *SPSS* (Norusis, 1994).

The analysis procedures began with the tabulation of frequencies and descriptive statistics of all measurable variables including the key words in the essays. An initial investigation of the demographic characteristics was carried out using a cross comparison analysis. Factor analysis was used to determine the underlying common structure in the Affective/Behavior (A/B) scales items. Validity in the A/B scale was assessed using the factor analysis. A reliability analysis consisting of Cronbach's (alpha) test of homogeneity was used to test each sub-scale in the instrument. A factorial analysis of variance (ANOVA) was used on the A/B and C scale scores with subgroups based on GENDER, LOCALE, EDUCATION, and CONCEPT. Lastly, a simple correlation analysis was completed to assess the linear relationship between the (dependent) A/B sub-scale scores and the C scale scores.

Summary

This Chapter described the design and methods of the study, Pupils' Attitudes Toward Technology in Botswana. Included in this section was specific reference to the scope of the study, population and sampling, the timeline, modification and revalidation of the instrument, data collection and analysis of the data.

The aims of the study were to develop an instrument for use in Botswana that could be applied to a population of 800 Form 5 pupils. The analysis of the data procedure was formulated to test the pilot questionnaire for reliability and validity. All analysis procedures focused on producing contributive findings to the main research question and sub-questions stated within the scope of the study.

Chapter Four

The Results of the Study

Introduction

In Botswana, the primary and senior secondary school year begins in mid-January and ends with a final exam period just before early December. Interim breaks are taken in April and again in August. In consideration of the school calendar, plans and preparations for an administration of the instrument were set for October to November 1993. Selecting this particular time of year placed the administration of the questionnaire as close to the end of the academic year as possible.

In terms of surveying the Form 5 pupils, timing was crucial. It was felt that the effects of maturation would be reduced if the study was carried out at the end of the year. Secondly, it was assumed that data collected from the pupils would, in effect, be seen as a benchmark that reflected the attitudes and concepts of this particular cohort. Therefore, if such an attitudinal profile was to be produced, it was felt that the benchmark should reflect the totality of learning achievement within the entire twelve years of schooling and not less. Hence, the pilot test period would be forced to occur just prior to final exams and graduation. In senior secondary schools, October to November are months that normally were designated for academic revision and "mock" testing. Thus the decision was made to design a timeline that set the testing stage to coincide with the eight to ten week period just prior to final examinations.

Informally, a number of preparations were undertaken over the course of the first year. Among these was the purchase of a personal computer and statistical software. Also there were attempts to obtain funding for the proposed study. And throughout, the researcher conducted an informal assessment of individuals whose assistance in the project would be valuable.

All things considered, it was not until the 1993 school year had been in progress for some months, that the study too, was actually launched and pupils surveyed. An application for official government approval to carry out the project was filed in March of that year. Government permission to go ahead with the proposed PATT research was given in a letter from the Office of the President dated May 3, 1993 (Appendix I).

A working group was identified to assist the researcher during specific stages of the research. The group was comprised mainly of educators whose areas of speciality and expertise offered valuable contributions to the outcomes of the project. The function of the group was to serve as an advisory board or panel. The members participated informally and often independent of one another. During these stages of the research members were called upon and assigned tasks that related to the following needs of the study:

- instrument design;
- data collection;
- data processing; and
- preliminary analysis of the data.

A complete list of individuals and their roles on the advisory panel is included in the Appendix J.

The months just prior to the closing of the 1993 school year provided the opportunity to administer the modified PATT-Botswana questionnaire. In total, 831 useable survey response forms were gathered and their data entered using a Macintosh LC computer and Fastat statistical software.

Results of the pilot study began to emerge during the early stages of analysis the following year, but were postponed until such time that a complete analysis would be carried out while in residence at Virginia Polytechnic Institute and State University.

The researcher took residence in the Fall of 1995 and resumed work. Owing much to the valued assistance and technical support from faculty and staff in the College of Education, and the SPSS 6.1 software (PowerMac version), the analysis was eventually completed and results were produced in the Spring of 1996.

The Procedure

The Advisory Group

Particular stages of the procedure called for specialized expertise in areas beyond the skills of the researcher. Modifying and designing the Botswana instrument was the first such stage to require assistance from a team of local colleagues.

The types of skills and/or special background needed for the tasks of modifying and validating the instrument were numerous. Initial planning for a group of advisors began with a pool of locally based individuals whose expertise in various fields lent support for the research endeavor. Firstly, the task of adapting the instrument to a social climate in southern Africa called for assistance from people with specific cultural perspectives, expertise in regional linguistics, an understanding of the student population and strong familiarity with the senior secondary education system.

Secondly, the task of validating the instrument required expertise in a variety of statistical applications. The process also called for persons with experience in data collection, and data analysis.

The initial search targeted local groups that were recognized for the skills or backgrounds outlined. These groups included education officials, teachers in the field of technical subjects as well as mathematics, science, English, and social studies, and experts in the field of quantitative research and analysis.

Information describing the aims of the proposed PATT study was mailed or delivered to potential candidates affiliated with the following institutions: (See Appendix J)

The Ministry of Education - Department of Technical Education, CEO Design and Technology, Gaborone;
The National Institute of Research - Director, Gaborone;
University of Botswana, - Office of the Vice-Chancellor, Departments of Maths, Science, and Social Studies, Gaborone;
Botswana Polytechnic - Department of Design and Technology, Gaborone;
Molepolole College of Education - Departments of Design and Technology, English, Maths, Science and Social Studies, Molepolole.

The initial contact helped narrow the field. Nearly all those who replied early expressed an interest in the outcomes of the research proposal. Some recipients endorsed others as they themselves declined. But, after a second round of informal meetings and discussions, a panel was formed. Most on the panel were directly involved in education and teaching. Most importantly, the final selection was made from individuals who shared interest in, and commitment to the research endeavor.

The Modified PATT Instrument

Plans were made during the conceptual phase of the study to assess the feasibility of using the (English) version of the Dutch PATT instrument. The instrument taken to Botswana was identical to the one used to study American pupils. (Bame and Dugger, 1989) The concern for the level of competency in English among Form 5 Batswana pupils was not viewed as a problem. Although English was a second language for most, its status as the nation's official language is supported by official policy mandates that require schools to consider English as the medium of instruction in all levels of secondary education and beginning in primary level four. Therefore, it was assumed that pupils enrolled in secondary school, and particularly those at senior secondary levels, were competent in English. Having prior experience teaching at the senior level, the language concerns of the researcher were directed toward distinctions drawn between American-English and the more familiar British style spoken in Botswana.

It was felt that there was a need to explore distinctions between American-English used in the translated instrument, and "the Queens" or British-English typically used throughout the region. This consideration took on some merit as assessments were being made over individual items within the questionnaire. Pupils who were "products" of a curriculum founded on textbooks printed in the U.K., also learned English through lessons that were designed to teach the British vernacular. For the most part differences were small but, adaptations were nevertheless required before it was felt that the questionnaire could be administered. For much of the instrument used in Botswana, little beyond changes in expressions, spelling, and word substitutions were made.

The most noticeable modification was made within the demographic section on the questionnaire. An additional set of questions was included to improve the quality of data about pupils educational backgrounds. Interest was raised to determine the range of technology subjects that pupils chose outside their core requirements. Tailoring the questionnaire in this way was seen as a valuable step toward gaining a clear picture about pupils' technological experience and their preferences. In modifying the questionnaire, the instrument also offered the utility to record the history of technology subjects taken by pupils sampled in the study. In this regard, the practical value of the questionnaire can be extended to technology educators wishing to quickly assess the backgrounds of incoming pupils and their course history. Appendix K contains the modified questionnaire.

The role of the advisory panel throughout the modification stage was to serve as a review team. General instructions to members were focused on drawing out comments specific to weaknesses or problems in filling out the form. Reviewers received a draft questionnaire and were expected to provide feedback regarding the following aspects:

- overall readability with respect to the target group,
- grammatical and contextual structure of statements,
- terminology,
- spelling, and
- response options.

Specific tasks were also assigned. For example, the first round of reviews were undertaken to consider the USA questionnaire for its appropriateness in Botswana. Where personal expertise in a particular area existed (ie. the Design And Technology teacher, the Form 5 English teacher, the Science teacher, etc.), individuals would be instructed to take charge of aspects that fell within the realm of their speciality.

Overall, the reviewing process worked well. Members of the panel felt that after three rounds the questionnaire was suitably adapted to the reading and comprehension levels expected from Form 5 pupils. In the end it had served to modify the questionnaire and subsequently lead to a version of the instrument that was well aligned with Botswana's specific conditions.

<u>Preliminary Trial Testing of the Modified Questionnaire</u>

Administration of the modified instrument was first trial tested at Molepolole College of Education (MCE). Groups selected for administrative trials were term one, first year, Design and Technology students. These students were generally two to three years older than average Form 5 pupils, and generally possessed no additional formal education. College entry requirements for the 1993 incoming Design and Technology (major) students (recruited in 1992) were typically less stringent than other college academic programs. However, students who overall, did poorly in Form 5, were not recruited. Also most of the MCE students had spent the period of time between graduation and entering college, participating in national service. Some had held jobs while many remained home applying to various tertiary and vocational schools.

The administration trials revealed useful information.

- First, students reported that the readability of the questionnaire matched levels they were familiar with in Form 5 settings.
- Second, after completing the form, many remarked that they felt it was long. The normal duration was 30-40 minutes to complete. Because it was long some felt that items interpreted as being similar should be removed. Others gleefully warned that some Form 5 pupils might only pretend to complete the entire questionnaire and return it partially or incorrectly intact.
- Thirdly, several who participated were observed skipping ahead to the fill-in sections before attempting to complete the essay section at the beginning.

Outcomes of the trials proved valuable. Adjustments were made in terms of verbal and written instructions for field administration. Beyond these adjustments, it was clear that instructions alone would not adequately boost efforts to gather reliable data.

Additional strategies were devised to help ensure complete and accurate sets of data. One strategy was designed to provide incentives for completing the questionnaire. A pencil and eraser were offered as tokens for carefully completed forms. Another measure was more direct. During the administration the researcher would be sure to include in his announcements that: the activity would be monitored closely; and that pupils would be released one at a time, only after their questionnaire had been inspected for evidence of thorough attention. Appendix K contains the instruction form used in the pilot administration.

The Subjects

Schools where administration of the modified instrument was to be carried out were randomly selected. In all practicality, the location of the school played a significant role in determining which schools were accessible. Give the financial limits of the study and considering special transportation and other costs associated in reaching the most remote senior secondary schools; two rural schools were scratched from the list (Kang and Moeng). In consideration of the numbers of schools in urban settlements, limits were placed on the selection of four schools from a pool totaling seven (Refer to Table 4.0 in Chapter Three)

The following criteria was used to assist in the selection of senior secondary schools:

- Location: being located either in an identifiably urban setting or rural setting.
- Official information: some schools maintain large numbers of boarding students. Official information helps to eliminate the problem of misrepresentation in cases where some rural schools house large numbers of urban pupils who were not able to find placement in crowded urban schools. (Shashe River and Tutume)
- Accessibility: Unfortunately not all schools are located at the end of a smooth tarred road. Some of the more remote rural schools are difficult to reach without a dependable four wheel drive vehicle. Also, at least one school in a remote area still depends on short wave radio for communication. (Kang and Moeng)
- Number of distinctly urban communities: The number of schools in Botswana with student bodies that, when considered,

actually live in urban communities is an obvious limiting factor. Gaborone and Francistown, the nation's two cities, contain at least five urban senior schools. The problem with defining schools in rapidly modernizing communities is that peri-urban communities are not necessarily *urban* communities but rapidly modernizing *traditional towns*. It becomes necessary to limit selection of urban school sites to primary industrial and commercial centers. Among these centers, Francistown, Gaborone, Lobatse, and Selebi-Phikwe are officially identified as primary, urban centers. (See Table L-1 in Appendix L).

Two pools combining nineteen total schools were used to draw the eight needed in the study. One pool of twelve rural schools was used to draw the four that were required. A second pool of seven urban schools produced the four urban schools needed in the study. Of the eight schools selected, four were located in urban communities and four were located in communities identified as rural. Table 5.0 shows the schools used in the research model.

School officials were contacted and informed about the selection of their schools in the PATT-Botswana study. School officials responded positively to requests for participation of their schools in the pilot test as well as the sampling of students during the questioning session. (See Appendix L) School officials also assisted in organizing and assembling pupils assigned to the sample.

Timing was a critical concern of the researcher and with officials. Pilot testing was timetabled closely with the end of the academic year. In the case of this study, timing was designed into the model to emphasize the culmination of pupils' primary and secondary school experiences. A timetable is produced in Appendix L. Within days of concluding the field tests, schools began year-end testing.

It was estimated that roughly 100 pupils would be sampled from each school. It was also hoped that the numbers of pupils sampled from schools classified as urban, would equal the numbers generated from rural school samples.

Table 5.0

Number and Classification of Schools Representing the Sample

School	Location	Classification
Francistown S.S.	Francistown	Urban
Gaborone S.S.	Gaborone	Urban
Lobatse S.S.	Lobatse	Urban
Naledi S.S.	Gaborone	Urban
Kgari Sechele S.S.	Molepolole	Rural
Matshekge Hill S.S.	Bobonong	Rural
Maun S.S.	Maun	Rural
Moshupa S.S.	Moshupa	Rural

The Results of the Field-Tests

The Analytical Model

Analysis of the instrument consisted of:

1. a frequency analysis on all measurable variables including the key words in the essays;
2. a cross-comparison on total sample demographic variables;
3. a factor analysis (Principle Components Method) of the Affective/Behavior (A/B) instrument to assess the validity of the A/B sub-scales in the modified instrument;
4. a reliability analysis using Cronbach's alpha for homogeneity for each of the A/B and Cognitive (C) attitude sub-scales,
5. a factorial (ANOVA) analysis of the independent variables GENDER, EDUCATION, and LOCALE on the dependent A/B and C sub-scale scores; and,

6. a correlation analysis of the independent variable CONCEPT on the A/B sub-scale scores.

From the schools located in rural communities, 435 completed instruments were received. The schools in urban communities produced 396 useable instruments. Table 6.0 illustrates an initial breakdown of the sampled population.

Table 6.0

Number of Rural and Urban Pupils in the Sample by Gender

Pupils	Boys	Girls	Total
Pupils from rural settlements	278	192	470
Pupils from urban settlements	211	141	352
Total			**831**
Missing			9

The PATT-Botswana Instrument

The instrument used in Botswana contains five sections. It begins with instructions that ask the respondent to write a short description of what he/she believes technology is. This section is followed by five questions that ask which, if any, of the practical school subjects (listed) have the pupil taken. For those who respond having taken none of the subjects listed, space on the questionnaire is provided to write a short statement explaining why he/she has not taken any of the subjects. The next section contains fourteen questions to gather demographic data about the respondent.

The remainder of the questionnaire contains sections nearly identical to those in the PATT-USA instrument. The attitude scale in section four, is made up of 57 statements that rely on a five-part Likert scale for response. The last section contains the 31 concept scale items. In their response, pupils choose from a range of options that vary from **Agree** to **Disagree** to **Don't Know**.

The Affective/Behavior Attitude section in the Dutch model according to de Klerk Wolters originally produced six scales:

- Interest - The extent to which pupils would like to be involved in technically oriented activities outside school.
- Role Pattern - The extent to which girls and boys are suited for technology as training and profession.
- Consequences - The economic, social, and political effects of technology
- Difficulty - The difficulty and accessibility of technology as a school subject, the way it is experienced by pupils.
- School - The position of technology in the school curriculum.
- Career - The pupils' view on a career in technology. (1989, p.53)

The Cognitive Attitude section was designed originally to measure four separate scales. De Klerk Wolters describes each in the list below:

- Society: Technology is directed and controlled by man and intervenes in all parts of society.
- Science: The difference between technology and the natural sciences and their mutual differences.
- Skills: To design (creativity) and practical skills are part of technology.
- Pillars: There are three pillars or dimensions in technology: matter, energy, and information. (1989, p.59)

Demographics - Describing the Sample

Data collected from a total of 831 useable questionnaires provided the basis for the information that follows. Of the 831 subjects that participated in the field tests, 493 (59.5%) were boys and 335 (40.5%) were girls. (Three people did not respond to this item.) All were enrolled in the Form 5 senior secondary level. (Table 7.0)

Table 7.0

Number of Form 5 Pupils in the Sample by Gender

Pupils	Boys	Girls	Total
Respondents to sex identification	493	335	828
Total			**831**
Missing			3

The ages of nearly half (49.1%) of the pupils were nineteen years or older. The figures indicated that the numbers of pupils in this age range was larger than expected based on the literature review. Boys made up 63.7% of this group. The percentage of boys whose ages were eighteen and under was 47.2%. In comparison, 66.0% of girls were ages eighteen and under. The eighteen year old group for both boys and girls made up 35.5% of all pupils sampled. The expected range in ages was initially predicted between 16-18. (Table 8.0)

Table 8.0
Number of Form 5 Pupils in the Sample by Age and Gender

Age of Pupils	Boys	Girls	Total
Less than or equal to 15	1	0	1
Age 16	7	11	18
Age 17	56	51	107
Age 18	167	125	292
Age 19 or more	258	147	405
Total			**823**
Missing			8

One question asked, "Was most of your life spent in a rural or urban area?" Six pupils did not respond to the question. The number of pupils who reported spending most of their lives in a rural area was 472 (57.2%). Urban received 353 (42.8%) responses. The distribution showed fewer urban responses than were anticipated. Having twenty five percent more rural pupils was viewed as an indication that more rural pupils are enrolled in urban schools than was assumed. (Table 9.0)

Part of this section contained six questions that were included to gather information about the pupils' technological climate at home. These items asked whether there was piped water in the home; if there was electricity; if any homes had a radio, telephone, television, calculator, and computer. Also, pupils were asked whether or not their home had a workshop to build things in or make household repairs. Analysis on the frequencies of these items revealed that 72.0% of all homes had piped water, 29.0% of homes had electricity, 94.9% of pupils' homes had either a calculator or radio, 32.9% of pupils responded to having a telephone in the home, televisions were

Table 9.0
Number of Form 5 Pupils in the Sample by Locale

Pupils	Rural	Urban	Total
Respondents to settlement identification	472	353	825
Total			**831**
Missing			6

recorded in 43.5% of households, and computers were reported in only 4.8% of homes. Pupils with workshops in the home accounted for 8.4% of those surveyed. (Table 10.0)

Table 10.0
Items Indicating the Technological Home Environment

Indicator	Yes, pupil has	Does not have	Total
Running Water	591 (72.0%)	230 (28.0%)	821 (100%)
Electricity	238 (29.0%)	582 (71.0%)	820 (100%)
Radio/calcu-lator	788 (94.9%)	42 (5.1%)	830 (100%)
Phone	273 (32.9%)	557 (67.1%)	830 (100%)
TV	358 (43.5%)	465 (56.5%)	823 (100%)
Computer	39 (4.8%)	770 (95.2%)	809 (100%)
Workshop	69 (8.4%)	755 (91.6%)	824 (100%)

Note: Cases reported do not always illustrate logical patterns of consistency. For example, 29% of pupils reported having electricity in the home while 43.5% report having TV. Though the data at first suggests discrepancies, the researcher believes this is due to broader interpretations of the question items rather than inaccuracy. It is likely that pupils in some cases reported having a TV in a family member's home and not necessarily within the pupil's immediate home. Another explanation might include the condition where "home" includes several family dwellings. This later condition is much more common place within the social structure of Botswana than in western societies. Hence, responses can be interpreted to emphasize the customary structure and importance of the extended family system.
Note also that the category representing the highest proportion of positive response (radio/calculator) illustrates only that these examples of affordable, relatively high tech products, not requiring household electricity, are available to virtually all pupils.

Pupils were asked if they would be likely to choose a technical job as their life's work. The results showed that 65.8% of pupils indicated they would choose a technical career. When asked if a family member was working in a technical job or studying for one, 55.9% of pupils declared that someone in the family was involved. Pupils were then asked to identify the member(s). The member most frequently reported as being involved in studying for, or working in a technical job, was the brother (42.0%). This can be contrasted with 6.9% of fathers being identified and 1.3% of mothers. "Other" ranked second in member's involvement with a 31.3% response. (Table 11.0)

In the section created to gather data about pupils' coursework history, respondents provided information about which practical subjects each had taken. The numbers showed that Technical Drawing was most frequently selected by pupils in the sample (315 pupils). The practical subject least selected was Technical Studies (115 pupils) followed closely by Metalwork (122 pupils). The aggregate of pupils who reported taking one or more of the listed practical subjects was 485 pupils (59.1%). A breakdown of individual and aggregate enrollment figures appears in (Table 12.0).

Table 11.0
Do you think you will you choose a technical job for your life's work?

Value	Number	Percent
Yes	539	65.8
No	280	34.2
Total	819	100

Do you have a family members working in a technical job or who are studying for it?

Value	Number	Percent
Yes	463	55.9
No	365	44.1
Total	831	100

Table 11.0 continued

If you answered YES above list those that are working or studying in technology.

Value	Number	Percent
Father	32	6.9
Mother	6	1.3
Brother	196	42.0
Sister	20	4.3
Other	146	31.3
More than one	67	14.3
Total	467	100

Table 12.0
Technology Subjects Survey

Subject	Value	Number	Percent
Have you taken or are you taking Woodwork?	No	593	71.4
	Yes	237	28.6
	Total	830	100
Have you taken or are you taking Metalwork?	No	706	85.3
	Yes	122	14.7
	Total	828	100
Have you taken or are you taking Technical Drawing?	No	516	62.1
	Yes	315	37.9
	Total	831	100
Have you taken or are you taking Technical Studies?	No	712	86.1
	Yes	115	13.9
	Total	827	100
Have you taken or are you taking Design and Technology?	No	532	64.3
	Yes	296	35.7
	Total	828	100
Pupils With a Practical Subject History vs. Pupils With No Prior Attendance in Practical Subjects.	1 or more	485	59.1
	0 classes	336	40.9
	Total	821	100
Breakdown of Numbers of Practical Classes Taken by Pupils	0 classes	336	40.9
	1 class	197	24.0
	2 classes	127	15.5
	3 classes	78	9.5
	4 classes	38	4.6
	5 classes	45	5.5
	Total	821	100

Another section of the instrument asked for statements from those pupils who had not taken any of the itemized subjects. Pupils were required to state the reason(s) why each had not enrolled in one of the practical courses. Categories were drawn from a sample of 200 questionnaires that contained reasons for not taking technology subjects. Of the 831 pupils who completed the survey, less than half (336) had not taken technology subjects throughout their junior and senior secondary education. Categories that emerged from a review of this groups' responses are listed in Table 13.0.

It is important to note that the most frequently stated reason for NOT taking technical subjects in school appears to be at least in part, related to gender. The largest portion of pupils who reported that technical subjects were not available to them were girls. It was repeatedly mentioned that ...'these subjects were not available to girls'. Fewer pupils identified... 'a lack of facilities or teachers'... as reasons of unavailability.

The written descriptions of technology that were produced revealed important information about pupils' conceptual knowledge. It was determined that written data should be categorized and available for analysis in conjunction with the concept scale information. Therefore, each of the questionnaires containing pupils' definitions required re-coding. The method used to categorize individual responses required a search for key words and careful interpretation of content and meaning. First, a sample of 200 questionnaires was read to determine whether it was possible to find similarities in the ways pupils responded to the definition section. The review revealed up to twenty distinct response categories. These are listed in Table 14.0.

Table 13.0

WHY PUPILS HAVE CHOSEN NOT TO STUDY TECHNOLOGY SUBJECTS?

Attribute	Number	Percent
Subject not available (to girls or lack of facilities/teacher)-	82	23.9%
Subject is too difficult/complicated-	67	19.5%
No interest-	65	19.0%
Preferred other optional subjects-	53	15.4%
This subject is meant for boys-	47	13.7%
Lacking ability in skills-	34	09.9%
Understands little about it-	24	09.9%
Career goals do not require technology-	19	05.5%
Subject is not useful or not considered important-	11	03.2%
Requires special knowledge or "know-how"-	10	02.9%
Total	*342	(100%)

*Note: 342 pupils responded to this statement although actual figures show that 336 pupils responded as not having taken any of the practical subjects listed in the questionnaire. The numbers in the right-hand column correspond with the numbers of pupils who expressed similar reasons for not taking technology subjects in the past. Many of the responses revealed more than one aspect. Thus, in some cases, multiple categories could be applied toward pupils' statements. However no more than four categories were found to apply toward any single description. A frequency table has been inserted below as a continuation of Table 13.0 totaling the number of categories applied to responses:

Table 13.0 continued
The Number of Categories Applied to Responses

Number of responses	Number	Percent
No response to this question	489	58.8%
One categorical response	276	33.2%
Two categorical responses	63	7.5%
Three categorical responses	2	0.24%
Four categorical responses	1	0.12%
Total	831	(100%)

Table 14.0
PLEASE WRITE A SHORT DESCRIPTION OF WHAT YOU THINK TECHNOLOGY IS:

Categorical Response	Number
An improved way of doing things (affecting life /comfort /nation/development)	271
Involves problem solving/imagination/ideas/designing	206
Related to science (or math)	187
Involves making things for one's self or consumer products	171
Involves working/using machines or tools	163
Related to livelihood/job/work (the human environment or social order)	96
Involves working with hands	79
Requires skills or talent or special knowledge	67
Learning about modern things	66
Utilizes natural materials or resources (working with)	61
Doing things (unqualified)	61
Related to engineering/mechanics/(industrial application ie. mass production)	59
Requires an understanding of how things work	51
Involves working with computers or information	44
Involves working with metal	25
Repairing things	16
Involves working with wood	16
Related to electronics	16
Involves working with plastic	5
Has negative impacts	5

Note: the numbers to the right of the Categorical Response reveal the numbers of respondents whose definition contains meaning or content which is closely related to the categorical heading. Many respondents' descriptions appeared to "fit" into more than one single category. Thus, in many cases, multiple categories were applied to pupils' descriptions. However, no more than five categories were found to apply toward any single description. A frequency table has been inserted as a continuation of table 14.0 below totaling the number of categories applied to responses:

Table 14.0 continued
The Number of Categories Applied to Responses

Number of responses	Number	Percent
No response to this question	15	1.8%
One categorical response	240	28.9%
Two categorical responses	361	43.4%
Three categorical responses	167	20.1%
Four categorical responses	38	4.5%
Five categorical responses	10	1.2%
Total	831	(100%)

The most frequently stated description of technology appeared to be in relationship to improved ways of doing things (271 responses). Pupils stated that better ways of technology affect life, comfort, the nation and its development. This description was in contrast with one stating that technology has negative impacts (5 responses). There were 206 pupils who responded to the description by stating that creative problem solving was a characteristic of technology. The third most frequently used description of technology included science as part of the statement.

Cross Comparisons on Demographics

Explorations of cross comparisons on demographic characteristics were carried out to determine if responses differed between those given by boys and girls in the study. (A comprehensive listing of Chi-Square tables is featured in Appendix M) The first comparison between gender, and age of the respondents, (Table 15.0) showed there was a larger proportion of boys in the older age groups. In age groups of younger pupils, girls began to make up larger proportions.

Table 15.0
How old are you?

Gender	15 or less	16 yrs.	17 yrs.	18 yrs.	19 or more	Total
Boys	1	7	56	167	258	489
Girls	0	11	51	125	147	334
Total	1	18	107	292	405	823

Chi-Square = 9.73, $p < .05$

Comparisons were also explored to assess whether patterns of enrollment in technology subjects differed between genders. In a series of cross comparisons, (Table 16.0 through Table 20.0) boys consistently out-proportioned girls in technology subjects.

Table 16.0

Have you, or are you taking Woodwork?

Gender	No	Yes	Total
Boys	300	192	492
Girls	291	44	335
Total	591	236	827

Chi-Square = 65.5, $p < .01$

Table 17.0
Have you, or are you taking Metalwork?

Gender	No	Yes	Total
Boys	386	104	490
Girls	317	18	335
Total	703	122	825

Chi-Square = 39.7, $p < .01$

Table 18.0
Have you, or are you taking Technical Drawing?

Gender	No	Yes	Total
Boys	223	270	493
Girls	292	43	335
Total	515	313	828

Chi-Square = 149.1, $p < .01$

Table 19.0

Have you, or are you taking Technical Studies?

Gender	No	Yes	Total
Boys	396	95	491
Girls	314	19	333
Total	710	114	824

Chi-Square = 31.0, $p < .01$

Table 20.0

Have you, or are you taking Design and Technology?

Gender	No	Yes	Total
Boys	260	230	490
Girls	270	65	335
Total	530	295	825

Chi-Square = 65.7, $p < .01$

Table 21.0 provides an interesting look at enrollments. The figures show that 80.5% of the boys have taken at least one or more technology subjects in school. Girls numbers in comparison illustrate less than thirty percent (28.2%) ever enrolled in one or more technology subjects in school. Table 22.0 provides a further look into the breakdown of enrollments. The table reveals that 8.7% of the girls took more than one technology class. Boys who enrolled in more than one class totalled nearly half (49.9%). Design And Technology was the class most frequently attended by girls (65 pupils,19.4%). The cell sizes in all other classes attended by female pupils are below 45, (13.%). The sample sizes of males in technology classes range from 95-270, (19.3%-54.8%). The small cell size for girls in technology subjects makes further analysis between boys and girls less reliable. Clearly, boys seemed to be more attracted to technology subjects than girls.

Table 21.0

Relationship of pupils who have enrolled in one or more technology classes with those who have had no such classes.

Gender	No	Yes	Total
Boys	260	230	490
Girls	270	65	335
Total	530	295	825

Chi-Square = 218.6, $p < .01$

Table 22.0

The relationship of the numbers of pupils who have enrolled in one or more technology subjects with those who have had no such classes and with each other.

Gender	No Classes	1 Class	2 Classes	3 Classes	4 Classes	5 Classes	Total
Boys	97	146	107	63	37	35	485
Girls	239	50	18	15	1	10	333
Total	336	196	125	78	38	45	818

Chi-Square = 227.5, $p < .01$

A different set of questions attempted to assess whether pupils believed they would pursue a technical career and if a relationship existed by having other family members involved in technical fields. The comparison of responses by gender, showed that 81.4% of the boys thought they would choose a technical job while 42.4% of girls felt they would (Table 23.0). The next question in the series asked pupils to state if a family member was working in a technical job or studying for one? Responses proved that little evidence could be produced to show that a correlation exists (Table 24.0). Of roughly half the pupils who said they had family members involved in technical work (56.0%), boys and girls were split evenly (boys=54.3%, girls=58.6%). The largest proportion of this segment of the population reported having a brother in a technical field (boys= 41.3%, girls= 43.1%). A detailed illustration is presented in Table 25.0.

Table 23.0
Do you think you will choose a technical job for your life's work?

Gender	No	Yes	Total
Boys	397	91	488
Girls	139	189	328
Total	536	280	816

Chi-Square = 132.2, $p < .01$

Table 24.0

Do you have family members who are working in a technical job or who are studying for it?

Gender	No	Yes	Total
Boys	267	225	492
Girls	195	138	333
Total	462	363	825

Chi-Square = 1.5

Table 25.0

If you answered YES above, list those who are working or studying in technology.

Gender	Father	Mother	Brother	Sister	Other	More than 1	Total
Boys	20	5	112	11	81	42	271
Girls	12	1	84	9	64	25	195
Total	32	6	196	20	145	67	466

Chi-Square = 2.9

*Cells with expected frequency < 5 - 2 of 12 (16.7%)

A different question searched to find if a relationship existed in the number of technology subjects taken by pupils who responded positively to choosing a technical job. The Table 26.0 shows that most who favored a job in a technical field, have also enrolled in at least one or more technology subjects. Still, a quarter of those who said they would choose a technical job (24.5%) have avoided taking even one technology subject. A third of those who reported they would not choose a technical job (29.6%) have enrolled in one or more technology subjects.

The data suggests that a variety of interpretations are needed to explain these unexpected responses. The majority of pupils tend to support the assumption that interest in technology subjects is associated with having interest in technical jobs later on. This pattern of responses was seen in the data. Reasons for what appears on the surface as contrary behavior, could be explained by pupils having poor perceptions of technical career fields. Another might be that some pupils have had bad experiences in technology subjects at school.

Table 26.0

The relationship of wanting a technical job and enrolling in one or more technology classes

Wanting a Technical job	No classes	One or more	Total
Yes	130	400	530
No	197	83	280
Total	327	483	810

Chi-Square = 159.8, $p < .01$

The section of the questionnaire designed to collect demographic information about pupils' technological climate at home, the type of community each was raised in, and so on, revealed interesting and useful data. First, pupils were asked to classify their backgrounds as either being rural or urban. The proportions of boys and girls from similar backgrounds was striking. In total, the largest proportion of pupils was reportedly rural (57.2%). In this regard, the data closely follows statistics found in official source estimates. In 1994, populations in urban settlements had reached an estimated 39% of the total (Ministry of Finance and Development Planning, 1991). However, the proportion of rural boys (59.1%) and rural girls (40.9%) seemed to match the proportion of boys (59.9%) and girls (40.1%) sampled with urban backgrounds (Table 27.0). Therefore, while the sample produced equal proportions of boys and girls with similar backgrounds, boys accounted for larger proportions when compared to girls.

Table 27.0
Gender

Locale	Boys	Girls	Total
Rural	287	192	470
Urban	211	141	352
Total	489	333	822

Chi-Square = 0.05

The method of selecting schools for the sample produced satisfactory results. Generally, the type of community surrounding senior schools proved to be a fairly reliable indicator of the backgrounds students represented. Schools in communities identified as urban or rural, typically produced four fifths of the target populations in most cases. Table 28.0 illustrates how rural schools and urban schools each produced an average four fifths population that was representative of the respective school.

One case, Lobatse, presented an exception. Its school was classified as being located in an "urban" settlement. However its school produced more rural pupils than were expected (43.9%). One explanation for this is that the town is an example of a settlement that was created to support a promising new cattle export industry. In this case, Lobatse can be seen as an economic enclave that developed somewhat independently within a larger rural area.

A survey of technology in the home consisted of assessing various levels of living standards. Many items in the survey were associated with conventions of modern living. The aim of the survey was not an attempt to extend empirical meaning to the hypothetical concept of modern technological living, but rather to establish levels of accessibility (at home) to what many would consider to be *current technologies*.

Table 28.0
School (r=Rural & u=Urban)

Locale	KSII r	GSS u	Mosh r	Lobot u	Naled u	Maun r	Mats r	FSS u	Total
Rural	76	29	102	47	10	77	108	23	472
Urban	21	110	21	60	41	18	11	71	353
Total	97	139	123	107	51	95	119	94	825

Chi-Square = 281.0, $p < .01$

The survey included an assessment of amenities such as water and electricity, a home workshop, radios, televisions, telephones, calculators and computers. Tables 29.0 through 35.0, present the precise break downs according to these figures. A summary of these cross-comparisons shows that living in an urban settlement doubles the likelihood of having such things as electricity in the home, a telephone, and a TV, over living in a rural community. Of the pupils who had computers at home (4.7%), those in urban settlements were three times more likely to have one than their rural counterpart. Cross-comparisons on homes without running water, again, favored the urban household nearly three to one. Most people did not have a home workshop (91.6%). Those that did were fairly evenly distributed across the two locations. Lastly, radios and calculators were the most widely shared technological device (94.9%). Even with such saturation, those without a radio or calculator were twice as likely to belong to rural communities. The results of this analysis suggests that location and background is strongly linked to differences in the levels of technological exposure one finds at home; and that the technological climate for pupils with minimal levels of exposure to current technologies, unfortunately weighs more heavily against rural communities.

Table 29.0
Is there piped water throughout your home?

Locale	Yes	No	Total
Rural	294	172	466
Urban	291	58	349
Total	585	230	815

Chi-Square = 40.5, $p < .01$

Table 30.0

Is there electricity in your home?

Locale	Yes	No	Total
Rural	72	392	464
Urban	162	188	350
Total	234	580	814

Chi-Square = 92.2, $p < .01$

Table 31.0

Is there a radio or calculator in your home?

Locale	Yes	No	Total
Rural	433	38	471
Urban	349	4	353
Total	782	42	824

Chi-Square = 20.1, $p < .01$

Table 32.0

Is there a telephone in your home?

Locale	Yes	No	Total
Rural	90	381	471
Urban	179	174	353
Total	269	555	824

Chi-Square = 91.6, $p < .01$

Table 33.0

Is there a television in your home?

Locale	Yes	No	Total
Rural	109	359	468
Urban	244	105	349
Total	353	105	817

Chi-Square = 177.1, $p < .01$

Table 34.0
Is there a computer in your home?

Locale	Yes	No	Total
Rural	9	453	462
Urban	29	312	341
Total	38	765	803

Chi-Square = 18.7, $p < .01$

Table 35.0

Do you have a home workshop to build things or make household repairs?

Locale	Yes	No	Total
Rural	32	437	469
Urban	37	313	350
Total	69	750	819

Chi-Square = 3.6, $p < .05$

The analysis returned to the question concerning pupil's choice in a technical career when coming from a rural, versus an urban, background. The data in Table 36.0 shows that there is no significant difference between rural and urban pupils in responding positively to this question. The same is true among pupils who stated they would choose a technical career when examining the relationship of having another family member working in technology. Data in Table 37.0 points out that the difference is less than 5%. Although the difference is not significant, it is interesting that the difference tends to favor rural pupils rather than urban ones.

Table 36.0

Do you think you will choose a technical job for your life's work?

Locale	Yes	No	Total
Rural	301	164	465
Urban	234	115	349
Total	535	279	814

Chi-Square = 0.47

Table 37.0

Do you have family members who are working in a technical job or who are studying for it?

Locale	Yes	No	Total
Rural	239	232	471
Urban	221	130	351
Total	460	362	822

Chi-Square = 12.2, $p < .01$

The last set of cross-comparisons pursued the investigation of pupils' rural or urban background by considering relationships in the types of technology subjects most frequently selected. Here the data show that from the list of five technology subjects, there is no significant difference between urban and rural pupils in their preference for choosing to study Design and Technology, Woodwork, or Metalwork (Tables 38.0, 39.0, and 40.0). The proportions of pupils who had reported taking the three subjects is however, relatively small, 36%, 28%, and 15% respectively. The data further indicate that geographical characteristics were apparent in relationship with pupils' choices in studying Technical Studies and Technical Drawing. In each of these two circumstances higher than expected numbers of urban pupils opting for these subjects were observed when compared to rural pupils (Tables 41.0 and 42.0).

Table 38.0

Have you taken, or are you taking Design and Technology?

Locale	No	Yes	Total
Rural	300	170	470
Urban	228	124	352
Total	528	294	822

Chi-Square = 0.1

Table 39.0
Have you taken, or are you taking Woodwork?

Locale	No	Yes	Total
Rural	343	129	472
Urban	247	105	352
Total	590	234	824

Chi-Square = 0.6

Table 40.0

Have you taken, or are you taking Metalwork?

Locale	No	Yes	Total
Rural	411	59	470
Urban	290	62	352
Total	701	121	822

Chi-Square = 4.1, $p < .05$

Table 41.0

Have you taken, or are you taking Technical Studies?

Locale	No	Yes	Total
Rural	423	48	471
Urban	283	67	350
Total	706	115	821

Chi-Square = 13.3, $p < .01$

Table 42.0

Have you taken, or are you taking Technical Drawing?

Locale	No	Yes	Total
Rural	323	149	472
Urban	188	165	353
Total	511	314	825

Chi-Square = 19.7, $p < .01$

Factor Analysis of the Data and Construction of the Attitude and Concept Scales

The results that were produced throughout this phase of the study were based on replicated procedures found within the literature on PATT research. These procedures include:

- a factor analysis of the Affective/Behavior (A/B) Attitude scale items to determine the factor pattern of the data,
- a reliability analysis of the A/B scales by means of Cronbach's homogeneity coefficient, (alpha),
- development of the A/B scale scores based on the underlying factor structure,
- separation of the four 'characteristics of technology' items used to define the structure of the Cognitive (C) Attitude scales developed by de Vries and Raat (de Klerk Wolters, 1989),
- a reliability analysis of the C scales by means of Cronbach's homogeneity coefficient, (alpha), and
- construction of the C scale scores.

The factor analytical phase was important for a number of reasons:

1. its data-reduction capability formulated the basis for determining an underlying pattern of relationships within the data; and therefore made it possible to establish a smaller set of components that could be taken as source variables accounting for the observed interrelations of the data;
2, the use of factor analysis in PATT research provided a means to establish the validation of theoretical aspects of the attitude toward technology (construct validity);
3. factor analysis in combination with methods of data rotation enhance the degree of interpretability of the factors by revealing the percentage of explained variance accountable

to each component of the scale (as shown in the factor loadings); and

4. replicating the methods of analysis presented in other PATT studies offers greater comparability of the results found in Botswana with the results from other PATT projects.

In previous studies (ie., the USA-PATT and Dutch-PATT), the methodology combined Principle Components Analyses for extraction of the initial factors and varimax-rotation to maximize the variance of the squared loadings in each column (Bame and Dugger, 1989) and (de Klerk Wolters, 1989). Similar techniques were applied to the data gathered in Botswana. All individual items that combined to form groupings recorded factor loadings > 0.30.

The factor analysis indicated that four common attitude dimensions were present:

1. General Interest,
2. Technology as an Activity for Both Boys and Girls,
3. Consequences of Technology,
4. and The Perception of Technology as being Difficult.

In Table 43.0 the factor loadings are shown for each item.

The results of the factor analysis (Principle Components Analysis) clearly illustrated a structure that was logical and easy to interpret. The combined factors accounted for 30% of the total variance explained by the Affective/Behavior instrument. The relative measure of the amount of variance explained in the model appears to be low. Thus while the model provides a fairly clear picture of the commonality among factors, it seems that a sizeable proportion of unique variance is not explained. The first factor, 'General Interest' accounts for the largest proportion of variance (16.9%). The second factor, centering around gender related items, accounted for 6.1% of the variance. Factors three and four each only accounted for 3.5% of the variance. What appears to be reflected in the findings suggests that even though a clear pattern is present,

Table 43.0
Affective/Behavior (A/B) Scale

Item#	General Interest Sub-scale	Factor Loading
15	When something new is discovered, I want to know more about it immediately.	.33354
19	At school you hear a lot about technology.	.38127
20	I will probably choose a job in technology.	.77569
26	I like to read magazines *that are all about technology.*	.64382
31	I will not *think of taking* a job in technology.	.60574
37	If there was a school club about technology, I would certainly join it.	.73522
42	I would enjoy a job in technology.	.79848
47	I should be able to take technology as a school subject.	.58443
48	I would like a career in technology later on.	.70276
49	I am not interested in technology	.57859
53	There should be more education about technology.	.50292
54	Working in technology would be boring.	.52046
55	I enjoy repairing things at home.	.59969
59	Technology as a subject should be taken by all pupils.	.43033
65	Technology lessons help to train you for a good job.	.44487
66	Working in technology would be interesting.	.65643
67	I *would find it boring to spend free time doing things with technology.*	.51173
69	Technology is the *most important* subject of the future.	.50080
71	Not everyone needs technology lessons at school.	.40660
72	With a technical job your future *success* is promised.	.59616

Item#	Technology as an Activity for Both Boys and Girls Sub-scale	Factor Loading
16	Technology is *less* difficult for boys *than* it is for girls.	.60378
22	A girl can *easily get* a technological job.	.41589
27	A girl can become a car mechanic.	.40460
33	Boys are able to do practical things better than girls.	.71946
44	Boys know more about technology than girls do.	.71600
50	Boys are more capable of doing technological jobs than girls.	.74262
62	Girls prefer not to go to a technical school.	.30897
68	Girls think technology is boring.	.31756

Item#	Consequences of Technology Sub-scale	Factor Loading
17	Technology is good for the future of the country.	.48142
28	Technology is very important in life.	.57858
30	Technology lessons are important.	.53969
32	There should be *fewer radio and television* programs about technology.	.46012
51	*Using technology weakens a country's economic future*	.37001

Table 43.0 Continued

Affective/Behavior (A/B) Scale

Item#	Technology is Difficult Sub-scale	Factor Loading
24	You have to be intelligent to study technology.	-.43704
29	Technology is only for intelligent people.	-.51699
46	To study technology you have to be talented.	-.51995
52	You can study technology only when you are good at both *maths* and science.	-.50214
58	Technology does not need a lot of *maths*.	-.40679

there is no great amount of interdependency among variables within each factor.

Analyses using oblique rotations were carried out to investigate whether theoretically related attitude dimensions (e.g. consequences of technology in society and consequences of learning about technology in school) would reveal higher percentages of variance explained. These results produced proportions of explained variance nearly identical to the orthogonal analysis and a factor solution that again supported initial interpretations.

Hence, the final results report findings derived by means of the Principle Components Analysis and combined varimax orthogonal rotation. These methods are consistent with methods reported in other PATT studies.

The 'General Interest' factor clearly contained items that were homogeneous. Question items that were included in this category referred to aspects of technology in the formal world of school and careers, and also in the more intimate aspect of pupils' spare time. Combined, these items were interpreted to reflect a broad, general interest in technology. The second common factor, 'Technology as an Activity for Both Boys and Girls', represented a group of items that addressed the natural tendency of males and females to pursue work in technological areas. This category tended to centralize on social norms and role patterns. 'Consequences of Technology' is a third factor. This factor was comprised of items that were linked to feelings about the effects and consequences of living with technology amidst society. The fourth common factor was The Perception of Technology as being Difficult. This factor grouped items that expressed varying levels of difficulty associated with technological work and study.

Scores for pupils on the four Affect/Behavior sub-scales were calculated by summing across each of the sub-scale items, and then calculating the mean. The Figures 2.0 through Figure 5.0 show the distribution of pupils' scores on each of the scales. The five point Likert scale used in the instrument gives a general picture of how all the students in the sample reacted to the separate scales. The first example (Figure 2.0) shows that most pupils had a positive general attitude toward technology at home, at school and for careers. Figure 3.0 shows that responses to items centering on attitudes about gender roles and technology slightly favored a positive male-only bias. On the consequences items, (Figure 4.0) pupils generally felt that technology brings more positive consequences than bad ones. A bimodal distribution is the most outstanding feature of Figure 5.0. On the whole, pupils' responses were slightly more positive than negative. It seems that on items of general interest and consequences, there was at least a moderately positive view.

Interest in Technology at Home, at School, and for Careers

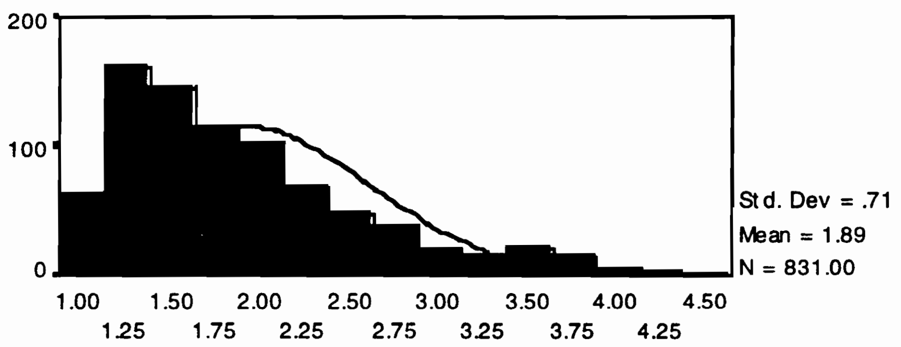
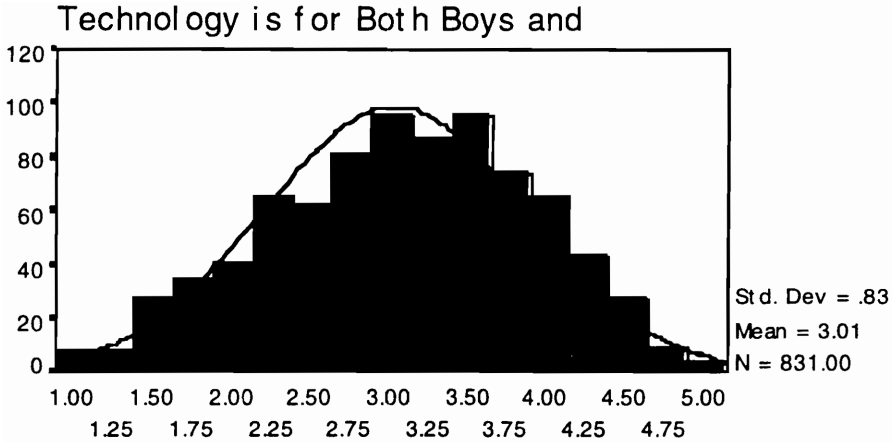


Figure 2.0 Shows scores on General Interest.

Low scores indicate pupils' positive general



<u>Figure 3.0</u> Shows scores on Roll Pattern.

Low scores indicate pupils feel it is for

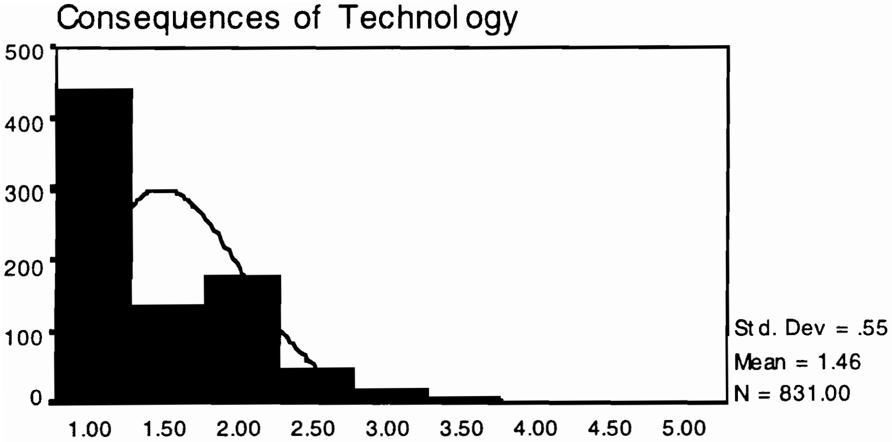


Figure 4.0 Shows scores on Consequences.

Low scores indicate pupils feel consequences are

Technology is

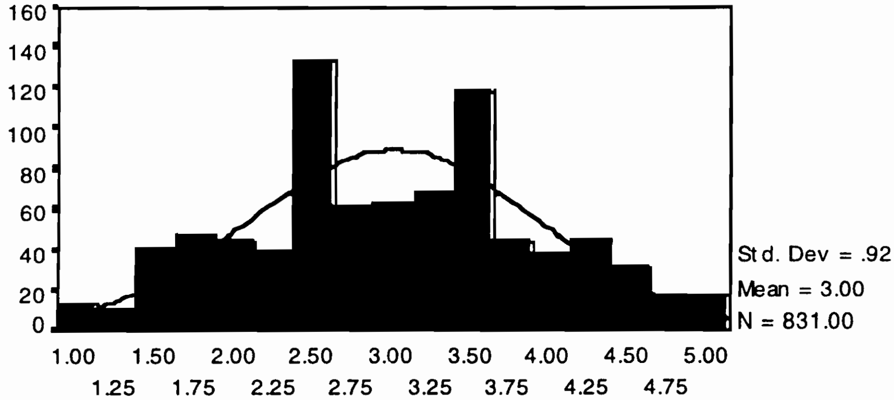


Figure 5.0 Shows scores on Difficulty.

Low scores indicate pupils feel it is

An analysis of reliability using these scores was carried out for the entire group of pupils and on each of the four factors. Cronbach's alpha was selected as the test measurement used to check the internal consistency of the instrument. The alpha values for the four separate scales appear in Table 44.0. The results indicate a measure of reliability for each of the separate sub-scales. Individually, the factors General Interest and Gender, showed high alpha values (alpha = .8957, alpha = .7054). Factor four, Difficulty, ranked third with a value of alpha = .5942. A very low value was revealed for the Consequences sub-scale (alpha = .4458).

Table 44.0
Affective / Behavior (A/B) Attitude Scale (ALPHA) Reliability Analysis

Factor	Reliability Coefficients	Alpha Measurement
General Interest	20 items	Alpha = .8957
Gender (Role Pattern)	8 items	Alpha = .7054
Consequences	5 items	Alpha = .4458
Difficulty	5 items	Alpha = .5942

The Cognitive attitude scale provided a straight forward approach in its interpretation. This section of the instrument incorporated a four component scale developed and used by de Vries and others. The instrument relies on a theoretical construct that is concerned with a priori determined groups of questions that operationalize a characteristic of technology. The research is based on a passive knowledge/concept of technology revealed in studies carried out by Streumer, de Klerk Wolters and others (de Klerk Wolters, 1989). Validation of the concept scales is based on the philosophy of technology literature study by de Vries (1990).

The Cognitive attitude instrument consists of the following scales:

1. **Society:** Technology is directed and controlled by man; and, technology intervenes in all parts of society.
2. **Science:** The difference between technology and the natural sciences and their mutual differences.
3. **Skills:** To design (creativity) and practical skills are part of technology.
4. **Pillars:** There are three pillars or dimensions in technology: matter, energy, and information.

Table 45.0 shows the scales that were used in the instrument.

Table 45.0
Cognitive (C) Attitude Scale

Item#	Society Sub-scale
77	With respect to technology I mostly think of dealing with equipment.
79	In my opinion technology is not very old.
82	Technology is as old as mankind.
85	Technology has a large influence on people.
88	In everyday life, I have a lot to do with technology.
91	The government can have an influence on technology.
94	Technology is meant to make our lives more comfortable.
96	Only technicians are in charge of technology.
100	Technology is far away from my daily life.
Item#	**Science Sub-scale**
74	I think physics and technology are related.
78	To me technology and science are the same.
83	Elements of physics are rarely used in technology.
86	I think technology is often used in physics.
90	Biology and technology have nothing in common.
103	There is a relationship between chemistry and technology.
Item#	**Skills Sub-scale**
75	In technology, you can seldom use your imagination.
80	n technology, you can think up new things for yourself.
84	You do not need to be technical to invent a new piece of equipment.
87	Manual dexterity is part of technology.
89	In technology there is little opportunity to to think up new things for yourself.
93	In technology you handle tools.
98	In technology there are less opportunities to do things with your hands.
Item#	**Pillars Sub-scale**
73	I think technology is more part of computers than of computer programs.
76	I think technology has little to do with our energy problem.
92	I think the transformation of energy is also part of technology.
95	When I think of technology I mainly think of computer programs.
99	Processing materials is an important part of technology.

Response options to these items were limited to Agree, Disagree, and Don't Know. Scores for pupils were calculated from the sum total of the number of items that showed knowledgeable responses about technology. Items on which respondents illustrated misinformation or no knowledge received no score. In the last cases the scores reflected a lack of information necessary to correctly answer the question.

Figures 6.0 through Figure 9.0 show the distributions of pupils responses to each of the four scales. The general observation can be made that most pupils scored slightly higher than average on each of the four scales. This is a fairly positive indication that in general, pupils have a higher concept of technology than was originally assumed. The pupils' response to items calculated in total for the Cognitive attitude instrument revealed a mean score of 19 out of 27 items. Figure 10.0 illustrates the distribution in greater detail.

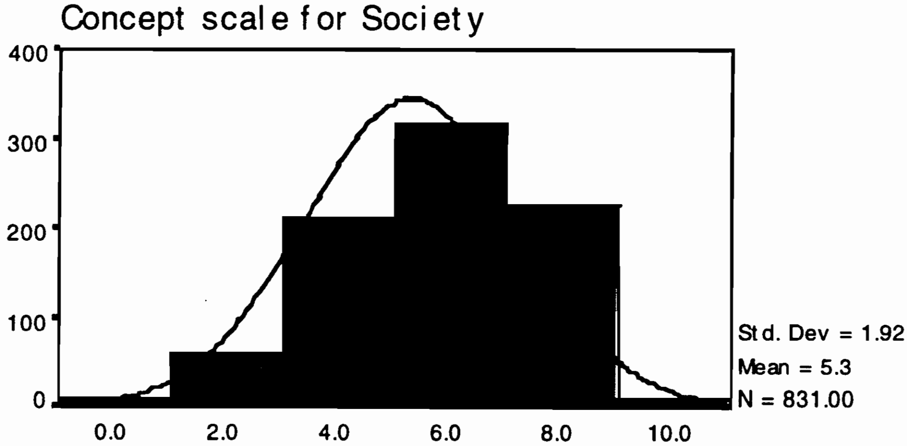


Figure 6.0 Shows scores on Society.

Higher scores show greater concept.

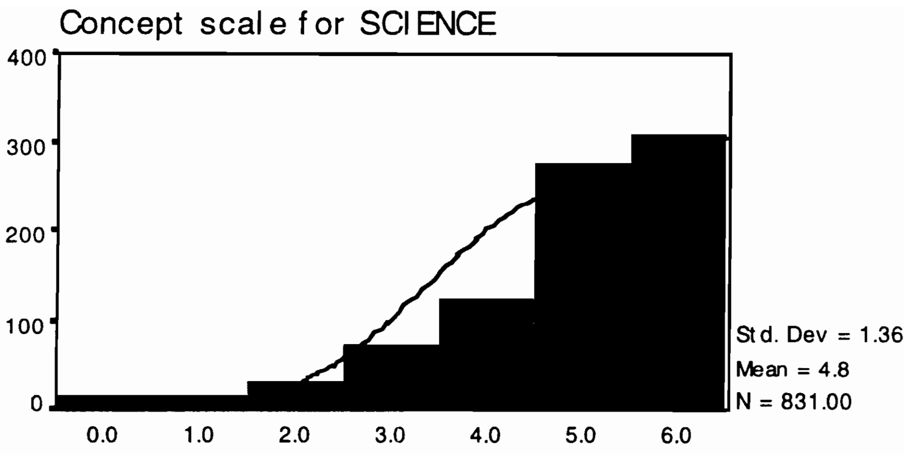


Figure 7.0 Shows scores on Science.

Higher scores show greater concept.

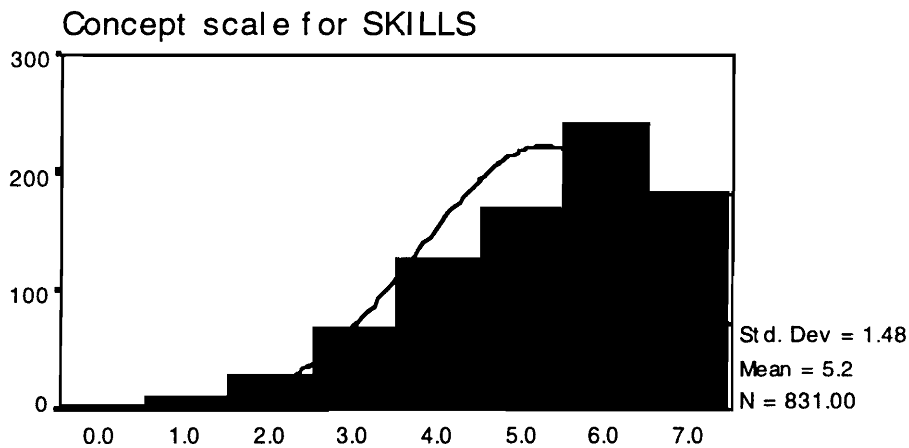


Figure 8.0 Shows scores on Skills.

Higher scores show greater concept.

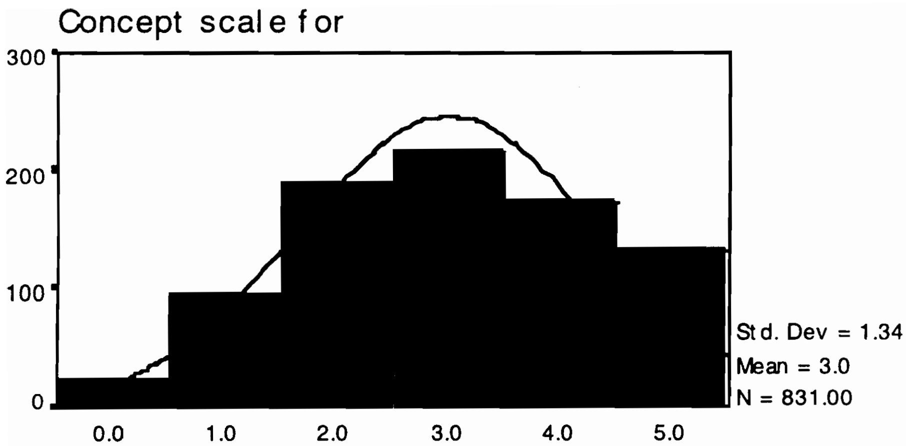


Figure 9.0 Shows scores on Pillars.

Higher scores show greater concept.

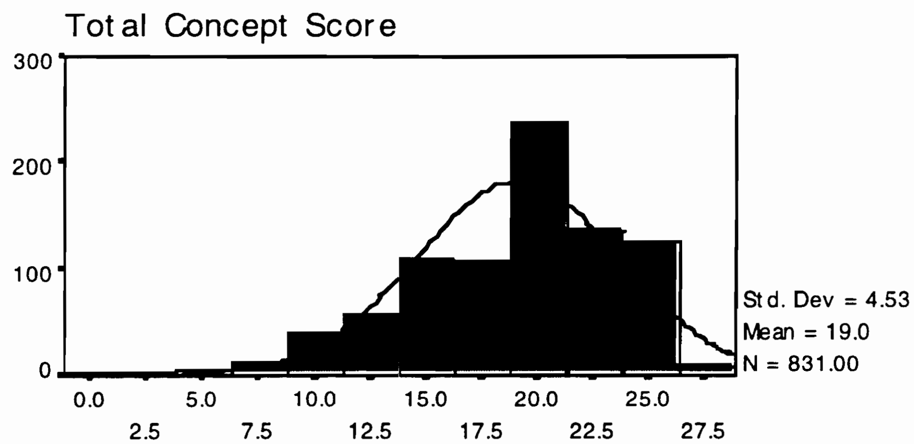


Figure 10.0 Shows overall Concept scores.
Higher score shows greater concept.

An analysis consisting of Cronbach's (alpha) measurement was also conducted on the Cognitive attitude scales to determine reliability (See Table 46.0). The alpha values for the four scales together was .7732. Dividing the scales separately produced only one scale (Science , alpha = .6297) with an alpha value above .6000. The other scales Society, Skills, and Pillars are ranked respectively, alpha = .5781, .5042, and .4777.

Table 46.0
COGNITIVE (C) ATTITUDE SCALE
(A L P H A) RELIABILITY ANALYSIS

Factor	Reliability Coefficients	Alpha Measurement
SOCIETY	9 items	Alpha = .5781
SCIENCE	6 items	Alpha = .6297
SKILLS	7 items	Alpha = .5042
PILLARS	5 items	Alpha = .4777
OVERALL C SCALE	28 items	Alpha = .7732

The higher values presented in the combined scales of the Cognitive attitude instrument provide an argument for comparisons and further analysis to consider one score (the total concept) with the highest alpha value as a means for comparisons between samples. In fact, this was the methodology used by the USA-PATT team (Bame and Dugger, 1989)

Factorial Analysis of Variance of the Demographic Characteristics on the Affective/Behavior and Cognitive Attitude Sub-scales.

This section of the analysis provided most of the answers to the secondary research questions. Since the thrust of the research sought to measure and analyze all pupils' attitudes toward technology, the secondary questions specifically focused on pupil characteristics that in previous studies had proved significant in their relationships in the ways students responded to questions on the instrument. The ANOVA method allowed the researcher to see, first, whether there were overall differences among the levels of each characteristic or factor, and second, whether the combined characteristics had a unique effect on the sub-scale scores (Huck et. al., 1974).

The ANOVA model used in this study is a 2 x 2 x 2 design. This three-way ANOVA model was intended for use in the comparison of groups which possessed the following characteristics: (1) GENDER, that was the comparison of boys to girls; (2) EDUCATION, more specifically a comparison of pupils that had taken one or more technology subject(s) to those who had no technology subject background; and, (3) LOCALE, a comparison of pupils with a generalized rural background to pupils with urban backgrounds.

The results of this analysis produced significance in findings for the main effects of EDUCATION, GENDER, and LOCALE. In addition, significance in the interactions involving two or more interrelated dimensions (ie. GENDER x EDUCATION) allowed for extended comparisons beyond those of the simple main effects (See Table 47.0). The 2 x 2 x 2 model offered fairly straight forward interpretational value when compared with models that include three or more levels of a single factor. Since there are only two levels of each factor, interactions can be interpreted readily by comparing cell means using plotted data tables. A complete listing of all first and second-order interaction comparisons is included in Appendix N. In reporting these results, while some may argue that interaction effects outweigh the meaning of the main effects, all significant findings were addressed. Where significance of interactions were present, they will be dealt with in greater detail. Complete ANOVA summary tables for each analysis are included in Appendix N. For the purposes of this study please note that the level of significance (alpha) is less than or equal to 0.05.

The independent variable GENDER had a significant effect on each of the sub-scales. Boys (mean=1.68) indicated a greater General Interest in technology than girls (mean=2.20). The perception that technology was Difficult was significantly stronger for boys (mean=2.95) than it was for girls (mean=3.07). In general, boys (mean=3.09) and girls (mean=2.90) appeared mostly neutral about whether technology is equally for both Boys & Girls. However, when compared to girls, boys exhibited a male bias over technology. Male dominance was stronger particularly in boys with urban backgrounds (mean=3.17). Girls with urban backgrounds

Table 47.0

Analysis of Variance of Affect/Behavior and Cognitive Attitude Scales

SCALE	EDUCATION (A)	GENDER (B)	LOCALE (C)	A x B	A x C	B x C	A x B x C
GENERAL INTEREST							
MS	19.432	15.488	1.342	.149	.010	.251	.004
F	46.063**	36.712**	3.182	.354	.023	.596	.010
TECHNOLOGY IS FOR BOTH BOYS AND GIRLS							
MS	2.982	9.492	.387	3.007	1.020	4.564	.057
F	4.385*	13.958**	.570	4.422*	1.501	6.711**	.084
CONSEQUENCES OF TECHNOLOGY							
MS	2.486	.173	.324	.732	.479	.209	2.516
F	8.645**	.603	1.126	2.547	1.665	.728	8.748**
TECHNOLOGY IS DIFFICULT							
MS	1.571	4.597	.128	1.356	1.345	.094	.089
F	1.882	5.508**	.154	1.625	1.611	.113	.107
SOCIETY CONCEPT							
MS	64.770	58.252	8.142	.029	30.536	24.652	2.700
F	19.313**	17.369**	2.428	.009	9.105**	7.350**	.805
SCIENCE CONCEPT							
MS	14.160	9.074	11.866	1.391	1.335	3.432	12.389
F	7.857**	5.046*	6.599**	.774	.742	1.909	6.890**
SKILLS CONCEPT							
MS	11.797	33.389	.121	3.817	1.987	1.079	13.250
F	5.610**	15.878**	.057	1.815	.945	.513	6.301**
PILLARS CONCEPT							
MS	11.434	36.843	.144	.478	2.901	15.210	.596
F	6.809**	21.941**	.086	.285	1.727	9.058**	.355
OVERALL CONCEPT							
MS	346.967	505.923	49.347	1.681	93.921	138.210	64.501
F	20.489**	29.875**	2.914	.099	5.664**	8.161**	3.809*

Note, df = 1 for education, gender, locale, AxB, AxC, BxC, AxBxC; df = 804 for within. *p. < .05., **p. < .01.

(mean=2.84) and girls who had studied technology in school (mean=2.69), seemed least likely to share in this view with either their male or female peers. Attitudes toward gender equity in technology among males remained constant in scores from those who had studied technology in school (mean=3.09) and those who had not (mean=3.09).

In general, all pupils shared a feeling that the Consequences of technology are positive (mean=1.45). The interaction of GENDER with EDUCATION and LOCALE proved that on the whole, boys (mean=1.34) and girls (mean=1.41) from urban backgrounds, who have studied technology, feel most strongly that the Consequences of technology are positive.

Boys (mean=5.67) scored higher on items about the interrelatedness of technology and Society than girls (mean=4.69). The interaction of GENDER and LOCALE illustrated that scores on items about the interrelatedness of technology and Society were higher for urban pupils than for rural pupils. A larger difference occurred between girls than boys in this case.

There was a significant main difference between boys' scores (mean=4.95) on the section that deals with the interrelation of Science and technology, and girls' scores (mean=4.54). The interaction of GENDER, EDUCATION, and LOCALE in this case, pointed to a number of interrelationships. Girls' scores on the items that deal with the interrelation of Science and technology were below the mean, whether or not they studied technology. The interrelationship involving the independent variable EDUCATION, showed that urban boys and urban girls respectively produced higher scores than their rural counterparts. Examining pupils without technology education, urban girls (mean=4.76) scored higher than their male urban counterparts (mean=4.36) but not as high as rural males (mean=4.81).

The factor GENDER produced a significant difference on the Skills sub-scale for boys and girls. Scores on the Skills sub-scale were higher for boys (mean=5.49) than for girls (mean=4.86). A three-way interaction between the factors GENDER, EDUCATION, and LOCALE revealed that where EDUCATION was compared across the Skills sub-scale, only one group (rural boys) reported a decrease in scores. The greatest difference in scores on the Skills sub-scale was shown between rural girls who had studied technology (mean=5.30) and those who had not (mean=4.66).

GENDER also produced a significant difference in boys' concept of technological Pillars and girls' concept. Scores on the sub-scale Pillars, showed that boys tended to measure above the total sample mean (mean=3.26) while girls' scores (mean=2.61) range below it.

There were significant differences between boys and girls (GENDER) in combined Concept scores as well. On the overall Concept scales, boys (mean=19.38) appeared to be more knowledgeable than girls (mean=16.69) about the relationships of technology with Society, Science, Skills, and its Pillars. Comparisons of the means included in a three-way interaction revealed interesting findings related to GENDER. Where the interaction occurred between GENDER and LOCALE, urban girls seem to benefit strongly from this relationship (urban mean=17.36, rural mean=16.20). Boys scores on the combined sub-scales (Concept) differed little when compared across LOCALE (urban mean=19.43, rural mean=19.35).

The independent variable EDUCATION, which distinguished whether or not pupils studied technology in school, also had a significant effect on all sub-scales except for one, Difficulty. It seems there, that regardless of educational history (with technology classes mean=3.01, without technology classes mean=2.99), pupils considered technology to be neither difficult nor easy. However, pupils who had studied technology in school (mean=1.67), indicated a greater General Interest in technology than pupils who had not taken technical subjects (mean=2.21).

There was a significant difference related to EDUCATION in the attitude that pupils held regarding the Consequences of technology. Those who had studied technology (mean=1.39) felt that technology's consequences were significantly more "positive" than than did pupils (mean=1.54) who had not taken technical subjects.

Scores on items about the interrelatedness of technology and Society were significantly higher for pupils that had studied some technology in classes (mean=5.68), than for those who had not taken technical subjects (mean=4.68). The interaction between EDUCATION and LOCALE showed that rural pupils (mean=4.72) who had not taken technical classes scored higher than urban pupils (mean=4.62) who had not taken technical classes. Yet, the opposite appears in scores between rural (mean=5.51) and urban (mean=5.92) pupils that have studied technology.

A significant main effect was encountered for EDUCATION on having an influence on scores that measure pupils concepts of the interrelation of Science and technology. In this case, pupils with technology education (mean=4.97) scored significantly higher than boys and girls who did not attend technology classes (mean=4.52). An interaction of GENDER, EDUCATION, and LOCALE showed that technology education among urban pupils produced higher scores (boys mean=5.21, girls mean=4.72) when compared to rural pupils with education (boys mean=4.90, girls mean=4.67). Interestingly, the group of urban girls (mean=4.76) who had not studied technology obtained a score that was higher than the average produced by female students who had studied technology (rural mean=4.67, urban mean=4.72).

Pupils' knowledge of the interrelationship of Skills required for technology was significantly different for pupils who studied technology in school and those who had not (variable: EDUCATION). Those who had taken technology classes received higher scores (mean=5.46) than peers who had no prior technology experience in school (mean=4.92). A significant interaction between GENDER, EDUCATION, and LOCALE revealed that while education reflected higher scores in female comparisons, education did not show higher scores among rural boys. The educated rural boys (boys mean=5.45) did not score nearly as well as their non-technologically educated rural counterpart (boys mean=5.61).

There was a significant main effect for EDUCATION on the Pillars sub-scale. Pupils who studied technology in school (mean=3.22) appeared to have a better concept of the Pillars that make up technology than did pupils who had no technology education (mean=2.68).

Significant differences were observed in relation to EDUCATION between groups on the combined concept scales. Knowledge about the relationships of technology with Society, Science, Skills, and its Pillars also differed significantly between pupils who had studied technology and those who had not taken technology subjects in school. Students who reportedly enrolled in technology classes (mean=19.33) had a higher understanding of these important relationships than pupils who have not studied technology (mean=16.80).

The characteristics of pupils defined by the variable LOCALE, produced few main effects in the analysis, but its interrelationship with several factors was notably seen in the interaction effects drawn out in the model. Seven of the ten total ANOVAs included LOCALE as a component of the interaction, and in one case, as a significant main effect.

Pupils' LOCALE contributed to findings of significance on two of the attitude sub-scales: 1) Technology for both Boys and Girls, and 2) Consequences of Technology. The interaction of LOCALE and GENDER on the Boys and Girls sub-scale implies that the distinctions of urban and rural are interrelated with role patterns and gender aspects. Boys (mean=3.02) and girls (mean=2.95) in rural areas were likely to share the common attitude that technology is more for males than females. Urban boys (mean=3.17) and girls (mean=2.84) on the other hand were less likely to share the same view, and instead, have attitudes that diverge in opposite directions. There was no direct relationship between where pupils lived and the view that Consequences of technology were good or bad. The three-way interaction of LOCALE, EDUCATION, and GENDER on the sub-scale Consequences, showed that technology education and community environments seemed to interrelate. Interpreting the scores on the sub-scale, one would observe from the no technology pupils, that, rural boys and urban girls felt more positive about technology's Consequences; when among the technology pupils, the rural girls and urban boys tended to see technology's Consequences more positively that their technology educated peers. An interesting yet confusing finding was revealed from this analysis. Of all the attitude sub-scales, the Consequences factor was the least reliable (alpha=.4458). Therefore the measure of significance in this case, stemming from as few as five items in a sub-scale with low reliability may have confounded actual conjecture and meaning from this example.

In general, scores on items about the interrelatedness of technology and Society were higher for urban pupils than for rural pupils. Both first order interactions (EDUCATION x LOCALE, and GENDER x LOCALE) presented in the findings, showed that differences favoring the urban 'locale' of pupils occurred in comparisons within groups on this sub-scale. Given that pupils' educational background was interrelated with these scores, it appeared likely that urban pupils had a better concept of the nature of technology in Society than did rural pupils.

LOCALE showed a significant difference between pupils with an urban background and pupils with rural backgrounds on the Science sub-scale. Pupils from urban settings scored higher (mean=4.93) than pupils with rural backgrounds (mean=4.68). Comparisons made from the interaction supported the main effect adding that this observation was notably apparent for females (rural/no technology education mean=4.27, urban/no technology education mean=4.76) (rural/technology education mean=4.67, urban/technology education mean=4.72). Pupils with an urban background when combined with technology classes in school, were observed to be among the most knowledgeable in their concept of the interrelationship of science and technology.

In general the interaction of pupils' community environment (LOCALE) with scores on the Skills sub-scale was observably weak. There was no difference regarding LOCALE and the concept of Skills pupils regard as being required for technology. The interaction of GENDER, EDUCATION, and LOCALE on this sub-scale revealed that technologically educated rural females have a better "skills" concept than do urban females; and that rural, technologically educated boys score lower on this scale than did their urban counterparts, and also lower than their non-educated, rural cohort. Reliability (alpha = .5042) on this seven item sub-scale was reportedly low.

A significant interaction of LOCALE x GENDER on the Pillars sub-scale revealed that urban girls (mean=2.80) scored higher than rural girls (mean=2.47), while urban boys (mean=3.16) scored lower than their rural cohort (mean=3.34). From the observed findings, the results suggested that an urban locale was favorable for females while having a rural locale was favorable for males in having knowledge about the pillars of technology.

The combined Concept sub-scale scores produced significant interactions that included all of the independent variables. Overall, rural pupils' scores on the combined concept sub-scales were lower than scores recorded for their urban counterparts. From this observation, urban pupils possessed greater combined knowledge about the relationships of technology with Society, Science, Skills, and its Pillars than did the rural pupils.

<u>The Correlation Analysis of the Independent Factor, Concept, on the Dependent A/B Sub-scale Scores</u>

A correlation analysis was conducted on the Affective/Behavior sub-scale scores to determine whether pupils' concepts of technology were related to their attitudes toward it. In this case the, Cognitive sub-scale scores were used as independent variables upon which to study the A/B scale responses. A correlation matrix of all the sub-scale scores was used to study the question. (See Table 48.0)

The findings showed that General Interest produced the highest correlation with scores on the Cognitive instrument when compared to other A/B sub-scale scoring coefficients. The negative signs in this case, were indicative of the method used to code pupil responses. Correlations were negative because scores on the Attitude sub-scales were more positive as the values get lower. (The exception, Difficulty, shows the effect of pupils feeling that technology is more difficult as values get lower.) The table illustrates that as pupils' knowledge of technology increases vis-a-vis the C-scale scores, responses on the A/B-scale scores were lowered (attitude sub-scales are more positive as the values get lower) thus, reflecting a direct correlation in terms of the relationship of knowledge with positive attitudes toward technology.

Observations made from the remaining information appeared less dramatic. Knowledge, in terms of its relationship with attitudes toward the gender equity in technology was equally significant, yet less outstanding in regard to the strength of its correlation.

This is true for most of the observations made from among all the data. The highest single correlation observed from individual sub-scale comparisons was that of knowledge about technology in Society and attitudes toward the General Interest of technology (-.4522). While the relationship was significant ($p < 0.01$), the correlation explained about 20% of the variance within this variable.

Knowledge, in terms of its relationship with attitudes toward the Consequences of technology ranked second as an overall factor. The relationship showed that as pupils' knowledge about the relationships of technology with Society, Science, Skills, and its Pillars increased, so did their attitudes about the consequences of technology turn more positive.

With the case of pupils' attitudes toward technology as something difficult (Difficulty), it appeared that the more pupils knew about Science the more difficult they perceived technology to be. In other aspects of knowledge, it appeared that knowledge lessened the perceptions of pupils that technology was something difficult.

Table 48.0
Correlation Matrix Table:

Cognitive Attitude Scale	Gen Interest	Boys & Girls	Conse-quences	Difficulty
Society	-.4522 P< .01	-.0771 P< .05	-.3406 P< .01	.1147 P< .01
Science	-.3827 P<.01	-.0425 P= .221	-.2827 P< .01	-.1065 P< .01
Skills	-.3539 P< .01	-.0972 P< .01	-.3014 P< .01	.0576 P= .097
Pillars	-.2580 P< .01	-.0455 P= .190	-.2185 P< .01	.0789 P< .05
CONCEPT	-.5169 P< .01	-.0940 P< .01	-.4069 P< .01	.0608 P= .080

(Coefficient / (Cases) / 2-tailed Significance)
* Note correlations are negative because scores on the Attitude sub-scales are more positive as the values get lower. The exception, Difficult, shows the effect of pupils feeling technology is more difficult as values get lower.

A Comparison of Findings

Data from the Botswana study were compiled and organized to present a preliminary comparison of findings with those reported in other countries. The studies represent findings from western, eastern and developing nations. The information presented in the following section includes tables that were reproduced from the PATT U.S.A. study conducted by Bame and Dugger (1989).

The first table (Table 49.0) shows a general comparison of the size of samples and numbers of pupils surveyed in studies. This information is followed by a presentation of sub-scale scores derived from the attitudinal measurements of both the Affective/Behavior (Table 50.0) and Cognitive attitude instruments (Table 51.0).

Table 49.0
A Comparison in the Size of Samples

	Girls	Boys	Total
Australia	111	101	212
Belgium	97	93	190
Botswana	335	493	*831
Denmark	73	79	152
France	122	112	234
India	276	349	625
Italy	281	285	566
Kenya	—	—	244
Mexico	98	115	215
Nigeria	200	103	303
Poland (2)	370	308	678
The Netherlands (3)	697	560	1257
U.K.	—	—	173
U.S.A.	6256	4013	10349

The data other than that for Botswana, are from "A Report of Findings" by A. Bame and W. Dugger Jr., 1989.
* Three pupils did not respond to this item.

Table 50.0
A Comparison of Boys' and girls' scores on the Affective/Behavior Attitude sub-scales

		Interest	Role Pattern	Conse-quences	Difficult
Belgium	B	2.3	2.8	2.3	2.8
	G	2.7	2.2	2.5	2.4
Botswana	B	1.7	3.1	1.4	2.9
	G	2.2	2.9	1.5	3.1
Denmark	B	2.3	2.4	2.5	2.8
	G	2.7	1.8	2.7	2.8
France	B	2.3	2.3	2.5	2.7
	G	2.7	1.8	2.6	2.6
Poland	B	2.4	3.o	2.3	3.0
	G	2.7	2.8	2.1	3.0
The Netherlands (3)	B	2.6	3.1	3.2	2.9
	G	2.1	1.9	2.5	2.9
U.K.	B	2.3	2.6	2.4	—
	G	2.9	2.0	2.6	—
U.S.A.	B	2.5	2.3	2.0	2.7
	G	3.0	1.7	2.1	2.4

The data other than that for Botswana, are from "A Report of Findings" by A. Bame and W. Dugger Jr., 1989.

Table 51.0
A Comparison of Boys' and Girls' scores on the Cognitive Attitude sub-scales

		Tech & Society	Tech & Science	Tech & Skills	Tech & Pillars	Total Score
Belgium	B	.48	.34	.80	.49	.53
	G	.40	.32	.88	.42	.51
Botswana	B	.63	.83	.78	.66	.71
	G	.52	.75	.70	.52	.62
Denmark	B	.46	.46	.76	.46	.54
	G	.40	.43	.73	.35	.48
France	B	.49	.39	.59	.60	.51
	G	.42	.34	.59	.49	.46
India	B	—	—	—	—	.60
	G	—	—	—	—	.61
Italy	B&G	.34	.36	.47	.55	.43
Nigeria	B&G	.43	.56	.51	.39	.47
Poland (2)	B	.66	.60	.60	.61	.62
	G	.61	.69	.68	.55	.63
U.S.A.	B	—	—	—	—	.50
	G	—	—	—	—	.47

The data other than that for Botswana, are from "A Report of Findings" by A. Bame and W. Dugger Jr., 1989.

Among the studies presented, PATT-Botswana ranks third in size. The scale of this study is considered medium by PATT standards. A simple comparison of scores on the Affective/Behavior scales indicates that the Form 5 pupils' general interest in technology is relatively high in comparison to others as is the perception that technology produces positive consequences. The pupils' scores on the Cognitive attitude scale shows that Batswana scored consistently high.

It would appear that these pupils have a particularly keen awareness of the relationship between technology and society, science, skills, and its pillars. It is quite possible that their knowledge of technology is enhanced by the rapid pace at which the process of modernization has taken place within their country. This may also stimulate the perception that technology brings generally positive consequences. Given the rate at which Botswana's development has taken place, when compared to the less abrupt transformations of many other nations listed, it would not be unusual to expect large differences in some aspects.

Summary

Official permission to carry out the proposed research was granted in May, 1993. An advisory panel was formed. It was comprised of specialists who agreed to share their expertise during various stages of the research agenda. Initially this, panel provided feedback during the course of several rounds of review and debate about the readability and appropriateness of items on the PATT instrument. The instrument was trial tested at Molepolole College of Education using first year students, roughly two years older in age than average Form 5 Pupils, and on approximately 130 Form 5 pupils from Molepolole and Gaborone.

Formal administration of the modified PATT was conducted between October and November, 1993. A total of 831 useable instruments were gathered and data were compiled and stored using a Macintosh personal computer and Fastat statistical Software.

The following analyses were carried out by the researcher while he was in residence at Virginia Polytechnic Institute and State University during 1996:

- a frequency analysis on all measurable variables including the key words in the essays,

- a cross-comparison on total sample demographic variables,
- a factor analysis (Principle Components Method) of the Affective/Behavior (A/B) instrument to assess the validity of the A/B sub-scales in the modified instrument,
- a reliability analysis using Cronbach's alpha for homogeneity for each of the A/B and Cognitive (C) attitude sub-scales,
- a factorial (ANOVA) analysis of the independent variables GENDER, EDUCATION, and LOCALE on the dependent A/B and C sub-scale scores, and
- a correlation analysis of the independent variable CONCEPT on the A/B sub-scale scores.

The analyses were carried out to provide findings that would lead to answers to the main research question: What is the attitude toward technology of Form 5 level pupils in Botswana and what is their concept of it?

The design of the sub-scales allowed for the results of the main research question to be based on the formulation and testing of a set of secondary questions:

- What is the impact of gender on the pupils' attitude and concept? Do boys have a more positive attitude toward technology than girls?
- What differences in attitude and concept are there between pupils who have had formal technical education and those who have not? Do pupils who have studied technology in school have a better understanding of technology?...a more positive attitude toward technology?
- Is there a difference in attitude toward and concept of technology between rural and urban pupils? Is the technological climate at home the same for rural and urban pupils?
- What is the impact of the concept of technology to the attitude toward technology?

The findings revealed that GENDER was a factor that affected students' attitudes toward technology, boys tended to have a more positive attitude and a generally higher understanding of technology than did the girls. The results showed that the level of technology (EDUCATION) pupils had studied in school also had an impact on pupils' attitudes and concepts of technology. Pupils who studied technology in school had a higher understanding about the relationships of technology with society, science, skills, and its pillars and also showed a more positive general interest in technology. To a lesser extent, but still an important factor, the urban/rural backgrounds of pupils were found to combine with other variables, and thus contributed toward pupils' attitudes and concepts of technology. Differences in the technological environment at home observed in cross-comparisons between rural and urban pupils may have contributed to the observed differences in pupil response patterns generated by the variable LOCALE. The findings also showed that in general, a positive correlation was determined to exist between pupils' concept of technology and their attitudes toward it.

CHAPTER FIVE

Conclusions and Recommendations

Introduction

This chapter begins with a summary of the study and a review of the findings. It is followed by a discussion on the conclusions drawn from the findings and closes with implications and recommendations for further research.

Summary of the Study

The purpose of this study was to explore the nature of pupils' attitudes toward technology and their concept of it. The researcher examined the responses of senior secondary pupils in the Form 5 level in Botswana to questions about technology. The questions were prepared in advance and administered in the form of a questionnaire to groups of pupils. A secondary focus of the study was to determine whether the following factors were related to pupils attitudes and concepts:

- whether boys and girls held similar or different views on technology (variable: GENDER);
- whether pupils who studied about technology had similar or different views on technology (variable: EDUCATION);
- whether pupils with urban backgrounds and pupils with rural backgrounds had similar or different views about technology (variable: LOCALE);
- whether the pupils' concept of technology was related with their attitude toward technology.

A method of replication of previous PATT research studies served as the model for this study. The *ex post facto* design of the study was facilitated by a single instrument to collect data. This instrument was a modified version of a validated PATT questionnaire designed for use in a similar study. The methodology and versions of the PATT questionnaire have proven to be reliable in measuring pupils' attitudes and concepts of technology in studies conducted in several other parts of the world. Validity of the Botswana instrument was assessed during the stage of analysis.

The sample in this study was drawn from a population of Form 5 pupils in Botswana. Pupils were drawn from communities in five separate regions of the country. Eight schools participated in the study. Four schools were located in rural settlements and four were located in urban settlements. The number of pupils involved in the study was 831.

At each of the test sites, school administrators participated by assisting with the random selection of pupils assigned to testing in the pilot stage of the study. Pupils that participated in the administration were drawn from three standard curricular streams:

1. Pure Science, the most math and science intensive of the academic streams where pupils generally do not take technology classes;
2. Combined Science, a science and practical subject curriculum where pupils mostly take less academically challenging math and/or science classes along with technology subjects; and
3. Practical Science, the most practical-oriented subject stream where pupils' core subjects combine with a concentration in technology and other practical subjects.

Obtaining a representative sample was formulated largely on composition and size of the classroom sets.

Five secondary research questions were stated prior to conducting the study. Factorial analysis of variance (ANOVA) served as the primary means of analyzing the data relative to the secondary questions. Pupils' sub-scale scores (of means) served as the basis for comparison.

The findings of the study are summarized as follows:

1. Reliability and validity was tested on the modified (89 item) questionnaire used in Botswana. Normality in response to individual items was observed using a frequency analysis on all measurable variables. Correlation analysis to find the reliability of the questionnaire by means of the item-total correlations with Cronbach's alpha as a central criterion produced a coefficient alpha = .7992 for the entire list of items contained in the instrument. When the correlation of items used on the attitude scale was measured, a coefficient alpha = .8145 was obtained. The coefficient alpha = .7732 was measured for item-total reliability on the (31 item) Cognitive Attitude scale.

   In order to reduce the 58 individual Affective/Behavior (A/B) Attitude scale items into meaningful sub-scales, and to then validate the newly created *a priori* groupings of the attitude sub-scales, factor analysis (Principle Components Method) with varimax-rotation was used. The results of the factor analysis yielded four factors. Interpretation of the factor structure was as follows:

   - General Interest in Technology;
   - Technology as an Activity for both Boys and Girls, ie. role pattern;
   - Consequences of Technology; and
   - Technology as Being Something Difficult.

   These four combined factors accounted for 30 percent of the total variance.

2. There was a significant difference between boys and girls in the way each group responded to items on the sub-scales. The findings revealed that boys scored higher than girls on both the A/B and Cognitive (C) Attitude sub-scales. This in turn was interpreted to illustrate that girls' attitudes toward technology were generally less positive than the attitudes (reflected in scores) among the boys. In addition, boys were observed to know more about the relationships of technology with society, science, skills, and its pillars than did the girls in the sample. In many cases, the difference was shown to be significant beyond the .05 *alpha* level.
3. A significant difference was found in most scores between pupils who had studied technology in school and those who opted not to enroll in technology subjects. This difference was extended to both A/B and C scale scores. The results not only reflected differences in behavioral attitudes but also differences in the concepts pupils held about the relationships of technology with society, science, skills, and its pillars. The responses revealed that pupils who had studied technology in school generally held more positive attitudes toward technology and possessed a greater understanding of the concepts related to it. Again, the difference was shown to be significant beyond the .05 *alpha* level across nearly all the sub-scales.

The findings revealed that one A/B sub-scale, Technology as Being Something Difficult, produced no significant difference between technologically educated pupils and non-technologically educated pupils. In this case, where self-disclosure generated scores that were used to control for prior technical knowledge, attitudes about the perception of technology as being difficult among pupils did not differ. The feeling among pupils about this view of technology was that it is neither difficult nor is it easy. The typical response was neutral on this item regardless of the level of technology pupils reported.

4. The findings on attitudes toward technology when scores were used to control for locational differences proved less significant on the whole, than was expected. Preliminary cross-comparisons between urban and rural pupils revealed significant differences stemming from question items designed to indicate levels of technological exposure. It was assumed, but later not supported, that the variable LOCALE could be used to represent and explain these differences in technological exposure that appeared to exist between urban and rural communities. Thus, determining the degree of exposure to and interaction with technologies involves a more complex factor structure than a simple location model can provide.

   When combined with GENDER, LOCALE contributed to several findings of significant interactions across the A/B sub-scales, particularly throughout the C sub-scale test scores. Analyses of the differences of means within groups across most of the interactions revealed interesting results. Noted were the following findings:

   - on investigations that compared the variances among females and males across urban and rural locations, girls scores were characterized by much wider distributions than were the scores observed for boys, and.
   - urban boys seemed to possess a greater concept of technology than rural males.

   The factor LOCALE produced only one significant main effect. In this case, scores that were compared on knowledge about the relationship of technology and science were significantly different for the two groups. The difference between pupils was observed on the higher scores of urban pupils over their rural classmates.

5. The findings also showed that a positive correlation was determined to exist between pupils' concept of technology and their attitudes toward it at the alpha .05 level. The highest correlation was shown to be present between pupils' concept of the interdependent relationship of technology and society and the pupils' General Interest toward technology.

Conclusions

The methodology used to conduct and carry out the study in Botswana is reflected in the design of earlier studies and therefore contributes toward the continuity of PATT research. In this regard the findings in the Botswana study have obvious limitations for comparative studies with children from industrialized, western, and other culturally dissimilar societies and may offer more valuable reference within regional cross-cultural and international settings.

Based on the outcomes of the pilot study conducted in Botswana, the researcher concludes that the modified Pupils' Attitudes Toward Technology instrument is a valid tool for "describing" the pupils' attitudes and concepts of technology. The instrument also provides the utility to produce reliable descriptions about pupils' attitudes and concepts toward technology and to provide the opportunity for comparisons of youngsters within Botswana.

This instrument was seen to perform well throughout the pilot study. In comparison with other PATT studies the findings showed similar patterns. In fact many findings appeared that were consistent with the outcomes of studies discussed in the literature of earlier PATT research. In one example, the underlying measures of reliability and validity of the instrument pilot tested in Botswana, were comparable with pilot studies reported by de Klerk Wolters. In his review of instrument reliability in previous research in Australia, Belgium, Canada, Hungary, Sweden, UK, and USA (Georgia), de Klerk Wolters noted the alpha values of the entire list of items (78 items) averaged above .85 (1989). This reliability measure is slightly higher than the alpha (.80) obtained in the PATT-Botswana study.

In the same report, de Klerk Wolters concluded that construct validity had been established for at least four attitude sub-scales in the pilot studies: Interest, Role Pattern, Consequences, and, Difficulty. The attitude sub-scales produced in the Botswana pilot study support this conclusion.

Previous pilot studies have shown that dimensions in the attitude scale differ in accordance to the proportion of variance explained by each sub-scale. One example that illustrates how this occurs was recorded in the Australian pilot study and was reported by de Klerk Wolters:

> A factor reflecting interest is most important. This factor explains 30.5% of the variance...'sex differences' 8.3% of the variance, 'consequences of technology' 7.5%, of the variance and 'difficulty of technology' 4.7% of the variance. (1989, p. 112)

The pilot study in Botswana displayed a similar factor structure in terms of the ranked proportion of variance explained by the individual attitude sub-scales. However the variance explained in the Botswana findings are somewhat lower in comparison to studies done in industrialized nations. This suggests to researchers the limitations to which an instrument designed and developed in one country can be expected to perform equally well in a culturally diverse setting.

Nevertheless factors that proved significant in other PATT studies appeared notably significant within this study. GENDER differences which have typically been the focus of PATT research, provided striking contrasts in the ways boys and girls in Botswana perceived technology. This variable was a significant factor in the study. The factor EDUCATION, which has been used in PATT research to assess the impact of technology programs on pupils, also produced significant findings in comparisons of pupils with varying levels of prior knowledge. The variable CONCEPT (this is the combined sub-scale Cognitive attitude score) described in the literature of PATT research as an important (dependent variable as well as an) independent factor, produced significance in the findings related to knowledge about technology and the positive linear relationship it has with a child's attitude.

Significant differences were found which revealed that females did not to know as much about technology as males did. Additionally, girls' attitudes toward technology were less "positive" than boys attitudes were found to be. These findings support the results of studies in the USA (Bame & Dugger, 1989), The Netherlands (Raat & de Vries, 1986), and in most countries where PATT research has been conducted (de Klerk Wolters, 1989).

The findings provided evidence in support of technology education. The results of the study showed that technologically educated pupils held superior knowledge about technology and its relationship with society, science, skills and its pillars. This supports findings revealed in other studies. The PATT research often focuses on the A/B and C scales to evaluate the affective outcomes of technology education programs. In a wide range of studies conducted with children ages 13-18, including studies in the USA (Bame & Dugger, 1989) and in The Netherlands, (Raat & de Vries, 1986) significant findings were reported that pupils from technology programs scored more positively on the A/B scales and higher on the C scales than pupils without technology backgrounds.

In other Botswana findings, the (measured) variable CONCEPT, when used as an independent factor, revealed that a direct linear relationship was present in a pupil's concept of technology which contributed toward the child's attitude. The conclusions reached by de Klerk Wolters (1989) are consistent with these findings. The direction of this relationship gives pupils with a broad concept of technology a **positive** attitude toward technology. The study conducted in Botswana supports this evidence.

Findings on the attitudes toward technology related to differences attributable to LOCALE in the Botswana study were less significant on the whole than expected. Despite the findings, the importance of this urban/rural variable is raised in the PATT literature. Unfortunately, specific conclusions about its statistical significance appear sparse.

The PATT research by Kapiyo and Otieno (1986) emphasized the need to recognize that distinctions between urban and rural communities (in Kenya) are much more acute in developing countries than the distinctions found in the developed nations. In research carried out in India, Rajput (1989) noted problems studying the concept of technology (by means of the concept questionnaire), specifically in the rural parts of his country.

The Botswana study produced little evidence that this variable was accountable for significant (main effect) differences. To conclude that samples of urban and rural pupils are not significantly different, based on the results of these main effects, may be misleading for several reasons. Among these reasons are problems that may bare concerns about instrumentation and sampling.

Dealing with the problem of instrumentation, the factor LOCALE needs to be further examined. The variable LOCALE was determined to reflect differences in the technological environment between urban and rural pupils. A series of cross-comparisons using identified *technology indicators* concluded that in most cases, urban pupils were twice as likely to respond affirmatively to questions surveying the range of technology indicators (i.e. electricity, telephone, etc.) as were the rural pupils in straight comparisons. In effect, the *indicator* was twice as likely to be found within urban households as rural households. The indicators, however, served to represent a limited list of distinctions between between urban and rural pupils, and did not account for aspects such as proximity to urban environments, interaction with modern technologies, norms of behavior in traditional and modern social structures, economic differences and other distinctions.

Perhaps the greatest evidence of this oversight lies in the conclusions drawn from examining the interaction effects from the study. It is apparent from these observations that although the main effect differences as revealed in the ANOVA model, do not show significant differences, LOCALE emerges in combination with GENDER in seven out of nine sub-scale test cases. The inference that is drawn from this association with GENDER is one that can be seen from the perspective of a traditional vs modern structure or model. This model is equally limited in its utility but it acknowledges that influences of the social setting on gender norms and particularly females are actively present. It is not surprising then, to find that variances are much more widely spread on sub-scale scores among rural and urban educated girls than are the same scores for males if, from this perspective, one can assume that roles of females differ across traditional and modern social structures to a greater extent than do the roles of boys.

Secondly, sampling may be a part of the reason why such unexpected results emerged. Official definitions of urban and rural settlements tend to be much more static in Botswana than is the number of communities being entered into the official list of urban settlements. In short, this list is growing every year. For example, Maun, a designated rural settlement at the time of testing, has since attained official urban status. Molepolole, another of the nation's largest rural settlements, is within range for daily commuters to work in the capital, and is well linked by public transportation. Under these conditions the gap between urban and rural settlements begins to narrow. The simple distinction between urban and rural communities fades as the two locations grow more complex and dynamic through the mixing of activities and values.

The patterns of settlement are noticeably changing. More so than even a decade age one finds traditional people living within the most modern city and technologically progressive Batswana choosing to live in the village. The absence or abundance of technological products helps one to visualize the diverse and at times polarizing effect of the affluence created through modernization. Yet with so much mixing who can say which village is more rural or town more urban?

Before completely discarding the rural/urban variable, it may well be worthwhile to explore a few senior secondary schools that lie far enough outside the shadows of urban lifestyles to perhaps warrant re-testing the LOCALE variable. The remoteness of these settlements is compounded by undeveloped road networks and communication systems. For these reasons the researcher unfortunately, abandoned plans to administer the questionnaire at these sites. Nevertheless, as roads and communication systems improve access to and from remote areas, so too will researchers expect the gap to begin to narrow.

Implications and Recommendations

The findings of this study are particularly relevant in light of recent shifts in education policy in Botswana. A plan was announced by the Ministry of Education in April, 1994 which included implementing Design and Technology along side other core subjects such as Mathematics, Science, Social Studies and language in the Junior Certificate Curriculum beginning in 1996. This decision came in reaction to the National Commission on Education recommendation proposing changes in the curriculum (National Assembly,1994, p. 63). This change in the curriculum signifies a stronger commitment toward technology education in schools than ever before, and it addresses the importance of providing a fundamental understanding of technology as an essential part of every child's basic education. In view of the astonishing pace with which modernization has transformed Botswana's social and physical character, the new policy highlights concerns to educate children about the effects of technology throughout the nation and its impact on social values.

The findings present implications to Design and Technology and to the efforts under way to develop it into a core curriculum technology program. Foremost, the findings show initial evidence of the value of studying technology as a means of enhancing pupils' awareness about technology, and signal to educators that pupils begin to gain positive attitudes toward technology as they learn more about it. The decision to include Design and Technology among the core of general education subjects offers the potential to re-address the issue of offering technology classes to females and to reshape the gender biased attitudes toward girls in technology that were revealed in the study. Most notably, the differences found during the study between pupils who had studied technology in schools and those who had not will be eliminated by providing technology education to all. In fact, future PATT researchers in Botswana will need to review the rationale for including the EDUCATION variable. While this variable produced valuable findings within the 1993 cohort, its usefulness may diminish as the technology education program moves upward throughout the junior and senior secondary levels.

Second, as a new core subject, Design and Technology can educate and inform pupils about growing opportunities for both men and women in technology fields. The PATT study revealed a number of reasons why pupils did not take technology subjects. The most frequently stated reason for not taking technology subjects in school came from girls who said that these subjects were not offered to girls. In this respect, the curricular change is an important redistributive effort on the part of Government to extend equality in education to those it serves. The issue of gender equity in school and employment in technological fields is one that needs to continue to draw further attention from Government.

The Commission has acknowledged that gender-stratification is among the barriers that continue to create disparities between boys and girls in access and performance in education and training, and subsequently in the labor market (1993). The findings of the PATT study provide additional evidence to support this conclusion. In addition, the study also revealed that boys more so than girls, felt that technology was a male dominated field. Girls on the other hand, expressed a more gender neutral view of technology fields. The findings that boys (more so than girls) tended to regard technology as a male dominated field, is a reminder of the more typically historical education problems associated with the stereotypes of technology subjects like Woodwork, Metalwork, and Technical Drawing. Hopefully the fresh philosophical approach found in Design and Technology combined with its status as a course for everyone, will strengthen its potential to remove attitudes of gender bias among pupils and give all a more equitable outlook in the workplace.

An additional measure that may help combat this problem, is found in the Commission's guideline to promote females in all levels of Science, Mathematics, and Technology. Equity in education can be matched in the workplace through hiring policies that reserve positions for females who excel in education programs. Simply providing Design and Technology or some other technology course to all students without offering incentives that reshape attitudes about the roles of women in technological fields will not reverse years of social and educational oversight.

Thirdly, one hopes that the new scope of the curriculum will encourage pupils to question and assess the impacts of technology within the social and ecological contexts of the region. Pupils should be able to define what technology means to the present and future system of social organization. For example, young people may wish to assess the role of modern technology in relation to the customary seasonal migration of people from homes in the village or towns to the pastoral lands and the cattle post. Other issues might include investigations of modes of production that weight the costs of job creation to those of production. Regardless, where technological and social issues arise, it will be crucial for pupils to gain the understanding that technology provides the means by which a society can control or modify its environment. It is important that through this understanding pupils are given opportunities to develop responsible attitudes about technology and some of its consequences.

The findings of the study showed the tendency of pupils (especially those without a technology background) to perceive the consequences of technology as positive, when we know that social and environmental tradeoffs are not always so. Exploring technological issues in the classroom can lead pupils toward greater awareness of the transformations being made to society through modernization and help pupils understand the relationship of technology with society and the consequences of adopting modern technological systems. It is encouraging to see education policies that help enable young people to formulate their own informed views about issues of national development. Further, by understanding pupils' attitudes and concepts toward technology, educators and curriculum planners position themselves to stay informed about views of technology that are relevant to pupils and appropriate to their future.

Looking to the past, the Design and Technology approach is quite a departure from the aims of technology-based education programs of the 1980's. "Technology assessment" in Woodwork, Metalwork, and Technical Drawing was foremost applied to technical craftsmanship. The Technical Studies curriculum which was introduced in 1986, also did not address the social implications linked to a technologically changing society. In none of the programmes was there a place in the curriculum for the technology teacher to provide pupils with the ability to assess the social consequences brought on by technology and the impacts of modernization.

The recent shifts in the education policy of Botswana will certainly bring on critics who will challenge the validity of prescribing a Design and Technology course that has traditionally been seen as an optional subject. Meeting the needs and expectations of a grossly larger student population will require a much broader understanding of segments of the student body. Technology subjects have historically not been required to address the needs of *all* students. Design and Technology teachers are likely to find more balanced numbers of girls in the lab. Here, teachers who are commonly unfamiliar with relating the subject to non-traditional Design and Technology students, will certainly meet with challenges. Curriculum planners will find it useful to gain information about segments of pupils who otherwise would not have opted to enroll in the course. In addition, the challenge exists for further development in establishing a content that is relevant to the needs of all pupils. Evaluating existing programs will not go far enough to provide the type of information planners will require. Further investigation and study will need to take place.

A greater recognition of Botswana's diversity must be taken into account if meaningful content within the curriculum is to be established. Whether or not the content is found to be relevant to pupils may depend more on the technological character of their communities than this study has shown using a comparison of "urban and rural" pupils. The survey of technology indicators that in the study attempted to quantify differences in the technological character of pupils' households, fails to bring a complete view of the wide ranging differences found within settlements. In some cases conflicting data (ie. the number of TV's compared to households with electricity) points out that these items alone are insufficient for adequately drawing conclusions about the technological environment of pupils' homes. Further consideration of social organization needs to be addressed when attempting to isolate variables that describe levels across the technological spectrum. These might include economic indicators, personal preferences for traditional and modern lifestyles, and the role of gender in various social settings.

Levels of technology in communities quite often reflect the blend of lifestyles across traditional and modern spectrums. When one observes Botswana's communities from a technology perspective, strikingly varied social and economic characteristics begin to appear as the levels of interaction with technology change. The range of indigenous and imported technology available across communities is a factor that certainly influences ways in which users of technology understand its potential. It would seem to follow that differences between the ways pupils perceive the content in a technology-based subject (ie abstractly or concretely) may be strongly connected to the social/economic/technological environment in which each lives. Clearly more research needs to be done to develop valid and reliable indices that help to describe forms of (indigenous or modern) technologies that families rely on to maintain the household and the community.

The PATT - Botswana instrument was designed to investigate specific pupil characteristics that can provide findings which are important to educators. Researchers using this model will be able to look closely at responses associated with perceptions of technology from pupils grouped according to age, gender, level of prior technical education, and other demographic characteristics.

As a tool for comparing pupils' attitudes and concepts of technology, the instrument has the means to monitor outcomes of the new curriculum as it improves and progresses. In addition, those who are involved in designing curriculum materials may find the instrument useful in identifying groups of pupils where targeted attention is required.

The results of PATT Botswana have added to the knowledge base for educators who wish to gain an understanding of the attitudes and concepts of technology among the Form 5 pupils of 1993. The design of this study is useful to many in Botswana who may wish to replicate it.

To aid further research attempts, the following recommendations are proposed:

1. Instrumentation was a limiting factor in this study with regard to describing the impacts of the social and economic settings in rural and urban communities. As modernization occurs throughout the country, changes in economic and social activities will certainly continue to penetrate

traditional enclaves rendering urban and rural labels imprecise. It is recommended that in the future this study be replicated and that researchers should concentrate efforts in consideration of the interrelated effects of social settings, economic settings, and gender role patterns. The unexpected findings from this study pose a challenge to researchers to develop a more effective model to study the dynamic influence of these elements

2. The Affective/Behavior scale produced homogeneous and easily recognizable sub-scales. However the proportion of variance explained across the four sub-scales (30%) is low. It is recommended that additional investigation and research is required to develop items that do more to explain aspects of the attitude dimension.
3. Repeated studies using the PATT Botswana instrument are recommended as steps toward further validation and testing of the stability and reliability of the A/B scales. Additional studies among the Form 5 population are recommended as a means for comparing pupils in progressive cohorts.
4. The researcher recommends that the data in this study be compared to data from PATT studies in other African settings and that an investigation be carried out to explore differences in pupil response.
5. For the purposes of comparing attitudes of pupils with younger ages, the researcher recommends that the design of this study be used to conducted similar studies with samples of Batswana pupils in junior secondary schools. The larger network of junior secondary schools may provide researchers greater opportunities to control for the effect of location. These pupils may also represent a larger, more socially diverse population simply because higher proportions of school aged children participate at the junior secondary level, and because schools are more likely to represent the social norms of the immediate community

than do the large centralized senior schools. In addition, the younger ages of pupils may permit greater investigation of the effect of gender role patterns in social settings.

6. To add to the effectiveness of educational policy and the implementation of Design and Technology, it is the recommendation of this researcher that the results of this and future PATT studies in Botswana, be reviewed as means to assess technology program effectiveness over time, and to be allowed to direct inquiry into issues related to the educational needs of pupils in ongoing curriculum efforts.
7. Because Design and Technology is now a core subject, it is recommended that the method of comparing pupils based on technology education differences must be re-evaluated for future PATT studies in Botswana. The relevance of comparing pupils based on differences in technological programs will obviously diminish as Design and Technology progresses throughout junior and senior secondary levels.
8. It is recommended that PATT studies in Botswana used to compare progressive groups of that same age or level monitor changes, and the direction of those changes, associated with the A/B sub-score: Technology is for both boys and girls across GENDER.

Summary

This pilot study was a replication of the original PATT research developed by Drs. Jan Raat and Marc de Vries of the Netherlands. In this study the pupils' attitudes toward technology were investigated. Pupils sampled in this study were from the Form 5 level in Botswana. The study began in 1993 and concluded in 1996.

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Appendix A

<u>Population and Selected Demographic Characteristics as Reported by the Government</u>

Table A-1

Age Distribution of the Population, 1991

Age Group	Population	% of Population
0-4	248,124	18.6
5-14	393,530	29.5
15-64	650,992	48.8
64+	41,354	3.1
Total	1,334,000	100.0

Note. Adapted from Central Statistics Office 1991 population projections, National Development Plan 7 1991-1997 (p. 11), Ministry of Finance and Development Planning, 1991, Gaborone: Government Printer.

Table A-2

Growth of Urban Settlements, 1971-1991

Population '000

Settlement	Actual 1971	Actual 1981	Estimated 1991
Gaborone	17.7	56.7	136.4
Francistown	18.6	31.1	58.2
Lobatse	11.9	19.0	28.4
Selebi-Phikwe	4.9	29.5	54.6
Orapa	1.2	5.2	9.8
Jwaneng		5.6	16.4
Palapye		9.6	19.0
Tlokweng		6.7	13.3
Mogoditshane			6.1
Serowe			30.1
Mahalapye			28.8
Maun			19.8
Letlhakane			9.0
Kasane			3.1
Ghanzi			6.1
Sowa			2.2
Total Urban	54.4	166.3	441.3
Total Population	596.9	941.0	1 334.4
Urban as Proportional Total	9.5%	17.7%	33.1%

Note. From Central Statistics Office, National Development Plan 7 1991-1997 (p. 12), Ministry of Finance and Development Planning, 1991, Gaborone: Government Printer.

Table A-3

Growth of Urban Settlements, 1971-1981

Settlement	Actual 1971	Actual 1981	Projected 1986	Projected 1991
Gaborone	17 718	56 659	96 100	134 800
Francistown	18 613	31 065	39 600	50 600
Lobatse	11 936	19 034	24 300	31 000
Selebi-Phikwe	4 940	29 469	34 700	40 800
Orapa	1 209	5 229	6 200	7 200
Jwaneng		5 567	9 000	14 400
Palapye		9 593	13 500	18 900
Tlokweng		6 653	9 300	13 100
Mogoditshane				6 000
Serowe				46 600
Mahalapye				40 700
Maun				22 200
Letlhakane				8 400
Total	54 416	166 265	232 700	434 800
% Urban	9,5	17,5	20,6	32,1

Note. From Central Statistics Office, National Development Plan 6 1985-1991 (p. 13), Ministry of Finance and Development Planning, 1985, Gaborone: Government Printer.

Table A-4

De Facto Population by Type of Settlement 1971 and 1981

Type and Size of Settlements	No. of settle-ments	1971 Census No. of Persons	%	No. of Settle-ments	1991 Census No. of Persons	%
Urban:		48 267	8.4	5	126 001	13.4
Non-mining	3	6 149	1.1	3		4.3
Mining	2					
Sub-Total	5	54 416	9.5	8	166 265	17.7
Rural:	0	0	0	4	85 153	9.0
20 000+	3	38 443	6.7	3	46 320	4.9
10 000-19 999	5	39 215	6.8	5	30 101	3.2
5 000-9 999	50	85 494	14.9	87	145 139	15.4
1 000-4 999	120	88 709	15.5	112	79 504	8.4
500-999	45	14 641	2.6	206	52 161	5.5
Under 500						
Sub-Total	223	266 502	46.4	417	438 378	46.6
Other Settlements (Lands, cattleposts)		253 176	44.1		336 384	35.7
Total Country		574 094	100.0		941 027	100.0

Note. From Central Statistics Office, National Development Plan 6 1985-1991 (p. 12), Ministry of Finance and Development Planning, 1991, Gaborone: Government Printer.

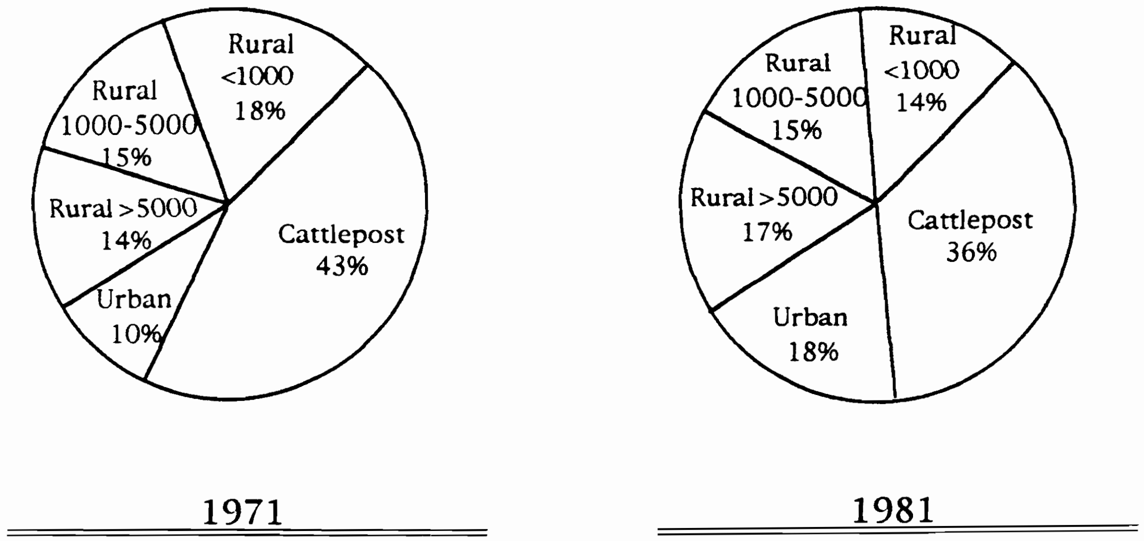


Figure A-1

Population Distribution by Size of Settlement

Note. Adapted from Central Statistics Office, National Development Plan 6 1985-1991 (p. 12), Ministry of Finance and Development Planning, 1991, Gaborone: Government Printer,

Appendix B

School Enrollment Projections and Selected Education Statistics

as Reported by the Central Statistics Office

and the Ministry of Education

Table B-1

Continuation Rates from Primary to Secondary Education, 1984-1991

Year		Standard 7 Students admitted to Form 1		
	Standard 7 Enrollment	Year	Number	Percent of Standard 7
1894	27 730	1985	10 577	38
1885	30 454	1986	11 090	36
1886	34 324	1987	12 904	38
1987	36 993	1988	16 719	45
1988	36 811	1989	17 983	49
1989	35 977	1990	22 671	63
1990	39 975	1991	25 952	65

Note. Adapted from Central Statistics Office Education Statistics; National Development Plan 7 1991-1997 (p. 323), Ministry of Finance and Development Planning, 1991, Gaborone: Government Printer.

Table B-2

Primary Enrollment Projections, 1990-1997

Standard	1990	1991	1992	1993	1994	1995	1996	1997
1	49 031	48 960	49 679	50 414	51 160	51 915	52 683	53 472
2	45 288	46 647	46 589	47 269	47 967	48 677	49 396	50 127
3	43 871	44 974	46 322	46 274	46 944	47 638	48 343	49 057
4	44 309	48 596	50 151	51 665	51 776	52 458	53 225	54 011
5	36 956	39 177	42 960	44 348	45 687	45 791	46 392	47 070
6	36 940	38 032	40 306	44 187	45 637	47 016	47 135	47 749
7	39 975	44 132	46 075	48 682	52 984	55 291	55 452	54 486
Total	296 390	310 528	322 082	332 839	342 155	348 786	352626	355 972

Note. Adapted from Ministry of Education figures, National Development Plan 7 1991-1997 (p. 339), Ministry of Finance and Development Planning, 1991, Gaborone: Government Printer. 1990 and 1991 figures are estimates by the Primary Education Department.

Table B-3

Number and Enrollments - Primary Education 1978-1991

Year	Number of Schools				Enrollment		
	Govt.	Grant Aided	Pvt.	Total	Male	Female	Total
1978	353	11	13	377	65 211	80 248	145 459
1979	371	11	12	394	70 457	86 207	156 664
1980	391	12	12	415	78 111	93 803	171 914
1981	403	11	9	423	81 975	96 132	178 107
1982	434	12	17	463	87 284	100 934	188 218
1983	464	13	25	502	92 593	105 735	198 328
1984	471	13	28	512	99 005	110 767	209 772
1985	489	13	26	528	106 423	117 185	223 608
1986	501	13	23	537	113 693	122 248	235 941
1987	518	13	26	557	120 196	128 627	248 823
1988	525	13	21	559	126 327	135 025	261 352
1989	540	17	27	584	133 608	141 829	275 437
1990	555	12	35	602	137 217	146 299	283 516
1991	583	14	50	647	145 266	153 546	298 812

Note. Central Statistics Office figures from the Report of the National Commission on Education 1993 (p. 83), National Commission on Education, 1993, Gaborone: Government Printer.

Table B-4

<u>Projection of the De Facto Population, 1991-2016</u>

(Population in '000)

Total Population of Which:	1991 (Number)	1991 (%)	2016 (Number)	2016 (%)
Economically active	651	48.8	1 623	59.4
Dependent	683	51.2	1 109	40.6
Primary school age	237	17.8	394	14.4
Junior secondary school age	96	7.2	184	6.7
Senior secondary school age	82	6.1	174	6.4

Note. From the Report of the National Commission on Education 1993 (p. 5), National Commission on Education, 1993, Gaborone: Government Printer.

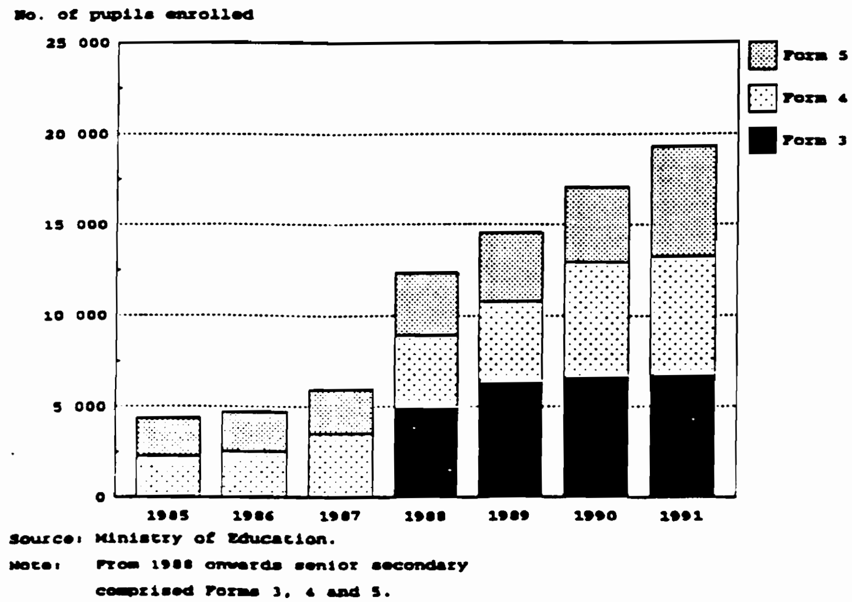
Table B-5

Age Distribution of the Population, 1991

Age Group	Population	% of Population
0-4	248 124	18.6
5-14	393 530	29.5
15-64	650 992	48.8
64+	41 354	3.1
Total	1 334 000	100.0

Note. Central Statistics Office preliminary results of the 1991 Population Census from the Report of the National Commission on Education 1993 (p. 4), National Commission on Education, 1993, Gaborone: Government Printer.

Senior Secondary Enrolments, 1985–1991



Secondary School Teachers, 1985–1991

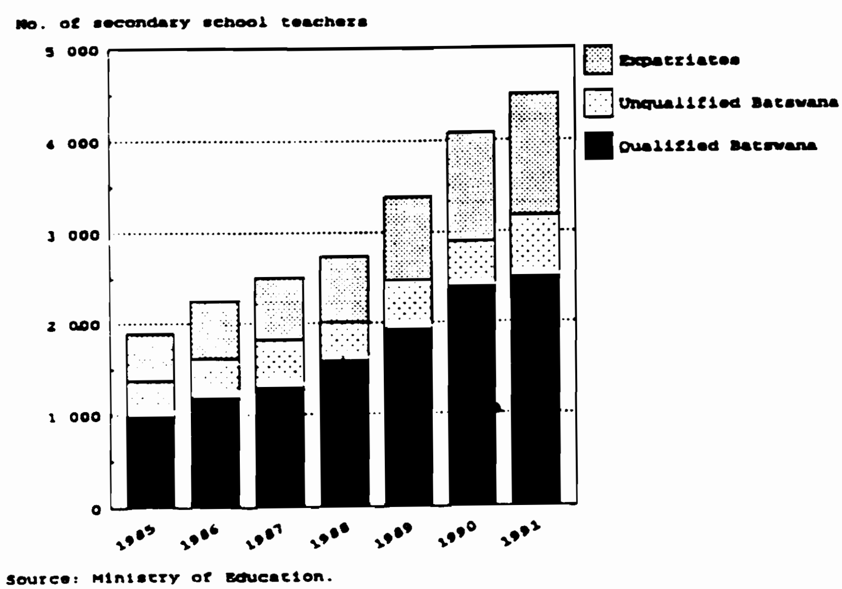
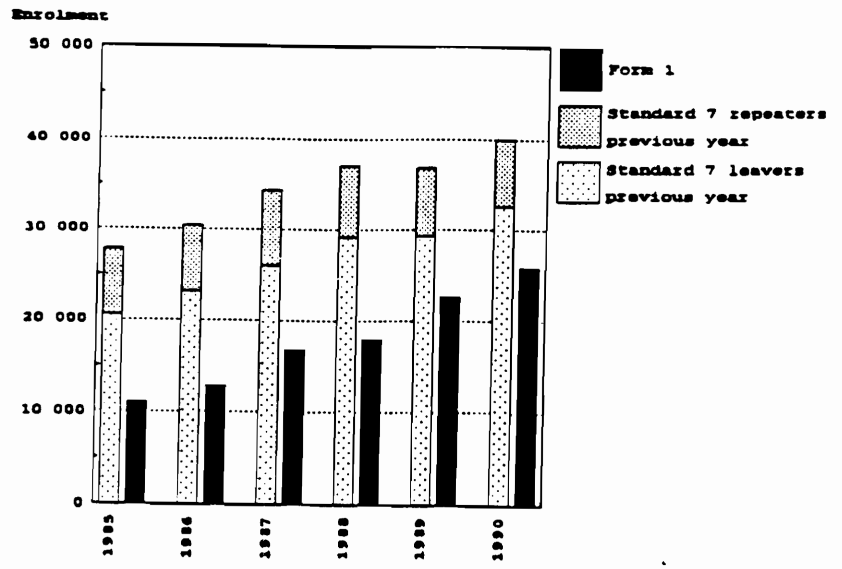


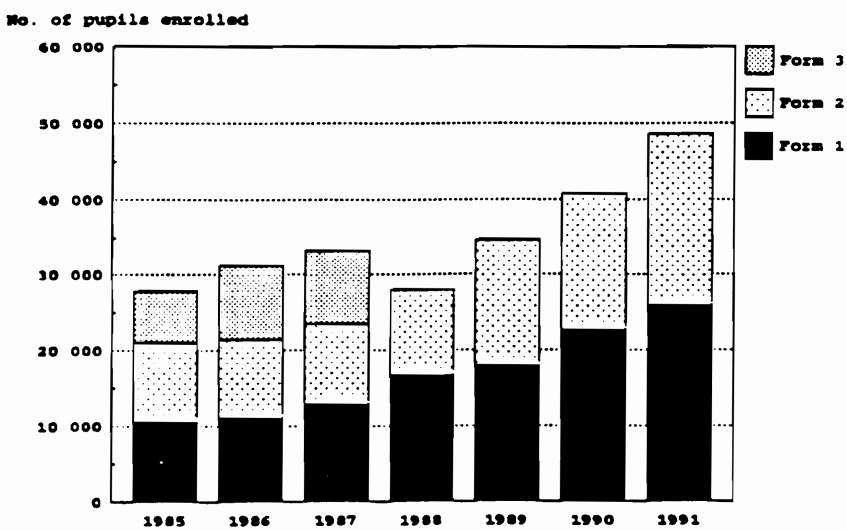
Figure B-1 Senior Secondary Enrollments and Secondary School Teachers

Progression from Primary to Junior Secondary School



Source: Ministry of Education.

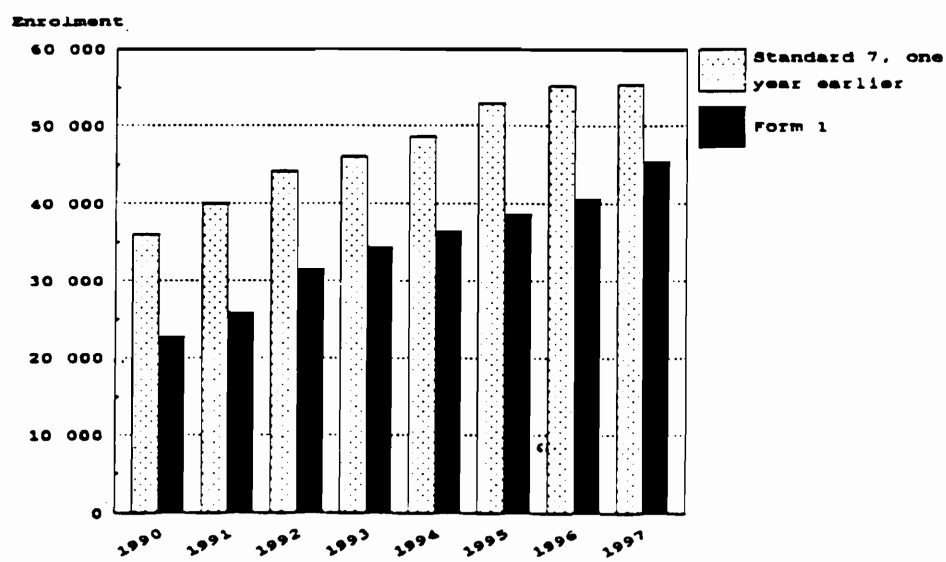
NDP 6 Junior Secondary Enrolments



Source: Ministry of Education.
Note: From 1988 onwards junior secondary comprised Forms 1 and 2 only.

Figure B-2 Progression From Primary to Junior Secondary School and Junior Secondary Enrollments

Projected Progression from Primary to Junior Secondary School, 1990–1997



Source: Ministry of Education.

Figure B-3 Projected Progression From Primary to Junior Secondary School

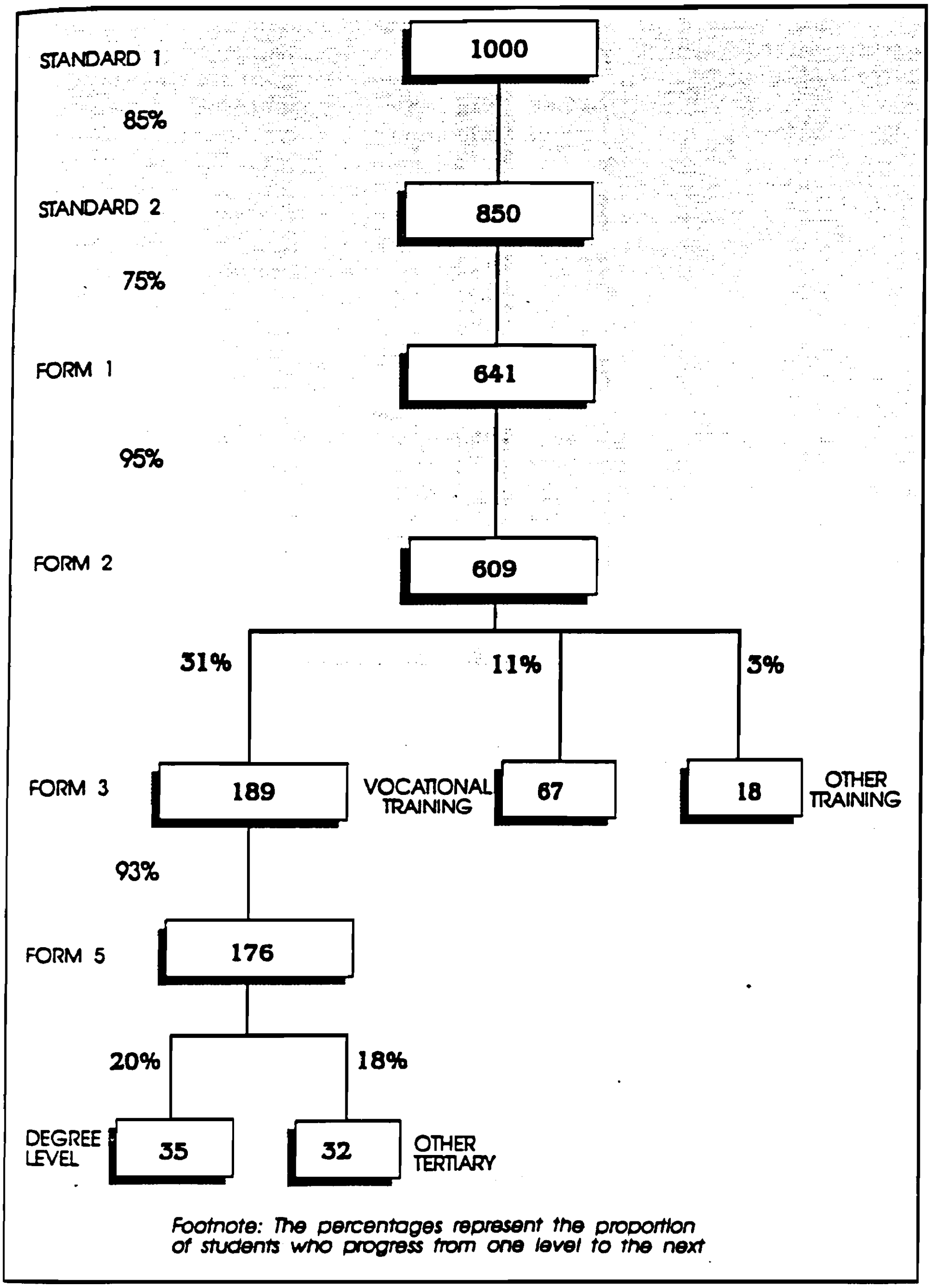


Figure B-4 Flow of Hypothetical Cohort Using 1991 Progression Rates.

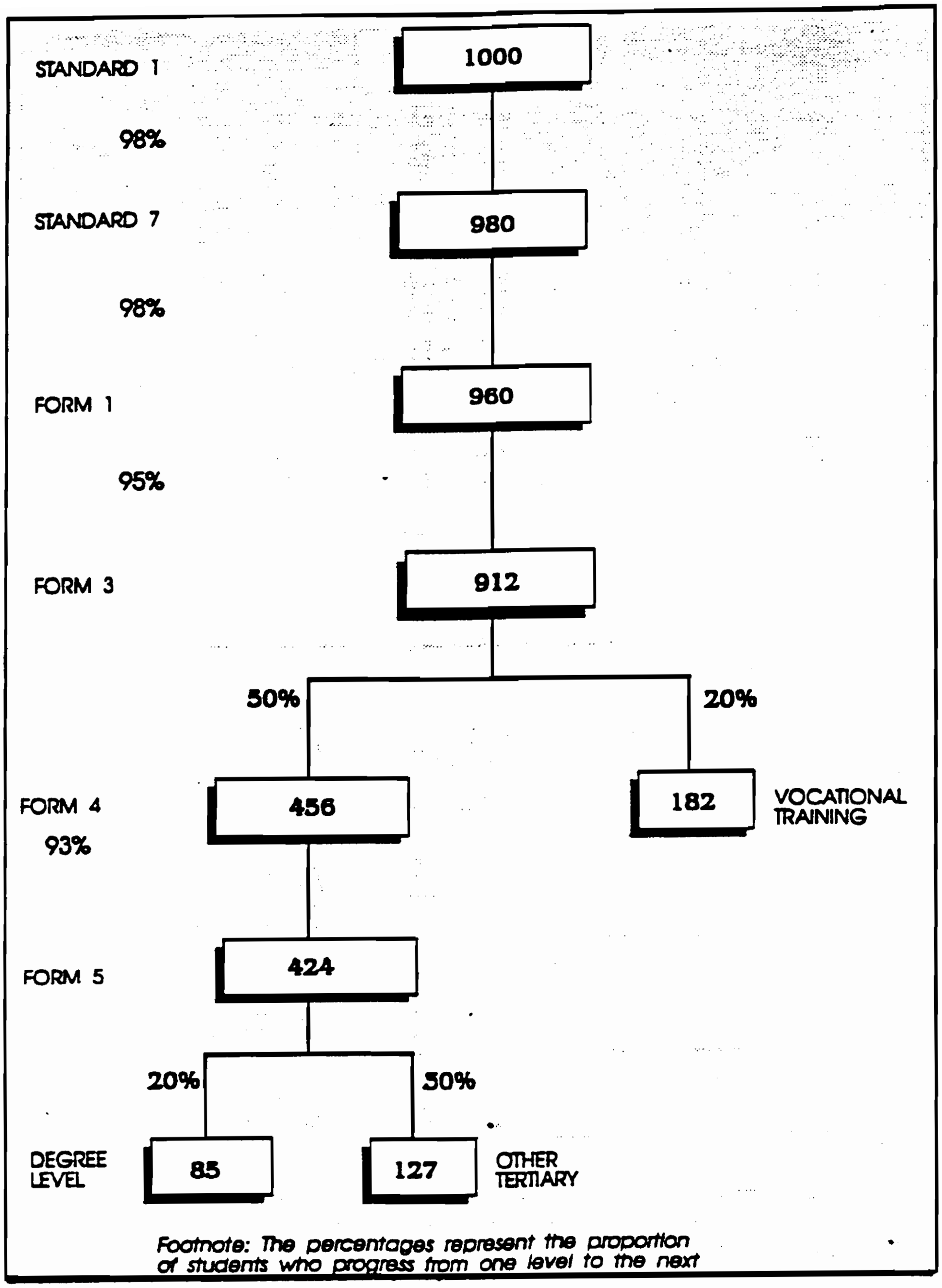


Figure B-5 Flow of Hypothetical Cohort Using Revised Progression Rates.

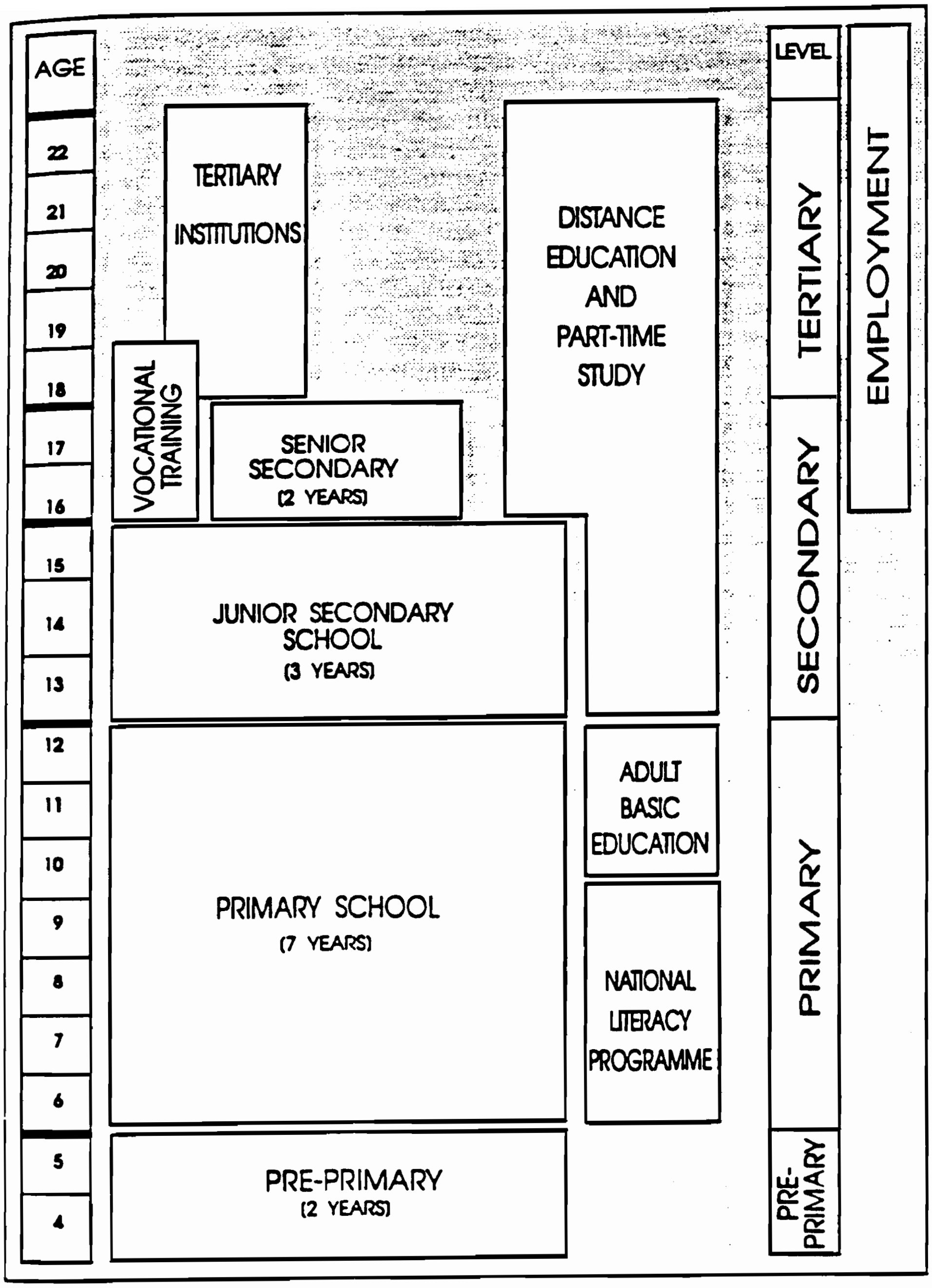


Figure B-6 The Future Structure of the Education and Training System

Appendix C

Aims of the Nine Year Curriculum and

Aims: Design & Technology Application/Relevance

Papers by Walton

A PHILOSOPHY OF DESIGN & TECHNOLOGY
FOR
THE COMMUNITY JUNIOR SECONDARY SCHOOL IN BOTSWANA

prepared by
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Technical Education Specialist JSEIP

REVISED APRIL, 1989

PHILOSOPHY OF DESIGN & TECHNOLOGY

INTRODUCTION

The Community Junior Secondary School (CJSS) represents the concluding years of Basic Education available to all Batswana of school age. The challenge for the CJSS is not merely to build upon the foundation that was provided in the primary school, but also to fill in such deficiencies as may be requisite for preparing its graduates for the various streams of life that they may enter.

It is anticipated that 40% of the CJSS graduates will proceed to Senior Secondary School. For the remaining 60%, (the majority), the CJSS represents the terminal point of their formal educational experiences. Some of the 60% will go on to vocational training, some to the unskilled labour market, and others into the non-cash economy of their communities.

Some may argue that specific programmes to prepare the CJSS students for the particular stream that they will enter is desirable; for several reasons, such as costs, physical facilities, and staffing, this is unwise and unrealistic. In keeping with the concept of basic education, relevant and appropriate for the diversity of streams, the Ministry of Education (MOE) has compiled a list of "Aims of the Nine Year Curriculum". These are:

1. Show knowledge and appreciation of the Tswana culture, language, literature, arts, crafts, and tradition.
2. Understand English and use it appropriately, both as a medium of learning at school, and as a vehicle of communication beyond school.
3. Apply knowledge and imagination to identify problems in household management and everyday commercial transactions, and have the mastery of basic scientific and mathematical concepts to solve them.
4. Be able to observe and record accurately and draw reasoned conclusions.
5. Realize the effect of Botswana's location in the African continent on political, economic and social life in Botswana
6. Acquire skills in food production, and industrial arts for self-reliance, self-sufficiency, and rural development.
7. Effectively use commonly needed tools and instruments in activities connected with later studies and out-of-school occupations.
8. Know how to run a home and care for a family.
9. Be able to assess their own achievements and capabilities in pursuit of appropriate employment and/or further education.
10. Have developed a sound moral code of behaviour compatible with the ethics and traditions of Botswana.
11. Be able to adapt to social, economic and technical change by adjusting acquired knowledge to new situations and by taking appropriate action.

Whatever programmes, then, are offered in the CJSS these must be consistent with the aims as noted above. These aims apply generally to the combined nine year program; for some subjects, only selected aims are applicable, however, Design & Technology has relevance to every aim.

AIMS: DESIGN & TECHNOLOGY APPLICATION / RELEVANCE

Each aim is addressed in the same order as it appears above.

1. Culture is a way of life, one aspect of that way of life is housing, of which the primary building materials are mud, sand, and cement. These are materials that are readily available and at affordable prices. Their use in the programme is an example of the use of culturally appropriate materials. The related technologies taught in the Design & Technology programme are simple, and yet can be used to enhance the quality of dwellings.

2. As Botswana becomes increasingly more technological, new words will become a part of language. Design & Technology affords the opportunity for the population to become literate, with respect to the technical vocabulary.

3. Managing a household often requires handyman-type skills and sometimes creative thinking. These are all skills that can be acquired in Design & Technology.

4. One important aspect of Design & Technology is research and experimentation, thus giving the student the opportunity "to find out" for him or herself.

5. The experience of using both local and imported tools, materials, and equipment in a variety of processes affords the opportunity for comparing and contrasting the political, economic, and social implications and the appropriateness of their use in various African countries.

6. One of the outstanding features of the skills acquired in Design & Technology is that they facilitate individuals being able to perform a variety of household and community tasks. Thus an economic advantage, a sense of independence, and the satisfaction that comes with personal accomplishments is achieved. Very often, in rural areas, there is a paucity of skilled labour, and a lack of understanding and appreciation of how simple technologies can contribute to the resolution of many problems. As students explore technology, in a program that identifies with the needs and realities of life in the rural districts, a foundation for rural development is built.

7. Every tool and piece of equipment used in Design & Technology is used in the real world of work. Some of the processes are directly applicable, others are a simulation of industrial practices. Participants of the programme, therefore, get useful insights and experiences that are directly related to a variety of occupations.

8. Running a home and caring for a family can be improved by knowing how to do such things as being able to heat hot water by use of the sun, reducing the amount of wood needed for cooking and heating, and being able to make a variety of items that contribute to improving the quality of life.

9. Design & Technology is not a job training program, yet its potential for providing clues as to one's suitability for various occupations is unsurpassed by any other subject in the school's curriculum. In Design & Technology, we provide the combined head/heart/hand developmental experiences.

10. In the "multi-activity lab" situations of the CJSSs, students develop respect and appreciation for the facilities, tools, and supplies; and an understanding of when properly used, these three contribute to man's well being. They also learn to take pride in their own work, and have respect for other people's work.

Learning to work with each other, in sometimes less than ideal circumstances, learning to share, and taking on responsibility are characteristics of the programme.

11. The present and future orientation of Design & Technology prepares the student not only to adapt appropriately to change, but also to be a part of the change process.

Relevance and value are two important criteria in curriculum development. The basic question, then, is what can the CJSS graduates do with what we give them? To respond to that challenge, it will be well to assess the context in which the education we provide will be used.

- Botswana is becoming an increasingly more technological society (not necessarily at high levels of sophistication).

- Dependence on foreign technical expertise is at unacceptable high levels.

- There is a great need for diversification of the economic base, and for private industry development.

- The realities of development require that education serves society better, by being more applicative, and providing students with more problem-solving and critical thinking skills.

- Social, economic, environmental, and development factors are changing the face of the job market.

- The responsibility for development is, quite rightly, being viewed as a truly national challenge and not merely a task for the politicians.

Design & Technology at the CJSSs could not claim to provide all it requires to appropriately address the above issues, but it plays a unique role in providing the insights and basic skills that will help lay the foundation upon which the national development programme can be built.

CONTEXTUAL EDUCATION FRAMEWORK

In the Botswana educational system, there are the:
Primary School
Community Junior Secondary School
Non Formal Education
Senior Secondary School
Vocational Training Institutions
Professional Educational Training Institutions
University

The primary school graduate is eligible for limited vocational training (probably only at the Brigades). The CJSS graduate is eligible for some types of vocational training. But for most career training programmes, successful senior secondary schooling, as measured by the results of the Cambridge Overseas School Certificate (COSC) examination, is required.

Of all the subjects offered in the secondary school, Design & Technology is one of the few, if not the only subject that does not have a counterpart in the primary school. Those students taking Design & Technology up to the Cambridge level are relatively few; for example, in 1985 only 91 students sat for the COSC in woodwork or technical drawing. It would appear therefore that the providing of insights into and basic skills preparation for future careers in vocational and technical fields, and for the exploration of Technology will be the onus of the CJSS.

Frequently the need for the type of education as offered in the Design & Technology programmes is voiced by our political and educational leaders. In reality, though, the subject has not received the appropriate support and attention, probably because of a misunderstanding of the subject. As a subject area, Design & Technology can be shown to contribute to the improvement of many of the so-called academic subjects. Activities in the Design & Technology programme can contribute to the student's academic success by helping the child to understand abstract concepts through the use of concrete materials.

There are those who feel that Design & Technology is only for the less competent. However, it must be pointed out that Design & Technology provides an intellectual experience, with the additional advantage of bringing other senses to bear upon the learning experience. Research shows that the more senses brought to bear upon the learning experience, the more effective and permanent it is. With its multi-sensory approach, and being one of the few subjects able to offer such an approach, Design & Technology lies in the fore-front of offering a solid "BASIC EDUCATION", that lives up to the aims of the nine year curriculum

DESIGN & TECHNOLOGY DEFINED

Design & Technology is the practical part of the student's education, in which the student is provided with the opportunity to experience using materials, tools, and equipment in a variety of processes. In this programme, students learn practical skills that are useful in the home and the community; they gain useful insights into the present and future applications of technology in Botswana; interests in career choices, that are consistent with local technical needs, are stimulated. Design & Technology is not designed to provide students with job skills. At the CJSS level it is an exploratory programme designed to provide such experiences as would help students to better relate and respond to their evolving technological society.

Design & Technology is an applicative education programme aimed at helping the young citizens of Botswana to respond more appropriately to the technological needs and developments of their country.

The purpose of education is to prepare students to cope with the realities of life beyond the classroom, and many of the problems a society faces require technological solutions.

Technology is and will continue to affect all of our lives, albeit at different levels and in different ways. Not all students will grow up to be at the forefront of technology development and implementation in Botswana, but as a user or consumer we become connected with technology. It is valuable, then, to provide technological insights to the citizenry. As we look at some of the problems facing Botswana and the developing world, it is not difficult to appreciate the role of technology in the solution of these problems. These problems include: food production and storage, sanitation, water, energy, housing, transportation, communication and production.

Design & technology is not simply about making things. It is about applying scientific principles, in a practical way, to the solution of problems in our society. The programme is designed to give young minds the opportunity to analyze problems, come up with creative solutions, and to select, make and test their solutions.

The focus of the programme is application, application of what we learn in school to life beyond school. We want our boys and girls not merely to be able to make a pencil box designed by the teacher, but rather to solve the problems of organizing, storing and carrying the variety of pencils, pen, and crayons they use in class. What the students take from the class is not merely the manipulative skills for making a box, but problem-solving, manipulative and testing skills.

RELEVANCE and VALUE

The junior secondary curriculum ought to be relevant to the society for which such education is intended to improve the quality of life. What is taught should have value and be meaningful in relationship to the student's present and anticipated future experiences.

Some factors that should be considered when looking at the basic nine year curriculum are (1) 60% of the student live in rural areas; (3) Botswana's ability to meet its technical manpower needs is dependent upon the type of foundation laid in the early stages of education, and the interests created in the students' minds; (4) the education provided our young citizens today, will affect our society tomorrow; and (5) education should be present and future oriented.

The Design & Technology curriculum thrives on relevance. Steps have to be continuously taken to keep the program up-to-date, and relevant to current technological and development requirements, and to society's needs. Like technology, the programme can not be static, it must be dynamic in order to be relevant. It is important, also, that with the relevance there be the type of instruction that will facilitate the use of what is learnt at school in situations outside of the classroom. And this must apply , regardless of into which stream the student will fall.

THE PROGRAMME

What we teach in the subject is the application of technology to problems within one's experiences. "Technology is a method for doing something. Using a method requires three elements; information about the method, the means of carrying it out, and some understanding of it" (Dahlman & Westphal, 1983, p.6). It should be kept in mind that technology does not necessarily mean that which is highly sophisticated. Technology could, and has to be appropriate to the society for which it is intended.

Now technology should not be taught for technology sake; it could, as it is being taught, be made to address pertinent problems and issues. The programme offered will be constrained by (a) financial resources (b) facilities (c) tools and equipment (c) type and quality of the human resources (d) inservice training opportunities (f) varying environmental and community factors (g) pre-service training of aspirant teachers and (h) timetabling considerations.

The program for Design & Technology can be divided into three areas:

1. GRAPHIC ARTS TECHNOLOGY
2. MATERIALS and STRUCTURES
3. ENERGY and MECHANISMS

While not oriented to job preparation, some basic skills will be acquired, but perhaps more importantly is the opportunity to be creative and inventive, to analyze and solve problems, to explore and experiment, and to relate it all to real life problems and needs.

Using a problem-solving approach in a programme of this nature, the student will be provided with the opportunity of:

- developing skills for self-reliance and self-sufficiency

- gaining useful insights, through practical experiences, into occupations that are of a technical nature, and that require the use of tools, equipment, and a variety of materials and processes;
- being prepared to address such issues as energy for the future;
- anticipating, adapting to, and even being part of the change process as Botswana develops technologically, socially, and economically; and
- building the foundation for research and development of technologies that respond to Botswana's needs, and for which we are dependent upon foreign countries.

GENERAL OBJECTIVES

1. The development of physical manipulative skills
2. Development of applicative problem-solving skills
3. An understanding and appreciation of technology as it relates to their present and future lives
4. Scope for inventiveness and creativity
5. Contribution to the development of self-sufficiency and self-reliance
6. Understanding of careers and career choices
7. Inspiration for industrial development
8. Application of simple technological principles to the home and community
9. Understanding of mass production
10. Understanding of technology as it relates to locally available materials
11. Development of graphic communication ability
12. Development of the ability to work effectively, efficiently and safely.

The Relevance and Value of Design & Technology in Schools

Aims of the Nine Year Curriculum

1. Show knowledge and appreciation of the Tswana culture, language, literature, arts, crafts & tradition.
2. Understand English and use it appropriately, both as a medium of learning at school and as a vehicle of communication beyond school.
3. Apply knowledge and imagination to identify problems in household management and everyday commercial transactions, and have the mastery of basic scientific and mathematical concepts to solve them.
4. Be able to observe and record accurately and draw reasoned conclusions.
5. Realise the effect of Botswana's location in the African continent on political, economic and social life in Botswana.
6. Acquire skills in food production, and industrial arts for self-reliance, elf-sufficiency and rural development.
7. Effectively use commonly needed tools and instruments in activities connected with later studies and out-of-school occupations.
8. Know how to run a home and care for a family.
9. Be able to assess their own achievements and capabilities in pursuit of appropriate employment and/or further education.
10. Have developed a sound moral code of behaviour compatible with the ethics and traditions of Botswana.
11. Be able to adopt to social, economic and technical change by adjusting acquired knowledge to new situations and by taking appropriate action.

From Ministry of Education

Rationale for Design & Technology in CJ Schools

Design & Technology is an education programme that applies knowledge from a variety of other subject areas, especially mathematics and science. It aims at helping the young citizens of Botswana to respond more appropriately to the technological needs and developments of their country. Design & Technology strives to provide students with the opportunity to be creative and inventive, to analyse and solve problems, and to explore and experiment. The programme does this through developing an understanding of design and problem solving skills through a multi-media approach. Design is seen as the unifying feature to this course.

Subject Aims

Those students who complete Design & Technology as a subject in their junior secondary programme should be able to:

1. Creatively and practically apply problem-solving skills through designing, making and evaluating.
2. Demonstrate an understanding and appreciation of technology as it relates to their present and future lives.
3. Contribute to their own self-sufficiency and self-reliance by practically applying simple technological principles to situations within the home and community.
4. Make choices with regard to the technological developments taking place worldwide with particular reference to Botswana.
5. Communicate their ideas through a range of graphical media.
6. Demonstrate the acquisition of a range of making skills.
7. Work safely with a range of materials, tools and equipment.
8. Work together with an attitude of social responsibility and cooperation.
9. Exercise value judgement of an aesthetic, technical, economic and moral nature.
10. Demonstrate their curiosity, ingenuity, initiative, resourcefulness and discrimination throughout the course.

From Curriculum Development Unit for D&T in the CJ Schools

Some issues that make D&T relevant to Botswana's youth.

- skills for self sufficiency and self reliance
- gaining some insight into occupations of a technical nature
- being able to address issues such as energy for the future
- being part of the change process
- building a foundation for research and development of technologies in response to Botswana's needs

What is Design and Technology?

Design and Technology is multy-activity, thematic approach to learning which combines 'activity based learning' and 'learning by discovering' in a problem solving situation. It is largely a 'child centred' approach rather than a teacher based one. This approach is based on the assumption that all people, including children, learn in different ways and that their learning is affected by many factors including past experiences. Further, it is argued that children develop many complex skills long before they enter the school. Therefore the role of the school should be to encourage children to build on their initial experiences, thus extending their knowledge boundaries as well as exploring their imaginative and creative abilities.

Through Design and Technology both boys and girls learn to to explore their creative and imaginative abilities. This may include a brainstorming and think tanking sessions which engage them in the search of a suitable solutions to a problem. students are also encouraged present their ideas logically. They are also encouraged to come up with as many solutions as possible solutions before selecting the best one. This is where a teachers plays a very vital role that of stimulating more ideas from students. Through this approach, children learn to think independently, creativity and imaginatively resulting in originality and inventiveness aspects. These skills are so vital in preparing children to become future decision makers and this includes engineers of all kinds, doctors, manufacturers, politicians etc..

Design and Technology also seeks to inculcate values and attitudes such as craftsmanship, appreciation of their environment, self reliance, responsibility, resourcefulness, appreciation of their culture as well as that of other etc. Some of these values have been outlined in Education for Kagisano.

Through Design and Technology children are helped to understand the vocational, social and Leisure opportunities that Design and Technology affords. Furthermore, by constantly solving problems, children learn to see their environment as a challenge that seeks their input. Additionally, Design and Technology provides both boys and girls with the awareness that there is 'good' bad technology.

What kind of Problems are presented to students?

Design and Technology engages children in varied problems depending on the given theme. The themes could be anything from 'Health, water, culture, transport, food, the disabled illumination, etc. Briefly the subject seeks to engage children in real life problems. Children are encouraged to analyse - themes/briefs in order to come up with ~~the desired~~ solutions to given problems. The design process is part of the problem solving strategy though it is not always linear. It all depends on the nature of the problem to be solved.

Design and Technology and Skills development

The development of skills is an integral part of Design and Technology. Both boys and girls learn to work with various materials inter alia wood, metal, plastics, ceramics, fabrics etc as they solve practical problems. In so doing they develop knowledge of tools and process resulting sharpened skills. Values and attitudes are also inherent skills development.

Design and Technology and other subjects of the Curriculum

Design and Technology plays a vital role consolidation knowledge of other subject areas. It does so by drawing their knowledge and putting it into practical use. For instance scientific and mathematical principles tend to feature prominently in design and technological activities. Literacy is also a vital tool for Design and technology since children need to do some research that might require reading and interviewing people. Similarly, subjects such as history, geography social studies etc do play a vital role in Design and Technology, since children learn about origins, locations and environmental issues respectively.

Design and Technology and Gender

Experience elsewhere has revealed that girls are capable of engaging successfully in design and technological activity as boys. In some cases they excel better than boys. This overrides the stereotype that there certain activities for boys as well as those for girls. This notion can be very misleading.

The role of the teacher in Design and Technology

N/N

Many people tend to think Design and Technology makes teachers redundant because it takes the authority away from them. Another notion is that students are allowed to do what ever they like implying that there is no sense of direction in the subject. Both notions are wrong because the teacher is indispensable in any learning situation. The teacher's role in Design and Technology is inter alia to:

- Manage the classroom situation as well as facilitating learning.
- To create a conducive learning situation for students.
- To stimulate more ideas from students as they explore possible solutions tom a given problem.
- To act as another readily available resources in terms of knowledge and provision of materials and equipment.
- To guide the learning situation by setting parameters which students are to work within.
- To encourage the less able students to learn by making tasks relevant to their ability.
- To prepare records of work as he/she monitors the various activities.
- Most importantly to make sure that students work safely with materials and tools.

Appendix D

Education Options and Entry Requirements

for Several Formal Vocational and Technical Training Institutes

Table D-1

Entry Requirements for Formal Vocational Technical Education

Entry Requirements:

Std. 7	-	Standard 7
JC	-	Junior Certificate
CSC	-	Cambridge Senior Certificate

Skill Levels:

V	-	Vocational education--i.e., training oriented toward craft skill development.
T	-	Technical education--i.e., academic and occupational training aimed at higher order technical skills, usually involving integration of several technical skills.

Type of Training:

I	-	In-service
P	-	Pre-service

Students:

FTEs	-	Full-Time Equivalents. This number may be less than the number of students enrolled (when students are not engaged fulltime), equal to the number enrolled, or more than the number enrolled (when students are enrolled for more than a year).
dnc	-	Data not complete. When this designation appears next to a year, data are incomplete for that year only; when it appears elsewhere, incomplete data constitute the cell.

FORMAL VOCATIONAL AND TECHNICAL TRAINING
WITHIN MINISTRIES AND PARASTATALS IN BOTSWANA

Name	Entry Req.	Occupational Study Areas	Skill Level	No. Courses	Type	Course duration in years	Students			
							Year	No. Enrolled	No. FTEs	No. Completers
Botswana Civil Aviation	JC CSC	Flight information, Aeronatical radio	Primarily V	3	I	0.5 - 1.3	1981	-	-	-
							1982	12(dnc)	-	12
							1953	-	-	- (dnc)
Telecommunications Training Centre	CSC JC	Fitting, jointing, telegraph, telephone electronics	Primarily V	12	Primarily I	0.07 - 0.38	1981(dnc)	98	-	93
							1982	154	-	154
							1983(dnc)	91	-	-
Department of Surveys & Lands	CSC	Cartography survey	T	2	I	1 - 2 5	1981	6	-	5
							1982	16	-	-
							1983	-(dnr)	-	-(dnc!
Department of Meteorology Services	CSC	Meteorology	T	1	I	-	1981	13	13	7
							1982	11	11	8
							1983	13	13	-
Commissioner for Customary Services	None Std.7	Police, chief & court clerks training; administrative	T	5	Primarily I	0.1	1981	140	140	80
							1982	13:8(dnc)	138(dnc)	91
							1983	116	116	- (dnc)
Department of Water Affairs	JC CSC	Mechanics, foremanship, engineering & crafts	V T	15	-	2 - 5	1981	12	77	17
							1982	4(dnc)	73(dnc)	59(dnc)
							1983	8	68	78
Cooperative Development Centre	None CSC	Bookkeeping, member education, management	Primarily V	5	I	0.03 - 0.41	1991	125	125	104
							1982	50(dnc)	50(dnc)	41(dnc)
							1983	106	106	-
Computer Bureau	CSC	Comouter concept, Programming	T	3	I	0.001 - 0.12	1981(dnc)	-	-	-
							1982	231	231	227
							1983(dnc)	124	129	-
Botswana Housing Corporation	JC CSC	Building, property management, secretarial, public administration, accountancy	V T	7	-	0.5 - 2.0	1991	45	43	40
							1992	52	58	49
							1983(dnc)	9	18	9

(Continued)

Table D-2

Formal Vocational and Technical Training with Ministries and Parastatals in Botswana

(Continued)

Name Acronym	Entry Req.	Occupational Study Areas	Skill Level	No. Courses	Type	Course duration in years	Students: Year	No. Enrolled	No. FTEs	No. Completers
Unified Local Government Service (ULGS)	Std.7 JC	Land board training, social & community development, supervision	Primarily T	7	Primarily I	0.02 - 0.4	1981 1982 1983	83 98(dnc) 11	83 98(dnc) 11	83 98(dnc) 11
Ministry of Local Government & Lands	JC	Day care	T	1	P	1	-	-	-	-
Botswana Meat Commission (BMC)	JC	Engineering, production; meat, leather, canning, & tanning technology	V T	6	I	1 - 2	1981 1982 1983	28 23 14(dnc)	- - -	- 22 -(dnc)
Rescue Fire Service Training	Std.7	Firemanship, officer training	V	3	I	.25	1981 1982 1983	20 14 12(dnc)	- - -	15 11 -(dnc)
Prisons	Std.7	Prisons	V	4	I	0.12 - 0.25	1981 1982 1983	110 130 169	110 130 169	108 128 -
Roads Training Centre	None Std.7 JC CSC	Road building skills, machine operation & supervision	V	9	-	0.04 - 3	1981 1982 1983	38 38 38(dnc)	38 38 38(dnc)	34 38 26(dnc)
Department of Town and Regional Planning	CSC	Drafting	T	1	Primarily I		1981 1982 1983(dnc)	4 0 3	4 0 3	4 0 -

Source: Ministry of Finance and Development Planning, 1983.

Table D-2 Continued

FORMAL VOCATIONAL AND TECHNICAL TRAINING INSTITUTIONS

Name	Entry Req.	Occupational Study Areas	Skill Level	No. of Courses	Type	Course Duration (years)	Students: Year	Students: No. Enrolled	Students: No. of FTEs	Students: No. of Completers
National Health Institute (NHI)	JC CSC	Nursing, dental care, pharmacy, health education, laboratory, records	Primarily T	16	Primarily P	0.75-4	1981 1982 1983	428 400 380(dnc)	865 973 1,013(dnc)	429 355 303(d)
Botswana Police College	Std. 7	Policing, driving, explosives	Primarily V	15	Primarily I	0.03-1.8	1981 1982 1983	529 607 72(dnc)	529 607 72(dnc)	529 599 72(d)
Automotive Trades Training School (ATTS)	JC	Automotive trades	V	3	P	3	1981 1982 1983	- 40[2] 40[2]	- 40[2] 74[2]	- 0 -
Botswana Polytechnic (BP)	JC CSC	* Plumbing, building, electricity	V T	24	P I	0-4	1981 ** 1982 1983	284 - 485[1](dnc)	456 16 -(dnc)	260 39 -(dnc)
Botswana Institute of Administration and Commerce (BIAC)	Std.7 JC CSC	Clerical, accounting, telephone, records, customs, building, administration	V	58	I	0.01-4	1981 ** 1982 1983	1,237 - 1,103[3]	1,237 - -	1,089 - -

Sources: Unless otherwise indicated, data are from Ministry of Finance and Development Planning, 1983
Source for item marked [1] is Botswana Polytechnic, source for items marked [2] is ATTS, and source for items marked [3] is BIAC.

Difference between tables in number of BP courses offered probably are due to data being compiled on different bases.

*Information missing on several areas; e.g., mechanical, electrical, and civil engineering; telecommunications; technical teacher training; industrial administration.

**Enrollment figures need checking.

Table D-2 Continued

OUT-OF-SCHOOL VOCATIONAL AND TECHNICAL TRAINING PROGRAMS IN BOTSWANA

Name	Entry Req.	Occupational Study Areas	Skill Level	No. of Courses	Type	Course Duration (years)	Students: Year	Students: No. Enrolled	Students: No. of FTEs	Students: No. of Completers
Botswana Brigades	Std.7	Building, carpentry, welding, mechanics, forestry, plumbing, electrical, metal	V	38	I	variable	1981	676	-	-
							1982	683	-	-
							1983	726	-	-
Rural Industries Innovation Centre (RIIC)	None	Blacksmithing, carpentry, leatherwork	V	5[1]	P		1981	83[1]		83[1]
							1982	138[1]		138[1]
							1983	98[1]		98[1]
Botswana Enterprise Development Unit (BEDU)		Metalwork[2] construction, garments, leatherwork, woodwork, jewelry	V				1981	37[2]		

Source: Ministry of Finance and Development Planning, 1983. (Source for items marked [1] is RIIC; source for items marked [2] is BEDU.)

Table D-2 Continued

Table D-2 Continued

VOCATIONAL AND TECHNICAL TRAINING OFFERED THROUGH BUSINESS AND INDUSTRY

Name	Entry Req.	Occupational Study Areas	Skill Level	No. of Courses	Type	Course Duration (years)	Students: Year	Students: No. Enrolled	Students: No. of FTEs	Students: No. of Completers
Standard Bank Training Centre	CSC	Clerking, billing, leadership	Primarily V	22	Primarily I	0.02-0.04	1981	156	-	129
							1982	190(dnc)	-	168(dnc)
							1983	98	-	46
Debswana	-	Typing, automotive, electrical, fitting, fabrication	T	19	Primarily I	-	1981	76	-	62
							1982	41	-	35
							1983	63	-	45
Multi Construction Building & Engineering Botswana	-	Siting, tiling first aid, clerical, supervision	V	5	Primarily I	-	1981	-	-	-
							1982	12	12	12
							1983	-	-	-
Engineering Management Services (EMS)	CSC	Civil engineering	T	2	-	4	1981	-	-	-
							1982	8	8	-
							1983	8	16	-
Barclays Bank Training Centre	CSC	Clerking, telling, supervision	V	8	Primarily I P		1981	282	282	282
							1982	311	311	311
							1983	491(dnc)	419(dnc)	45(dnc)

Source: Ministry of Finance and Development Planning 1983.

PROPRIETARY ESTABLISHMENTS OFFERING VOCATIONAL TRAINING IN BOTSWANA

Name	Entry Req.	Occupational Study Areas	Skill Level	No. of Courses	Type	Course Duration in years	Students: Year	No. Enrolled	No. FTEs	No. Completers
Mochudi Typing School	Std.7	Typing, Bookkeeping	V	2	P	0.5-1	1981 1982 1983	140 180(dnc) 171	- - -	80 120(dnc) -
Gaborone Cathedral Commercial School	Std.7 JC	Shorthand, Typing, Clerical, Bookkeeping	V	8	P	0.5-1.3	1981 1982 1983	205 226(dnc) 104	205 226(dnc) 104	205 226(dnc) 20
Tshipidi Commercial School	Std.7	Clerical	V	1	P	1.5	1981 1982 1983	76 88 96	137 164 184	40 50 -
Assemblies of God[1] Typing School	Std.7	Typing	V	1	P	0.3	1983	20		
Aunt Ellen's[1] Typing School	Std.7	Typing	V	2	P	0.5-0.75	1983	40		
[illegible]nyo Touch[1] Typing School	Std.7	Typing	V	2	P	0.5				
Gabriel's Typing[1] School	JC	Typing	V	1	P	0.5-0.75	1983	60		
Modern Typing[1] School	Std.7	Typing, Bookkeeping, Office Skills	V	1	P	0.5-0.75	1983	134		
St. Peter's[1] Typing School	Std.7	Typing	V	1	P	0.5	1983	28		

Source: Ministry of Finance & Development Planning, 1983 (Source of items marked [1] is 1983 Assessment & Analysis of Nonformal Education in Botswana by Creative Associates, Inc.).

Table D-2 Continued

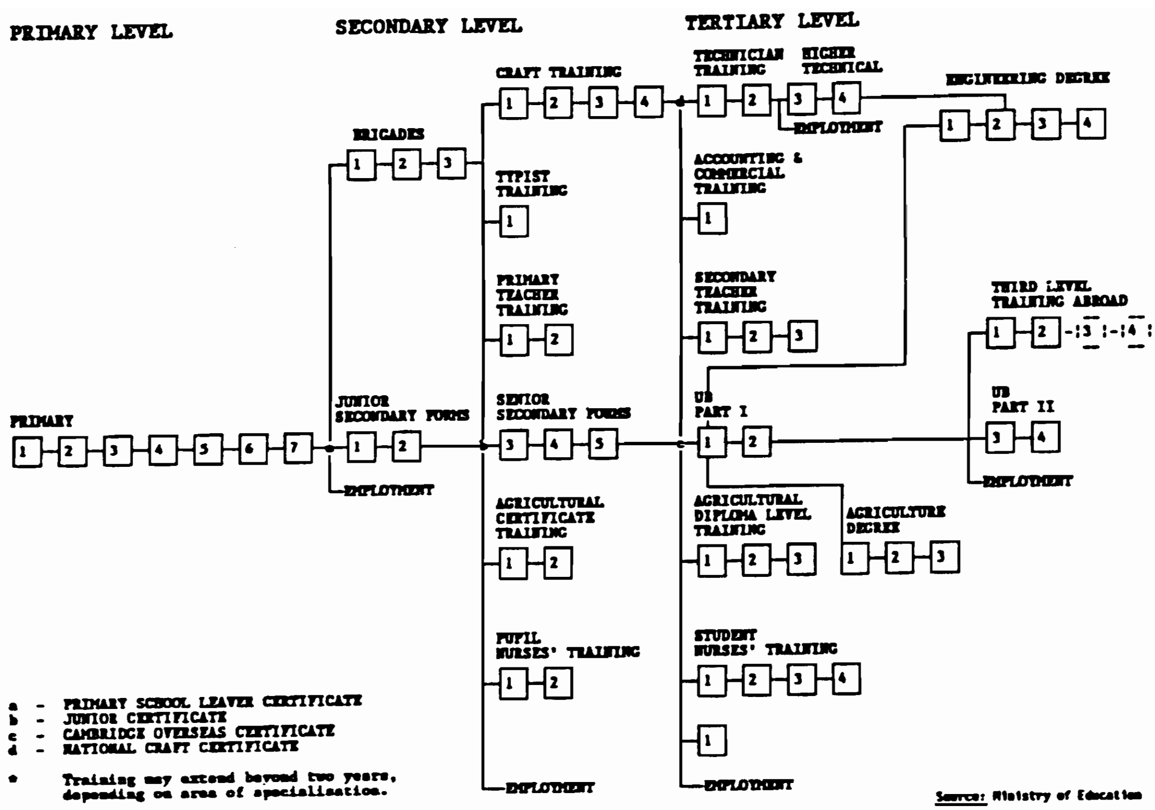


Figure D-1 The Structure of the Education System

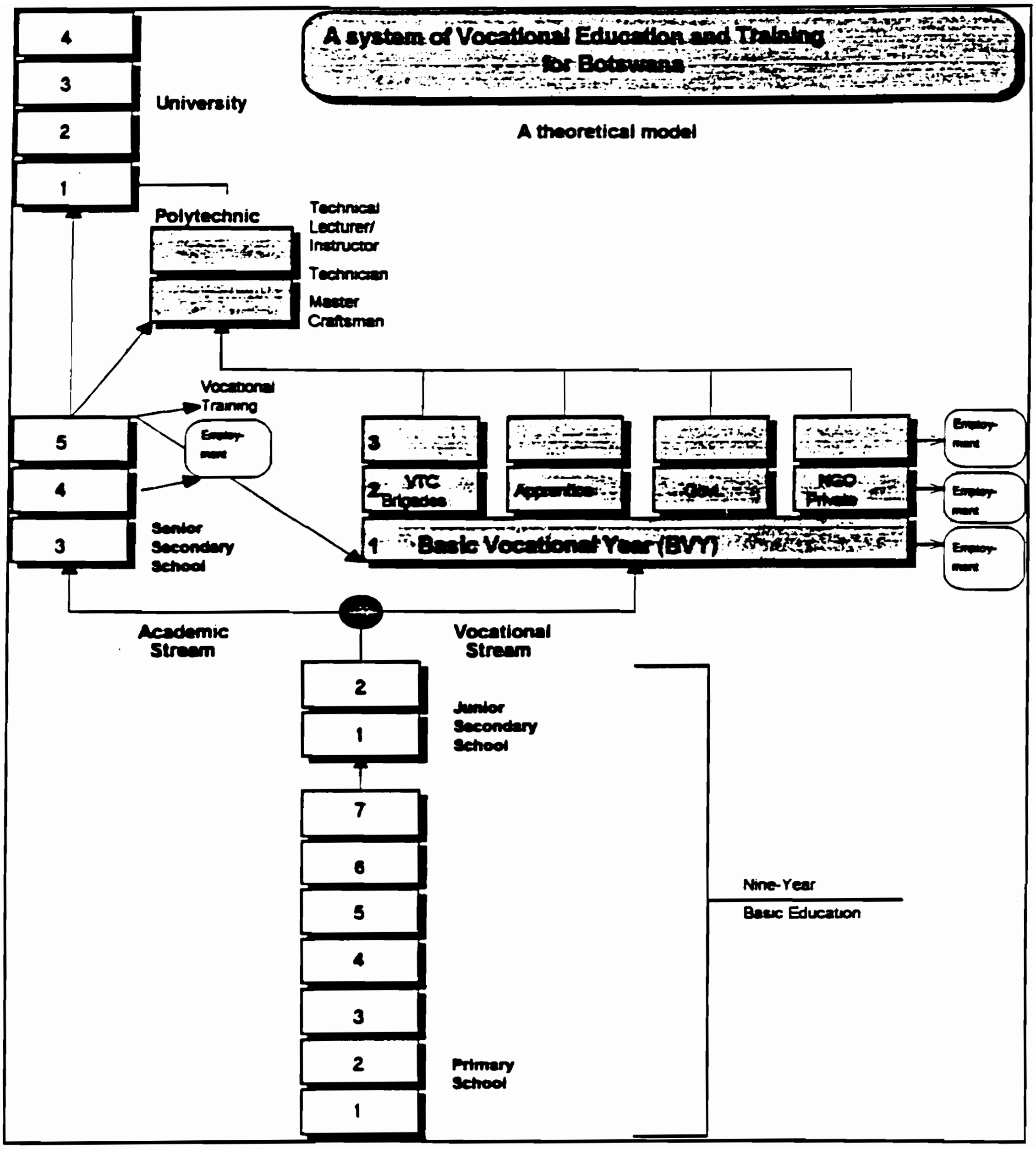


Figure D-2 A System of Vocational Education and Training for Botswana

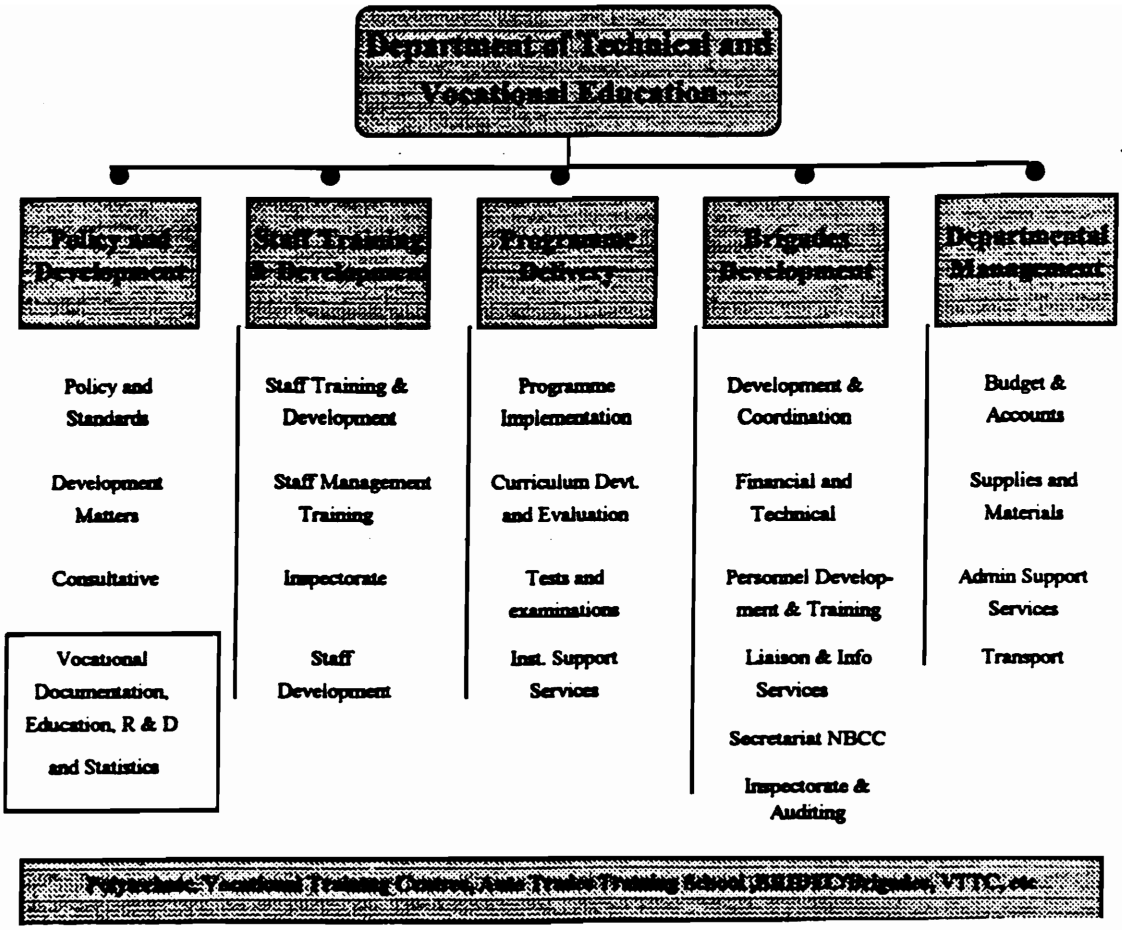


Figure D-3 Department of Technical and Vocational Education

Appendix E

Drop-out Rates and Enrollment of Females

At Various School Levels

Table E-1

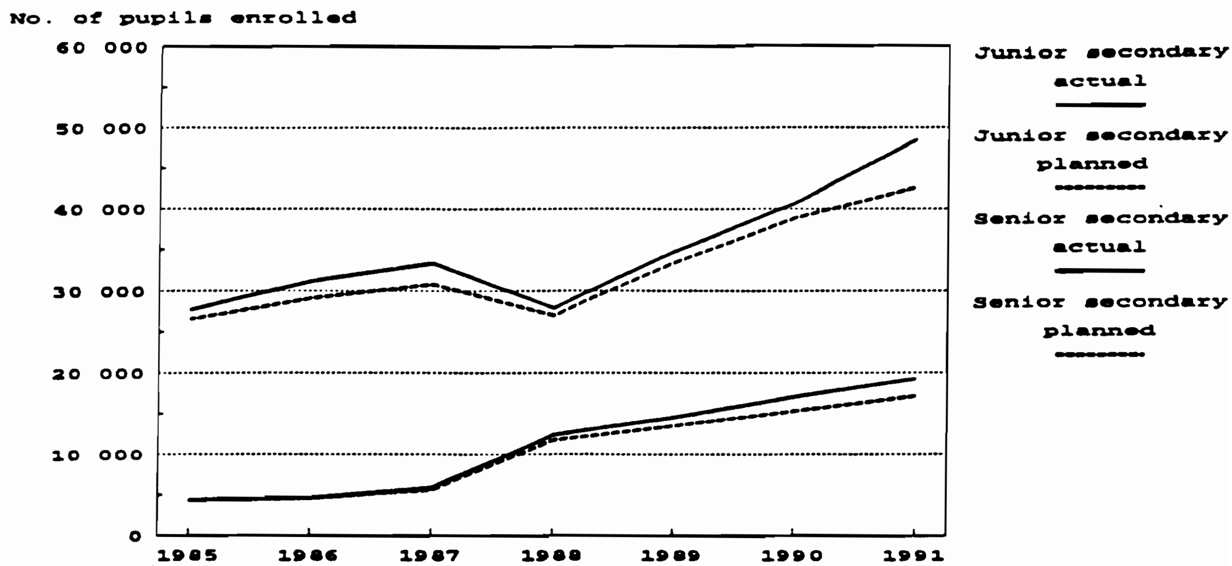
Female Enrollments at Various Levels

Female Enrolments at Various Levels, 1979, 1984 and 1989

	1979	1984	1989
Primary:			
Standard 1	52,4%	50,6%	50,2%
Standard 7	60,4%	56,4%	55,9%
Total Primary	55,0%	52,8%	51,5%
Secondary:			
Form 1	59,0%	56,9%	55,5%
First year senior secondary[a]	41,0%	43,7%	50,3%
Teacher Training Colleges	79,9%	84,1%	82,5%
Vocational and Technical Training	33,1%	33,6%	31,9%
University of Botswana	37,4%	41,5%	43,8%

Source: Education Statistics.
Note: (a) Form 4 in 1979 and 1984, Form 3 in 1989.

Secondary Education – Planned and Actual Enrolments



Source: Ministry of Education.

Note: From 1988 onwards senior secondary comprised Forms 3, 4 and 5.

Secondary School Drop-Outs by Sex, 1984–1989

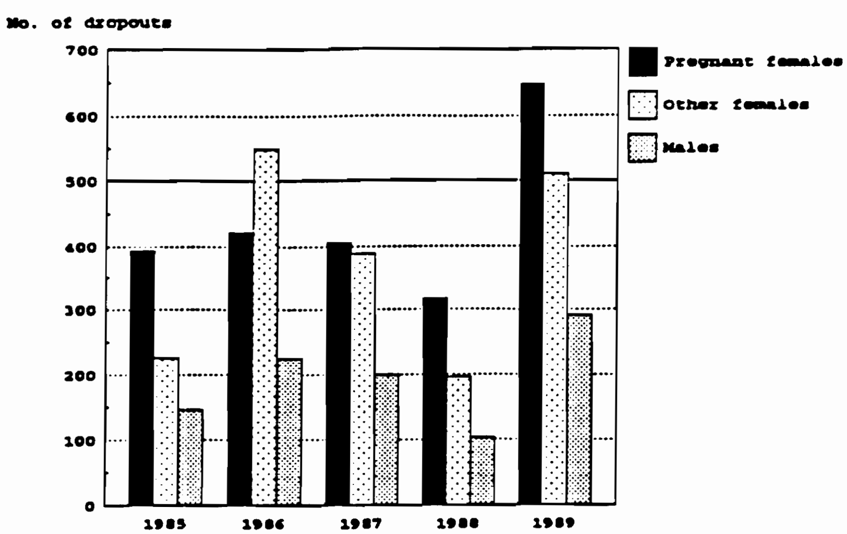


Figure E-1 Secondary School Enrollments and Drop-outs by Sex

Appendix F

A Comparison of the Four Attitude Scales

Table F-1

A Comparison of the Four Standard Attitude Scales

A Comparison of the Four Standard Attitude Scales

	Guttman	Thurstone	Likert	Semantic Differential
Properties of Items				
Quantification	ordinal	"interval"	qualitative	—
Neutral items retained	yes	yes	no	no
Tracelines	monotonic (step-shaped)	nonmonotonic (inverted U)	monotonic (linear)	monotonic (linear)
Cumulative scale	yes	no	no	no
Item selection	response-inferred	response-inferred and judgmental	response-inferred	response-inferred
Properties of Attitude Scores				
Values of b	0, ±1	0, 1	−2 to +2	0 to 3
Values of e	±1	−5 to +5	−1, +1	−1, +1
Values of $b \times e$	0, 1	−5 to +5	−2 to +2	−3 to +3
Disbeliefs	yes	no	yes	no
Computational formulas	$\Sigma b_i e_i$	$\Sigma b_i e_i / \Sigma b_i$	$\Sigma b_i e_i$	$\Sigma b_i e_i$ or $\Sigma b_i e_i / n$
Quantification	ordinal	"interval"	ordinal	"interval"

20. As noted previously, the same may be true for certain other single bipolar scales, such as *I like–dislike* or *favorable–unfavorable*.

Appendix G

A Summary of Findings of PATT-USA and Selected International Comparisons

FINDINGS

1. Boys indicated a greater interest in technology than girls.

2. Boys rated technology as having more consequence than did the girls. It is interesting to note that even though the boys exhibited a more positive attitude toward technology than the girls, the males also perceive technology as being more difficult.

3. The girls view technology as being an activity for both boys and girls to a greater extent than do the boys.

4. There is a significant difference between boys and girls on their knowledge about technology (i.e., boys appear to be knowledgeable).

5. The general interest in technology of older students was significantly greater than that of those who were younger.

6. There was no direct relationship between grade level and the view that technology is an activity for boys and girls.

7. The extent that a student's father was reported as having a job dealing with technology was significantly related to the pupils' general interest in technology.

FINDINGS (continued)

8. Students with fathers who have jobs that deal to some extent with technology had a more positive view on the consequences of technology than did the students whose fathers' jobs had nothing to do with technology.

9. More technology represented in the fathers' jobs corresponded to a greater knowledge about technology.

10. Students with mothers whose jobs were rated as "very much" related to technology had more general interest in technology than those whose mothers' jobs were rated as "little" or "nothing" to do with technology.

11. If the mothers' jobs had "very much" to do with technology, then their children had a better attitude toward technology than any of the other students.

12. The technological vent of mothers' professions had a nonlinear effect on children's knowledge about technology.

13. The existence of technical toys in the home had a significantly positive impact on all attitude scales.

14. Having technical toys at home also had a significant effect on the knowledge about technology that students have.

FINDINGS (continued)

15. Having a technical workshop in the home does not appear to have the effect that having technical toys does.

16. Students who come from homes equipped with technical workshops have more general interest in technology and a greater positive view on the consequences of technology.

17. Having a personal computer in the home had a significant positive effect on their general interest in technology.

18. Students who think they will choose a technological profession were significantly more likely to have a greater general interest in technology, a more positive attitude toward technology, a better view of the consequences of technology, and greater knowledge about technology than those shying away from a technological profession.

19. Taking or having taken Technology Education/ Industrial Arts made a significant difference on all attitude scales, as well as the concept scale.

20. Students who took Technology Education/Industrial Arts classes displayed a greater knowledge about technology than did students who had no exposure to the classes.

Number of pupils in the samples

	girls (n)	boys (n)	total (n)
Poland (1)	- - -	- - -	321
Poland (2)	370	308	678
Kenya	- - -	- - -	244
U.K.	- - -	- - -	173
India	276	349	625
Italy	281	285	566
Nigeria	200	103	303
Australia	111	101	212
France	122	112	234
Denmark	73	79	152
Mexico	98	115	215
The Netherlands (1)	1042	1427	2469
Belgium	97	93	190
The Netherlands (2)	1021	1029	2050
The Netherlands (3)	697	560	1257
U.S.A.	6256	4013	10349

Boys' and girls' scores on the Attitude scales

		Interest	Role Patn.	Conse-quence	Diffic.	Curric.	Career
U.K.	B	2.3	2.6	2.4	---	2.4	2.6
	G	2.9	2.0	2.6	---	2.7	3.2
France	B	2.3	2.3	2.5	2.7	2.6	2.7
	G	2.7	1.8	2.6	2.6	2.9	3.1
Denmark	B	2.3	2.4	2.5	2.8	2.6	2.5
	G	2.7	1.8	2.7	2.8	2.8	2.8
Belgium	B	2.3	2.8	2.3	2.8	---	---
	G	2.7	2.2	2.5	2.4	---	---
The Netherlands (1)	B	2.3	2.5	2.3	2.3	---	---
	G	3.0	2.2	2.6	2.2	---	---
Poland	B	2.4	3.0	2.3	3.0	2.8	2.8
	G	2.7	2.8	2.1	3.0	2.8	3.1
The Netherlands (2)	B	2.3	2.0	2.3	2.3	2.1	2.0
	G	3.0	1.6	2.4	2.4	2.6	2.6
The Netherlands (3)	B	2.6	3.1	3.2	2.9	2.9	2.6
	G	2.1	1.9	2.5	2.9	3.1	3.1
U.S.A.	B	2.5	2.3	2.0	2.7	---	---
	G	3.0	1.7	2.1	2.4	---	---

Boys' and girls' scores on the concept scales

		Tech. & Society	Tech. & Sciences	Tech. & Skills	Tech & Pillars	Total Score
Belgium	B	.48	.34	.80	.49	.53
	G	.40	.32	.88	.42	.51
The Netherlands (1)	B	.50	.48	.75	.57	.57
	G	.36	.33	.65	.45	.45
France	B	.49	.39	.59	.60	.51
	G	.42	.34	.59	.49	.46
Denmark	B	.46	.46	.76	.46	.54
	G	.40	.43	.73	.35	.48
Italy	B+G	.34	.36	.47	.55	.43
Poland (1)	B+G	.63	.65	.56	.48	.58
Poland (2)	B	.66	.60	.60	.61	.62
	G	.61	.69	.68	.55	.63
Nigeria	B+G	.43	.56	.51	.39	.47
India	B	---	---	---	---	.60
	G	---	---	---	---	.61
The Netherlands (3)	B	.62	.75	.72	.70	.70
	G	.52	.71	.71	.63	.63
The Netherlands (2)	B	.60	---	.70	---	.55
	G	.29	---	.63	---	.46
U.S.A.	B	---	---	---	---	.50
	G	---	---	---	---	.47

Appendix H

Time Line for the PATT-Botswana Study

Jan. 1992	Prospectus Exam - VPISU, Blacksburg
Feb. 1992	Arrival in Botswana - MCE, Molepolole
Mar. 1992	
Apr. 1992	
May 1992	Search for members to act on PATT Advisory Panel
Jun. 1992	Senior secondary school identification re-confirmed.
Jul. 1992	Apply for Natl. Inst. of Research funding. Nominees for advisory panel contacted and informed about the project.
Aug. 1992	The advisory panel is formed.
Sep. 1992	The USA instrument is circulated among members. Feedback concerning readability (ages 16-20) of the questioninnaire is obtained.
Oct. 1992	Pre-Pilot Testing of PATT-USA instrument with first-year teacher candidates (ages 20-24)
Nov. 1992	Application for permission with Gov. of Botswana to carry out PATT research.
Dec. 1992	A Botswana version of the USA questionnaire is produced with minor modifications.
Jan. 1993	Pre-Pilot Testing of PATT-Botswana instrument with first-year teacher candidates (ages 20-24) is used to test readibility and gain records of students' background
Feb. 1993	
Mar. 1993	

Apr. 1993	
May 1993	Permission from the Office of the President to carry out PATT research in Botswana received. Pilot questionnaires printed.
Jun. 1993	Pilot schools contacted. Permission received
Jul. 1993	Pilot Phase: Kgosi Kgari Sechele SSS (B=42/G=56/T=98) & Gaborone SSS. (B=79/G=60/T=139)
Aug. 1993	Review of pilot data/proceedures Permission for final phase obtained from schools
Sep. 1993	Final Phase: Moshupa SSS (B=69/G=54/T=123) Lobatse SSS (B=82/G=26/T=108) Naledi SSS (B=33/G=18/T=51)
Oct. 1993	Maun SSS (B=54/G=41/T=96) Bobonong SSS (B=79/G=41/T=120) Francistown SSS (B=55/G=39/T=94)
Nov. 1993	
Dec. 1993	
Jan. 1994	
Feb. 1994	Data Entry Stage Start
Mar. 1994	Data Entry Stage Complete
Apr. 1994	
May 1994	Analysis Stage Start
Jun. 1994	

Jul. 1994	
Aug. 1994	
Sep. 1994	
Oct. 1994	Botswana-based phase of the study concludes
Jul. 1995	Study resumes: VPISU, Blacksburg
Apr. 1996	Analysis complete: Concusions Drawn
May. 1996	Findings presented to Faculty at VA Tech

Appendix I

Official Notification of

Approval to Conduct Research in Botswana

Office of the President
Private Bag 001
GABORONE

REF. NO: OP 46/1 XXXVII (125)

3rd May 1993

TO: Mr. Jeff Meide
P/Bag 008
Molepolole

Dear Sir/Madam,

ANTHROPOLOGICAL RESEARCH ACT
GRANT OF PERMIT UNDER SECTION 3

I refer to your letter dated ....

about application to do research.

In exercise of the powers vested in him by the Anthropological research act the Minister of Presidential Affairs and Public Administration has granted permission to Mr. Jeff Meide to carry out research on the Pupil's Attitudes Towards Technology (PATT) - Botswana

The research will be carried out for a period not exceeding Sixteen (16) months, with effect from 4/5/93 and will be carried out at parts of the Country

This permit is granted subjective to the condition that any papers written as a result of the research shall be deposited with Government Archivist, Director - National Library Service.

Yours faithfully,

D.L.D. GOPOLANE
for/PERMANENT SECRETARY/TO THE PRESIDENT

c.c. District Commissioner, Maun, Tsabong, Molepolole, Gaborone, F/Town, Lobatse
Director, Library Service
Government Archivist
Director, N.I.R.

Appendix J

Information Including the Information Dissemination of the Project, Recruitment of Advisory Board Members, and Official List of Participating Members

The following individuals served as consultants throughout the initial stages of instrument design and modification:

Elsie Alexander - Women's Studies, University of Botswana
Sally Jobson - Department of English, Chair, Kgosi Kgari Sechele SSS.
Nick Ndaba - Senior Education Officer - Design And Technology
Peggy Ntseane - Social and Cultural Studies, University of Botswana

These individuals assisted in the phase of the project that took to task data gathering, data processing, and an early analysis of the raw data:

Ray Charakupa - Maths and Science, University of Botswana
Dr. William North - Maths/Statistics , Molepolole College of Education

To each a great deal of thanks is given.

To: (Candidates to participate in the research) May 4, 1992

From: Jeff Meide

Re: <u>The PATT-Botswana Project</u>

A study of this type requires a team effort. To effectively conduct PATT Research as described within the proposal it is imperative that I seek the assistance of one or more citizen researchers. It is with eager anticipation that I hope, after reviewing the information enclosed regarding the PATT Project, you will consider joining the PATT-Botswana team.

Below is an outline describing the needs for citizen participation. Your involvement would be a valuable contribution to the profession.

<u>The Need for Participation in Pupils' Attitudes Toward Technology (PATT)</u>

1. To serve in the capacity of advisor during the period of modification and revalidation of the instrument. There is a need for this person to identify a body of primarily technology education specialists and others to assist the researcher(s) in modifying the instrument.

2. To serve as a liaison officer between identified schools and the research team to coordinate a workable timeframe to carry out both pilot and executive phases of data collection.

3. For persons who show active involvement in the field of Technology Education and a willingness to engage in support for PATT Research in Botswana.

Thank you for your expressed interest in PATT.

Sincerely,

J. Meide

P/Bag 8

Molepolole

Tel- 320275

1. **What is PATT?**
PATT is a research model that has been used for international measurement of pupils' concept of and attitude towards technology.

2. **Methodology**
PATT employs an attitude and concept questionnaire plus an open-ended statement used to describe what pupils believe technology is.

3. **Why is PATT research important for Botswana?**
   a. Technology has a very large impact on the nation's cultural, social, economic and political life.
   b. Technology education has been identified by the government as a crucial component in the strategy for national development.
   c. We do not know what the attitude of boys and girls in Botswana is toward technology.
   d. The research findings will offer curriculum planners a student-centered approach to develop and assess technical programs for Batswana pupils ages 12-18.
   e. The results will help to formulate a cultural definition of the role of technology in Botswana that can serve as a benchmark in future 'O' level studies.

4. **Problem Statement**
What is the attitude toward and the concept of technology among 'O' level Batswana pupils?

5. **Purpose of the Study**
To measure the attitudes of 'O' level Batswana students using the PATT attitude measurement instrument.

PUPILS' ATTITUDE TOWARD TECHNOLOGY

Introduction:

Pupils' Attitude Toward Technology (PATT) Research is designed to measure the attitudes and concepts of technology held by the pupils sampled. One of the results of the proposed study is a descriptive profile of the sample based on a comparative framework accounting for differences in demographic characteristics. Another aspect of the findings draws cross-cultural comparisons with pupils from other countries.

As a curriculum development tool the model used in PATT Research can provide educators and program planners with an instrument to assess the needs of particular pupil populations and to follow up program effectiveness. In Botswana the contributions of PATT Research offer both Government and local planners a means of monitoring formal educational efforts to eliminate constraints now present within the nation's technically skilled manpower sector.

In 1992, research began on Pupils' Attitude Toward Technology in Botswana (PATT-Botswana) by Jeff Meide under the supervision of William Dugger and Josiah Tlou, faculty members of Virginia Polytechnic Institute and State University, USA. The instrument to be developed is an adaptation of one created at the University of Technology Eindhoven, The Netherlands, by Jan Raat and Marc De Vries in 1984. The Dutch instrument has been used in the past eight years to assess the pupils' attitude toward technology in over 20 countries worldwide.

The instrument contains four basic parts. The first question asks for a short description of what the student thinks technology is. The second part consists of 11 questions to gather demographic data about the respondents. In the third part, 58 statements are included to assess the *attitude* toward technology. In the fourth part, 31 items assess the pupils' *concept* of technology.

The Botswana instrument which has been designed for Form V pupils (ages 16-20) is to be field tested and validated during November 1992-January 1993 with 200 pupils in two schools in Botswana. Administration of the validated instrument will take place throughout the final term of the 1993 school year with 600 pupils in six schools across the nation.

Aims:

The aims of PATT-Botswana have been formulated to address culturally specific demographic characteristics. An emphasis has been placed on rural and urban segments of the population. Therefore, one aim focuses on the comparative analysis between responses of pupils from primarily rural and primarily urban environments. Another aim seeks to compare responses from pupils with a Technical Studies background to pupils with no prior Technical Studies course work. Thirdly the study will examine responses across gender.

The method of analysis will allow the researcher to process data comparatively both between and within groups. One final assumption suggests that the data collected will provide a representative profile of pupils' attitude toward technology from schools across the nation.

Appendix K

Specimens of the PATT-USA Instrument and

Modified PATT-Botswana Instrument and Instruction Form

Printed in U.S.A. NCS Trans-Optic MP18 28215 321 A2403

PUPILS' ATTITUDE TOWARDS TECHNOLOGY

Developed by: Virginia Tech - Technology Education and Eindhoven University, The Netherlands

We are interested in your opinion on technology. Therefore, we would like you to answer some questions on this subject. This is not a test. There are no right or wrong answers. You are not to be graded on this. Do not take too much time for one question. You should only need about 25 minutes for the whole questionnaire. The first set of questions are about you so we can get to know you better. These are followed by statements about technology. Indicate to what extent you agree or disagree with them. In the last set of statements you only have to indicate agree, disagree or don't know.

Please give a short description of what you think technology is:

WRITE ONLY INSIDE THIS BLOCK

WRONG 1
WRONG 2
WRONG 3
RIGHT 4

1. Are you a boy or a girl? .... 1. B Boy G Girl
2. How old are you? .... 2. 12 or younger 13 14 15 16 or older
3. What is your grade in school? .... 3.

(Very Much / Much / Little / Nothing)

4. If your father has a job, indicate to what extent it has to do with technology 4
5. If your mother has a job, indicate to what extent it has to do with technology ... 5
6. Do you have technical toys, like Tinkertoy, Erector Set or LEGO at home? .... 6. Y Yes N No
7. Is there a technical workshop in your home? .... 7. Y Yes N No
8. Is there a personal computer in your home? .... 8. Y Yes N No
9. Do you think you will choose a technological profession? .... 9. Y Yes N No
10. Do you have brothers or sisters that have a technological profession or that are studying for it? .... 10. Y Yes N No
11. Are you taking or have you taken Technology Education/Industrial Arts? .... 11. Y Yes N No

(AGREE / TEND TO AGREE / NEUTRAL / TEND TO DISAGREE / DISAGREE)

12. When something new is discovered, I want to know more about it immediately 12
13. Technology is as difficult for boys as it is for girls 13
14. Technology is good for the future of this country 14
15. To understand something of technology you have to take a difficult training course 15
16. At school you hear a lot about technology 16
17. I will probably choose a job in technology 17
18. I would like to know more about computers 18
19. A girl can very well have a technological job 19
20. Technology makes everything work better 20
21. You have to be smart to study technology 21
22. I would not like to learn more about technology at school 22
23. I like to read technological magazines 23
24. A girl can become a car mechanic 24
25. Technology is very important in life 25
26. Technology is only for smart people 26
27. Technology lessons are important 27
28. I will not consider a job in technology 28
29. There should be less TV and radio programs about technology 29
30. Boys are able to do practical things better than girls 30
31. Everyone needs technology 31
32. I would rather not have technology lessons at school 32
33. I do not understand why anyone would want a job in technology 33
34. If there was a school club about technology I would certainly join it 34
35. Girls are able to operate a computer 35
36. Technology has brought more good things than bad 36
37. You have to be strong for most technological jobs 37
38. Technology at home is something schools should teach about 38
39. I would enjoy a job in technology 39
40. I think visiting a factory is boring 40
41. Boys know more about technology than girls do 41
42. The world would be a better place without technology 42

Over Please

43. To study technology you have to be talented 43
44. I should be able to take technology as a school subject 44
45. I would like a career in technology later on 45
46. I am not interested in technology 46
47. Boys are more capable of doing technological jobs than girls 47
48. Using technology makes a country less prosperous 48
49. You can study technology only when you are good at both mathematics and science 49
50. There should be more education about technology 50
51. Working in technology would be boring 51
52. I enjoy repairing things at home 52
53. More girls should work in technology 53
54. Technology causes large unemployment 54
55. Technology does not need a lot of mathematics 55
56. Technology as a subject should be taken by all pupils 56
57. Most jobs in technology are boring 57
58. I think machines are boring 58
59. Girls prefer not to go to a technical school 59
60. Because technology causes pollution, we should use less of it 60
61. Everybody can study technology 61
62. Technology lessons help to train you for a good job 62
63. Working in technology would be interesting 63
64. A technological hobby is boring 64
65. Girls think technology is boring 65
66. Technology is the subject of the future 66
67. Everybody can have a technological job 67
68. Not everyone needs technology lessons at school 68
69. With a technological job your future is promised 69

FROM NOW ON YOU ONLY HAVE THREE CHOICES

(AGREE / DISAGREE / DON'T KNOW)

70. When I think of technology I mostly think of computers 70
71. I think science and technology are related 71
72. In technology, you can seldom use your imagination 72
73. I think technology has little to do with our energy problem 73
74. When I think of technology, I mostly think of equipment 74
75. To me technology and science are the same 75
76. In my opinion, technology is not very old 76
77. In technology, you can think up new things 77
78. Working with information is an important part of technology 78
79. Technology is as old as humans 79
80. Elements of science are seldom used in technology 80
81. You need not be technological to invent a new piece of equipment 81
82. Technology has a large influence on people 82
83. I think technology is often used in science 83
84. Working with your hands is part of technology 84
85. In everyday life, I have a lot to do with technology 85
86. In technology, there is little opportunity to think up things yourself 86
87. Science and technology have nothing in common 87
88. The government can have influence on technology 88
89. I think the conversion of energy is also part of technology 89
90. In technology, you use tools 90
91. Technology is meant to make our life more comfortable 91
92. When I think of technology, I mainly think of computer programs 92
93. Only technicians are in charge of technology 93
94. Technology has always to do with mass production 94
95. In technology, there are less opportunities to do things with your hands 95
96. Working with materials is an important part of technology 96
97. Technology has little to do with daily life 97
98. When I think of technology I mainly think of working with wood 98
99. Technology can mainly be found in industry 99
100. There is a relationship between technology and science 100

PUPIL'S ATTITUDE TOWARD TECHNOLOGY

)eveloped for Botswana by J. Meide in affiliation with Virginia Polytechnic Institute and State University, USA.

u interested in your opinion in technology. Therefore, we would like you to answer some questions on this t This is not a test. There are no right or wrong answers. You are not to be graded on this. Do not take ıch time for one question. You should only need about 40 minutes to answer all of the questions. The first questions are about you so we can get to know you better. These are followed by statements about ılogy. Mark how much you agree or disagree with them. In the last set of statements you only have to e whether you agree, disagree or don't know.

'lease write a short description of what you think technology is:

WRITE ONLY INSIDE THIS BLOCK

ıve you taken or are you taking any of the following subjects?:

oodwork	Ⓨ YES	Ⓝ NO
ıtalwork	Ⓨ YES	Ⓝ NO
ıchnical Drawing	Ⓨ YES	Ⓝ NO
ıchnical Studies	Ⓨ YES	Ⓝ NO
ısign and Technology	Ⓨ YES	Ⓝ NO

you answered NO to all of the above, briefly state why in the above box.

ı a boy or a girl?	1. Ⓑ Boy	Ⓖ Girl
'd are you?	2. ⑮ or younger ⑯ ⑰ ⑱	⑲ or older
; your level in school?	3. Form: ③ ④ ⑤	
ıost of your life spent in a rural or urea?	4. Ⓡ Rural	Ⓤ Urban
o water piped throughout your home?	5. Ⓨ YES	Ⓝ NO
o electricity in your home?	6. Ⓨ YES	Ⓝ NO
e a radio or calculator in your home?	7. Ⓨ YES	Ⓝ NO
e a telephone in your home?	8. Ⓨ YES	Ⓝ NO
e a television in your home?	9. Ⓨ YES	Ⓝ NO
e a computer in your home?	10. Ⓨ YES	Ⓝ NO
u have a home workshop to build ; or make household repairs?	11. Ⓨ YES	Ⓝ NO
u think you will choose a technical job for life's work?	12. Ⓨ YES	Ⓝ NO
ıu have family members working in a ıical job or who are studying for it?	13. Ⓨ YES	Ⓝ NO

USE HB PENCIL ONLY

RIGHT—— Ⓐ ● Ⓝ ⓉⒹ Ⓓ

ı answered YES above, mark those are working or studying in technology.

ı Ⓕ Father Ⓜ Mother Ⓑ Brother Ⓢ Sister Ⓞ Other

AGREE / TEND TO AGREE / NEUTRAL / TEND TO DISAGREE / DISAGREE

ı something new is discovered, I want to know more about it immediately. — 15.
ıology is less difficult for boys than it is for girls. — 16.
ıology is good for the future of this country. — 17.
ıderstand something of technology you have to take a difficult training course. — 18.
hool you hear a lot about technology. — 19.
probably choose a job in technology. — 20.
ıd like to know more about computers. — 21.
ı can easily get a technological job. — 22.
ıneral, technology makes everything work better. — 23.
have to be intelligent to study technology. — 24.
ıld not like to learn more about technology in school. — 25.
to read magazines that are all about technology. — 26.
ı can become a car mechanic. — 27.
ınology is very important in life. — 28.
ınology is only for intelligent people. — 29.
ınology lessons are important. — 30.
ı not think of taking a job in technology. — 31.
ıe should be fewer radio and television programs about technology. — 32.
; are able to do practical things better than girls. — 33.
ryone needs technology. — 34.
ıuld rather not have technology lessons at school. — 35.
ınnot imagine why anyone would want a job in technology. — 36.
ere was a school club about technology I would certainly join it. — 37.
; are able to operate a computer. — 38.
hnology has brought more good things than bad things. — 39.
ı have to be strong for most jobs in technology. — 40.
hnology at home is something that schools should teach about. — 41.
ıuld enjoy a job in technology. — 42.
nk visiting a factory is boring. — 43.

44. Boys know more about technology than girls do. — 44.
45. The world would be a better place without technology. — 45.
46. To study technology you have to be talented. — 46.
47. I should be able to take technology as a school subject. — 47.
48. I would like a career in technology later on. — 48.
49. I am not interested in technology. — 49.
50. Boys are more capable of doing technological jobs than girls. — 50.
51. Using technology weakens a country's economic future. — 51.
52. You can study technology only when you are good at both maths and science. — 52.
53. There should be more education about technology. — 53.
54. Working in technology would be boring. — 54.
55. I enjoy repairing things at home. — 55.
56. More girls should work in technology. — 56.
57. Technology causes large unemployment. — 57.
58. Technology does not need a lot of maths. — 58.
59. Technology as a subject should be taken by all pupils. — 59.
60. Most jobs in technology are boring. — 60.
61. I think machines are boring. — 61.
62. Girls prefer not to go to a technical school. — 62.
63. Because technology causes pollution, we should use less of it. — 63.
64. Everybody can study technology. — 64.
65. Technology lessons help to train you for a good job. — 65.
66. Working in technology would be interesting. — 66.
67. I would find it boring to spend free time doing things with technology. — 67.
68. Girls think technology is boring. — 68.
69. Technology is the most important subject of the future. — 69.
70. Everybody can have a job where technology is required. — 70.
71. Not everyone needs technology lessons at school. — 71.
72. With a technical job your future success is promised. — 72.

FROM NOW ON YOU ONLY HAVE THREE CHOICES:

AGREE / DISAGREE / DON'T KNOW

73. When I think of technology I mostly think of computers. — 73.
74. I think science and technology are related. — 74.
75. In technology, you do not often use your imagination. — 75.
76. I think technology has little to do with the way we use energy. — 76.
77. When I think of technology, I mostly think of equipment. — 77.
78. To me technology and science are the same. — 78.
79. In my opinion, technology is not very old. — 79.
80. In technology, you can think up new things. — 80.
81. Working with information is an important part of technology. — 81.
82. Technology is as old as humans. — 82.
83. Theories of science are not often used in technology. — 83.
84. You do not need to understand technology to invent a new piece of equipment. — 84.
85. Technology has a large influence on people. — 85.
86. I think technology is often used in science. — 86.
87. Working with your hands is part of technology. — 87.
88. In everyday life, I have a lot to do with technology. — 88.
89. In technology, there is little opportunity to think up things for yourself. — 89.
90. Science and technology have nothing in common. — 90.
91. The government can have influence on technology. — 91.
92. I think the processing of energy is also part of technology. — 92.
93. In technology, you use tools. — 93.
94. Technology is meant to make our life more comfortable. — 94.
95. When I think of technology, I mainly think of computer programs. — 95.
96. Only technicians are in charge of technology. — 96.
97. Technology always has to do with mass production of goods. — 97.
98. In technology, there are less opportunities to do things with your hands. — 98.
99. Working with materials is an important part of technology. — 99.
100. Technology has little to do with daily life. — 100.
101. When I think of technology, I mainly think of working with wood. — 101.
102. Technology can mainly be found in industry. — 102.
103. There is a relationship between technology and science. — 103.

PATT Questionnaire Instructions:

You will be give as much time as you need to complete the questions on the form in front of you. It is not a test. You need not put your name on it. It is a survey that was made to show how you feel about technology and issues related to technology. I am very interested in your ideas about technology.

In return for carefully completing each item on your form the pencil and rubber you have been given will be yours as a gift. When you are told to begin complete the short definition at the top of the page before moving on to the following sections. I (and my assistant) will be moving round the hall to see how each of you is doing. If you have questions please raise your hand and (one of us/I) will come to you.

When you are finished remain in your seat and raise your hand. I (and my assistant) will come to see that the form has been carefully completed before you are allowed to go. Once your paper has been checked and OK'ed, you will be dismissed. Does everyone understand the rules?

------Admin. dismissal instructions------

Are there any questions before we begin?

The time is ______ please begin and answer each question carefully.

Appendix L

A List of Schools Used in the Study, Official School Assistance Request, and Timetable Showing Visits to Schools

Table L-1

Senior Secondary Schools in Botswana

Senior Secondary Schools in Botswana

	School	Classification	Settlement	
1	Francistown	U	Francistown	X
2	Gaborone S. S.	U	Gaborone	X
3	Kagiso	R	Ramotswa	
4	Kgari Sechele	R	Molepolole	Y
5	Letlhakane	U	Orapa	
6	Lobatse	U	Lobatse	X
7	Lotsane	R	Palapye	
8	Madiba	R	Mahalapye	
9	Mater Spei	U	Francistown	
10	Matsha	U	Kang	
11	Matshekge Hill	R	Bobonong	Y
12	Maun	R	Maun	Y
13	Moeding	R	Otse	
14	Moeng	R	Moeng	
15	Molefi	R	Mochudi	
16	Moshupa	R	Moshupa	Y
17	Naledi	U	Gaborone	X
18	St. Josephs	U	Gaborone	
19	Seepapitso	R	Kanye	
20	Selebi-Phikwe	U	Selebi-Phikwe	
21	Shashe River	R	Shashe	
22	Swaneng Hill	R	Serowe	
23	Tutume	R	Tutume	

Key: U = Urban. R = Rural

X = Urban school used in the study
Y = Rural school used in the study

Source: Ministry of Education. (1992). *Secondary Schools in Botswana* (Map, Department of Surveys and Lands) . Gaborone, Botswana: Government Printing Office.

MOLEPOLOLE COLLEGE OF EDUCATION

DEPARTMENT OF DESIGN AND TECHNOLOGY
Private Bag 008
Molepolole, Botswana
Africa

I enjoyed speaking with you on the telephone and look foreword to seeing soon. As per our discussion, I will visit your school on day month the 0th, at 00:00.

As a reminder, can you or a member of your staff identify 35 - 40 Form 5 pupils from each of the following sections?:

1. Practical (Woodwork, Metalwork, TD, D&T);
2. Combined Science; and
3. Pure Science.

I do not know what your class size averages are. In the past, we have used complete classes and found that this provides a manageable system.

Will it be possible to assemble 105 - 120 student participants in one room, say the dinning hall?

Once again, I appreciate your assistance with the Pupils' Attitude Toward Technology study being conducted throughout Botswana. I will speak with you again soon to confirm the arrangements. Thank you.

Sincerely,

J. T. B. Meide

SEPTEMBER

SUN	MON	TUE	WED	THU	FRI	SAT
19	20 MOSHUPA	21	22	23	24 NALEDI	25
26	27 LOBOTSE	28	29	30 ************ HOLIDAY***********		

OCTOBER

SUN	MON	TUE	WED	THU	FRI	SAT
					1 *** HOLIDAY***	2
3	4 MAUN	5 BOBONONG	6	7	8	9 F/TOWN

*Pupils in the two schools. Kgari Sechele and Gaborone Secondary were interviewed during the month of July before the 1993 school year began its third term. The reason these schools did not follow the same timeframe was because they served as large scale administrative test sites. The results of the testing done in these schools confirmed the decisions to implement additional administrative strategies during the field test stage.

Appendix M

Cross Comparisons on Selected Demographic Variables

Table 4-11
GENDER by AGE

GENDER	Count / Row Pct / Col Pct	AGE: 15 or <	16	17	18	19 or >	Row Total
	BOY	1 .2 100.0	7 1.4 38.9	56 11.5 52.3	167 34.2 57.2	258 52.8 63.7	489 59.4
	GIRL		11 3.3 61.1	51 15.3 47.7	125 37.4 42.8	147 44.0 36.3	334 40.6
	Column Total	1 .1	18 2.2	107 13.0	292 35.5	405 49.2	823 100.0

Chi-Square	Value	DF	Significance
Pearson	9.73933	4	.04506
Likelihood Ratio	10.02645	4	.03998
Mantel-Haenszel test for linear association	7.83779	1	.00512

Minimum Expected Frequency - .406
Cells with Expected Frequency < 5 - 2 OF 10 (20.0%)

Statistic	Value	ASE1	Val/ASE0	Approximate Significance
Phi	.10878			.04506 *1
Cramer's V	.10878			.04506 *1
Contingency Coefficient	.10815			.04506 *1

*1 Pearson chi-square probability

Number of Missing Observations: 8

Table 4-12
GENDER by WOODWORK (class taken?)

GENDER	Count / Row Pct / Col Pct	WOOD NO	YES	Row Total
	BOYS	300 61.0 50.8	192 39.0 81.4	492 59.5
	GIRLS	291 86.9 49.2	44 13.1 18.6	335 40.5
	Column Total	591 71.5	236 28.5	827 100.0

Chi-Square	Value	DF	Significance
Pearson	65.50616	1	.00000
Continuity Correction	64.24277	1	.00000
Likelihood Ratio	70.27384	1	.00000
Mantel-Haenszel test for linear association	65.42695	1	.00000

Minimum Expected Frequency - 95.599

Statistic	Value	ASE1	Val/ASE0	Approximate Significance
Phi	-.28144			.00000 *1
Cramer's V	.28144			.00000 *1
Contingency Coefficient	.27092			.00000 *1

*1 Pearson chi-square probability

Number of Missing Observations: 4

Table 4-13
GENDER by METALWORK (class taken?)

GENDER	Count / Row Pct / Col Pct	METAL NO	METAL YES	Row Total
	BOYS	386 78.8 54.9	104 21.2 85.2	490 59.4
	GIRLS	317 94.6 45.1	18 5.4 14.8	335 40.6
	Column Total	703 85.2	122 14.8	825 100.0

Chi-Square	Value	DF	Significance
Pearson	39.67459	1	.00000
Continuity Correction	38.42663	1	.00000
Likelihood Ratio	44.52179	1	.00000
Mantel-Haenszel test for linear association	39.62650	1	.00000

Minimum Expected Frequency - 49.539

Statistic	Value	ASE1	Val/ASE0	Approximate Significance
Phi	-.21930			.00000 *1
Cramer's V	.21930			.00000 *1
Contingency Coefficient	.21421			.00000 *1

*1 Pearson chi-square probability

Number of Missing Observations: 6

Table 4-14
GENDER by TECHNICAL DRAWING (class taken?)

GENDER	Count / Row Pct / Col Pct	DRAW: NO	DRAW: YES	Row Total
	BOYS	223 45.2 43.3	270 54.8 86.3	493 59.5
	GIRLS	292 87.2 56.7	43 12.8 13.7	335 40.5
	Column Total	515 62.2	313 37.8	828 100.0

Chi-Square	Value	DF	Significance
Pearson	149.15546	1	.00000
Continuity Correction	147.37741	1	.00000
Likelihood Ratio	162.33508	1	.00000
Mantel-Haenszel test for linear association	148.97532	1	.00000

Minimum Expected Frequency - 126.636

Statistic	Value	ASE1	Val/ASE0	Approximate Significance
Phi	-.42443			.00000 *1
Cramer's V	.42443			.00000 *1
Contingency Coefficient	.39069			.00000 *1

*1 Pearson chi-square probability

Number of Missing Observations: 3

Table 4-15
GENDER by TECHNICAL STUDIES (class taken?)

GENDER (Count / Row Pct / Col Pct)	TECHSTU NO	TECHSTU YES	Row Total
BOYS	396 80.7 55.8	95 19.3 83.3	491 59.6
GIRLS	314 94.3 44.2	19 5.7 16.7	333 40.4
Column Total	710 86.2	114 13.8	824 100.0

Chi-Square	Value	DF	Significance
Pearson	30.98002	1	.00000
Continuity Correction	29.84616	1	.00000
Likelihood Ratio	34.31664	1	.00000
Mantel-Haenszel test for linear association	30.94242	1	.00000

Minimum Expected Frequency - 46.070

Statistic	Value	ASE1	Val/ASE0	Approximate Significance
Phi	-.19390			.00000 *1
Cramer's V	.19390			.00000 *1
Contingency Coefficient	.19035			.00000 *1

*1 Pearson chi-square probability

Number of Missing Observations: 7

Table 4-16
GENDER by DESIGN AND TECHNOLOGY (class taken?)

GENDER	Count / Row Pct / Col Pct	DESTECH NO	YES	Row Total
	BOYS	260 53.1 49.1	230 46.9 78.0	490 59.4
	GIRLS	270 80.6 50.9	65 19.4 22.0	335 40.6
	Column Total	530 64.2	295 35.8	825 100.0

Chi-Square	Value	DF	Significance
Pearson	65.67378	1	.00000
Continuity Correction	64.48056	1	.00000
Likelihood Ratio	68.72189	1	.00000
Mantel-Haenszel test for linear association	65.59418	1	.00000

Minimum Expected Frequency - 119.788

Statistic	Value	ASE1	Val/ASE0	Approximate Significance
Phi	-.28214			.00000 *1
Cramer's V	.28214			.00000 *1
Contingency Coefficient	.27154			.00000 *1

*1 Pearson chi-square probability

Number of Missing Observations: 6

Table 4-17
GENDER by ED_NET (ED_NET = pupils enrolled in 1 or more technical subject)

ED_NET Page 1 of 1

GENDER	Count / Row Pct / Col Pct	.00	1 or >	Row Total
	BOYS	97 20.0 28.9	388 80.0 80.5	485 59.3
	GIRLS	239 71.8 71.1	94 28.2 19.5	333 40.7
	Column Total	336 41.1	482 58.9	818 100.0

Chi-Square	Value	DF	Significance
Pearson	218.64473	1	.00000
Continuity Correction	216.51095	1	.00000
Likelihood Ratio	226.06570	1	.00000
Mantel-Haenszel test for linear association	218.37744	1	.00000

Minimum Expected Frequency - 136.782

Statistic	Value	ASE1	Val/ASE0	Approximate Significance
Phi	-.51700			.00000 *1
Cramer's V	.51700			.00000 *1
Contingency Coefficient	.45926			.00000 *1

*1 Pearson chi-square probability

Number of Missing Observations: 13

Table 4-18
The number of technical classes taken by pupils comparing gender.

ED_TOT	Count / Row Pct / Col Pct	GENDER Boys	Girls	Row Total
.00	Count	97	239	336
	Row Pct	28.9	71.1	41.1
	Col Pct	20.0	71.8	
1.00 class	Count	146	50	196
	Row Pct	74.5	25.5	24.0
	Col Pct	30.1	15.0	
2.00 classes	Count	107	18	125
	Row Pct	85.6	14.4	15.3
	Col Pct	22.1	5.4	
3.00 classes	Count	63	15	78
	Row Pct	80.8	19.2	9.5
	Col Pct	13.0	4.5	
4.00 classes	Count	37	1	38
	Row Pct	97.4	2.6	4.6
	Col Pct	7.6	.3	
5.00 classes	Count	35	10	45
	Row Pct	77.8	22.2	5.5
	Col Pct	7.2	3.0	
Column Total		485	333	818
		59.3	40.7	100.0

Chi-Square	Value	DF	Significance
Pearson	227.54528	5	.00000
Likelihood Ratio	242.78680	5	.00000
Mantel-Haenszel test for linear association	141.05189	1	.00000

Minimum Expected Frequency - 15.469

Statistic	Value	ASE1	Val/ASE0	Approximate Significance
Phi	.52742			.00000 *1
Cramer's V	.52742			.00000 *1
Contingency Coefficient	.46651			.00000 *1

*1 Pearson chi-square probability
Number of Missing Observations: 13

Table 4-19
GENDER by Do you think you will choose a technical job as your life's work?

GENDER	JOBTEC Count Row Pct Col Pct	YES	NO	Row Total
	BOYS	397 81.4 74.1	91 18.6 32.5	488 59.8
	GIRLS	139 42.4 25.9	189 57.6 67.5	328 40.2
	Column Total	536 65.7	280 34.3	816 100.0

Chi-Square	Value	DF	Significance
Pearson	132.19655	1	.00000
Continuity Correction	130.47303	1	.00000
Likelihood Ratio	132.95143	1	.00000
Mantel-Haenszel test for linear association	132.03454	1	.00000

Minimum Expected Frequency - 112.549

Statistic	Value	ASE1	Val/ASE0	Approximate Significance
Phi	.40250			.00000 *1
Cramer's V	.40250			.00000 *1
Contingency Coefficient	.37339			.00000 *1

*1 Pearson chi-square probability

Number of Missing Observations: 15

Table 4-20
GENDER by Do you have family members who are working in a tecnical job or who are studying for it?

GENDER	FAMTEC Count Row Pct Col Pct	YES	NO	Row Total
	BOYS	267 54.3 57.8	225 45.7 62.0	492 59.6
	GIRLS	195 58.6 42.2	138 41.4 38.0	333 40.4
	Column Total	462 56.0	363 44.0	825 100.0

Chi-Square	Value	DF	Significance
Pearson	1.48348	1	.22323
Continuity Correction	1.31448	1	.25159
Likelihood Ratio	1.48602	1	.22283
Mantel-Haenszel test for linear association	1.48169	1	.22351

Minimum Expected Frequency - 146.520

Statistic	Value	ASE1	Val/ASE0	Approximate Significance
Phi	-.04240			.22323 *1
Cramer's V	.04240			.22323 *1
Contingency Coefficient	.04237			.22323 *1

*1 Pearson chi-square probability

Number of Missing Observations: 6

Table 4-21
WHO is working in technical fields? by GENDER

WHOTEC	Count / Row Pct / Col Pct	BOYS	GIRLS	Row Total
Father	Count	20	12	32
	Row Pct	62.5	37.5	6.9
	Col Pct	7.4	6.2	
Mother	Count	5	1	6
	Row Pct	83.3	16.7	1.3
	Col Pct	1.8	.5	
Brother	Count	112	84	196
	Row Pct	57.1	42.9	42.1
	Col Pct	41.3	43.1	
Sister	Count	11	9	20
	Row Pct	55.0	45.0	4.3
	Col Pct	4.1	4.6	
Other	Count	81	64	145
	Row Pct	55.9	44.1	31.1
	Col Pct	29.9	32.8	
More than one	Count	42	25	67
	Row Pct	62.7	37.3	14.4
	Col Pct	15.5	12.8	
Column Total		271	195	466
		58.2	41.8	100.0

Chi-Square	Value	DF	Significance
Pearson	2.85427	5	.72244
Likelihood Ratio	3.05471	5	.69155
Mantel-Haenszel test for linear association	.02701	1	.86945

Minimum Expected Frequency - 2.511
Cells with Expected Frequency < 5 - 2 OF 12 (16.7%)

Statistic	Value	ASE1	Val/ASE0	Approximate Significance
Phi	.07826			.72244 *1
Cramer's V	.07826			.72244 *1
Contingency Coefficient	.07802			.72244 *1

*1 Pearson chi-square probability

Number of Missing Observations: 365

Table 4-22
Relationship of choosing a technical job and taking one or more technical subjects.
JOBTEC by ED_NET

JOBTEC	Count / Row Pct / Col Pct	ED_NET .00	1 or >	Row Total
	Yes	130 24.5 39.8	400 75.5 82.8	530 65.4
	No	197 70.4 60.2	83 29.6 17.2	280 34.6
	Column Total	327 40.4	483 59.6	810 100.0

Chi-Square	Value	DF	Significance
Pearson	159.84600	1	.00000
Continuity Correction	157.94790	1	.00000
Likelihood Ratio	161.77404	1	.00000
Mantel-Haenszel test for linear association	159.64866	1	.00000

Minimum Expected Frequency - 113.037

Statistic	Value	ASE1	Val/ASE0	Approximate Significance
Phi	-.44423			.00000 *1
Cramer's V	.44423			.00000 *1
Contingency Coefficient	.40598			.00000 *1

*1 Pearson chi-square probability

Number of Missing Observations: 21

Table 4-23
LOCALE by GENDER

LOCALE (Count / Row Pct / Col Pct)	BOYS	GIRLS	Row Total
RURAL	278 59.1 56.9	192 40.9 57.7	470 57.2
URBAN	211 59.9 43.1	141 40.1 42.3	352 42.8
Column Total	489 59.5	333 40.5	822 100.0

Chi-Square	Value	DF	Significance
Pearson	.05268	1	.81846
Continuity Correction	.02488	1	.87467
Likelihood Ratio	.05270	1	.81843
Mantel-Haenszel test for linear association	.05262	1	.81857

Minimum Expected Frequency - 142.599

Statistic	Value	ASE1	Val/ASE0	Approximate Significance
Phi	-.00801			.81846 *1
Cramer's V	.00801			.81846 *1
Contingency Coefficient	.00801			.81846 *1

*1 Pearson chi-square probability

Number of Missing Observations: 9

Table 4-24
LOCALE by SCHOOL

LOCALE	Count / Row Pct / Col Pct	KSII-R	GSS-U	MOSHUP-R	LOBSEC-U	NALEDI-U	Row Total
RURAL	Count	76	29	102	47	10	472
	Row Pct	16.1	6.1	21.6	10.0	2.1	57.2
	Col Pct	78.4	20.9	82.9	43.9	19.6	
URBAN	Count	21	110	21	60	41	353
	Row Pct	5.9	31.2	5.9	17.0	11.6	42.8
	Col Pct	21.6	79.1	17.1	56.1	80.4	
Column Total		97	139	123	107	51	825
		11.8	16.8	14.9	13.0	6.2	100.0

(Continued)

LOCALE	Count / Row Pct / Col Pct	MAUN-R	MATSEG-R	FSS-U	Row Total
RURAL	Count	77	108	23	472
	Row Pct	16.3	22.9	4.9	57.2
	Col Pct	81.1	90.8	24.5	
URBAN	Count	18	11	71	353
	Row Pct	5.1	3.1	20.1	42.8
	Col Pct	18.9	9.2	75.5	
Column Total		95	119	94	825
		11.5	14.4	11.4	100.0

Chi-Square	Value	DF	Significance
Pearson	281.05374	7	.00000
Likelihood Ratio	302.89515	7	.00000
Mantel-Haenszel test for linear association	.85974	1	.35381

Minimum Expected Frequency - 21.822

Statistic	Value	ASE1	Val/ASE0	Approximate Significance
Phi	.58367			.00000 *1
Cramer's V	.58367			.00000 *1
Contingency Coefficient	.50409			.00000 *1

*1 Pearson chi-square probability
Number of Missing Observations: 6

Table 4-25
LOCALE by WATER IN THE HOME

LOCALE	Count / Row Pct / Col Pct	WATER: YES	NO	Row Total
	RURAL	294 63.1 50.3	172 36.9 74.8	466 57.2
	URBAN	291 83.4 49.7	58 16.6 25.2	349 42.8
	Column Total	585 71.8	230 28.2	815 100.0

Chi-Square	Value	DF	Significance
Pearson	40.55930	1	.00000
Continuity Correction	39.56379	1	.00000
Likelihood Ratio	42.24160	1	.00000
Mantel-Haenszel test for linear association	40.50953	1	.00000

Minimum Expected Frequency - 98.491

Statistic	Value	ASE1	Val/ASE0	Approximate Significance
Phi	-.22308			.00000 *1
Cramer's V	.22308			.00000 *1
Contingency Coefficient	.21773			.00000 *1

*1 Pearson chi-square probability

Number of Missing Observations: 16

Table 4-26
LOCALE by ELECTRICITY

LOCALE (Count / Row Pct / Col Pct)	ELECTRICITY: YES	NO	Row Total
RURAL	72 15.5 30.8	392 84.5 67.6	464 57.0
URBAN	162 46.3 69.2	188 53.7 32.4	350 43.0
Column Total	234 28.7	580 71.3	814 100.0

Chi-Square	Value	DF	Significance
Pearson	92.21009	1	.00000
Continuity Correction	90.71407	1	.00000
Likelihood Ratio	92.81512	1	.00000
Mantel-Haenszel test for linear association	92.09681	1	.00000

Minimum Expected Frequency - 100.614

Statistic	Value	ASE1	Val/ASE0	Approximate Significance
Phi	-.33657			.00000 *1
Cramer's V	.33657			.00000 *1
Contingency Coefficient	.31899			.00000 *1

*1 Pearson chi-square probability

Number of Missing Observations: 17

Table 4-27
LOCALE by RADIO

LOCALE	Count / Row Pct / Col Pct	RADIO: YES	NO	Row Total
	RURAL	433 91.9 55.4	38 8.1 90.5	471 57.2
	URBAN	349 98.9 44.6	4 1.1 9.5	353 42.8
	Column Total	782 94.9	42 5.1	824 100.0

Chi-Square	Value	DF	Significance
Pearson	20.06015	1	.00001
Continuity Correction	18.65215	1	.00002
Likelihood Ratio	23.89118	1	.00000
Mantel-Haenszel test for linear association	20.03580	1	.00001

Minimum Expected Frequency - 17.993

Statistic	Value	ASE1	Val/ASE0	Approximate Significance
Phi	-.15603			.00001 *1
Cramer's V	.15603			.00001 *1
Contingency Coefficient	.15416			.00001 *1

*1 Pearson chi-square probability

Number of Missing Observations: 7

Table 4-28
LOCALE by TELEPHONE

LOCALE	PHONE Count Row Pct Col Pct	YES	NO	Row Total
	RURAL	90 19.1 33.5	381 80.9 68.6	471 57.2
	URBAN	179 50.7 66.5	174 49.3 31.4	353 42.8
	Column Total	269 32.6	555 67.4	824 100.0

Chi-Square	Value	DF	Significance
Pearson	91.63259	1	.00000
Continuity Correction	90.20109	1	.00000
Likelihood Ratio	92.15516	1	.00000
Mantel-Haenszel test for linear association	91.52138	1	.00000

Minimum Expected Frequency - 115.239

Statistic	Value	ASE1	Val/ASE0	Approximate Significance
Phi	-.33347			.00000 *1
Cramer's V	.33347			.00000 *1
Contingency Coefficient	.31635			.00000 *1

*1 Pearson chi-square probability

Number of Missing Observations: 7

Table 4-29
LOCALE by TELEVISION

LOCALE	Count / Row Pct / Col Pct	TV: YES	TV: NO	Row Total
	RURAL	109 23.3 30.9	359 76.7 77.4	468 57.3
	URBAN	244 69.9 69.1	105 30.1 22.6	349 42.7
	Column Total	353 43.2	464 56.8	817 100.0

Chi-Square	Value	DF	Significance
Pearson	177.09623	1	.00000
Continuity Correction	175.20132	1	.00000
Likelihood Ratio	182.55752	1	.00000
Mantel-Haenszel test for linear association	176.87946	1	.00000

Minimum Expected Frequency - 150.792

Statistic	Value	ASE1	Val/ASE0	Approximate Significance
Phi	-.46558			.00000 *1
Cramer's V	.46558			.00000 *1
Contingency Coefficient	.42208			.00000 *1

*1 Pearson chi-square probability

Number of Missing Observations: 14

Table 4-30
LOCALE by COMPUTER AT HOME

LOCALE	Count / Row Pct / Col Pct	COMPUTER YES	COMPUTER NO	Row Total
	RURAL	9 1.9 23.7	453 98.1 59.2	462 57.5
	URBAN	29 8.5 76.3	312 91.5 40.8	341 42.5
	Column Total	38 4.7	765 95.3	803 100.0

Chi-Square	Value	DF	Significance
Pearson	18.70642	1	.00002
Continuity Correction	17.28041	1	.00003
Likelihood Ratio	18.91074	1	.00001
Mantel-Haenszel test for linear association	18.68313	1	.00002

Minimum Expected Frequency - 16.137

Statistic	Value	ASE1	Val/ASE0	Approximate Significance
Phi	-.15263			.00002 *1
Cramer's V	.15263			.00002 *1
Contingency Coefficient	.15088			.00002 *1

*1 Pearson chi-square probability

Number of Missing Observations: 28

Table 4-31
LOCALE by WORKSHOP IN THE HOME

LOCALE (Count / Row Pct / Col Pct)	WORKSHOP: YES	NO	Row Total
RURAL	32 6.8 46.4	437 93.2 58.3	469 57.3
URBAN	37 10.6 53.6	313 89.4 41.7	350 42.7
Column Total	69 8.4	750 91.6	819 100.0

Chi-Square	Value	DF	Significance
Pearson	3.65011	1	.05607
Continuity Correction	3.18043	1	.07453
Likelihood Ratio	3.60645	1	.05756
Mantel-Haenszel test for linear association	3.64566	1	.05622

Minimum Expected Frequency - 29.487

Statistic	Value	ASE1	Val/ASE0	Approximate Significance
Phi	-.06676			.05607 *1
Cramer's V	.06676			.05607 *1
Contingency Coefficient	.06661			.05607 *1

*1 Pearson chi-square probability

Number of Missing Observations: 12

Table 4-32
LOCALE by Do you think you will choose a technical job for your life's work?

LOCALE	Count / Row Pct / Col Pct	JOBTEC YES	NO	Row Total
	RURAL	301 64.7 56.3	164 35.3 58.8	465 57.1
	URBAN	234 67.0 43.7	115 33.0 41.2	349 42.9
	Column Total	535 65.7	279 34.3	814 100.0

Chi-Square	Value	DF	Significance
Pearson	.47533	1	.49055
Continuity Correction	.37802	1	.53867
Likelihood Ratio	.47613	1	.49018
Mantel-Haenszel test for linear association	.47475	1	.49081

Minimum Expected Frequency - 119.620

Statistic	Value	ASE1	Val/ASE0	Approximate Significance
Phi	-.02416			.49055 *1
Cramer's V	.02416			.49055 *1
Contingency Coefficient	.02416			.49055 *1

*1 Pearson chi-square probability
Number of Missing Observations: 17

Table 4-33
LOCALE by Do you have a family members working in a technical job or are studying for it?

LOCALE	Count / Row Pct / Col Pct	FAMTEC YES	NO	Row Total
	RURAL	239 50.7 52.0	232 49.3 64.1	471 57.3
	URBAN	221 63.0 48.0	130 37.0 35.9	351 42.7
	Column Total	460 56.0	362 44.0	822 100.0

Chi-Square	Value	DF	Significance
Pearson	12.18614	1	.00048
Continuity Correction	11.69534	1	.00063
Likelihood Ratio	12.25677	1	.00046
Mantel-Haenszel test for linear association	12.17131	1	.00049

Minimum Expected Frequency - 154.577

Statistic	Value	ASE1	Val/ASE0	Approximate Significance
Phi	-.12176			.00048 *1
Cramer's V	.12176			.00048 *1
Contingency Coefficient	.12087			.00048 *1

*1 Pearson chi-square probability
Number of Missing Observations: 9

Table 4-34
LOCALE by DESIGN AND TECHNOLOGY

LOCALE (Count / Row Pct / Col Pct)	DESTECH NO	DESTECH YES	Row Total
RURAL	300 63.8 56.8	170 36.2 57.8	470 57.2
URBAN	228 64.8 43.2	124 35.2 42.2	352 42.8
Column Total	528 64.2	294 35.8	822 100.0

Chi-Square	Value	DF	Significance
Pearson	.07789	1	.78017
Continuity Correction	.04226	1	.83713
Likelihood Ratio	.07794	1	.78011
Mantel-Haenszel test for linear association	.07780	1	.78030

Minimum Expected Frequency - 125.898

Statistic	Value	ASE1	Val/ASE0	Approximate Significance
Phi	-.00973			.78017 *1
Cramer's V	.00973			.78017 *1
Contingency Coefficient	.00973			.78017 *1

*1 Pearson chi-square probability
Number of Missing Observations: 9

Table 4-35
LOCALE by WOODWORK COURSE

LOCALE (Count / Row Pct / Col Pct)	WOOD: NO	WOOD: YES	Row Total
RURAL	343 72.7 58.1	129 27.3 55.1	472 57.3
URBAN	247 70.2 41.9	105 29.8 44.9	352 42.7
Column Total	590 71.6	234 28.4	824 100.0

Chi-Square	Value	DF	Significance
Pearson	.61928	1	.43131
Continuity Correction	.50248	1	.47841
Likelihood Ratio	.61785	1	.43185
Mantel-Haenszel test for linear association	.61853	1	.43159

Minimum Expected Frequency - 99.961

Statistic	Value	ASE1	Val/ASE0	Approximate Significance
Phi	.02741			.43131 *1
Cramer's V	.02741			.43131 *1
Contingency Coefficient	.02740			.43131 *1

*1 Pearson chi-square probability
Number of Missing Observations: 7

Table 4-36
LOCALE by METALWORK COURSE

LOCALE	METAL: Count / Row Pct / Col Pct	NO	YES	Row Total
	RURAL	411 87.4 58.6	59 12.6 48.8	470 57.2
	URBAN	290 82.4 41.4	62 17.6 51.2	352 42.8
	Column Total	701 85.3	121 14.7	822 100.0

Chi-Square	Value	DF	Significance
Pearson	4.10569	1	.04274
Continuity Correction	3.71247	1	.05401
Likelihood Ratio	4.06740	1	.04372
Mantel-Haenszel test for linear association	4.10070	1	.04287

Minimum Expected Frequency - 51.815

Statistic	Value	ASE1	Val/ASE0	Approximate Significance
Phi	.07067			.04274 *1
Cramer's V	.07067			.04274 *1
Contingency Coefficient	.07050			.04274 *1

*1 Pearson chi-square probability
Number of Missing Observations: 9

Table 4-37
LOCALE by TECHNICAL STUDIES COURSE

LOCALE	Count / Row Pct / Col Pct	TECHSTU NO	TECHSTU YES	Row Total
	RURAL	423 89.8 59.9	48 10.2 41.7	471 57.4
	URBAN	283 80.9 40.1	67 19.1 58.3	350 42.6
	Column Total	706 86.0	115 14.0	821 100.0

Chi-Square	Value	DF	Significance
Pearson	13.35820	1	.00026
Continuity Correction	12.62535	1	.00038
Likelihood Ratio	13.20222	1	.00028
Mantel-Haenszel test for linear association	13.34193	1	.00026

Minimum Expected Frequency - 49.026

Statistic	Value	ASE1	Val/ASE0	Approximate Significance
Phi	.12756			.00026 *1
Cramer's V	.12756			.00026 *1
Contingency Coefficient	.12653			.00026 *1

*1 Pearson chi-square probability
Number of Missing Observations: 10

Table 4-38
LOCALE by TECHNICAL DRAWING COURSE

LOCALE	Count / Row Pct / Col Pct	DRAW: NO	YES	Row Total
	RURAL	323 68.4 63.2	149 31.6 47.5	472 57.2
	URBAN	188 53.3 36.8	165 46.7 52.5	353 42.8
	Column Total	511 61.9	314 38.1	825 100.0

Chi-Square	Value	DF	Significance
Pearson	19.72622	1	.00001
Continuity Correction	19.08779	1	.00001
Likelihood Ratio	19.68304	1	.00001
Mantel-Haenszel test for linear association	19.70231	1	.00001

Minimum Expected Frequency - 134.354

Statistic	Value	ASE1	Val/ASE0	Approximate Significance
Phi	.15463			.00001 *1
Cramer's V	.15463			.00001 *1
Contingency Coefficient	.15281			.00001 *1

*1 Pearson chi-square probability
Number of Missing Observations: 6

Appendix N

Analyses of Variance and Comparisons of Means Involved in Interaction Effects

* * * A N A L Y S I S   O F   V A R I A N C E * * *

FACT_A1 Factor A1 - General Interest
by ED_NET
GENDER
LOCALE

EXPERIMENTAL sums of squares
Covariates entered FIRST

Source of Variation	Sum of Squares	DF	Mean Square	F	Sig of F
Main Effects	73.504	3	24.501	58.078	.00
ED_NET	19.432	1	19.432	46.063	.001**
GENDER	15.488	1	15.488	36.712	.001**
LOCALE	1.342	1	1.342	3.182	.075
2-Way Interactions	.583	3	.194	.461	.710
ED_NET GENDER	.149	1	.149	.354	.552
ED_NET LOCALE	.010	1	.010	.023	.880
GENDER LOCALE	.251	1	.251	.596	.440
3-Way Interactions	.004	1	.004	.010	.919
ED_NET GENDER LOCALE	.004	1	.004	.010	.919
Explained	74.091	7	10.584	25.090	.00
Residual	339.181	804	.422		
Total	413.272	811	.510		

831 cases were processed.
19 cases (2.3 pct) were missing.

*** CELL MEANS ***

Factor A1 - General Interest by GENDER - LOCALE - ED_NET

Total Population

1.89
(812)

GENDER

1	2
1.68	2.20
(481)	(331)

LOCALE

1	2
1.86	1.94
(465)	(347)

ED_NET

0	1
2.21	1.67
(334)	(478)

GENDER	LOCALE 1	LOCALE 2
1	1.67	1.70
	(274)	(207)
2	2.14	2.28
	(191)	(140)

GENDER	ED_NET 0	ED_NET 1
1	2.00	1.60
	(96)	(385)
2	2.29	1.96
	(238)	(93)

LOCALE	ED_NET 0	ED_NET 1
1	2.16	1.65
	(194)	(271)
2	2.28	1.70
	(140)	(207)

ED_NET = 0

GENDER	LOCALE 1	LOCALE 2
1	1.98	2.03
	(57)	(39)
2	2.23	2.38
	(137)	(101)

ED_NET = 1

GENDER	LOCALE 1	LOCALE 2
1	1.58	1.63
	(217)	(168)
2	1.91	2.03
	(54)	(39)

* * * A N A L Y S I S   O F   V A R I A N C E * * *

FACT_A2 Factor A2 - Gender
by ED_NET
GENDER
LOCALE

EXPERIMENTAL sums of squares
Covariates entered FIRST

Source of Variation	Sum of Squares	DF	Mean Square	F	Sig of F
Main Effects	9.900	3	3.300	4.853	.002
ED_NET	2.982	1	2.982	4.385	.037*
GENDER	9.492	1	9.492	13.958	.001**
LOCALE	.387	1	.387	.570	.451
2-Way Interactions	7.671	3	2.557	3.760	.011
ED_NET GENDER	3.007	1	3.007	4.422	.036*
ED_NET LOCALE	1.020	1	1.020	1.501	.221
GENDER LOCALE	4.564	1	4.564	6.711	.010**
3-Way Interactions	.057	1	.057	.084	.772
ED_NET GENDER LOCALE	.057	1	.057	.084	.772
Explained	17.628	7	2.518	3.703	.001
Residual	546.771	804	.680		
Total	564.399	811	.696		

831 cases were processed.
19 cases (2.3 pct) were missing.

*** CELL MEANS ***

Factor A2 - Gender by GENDER, LOCALE, ED_NET

Total Population

3.01
(812)

GENDER

1	2
3.09	2.90
(481)	(331)

LOCALE

1	2
2.99	3.04
(465)	(347)

ED_NET

0	1
3.02	3.01
(334)	(478)

GENDER	LOCALE 1	LOCALE 2
1	3.02	3.17
	(274)	(207)
2	2.95	2.84
	(191)	(140)

GENDER	ED_NET 0	ED_NET 1
1	3.09	3.09
	(96)	(385)
2	2.99	2.69
	(238)	(93)

LOCALE	ED_NET 0	ED_NET 1
1	3.01	2.98
	(194)	(271)
2	3.04	3.04
	(140)	(207)

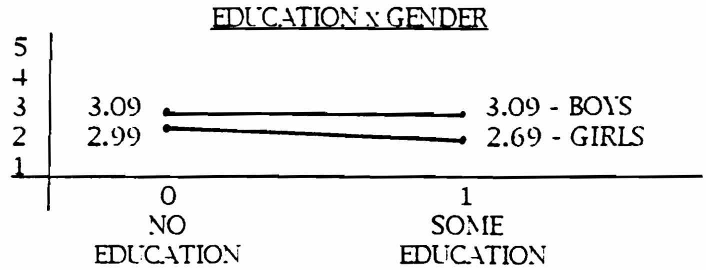
ED_NET = 0

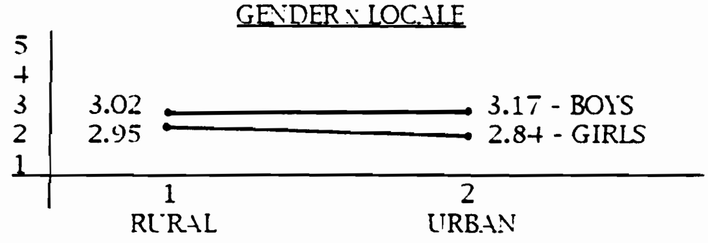
GENDER	LOCALE 1	LOCALE 2
1	2.99	3.25
	(57)	(39)
2	3.01	2.95
	(137)	(101)

ED_NET = 1

GENDER	LOCALE 1	LOCALE 2
1	3.03	3.16
	(217)	(168)
2	2.80	2.53
	(54)	(39)

First Order Interaction: Factor A2 - Technology is for both boys and girls.
Low scores indicate pupils feel technology is for both boys and girls.





- In general, boys and girls appear mostly neutral about whether technology is for both girls and boys.
- Attitudes about whether technology is for both girls and boys does not seem to change for boys regardless of having taken technical subjects.
- Girls with technical education express less male bias toward technology than do their female counterparts who have had no technical education.
- Urban boys express slightly more male bias toward technology than do their rural counterparts.
- Urban girls show less male bias than do their rural classmates.
- Boys and girls in rural areas show more similarity on this issue than do their urban counterparts.

* * * A N A L Y S I S   O F   V A R I A N C E * * *

FACT_A3 Factor A3 - Consequences
by ED_NET
GENDER
LOCALE

EXPERIMENTAL sums of squares
Covariates entered FIRST

Source of Variation	Sum of Squares	DF	Mean Square	F	Sig of F
Main Effects	4.928	3	1.643	5.712	.001
ED_NET	2.486	1	2.486	8.645	.003**
GENDER	.173	1	.173	.603	.438
LOCALE	.324	1	.324	1.126	.289
2-Way Interactions	1.236	3	.412	1.433	.232
ED_NET GENDER	.732	1	.732	2.547	.111
ED_NET LOCALE	.479	1	.479	1.665	.197
GENDER LOCALE	.209	1	.209	.728	.394
3-Way Interactions	2.516	1	2.516	8.748	.003
ED_NET GENDER LOCALE	2.516	1	2.516	8.748	.003**
Explained	8.680	7	1.240	4.312	.000
Residual	231.224	804	.288		
Total	239.904	811	.296		

831 cases were processed.
19 cases (2.3 pct) were missing.

*** CELL MEANS ***

Factor A3 - Consequences by GENDER - LOCALE - ED_NET

Total Population

1.45
(812)

GENDER

1	2
1.41	1.51
(481)	(331)

LOCALE

1	2
1.47	1.43
(465)	(347)

ED_NET

0	1
1.54	1.39
(334)	(478)

LOCALE

GENDER	1	2
1	1.43	1.39
	(274)	(207)
2	1.54	1.49
	(191)	(140)

ED_NET

GENDER	0	1
1	1.46	1.40
	(96)	(385)
2	1.57	1.37
	(238)	(93)

ED_NET

LOCALE	0	1
1	1.54	1.42
	(194)	(271)
2	1.55	1.35
	(140)	(207)

ED_NET = 0

LOCALE

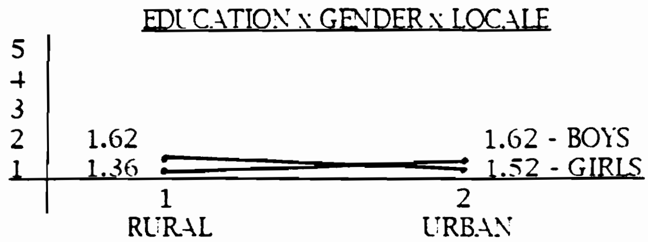
GENDER	1	2
1	1.36	1.62
	(57)	(39)
2	1.62	1.52
	(137)	(101)

ED_NET = 1

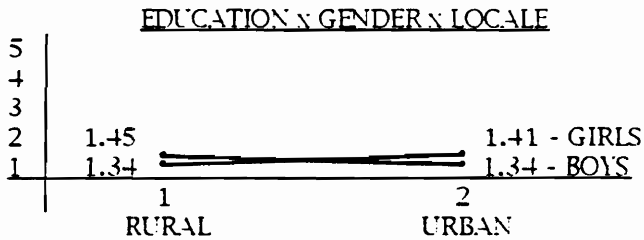
LOCALE

GENDER	1	2
1	1.45	1.34
	(217)	(168)
2	1.34	1.41
	(54)	(39)

Second Order Interaction: Factor A3 - Consequences of Technology.
Low scores indicate pupils feel consequences are positive.



NO
EDUCATION



SOME
EDUCATION

- In general, pupils believe that the consequences of technology are positive.
- Boys with no technical education in the rural areas are more likely than those in urban areas to associate positive consequences with technology.
- Girls with no technical education in the urban areas are more likely than those in rural areas to associate positive consequences with technology
- Consequences of technology are viewed slightly more positive by technically educated rural girls than their urban counterparts.

*** A N A L Y S I S   O F   V A R I A N C E ***

FACT_A4 Factor A4 - Difficult
by ED_NET
GENDER
LOCALE

EXPERIMENTAL sums of squares
Covariates entered FIRST

Source of Variation	Sum of Squares	DF	Mean Square	F	Sig of F
Main Effects	4.754	3	1.585	1.899	.128
ED_NET	1.571	1	1.571	1.882	.170
GENDER	4.597	1	4.597	5.508	.019**
LOCALE	.128	1	.128	.154	.695
2-Way Interactions	2.807	3	.936	1.121	.340
ED_NET GENDER	1.356	1	1.356	1.625	.203
ED_NET LOCALE	1.345	1	1.345	1.611	.205
GENDER LOCALE	.094	1	.094	.113	.737
3-Way Interactions	.089	1	.089	.107	.744
ED_NET GENDER LOCALE	.089	1	.089	.107	.744
Explained	7.650	7	1.093	1.309	.243
Residual	671.050	804	.835		
Total	678.700	811	.837		

831 cases were processed.
19 cases (2.3 pct) were missing.

*** CELL MEANS ***

Factor A4 - Difficult by GENDER - LOCALE - ED_NET

Total Population

3.00
(812)

GENDER

1	2
2.95	3.07
(481)	(331)

LOCALE

1	2
2.99	3.02
(465)	(347)

ED_NET

0	1
2.99	3.01
(334)	(478)

GENDER	LOCALE 1	LOCALE 2
1	2.93	2.98
	(274)	(207)
2	3.08	3.07
	(191)	(140)

GENDER	ED_NET 0	ED_NET 1
1	2.79	2.99
	(96)	(385)
2	3.07	3.07
	(238)	(93)

LOCALE	ED_NET 0	ED_NET 1
1	3.02	2.97
	(194)	(271)
2	2.95	3.06
	(140)	(207)

ED_NET = 0

GENDER	LOCALE 1	LOCALE 2
1	2.82	2.75
	(57)	(39)
2	3.11	3.03
	(137)	(101)

ED_NET = 1

GENDER	LOCALE 1	LOCALE 2
1	2.96	3.03
	(217)	(168)
2	3.00	3.18
	(54)	(39)

* * * A N A L Y S I S   O F   V A R I A N C E * * *

ATTITUDE attitude = (Fa1+Fa2+Fa3+Fa4)/4
by ED_NET
GENDER
LOCALE

EXPERIMENTAL sums of squares
Covariates entered FIRST

Source of Variation	Sum of Squares	DF	Mean Square	F	Sig of F
Main Effects	6.649	3	2.216	15.788	.000
ED_NET	2.607	1	2.607	18.570	.001**
GENDER	.729	1	.729	5.193	.023*
LOCALE	.154	1	.154	1.097	.295
2-Way Interactions	.924	3	.308	2.193	.087
ED_NET GENDER	.709	1	.709	5.049	.025*
ED_NET LOCALE	.026	1	.026	.183	.669
GENDER LOCALE	.199	1	.199	1.419	.234
3-Way Interactions	.156	1	.156	1.111	.292
ED_NET GENDER LOCALE	.156	1	.156	1.111	.292
Explained	7.729	7	1.104	7.865	.000
Residual	112.870	804	.140		
Total	120.599	811	.149		

831 cases were processed.
19 cases (2.3 pct) were missing.

*** CELL MEANS ***

ATTITUDE attitude = (Fa1+Fa2+Fa3+Fa4)/4

by ED_NET - GENDER - LOCALE

Total Population

2.34
(812)

ED_NET

0	1
2.44	2.27
(334)	(478)

GENDER

1	2
2.28	2.42
(481)	(331)

LOCALE

1	2
2.33	2.35
(465)	(347)

ED_NET	GENDER 1	GENDER 2
0	2.34	2.48
	(96)	(238)
1	2.27	2.27
	(385)	(93)

ED_NET	LOCALE 1	LOCALE 2
0	2.43	2.45
	(194)	(140)
1	2.26	2.29
	(271)	(207)

GENDER	LOCALE 1	LOCALE 2
1	2.26	2.31
	(274)	(207)
2	2.43	2.42
	(191)	(140)

LOCALE = 1

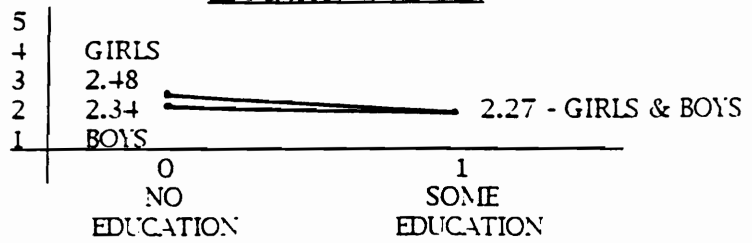
ED_NET	GENDER 1	GENDER 2
0	2.29	2.49
	(57)	(137)
1	2.25	2.26
	(217)	(54)

LOCALE = 2

ED_NET	GENDER 1	GENDER 2
0	2.41	2.47
	(39)	(101)
1	2.29	2.28
	(168)	(39)

First Order Interaction: Factor ATT - Overall Attitude. A/B scale.
Low scores indicate a general positive Affective/Behavioral Attitude.

EDUCATION x GENDER



- Scores averaged across all A/B sub-scales produce measurements that center slightly above neutral.
- Overall scores on these A/B sub-scales show that boys and girls without prior technical education express less positive feelings about technology than do boys and girls who have studied about technology.
- Boys and girls that have studied about technology score equally on overall A/B sub-scales.

* * * A N A L Y S I S   O F   V A R I A N C E * * *

FACT_C5 Concept scale = society
by ED_NET
GENDER
LOCALE

EXPERIMENTAL sums of squares
Covariates entered FIRST

Source of Variation	Sum of Squares	DF	Mean Square	F	Sig of F
Main Effects	264.776	3	88.259	26.316	.00
ED_NET	64.770	1	64.770	19.313	.001**
GENDER	58.252	1	58.252	17.369	.001**
LOCALE	8.142	1	8.142	2.428	.120
2-Way Interactions	36.481	3	12.160	3.626	.013
ED_NET GENDER	.029	1	.029	.009	.926
ED_NET LOCALE	30.536	1	30.536	9.105	.003**
GENDER LOCALE	24.652	1	24.652	7.350	.007**
3-Way Interactions	2.700	1	2.700	.805	.370
ED_NET GENDER LOCALE	2.700	1	2.700	.805	.370
Explained	303.957	7	43.422	12.947	.00
Residual	2696.437	804	3.354		
Total	3000.394	811	3.700		

831 cases were processed.
19 cases (2.3 pct) were missing.

*** CELL MEANS ***

FACT_C5 Concept scale = society by ED_NET - GENDER - LOCALE

Total Population

5.27
(812)

ED_NET

0	1
4.68	5.68
(334)	(478)

GENDER

1	2
5.67	4.69
(481)	(331)

LOCALE

1	2
5.18	5.39
(465)	(347)

ED_NET	GENDER 1	GENDER 2
0	5.13	4.50
	(96)	(238)
1	5.81	5.16
	(385)	(93)

ED_NET	LOCALE 1	LOCALE 2
0	4.72	4.62
	(194)	(140)
1	5.51	5.92
	(271)	(207)

GENDER	LOCALE 1	LOCALE 2
1	5.64	5.71
	(274)	(207)
2	4.51	4.92
	(191)	(140)

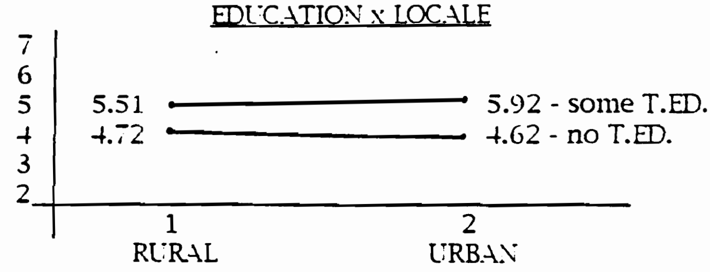
LOCALE = 1

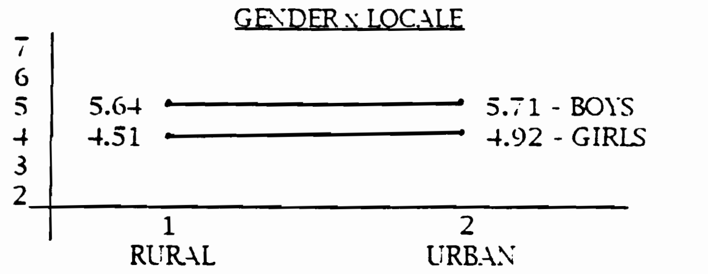
ED_NET	GENDER 1	GENDER 2
0	5.49	4.40
	(57)	(137)
1	5.68	4.80
	(217)	(54)

LOCALE = 2

ED_NET	GENDER 1	GENDER 2
0	4.59	4.63
	(39)	(101)
1	5.98	5.67
	(168)	(39)

First Order Interaction: Factor C5 - Society and Technology Concept.
Superior concept = score of 9, mean score =5.27.





- Scores on items about the interrelatedness of technology and society were higher for pupils that have studied some technology in classes than for those who have not taken technical classes.
- In general boys out score girls on items about the interrelatedness of technology and society.
- Scores on items about the interrelatedness of technology and society are lower for urban pupils who have not taken technical classes than are scores for rural pupils who have not taken technical classes.
- Urban pupils who have studied technology show higher scores on items about the interrelatedness of technology and society than their rural counterparts.
- In general, scores on items about the interrelatedness of technology and society are higher for urban pupils than for rural pupils.
- A larger difference occurs between girls than boys in this case.

* * * A N A L Y S I S   O F   V A R I A N C E * * *

FACT_C6 Concept scale = science
by ED_NET
GENDER
LOCALE

EXPERIMENTAL sums of squares
Covariates entered FIRST

Source of Variation	Sum of Squares	DF	Mean Square	F	Sig of F
Main Effects	60.346	3	20.115	11.186	.000
ED_NET	14.160	1	14.160	7.875	.005**
GENDER	9.074	1	9.074	5.046	.025*
LOCALE	11.866	1	11.866	6.599	.010**
2-Way Interactions	4.820	3	1.607	.894	.444
ED_NET GENDER	1.391	1	1.391	.774	.379
ED_NET LOCALE	1.335	1	1.335	.742	.389
GENDER LOCALE	3.432	1	3.432	1.909	.168
3-Way Interactions	12.389	1	12.389	6.890	.009
ED_NET GENDER LOCALE	12.389	1	12.389	6.890	.009**
Explained	77.555	7	11.079	6.161	.000
Residual	1445.729	804	1.798		
Total	1523.284	811	1.878		

831 cases were processed.
19 cases (2.3 pct) were missing.

*** CELL MEANS ***

FACT_C6 Concept scale = science by ED_NET - GENDER - LOCALE

Total Population

4.78
(812)

ED_NET

0	1
4.52	4.97
(334)	(478)

GENDER

1	2
4.95	4.54
(481)	(331)

LOCALE

1	2
4.68	4.93
(465)	(347)

ED_NET	GENDER 1	GENDER 2
0	4.63	4.48
	(96)	(238)
1	5.04	4.69
	(385)	(93)

ED_NET	LOCALE 1	LOCALE 2
0	4.43	4.65
	(194)	(140)
1	4.86	5.12
	(271)	(207)

GENDER	LOCALE 1	LOCALE 2
1	4.88	5.05
	(274)	(207)
2	4.38	4.75
	(191)	(140)

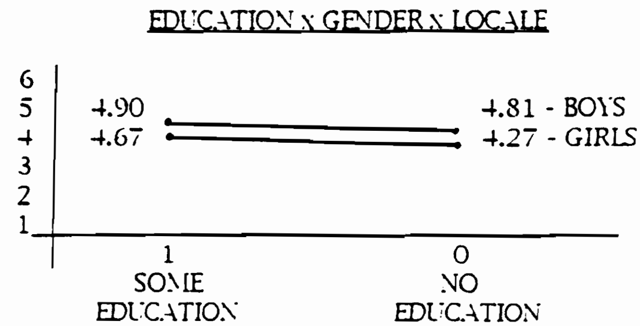
LOCALE = 1

ED_NET	GENDER 1	GENDER 2
0	4.81	4.27
	(57)	(137)
1	4.90	4.67
	(217)	(54)

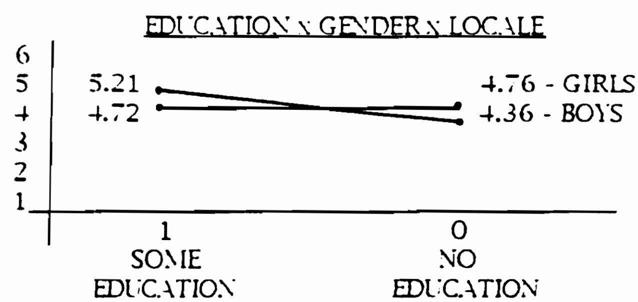
LOCALE = 2

ED_NET	GENDER 1	GENDER 2
0	4.36	4.76
	(39)	(101)
1	5.21	4.72
	(168)	(39)

Second Order Interaction: Factor C6 - Science and Technology Concept.
Superior concept = score of 6, mean score =4.79.



RURAL



URBAN

- Boys' scores on the section that deals with the interrelation of science and technology are higher than girls' scores.
- Girls' scores on the items that deal with the interrelation of science and technology are below the mean, regardless of education.
- Of the pupils with technical education, urban boys and urban girls respectively produce higher scores than their rural counterparts, on the items that deal with the interrelation of science and technology.
- Urban girls illustrated stability in scores on the section that deals with the interrelation of science and technology regardless of education.
- Urban girls without technical classes scored higher than boys without technical classes on the items that dealt with the interrelation of science and technology.

* * * A N A L Y S I S   O F   V A R I A N C E * * *

FACT_C7 Concept scale = skills
by ED_NET
GENDER
LOCALE

EXPERIMENTAL sums of squares
Covariates entered FIRST

Source of Variation	Sum of Squares	DF	Mean Square	F	Sig of F
Main Effects	90.188	3	30.063	14.297	.000
ED_NET	11.797	1	11.797	5.610	.018**
GENDER	33.389	1	33.389	15.878	.001**
LOCALE	.121	1	.121	.057	.811
2-Way Interactions	5.989	3	1.996	.949	.416
ED_NET GENDER	3.817	1	3.817	1.815	.178
ED_NET LOCALE	1.987	1	1.987	.945	.331
GENDER LOCALE	1.079	1	1.079	.513	.474
3-Way Interactions	13.250	1	13.250	6.301	.012
ED_NET GENDER LOCALE	13.250	1	13.250	6.301	.012**
Explained	109.427	7	15.632	7.434	.000
Residual	1690.645	804	2.103		
Total	1800.073	811	2.220		

831 cases were processed.
19 cases (2.3 pct) were missing.

*** CELL MEANS ***

FACT_C7 Concept scale = skills by ED_NET - GENDER - LOCALE

Total Population

5.24
(812)

ED_NET

0	1
4.92	5.46
(334)	(478)

GENDER

1	2
5.49	4.86
(481)	(331)

LOCALE

1	2
5.22	5.25
(465)	(347)

ED_NET	GENDER 1	GENDER 2
0	5.39	4.73
	(96)	(238)
1	5.52	5.19
	(385)	(93)

ED_NET	LOCALE 1	LOCALE 2
0	4.95	4.88
	(194)	(140)
1	5.42	5.51
	(271)	(207)

GENDER	LOCALE 1	LOCALE 2
1	5.49	5.50
	(274)	(207)
2	4.84	4.89
	(191)	(140)

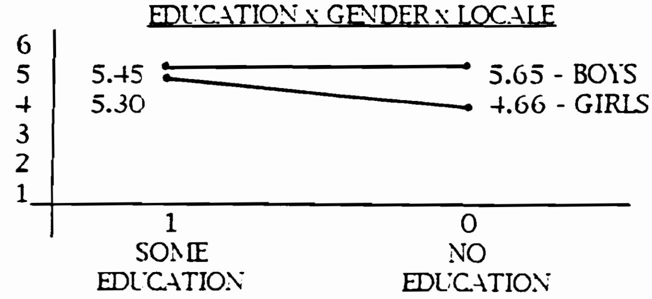
LOCALE = 1

ED_NET	GENDER 1	GENDER 2
0	5.65	4.66
	(57)	(137)
1	5.45	5.30
	(217)	(54)

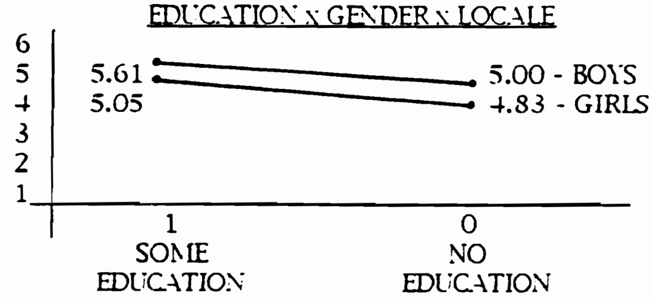
LOCALE = 2

ED_NET	GENDER 1	GENDER 2
0	5.00	4.83
	(39)	(101)
1	5.61	5.05
	(168)	(39)

Second Order Interaction: Factor C7 - Skills and Technology Concept.
Superior concept = score of 7, mean score =5.24.



RURAL



URBAN

- Scores on the skills sub-scale were higher for boys than for girls.
- Where education level was compared on the skills sub-scale, only one group reported a decrease in scores (rural boys: no ed =5.65, ed =5.45).
- The greatest difference in scores on the skills sub-scale is shown between rural girls who have taken technical classes and those who have not.

* * * A N A L Y S I S   O F   V A R I A N C E * * *

FACT_C8 Concept scale = pillars
by ED_NET
GENDER
LOCALE

EXPERIMENTAL sums of squares
Covariates entered FIRST

Source of Variation	Sum of Squares	DF	Mean Square	F	Sig of F
Main Effects	95.412	3	31.804	18.940	.00
ED_NET	11.434	1	11.434	6.809	.009**
GENDER	36.843	1	36.843	21.941	.001**
LOCALE	.144	1	.144	.086	.770
2-Way Interactions	15.904	3	5.301	3.157	.024
ED_NET GENDER	.478	1	.478	.285	.594
ED_NET LOCALE	2.901	1	2.901	1.727	.189
GENDER LOCALE	15.210	1	15.210	9.058	.003**
3-Way Interactions	.596	1	.596	.355	.552
ED_NET GENDER LOCALE	.596	1	.596	.355	.552
Explained	111.911	7	15.987	9.521	.000
Residual	1350.084	804	1.679		
Total	1461.995	811	1.803		

831 cases were processed.
19 cases (2.3 pct) were missing.

*** CELL MEANS ***

FACT_C8 Concept scale = pillars by ED_NET - GENDER - LOCALE

Total Population

3.00
(812)

ED_NET

0	1
2.68	3.22
(334)	(478)

GENDER

1	2
3.26	2.61
(481)	(331)

LOCALE

1	2
2.98	3.02
(465)	(347)

ED_NET	GENDER 1	GENDER 2
0	3.08	2.51
	(96)	(238)
1	3.31	2.86
	(385)	(93)

ED_NET	LOCALE 1	LOCALE 2
0	2.65	2.71
	(194)	(140)
1	3.22	3.23
	(271)	(207)

GENDER	LOCALE 1	LOCALE 2
1	3.34	3.16
	(274)	(207)
2	2.47	2.80
	(191)	(140)

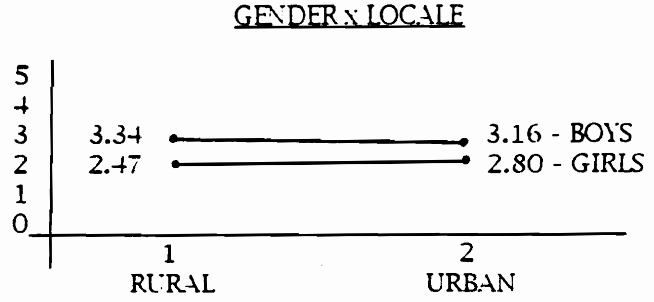
LOCALE = 1

ED_NET	GENDER 1	GENDER 2
0	3.21	2.42
	(57)	(137)
1	3.37	2.59
	(217)	(54)

LOCALE = 2

ED_NET	GENDER 1	GENDER 2
0	2.90	2.63
	(39)	(101)
1	3.23	3.23
	(168)	(39)

First Order Interaction: Factor C8 - PILLARS and Technology Concept.
Superior concept = score of 5, mean score =2.99.



- Scores on the sub-scale Pillars, show that boys tend to measure above the total sample mean while girls' scores range below it.
- Urban girls out-score rural girls, while urban boys score lower than their rural cohort on the Pillars sub-scale.

* * * A N A L Y S I S   O F   V A R I A N C E * * *

CONCEPT Concept scale = (C5+C6+C7+C8)
by ED_NET
GENDER
LOCALE

EXPERIMENTAL sums of squares
Covariates entered FIRST

Source of Variation			Sum of Squares	DF	Mean Square	F	Sig of F
Main Effects			1817.972	3	605.991	35.784	.00
ED_NET			346.967	1	346.967	20.489	.001**
GENDER			505.923	1	505.923	29.875	.001**
LOCALE			49.347	1	49.347	2.914	.088
2-Way Interactions			158.617	3	52.872	3.122	.025
ED_NET	GENDER		1.681	1	1.681	.099	.753
ED_NET	LOCALE		95.921	1	95.921	5.664	.018**
GENDER	LOCALE		138.210	1	138.210	8.161	.004**
3-Way Interactions			64.501	1	64.501	3.809	.051
ED_NET	GENDER	LOCALE	64.501	1	64.501	3.809	.051*
Explained			2041.090	7	291.584	17.218	.00
Residual			13615.477	804	16.935		
Total			15656.567	811	19.305		

831 cases were processed.
19 cases (2.3 pct) were missing.

*** CELL MEANS ***

CONCEPT Concept scale = (C5+C6+C7+C8) by ED_NET - GENDER - LOCALE

Total Population

18.29
(812)

ED_NET

0	1
16.80	19.33
(334)	(478)

GENDER

1	2
19.38	16.69
(481)	(331)

LOCALE

1	2
18.06	18.59
(465)	(347)

ED_NET	GENDER 1	GENDER 2
0	18.22	16.22
	(96)	(238)
1	19.68	17.90
	(385)	(93)

ED_NET	LOCALE 1	LOCALE 2
0	16.75	16.86
	(194)	(140)
1	19.00	19.77
	(271)	(207)

GENDER	LOCALE 1	LOCALE 2
1	19.35	19.43
	(274)	(207)
2	16.20	17.36
	(191)	(140)

LOCALE = 1

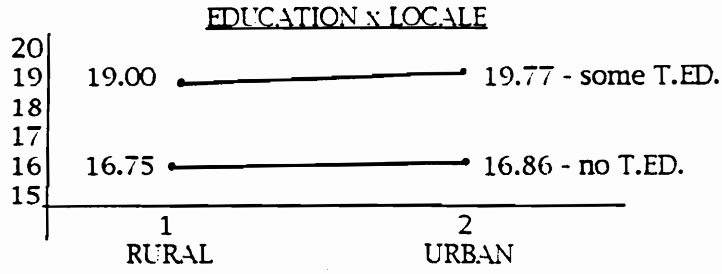
ED_NET	GENDER 1	GENDER 2
0	19.16	15.75
	(57)	(137)
1	19.41	17.35
	(217)	(54)

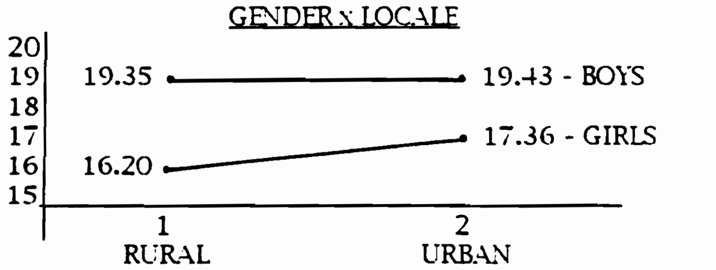
LOCALE = 2

ED_NET	GENDER 1	GENDER 2
0	16.85	16.86
	(39)	(101)
1	20.02	18.67
	(168)	(39)

First Order Interaction: Factor CONCEPT - Overall Cognitive (C) Attitude Score.

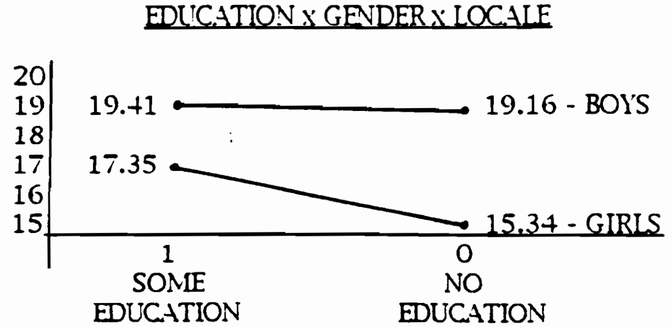
Superior concept = score of 27, mean score =18.29.



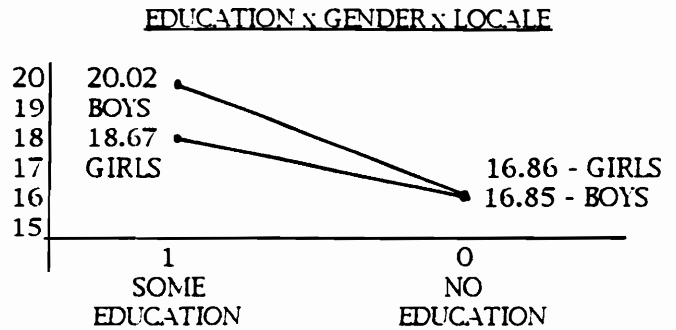


- In comparisons between boys and girls on scores calculated by totaling together each of the four C sub-scales, boys' average scores range above the grand mean, girls below.
- Comparisons of all pupils revealed that those in urban areas obtained higher overall combined C scores than did their rural cohort.
- Pupils that had taken technical classes had substantially higher scores than were evident from the scores produced by pupils who had not chosen to study technology.
- Where the interaction occurs between gender and locale, urban girls seem to benefit strongly from this relationship.
- Boys scores on the combined C sub-scales differ little when compared across locale.

Second Order Interaction: Factor CONCEPT - Overall Concept Score.
Superior concept = score of 27, mean score =18.29.



RURAL



URBAN

- Technical education appears to support higher scores on the combined C sub-scales for all pupils in all locations.
- Technical education also appears to support higher scores on the combined C sub-scales favoring urban males when compared to females' scores.
- Technical education appears to show a greatly increased difference in scores for females beyond that for males.
- Urban boys and girls with no technical education scored equally below the grand mean on the combined C sub-scales.

Appendix O

<u>Researcher's Curriculum Vita</u>

JEFF T. B. MEIDE

1830-4 Grayland Street
Blacksburg, Virginia 24060
Email: jmeide@vt.edu

Career Objective

Seeking a university level position in the field of Technology Education and teacher training with opportunities to conduct educational research and curriculum planning.

Education

***Virginia Polytechnic Institute and State University*, Blacksburg, Virginia** — **1995-1996**
- Ph.D., Vocational and Technology Education
  Cognate: International Development Studies
- Certificate of Advanced Graduate Studies 1992. Technology Education — **1989-1992**
- Masters of Science Degree 1991. Vocational / Technical Education

***Eastern Montana College*, Billings, Montana** — **1978-1982**
- Baccalaureate Degree in Fine Arts
  - Internship in the study of Curatorial and Museum Management
    Yellowstone Art Center 1980
  - Gallery Director; Eastern Montana College, Exposure Gallery

***University of Montana*, Missoula, Montana** — **1975-1976**
- Undergraduate Liberal Arts Program

Technical Training

***Bozeman Bronze*, Bozeman, Montana** — **Spring 1985**
- Study in Foundry and Moldmaking through a cooperative educational exchange program

***Billings Vocational Technical Center*, Billings, Montana** — **Winter 1984**
- Industrial MIG/TIG Welding Course

Professional Experience

Technology for All Americans Project, Blacksburg, Virginia
A Project Sponsored by the International Technology Education Association and funded by the National Science Foundation and National Aeronautics and Space Administration to develop national standards in technology education.
Research Associate
Aug. 1995-present
- Responsible in designing an electronic WWW survey and feedback data gathering system for the purpose of building consensus around issues related to the development of national standards in technology education.
- Monitored and reported on the activities of other national standards projects.
- Analyzed and assessed the levels of technology overlap in core curriculum subjects.

***Molepolole College of Education*, Molepolole, Botswana**
Department of Design And Technology
Teacher Trainer
Jan 1992-Jan 1995
- Taught introductory through advanced level D&T courses including: Communications, Manufacturing, Mechanisms and Professional Studies.
- Involvement in instructional development and programme planning.
- Established a foundry facility.
- Established a departmental, computer-based system of storing and filing instructional/course materials.
- Conducted educational research into pupils' attitudes toward technology.

Eastern Montana College, **Billings, Montana**
Department of Fine Arts
Lab Technician
May 1982-Feb 1986

- Maintained equipment within the art facility including: kilns, foundry, welding, and general wood working.
- Designed and fabricated specialized equipment.
- Assisted in delivery of technical instruction.
- Assumed stock taking, purchasing and Safety Officer duties.

Peace Corps Volunteer Experience

Shashe River Senior Secondary School, **Tonota, Botswana**
Department of Technical Education
Technical Drawing Instructor
May 1986-Dec 1986

- Taught senior level Technical Drawing courses.
- Assisted in coaching and extra curricular activities.

Mmei Community Junior Secondary School, **Francistown, Botswana**
Department of Technical Studies
Head of Department
Jan 1987-April 1989

- Established the school's first Technical Studies facility and led the new program.
- Initiated community related projects and fund raising events through the formation of a school club.

Supa-Ngwao Museum, **Francistown, Botswana**
Founding Member
1987-1988

- Assisted in establishing Francistown's Supa-Ngwao Ngwao museum.
- Assumed the duties of secretary and led in the campaign to raise both money and community awareness for the museum.

Independent Study Abroad

ASIA- India,Thailand, and mainland China- materials and traditional home construction 1989.
AFRICA- Botswana- historical / cultural survey of the Masazuru; a sub-cultural group independent through technological self-sufficiency 1987.
Mexico- Pacific Coast- Independent survey of art within its coastal environment 1985.
Europe- Italy-Explored the tradition of Italian bronze casting; Carrera, Pietra Santa 1983.
Europe- Study focusing on the great museums of Europe and their collections 1980.

Research

Botswana-"*Pupils' Attitudes Towards Technology*" (PATT-Botswana) 1994. A study with the aim of measuring and comparing pupils' attitudes toward technology among children with differing backgrounds.

Certificates

Holds current teaching certification in Technology Education and Fine Art K-12.

Organizations and Interests

- Member of the International Technology Education Association.
- Member of the Virginia Technology Association.
- Member of the Council on Technology Teacher Education.

Specific Strengths and Skills:

- Possesses knowledge and interest in southern Africa and its multi-cultural heritage.
- Proficient in general computing applications. Familiar with Mac OS, MS-DOS, SPSS and CAD operations.
- Intermediate conversational Setswana and Spanish. Limited understanding of Afrikaans.

Presentations and Papers

- (February, 1989) *Cultural survey of the Masazuru: a sub-cultural group independent through technological self-sufficiency* Presentation at a community forum, Billings, Montana.

- (March, 1991) *Botswana: A case study of technology education in transition.* Symposium conducted at the 53rd Annual International Technology Education Association Conference, Indianapolis.

- (April, 1991) *The social significance of education in development planning: A case study of the primary education improvement project in Botswana.* Unpublished manuscript, Virginia Polytechnic Institute and State University, Department of Urban Affairs and Planning.

- (November, 1992) [A photographic series] In, J. B. Gardner's *Baboon Valley.* Published in *Marung 10*(70) 29-31.

- (August, 1993) *Design & technology: Is it time for change?* Unpublished manuscript, Molepolole College of Education, Department of Design & Technology.

- (November, 1995) *How reviewer response forms were designed and implemented by national subject reform panels to achieve consensus in setting new standards* (Research Rep. TAA 1, Meide)

- (February,1996) *Standards in technology education in America: A survey for curriculum developers and policy makers.* (Research Rep. TAA 2, Meide)

- (April, 1996) [A photographic series] In, *L'Attitude.* Spring 1996, vol. 7.