The Impact of Lack of Resources on Declining Students' Enrolments in Design and Technology in Botswana Junior Secondary Schools

Michael Gaotlhobogwe, University of Botswana, Botswana

Abstract
Lack of resources has resulted in declining students' enrolment in design and technology in Botswana junior secondary schools by up to 6% per year over 10 years, despite positive encouragement by the government. Based on the PATT (pupils' attitude towards technology) theoretical framework this study indicated how a lack of resources in Botswana junior secondary schools impacted upon students' attitudes towards design and technology. Research from most parts of the world indicates that attitudes toward technology is increasingly becoming an important area of research as the impact of technology on society increases. Technological impact on society has resulted in a shift of perceptions about the role of technology education the world over. Views of students expressed during focus group interviews and analysed through a hybrid of a data driven inductive approach and deductive a priori template of codes approach indicated that lack of resources impacted upon students' enjoyment and performance of Design and Technology.

Key words
design and technology, technology education, Botswana, attitudes and perceptions, Nvivo

RESEARCH

Introduction

The Revised National Policy on Education (RNPE) (Republic of Botswana, 1994b) recommended that design and technology be made a core subject in Junior Secondary Schools in Botswana by the year 2000. Prior to the RNPE, design and technology had been offered as an optional subject since its introduction in the curriculum in 1990. Although design and technology has evolved from craft subjects such as woodwork and metalwork, it is relatively a new subject in Botswana (Moalosi, 2001), as it is on a world scale (Owen-Jackson, 2002; Ginestiẽ, 2005; Barlex, 2007). To emphasize the connection between design and technology and the old craft subjects, Gawith et al (2007) wrote that technology education (an equivalent to design and technology in Botswana) in New Zealand was both an old and a new subject. Design and technology education in Botswana, like technology education in New Zealand has this dual nature. As an old subject it is associated with notions of craft and vocational preparation, and as a new subject, a greater emphasis is being placed on technology in a critical social context.

The dual nature of design and technology has resulted in diverse views about its place in the curriculum. This dual nature has also placed a tremendous strain on the subject's resources. Perceptions about the value, and the role, of design and technology education in the 21st century are also divided (Gaotlhobogwe, 2010).
As an old subject, design and technology education is founded on competencies, which only a few people need in order to accomplish given tasks. This position carries with it a stigma, a history that may render the subject out of date in the 21st century curriculum. As an emerging technological literacy subject, design and technology education is founded on technological literacy, which everybody needs to survive in this technology driven world. This position conflicts with roots and history which makes it a distinct subject with a defined role in the school curriculum. As a new subject it is expected to shift, to be better placed to accommodate (embrace, even) the change that is brought about by a range of technological, legal and social developments in the ways that products are designed and made. Historical periods of human society (de Vries, 1996) and the corresponding trends in the development of technology in post-industrial society (Ivanov, 2006; Steeg, 2008) have led to many questions about the mutual co-existence and interaction of education and technology at the present time (Levin and Kojukhov, 2008; Steeg, 2008; Kumar, 2002).

The teaching and learning of design and technology has been reported to be impacted upon by technological developments at a more regular and rapid rate than the teaching and learning of any other subject (Barlex, 2007; Keirl, 2007; Kumar, 2002). Design and technology is constantly going through transformation, as a result of this constant change, resource availability and management are affected. Having evolved from traditional craft subjects and been classified as a practical subject, design and technology in Botswana junior secondary schools is assumed to be synonymous with vocational education. As such, there is much emphasis on simple motor skills which are heavily dependent on the use of material resources, tools, and equipment and machinery resources.

Resources

The concept of resources in educational terms is not very restrictive as it includes anything that can be used as an educational tool. In the context of this study, resources refer to the following: materials used in the actualization of products; tools and other electronic and mechanical equipment used to manipulate materials when actualizing products. The introduction, and resourcing of the current

design and technology education in Botswana was in line with the goal of the RNPE, which was to prepare Batswana for the transition from a traditional agro-based economy to the industrial economy (Republic of Botswana, 1996). The advent of computerisation and globalisation has influenced nations, including Botswana, towards the post-industrial society, and this has resulted in policy contradictions and paradoxes (Tabulawa, 2009). Attributes of this post-industrial society brought about conflicts as to the nature and the role of design and technology education in the post-industrial society's school curriculum. According to Levin and Kojukhov (2008) micro-technologies are the basis of the post-industrial society, and so the traditional technology education (experience based or handicraft technology) faces significant difficulties in the case of studying micro-technologies. Steeg (2008) observed the same problem in England where, according to him the subject develops in pupils, designing and making skills and knowledge that are derived from industrial design practice. According to him, ideas of designing for clients, designing for mass production, market awareness and protecting design ideas, which derive from industrial design practice, are irrelevant in this age. In the case of Botswana, Tabulawa (2009: 103) observed that the RNPE and its attendant learning programmes (curricula) are more likely to produce conformists fit only for outdated Fordist production processes. As such, despite the continuing popularity of Design and Technology, there are suggestions that things remain insecure (Keirl, 2007), and that many pupils find the subject unsatisfying (Steeg, 2008).

Theoretical framework: attitudes of pupils towards technology education

Pupils' attitude towards design and technology education is increasingly becoming an important area of research as the impact of technology on society is increasing. Research (Neale, 2003; Gaotlhobogwe, 2008; Van Rensburg and Ankiewicz, 1999) from most parts of the world expresses similar views. The advancement of technology and curriculum integration (Tabulawa, 2009) has pushed the parameters of technological literacy across the traditional boundaries between curriculum subjects. As such, more and more subjects that were traditionally not technical in nature now are. Skills and attributes such as creativity, innovativeness, and problem-solving, that were traditionally technical have become more and more generic and so design and technology education is entwined with the sciences, the arts, mathematics and economics. As a result, Mottier (1999) observed that the more we live in increasingly technological environments, the more the younger generation do not see it as technical anymore and ironically, the more technology education is introduced in general education, the more students turn to other studies. However, the role of design and technology education continues to impact on the 21st century society and so remains a national priority for most governments.

Research to determine pupils' attitudes towards, and concept of, technology has been conducted around the world (Netherlands, 1984; USA, 1988; Botswana, 1997; Hong-Kong, 1999; South Africa, 1999, 2001; Thailand, 2002). An attitude in the context of this framework is:

> a relatively enduring organization of beliefs around an object or situation predisposing one to respond in some preferential manner (Rokeach, 1970: in Ankiewicz and Van Rensburg, 2001: 98).

Ankiewicz and Van Rensburg (2001) indicated that there are three dimensions to attitudes, namely; the cognitive, the affective and the behavioural dimensions. The cognitive dimension is about a person's ideas or statements that express the relationship between situational and attitudinal objects (Gagné, 1977: in Ankiewicz and Van Rensburg, 2001). According to Corsini & Ozaki in Ankiewicz and Van Rensburg (2001) the cognitive dimension is the opinion that reflects an individual's perception of, and information on, the attitudinal object. The affective dimension refers to an individual's feeling or emotion concerning an attitudinal object (Van Rensburg and Ankiewicz, 1999:142). The behavioural dimension is about an individual's pre-dispositions or readiness for action, as well as his or her actions towards the attitudinal object (Ankiewicz and Van Rensburg, 2001). White, as cited in Ankiewicz and Van Rensburg (2001) clearly shows the interplay of these three dimensions to attitudes.

An attitude to a concept such as science is the person's collection of beliefs about it, and episodes that are associated with it, that are linked with emotional reactions. The stimulation of these reactions affects decisions to engage in behaviour, such as choosing to take a science course, to read scientific matters, or to adopt a scientific-related hobby (Ankiewicz and Van Rensburg, 2001: 98).

The pupils' attitudes towards technology (PATT) questionnaire developed in the Netherlands by de Vries (1988) concentrated on the cognitive and the affective dimensions. The questionnaire was validated by de Vries, Dugger and Bame (1993) and used in the USA. It has since been used in many other countries around the world including Botswana, Kenya, India, South Africa, Nigeria and Mexico according to de Klerk Wolters in Van Rensburg and Ankiewicz (1999). However, Van Rensburg and Ankiewicz (1999) concluded that the PATT instrument did not yield valid and reliable results from the South African learners

because of differences in language, terminology and contexts between developed first-world countries and Southern Africa.

Ankiewicz and Van Rensburg (2001) developed a similar instrument to the PATT instrument, suitable for the South African context and called it the Attitudinal Technology Profile (ATP). Anderson and Myburgh in Van Rensburg and Ankiewicz (1999) pointed out that, concepts and terminology, the frame of reference, the culture and how a question is formulated, all influence empirical research. The ATP instrument had fewer items (24) than the PATT instrument (100 items). Also the ATP instrument avoided formulating items using prescriptive/evaluative prepositions, which according to Ankiewicz and Van Rensburg (2001) demanded high level language proficiency in order for the learners to understand and interpret complicated technology related terms.

Although the PATT framework was essentially quantitative, a qualitative design method was adopted in the current study, as was suggested in Ankiewicz and Van Rensburg (2001), to corroborate the quantitative findings and to add depth to the study of pupils' attitudes towards technology.

Research method

The research methodology used examined the views of form three (16-18 years old) design and technology students to help explain the problem of declining enrolment in the subject. Focus group interviews with students were used to examine the views of students concerning their attitudes towards and perceptions of design and technology, as well as their underlying drivers as revealed in the way they respond to the subject. The views of students expressed during the focus group interviews helped to explain in detail the problem of declining enrolment in design and technology, and how this could be tackled.

Focus group interviews were conducted during the summer of 2008 across five Junior Secondary Schools in Botswana. One focus group interview involving between seven and ten participants (boys and girls) was conducted at each of the five Junior Secondary School by the researcher. A total of 47 students participated in these focus group interviews. Participants were selected through convenience sampling from a population that previously participated in a questionnaire survey, the results of which were reported in Gaotlhobogwe (2010). The focus group interviews were conducted in English then transcribed verbatim to try and capture how respondents expressed themselves by preserving all the regional terms and grammatical expressions (Gibbs, 2007).

To maximize consistency, a semi-structured schedule informed by the experience gained from the preliminary questionnaire survey (Gaotlhobogwe, 2010) was used for the focus group interviews.

A digital recording machine and an audiocassette recorder were used concomitantly to record the focus groups interviews as a precautionary measure in case any one of these machines failed to function. All the transcriptions were double checked against the original recordings and any mistakes identified were corrected.

The transcribed data was then imported into NVivo 8 (QSR, 2007), a software programme developed by Qualitative Solutions and Research International (QSR). In NVivo 8, fragments of text, representing individuals' views were ascribed to categories of responses contained in specific folders known as 'nodes'. Through these nodes it was easy to access specific responses, analyze, and present them in a variety of ways such as graphs and models (data driven inductive approach).

Transcriptions (using pseudo names) were imported into NVivo 8 as sources contained in different folders, namely School one, School two, School three, School four, and School five. The data was explored by querying the themes (factors) identified through the questionnaire survey as those having a major influence in students' attitudes towards and perceptions of design and technology (Gaotlhobogwe, 2010). Queries explored and results saved as 'free nodes' included the following perceptions about design and technology, which had already been identified through the questionnaire survey: Importance; Level of difficulty; and Resources (deductive a priori template of codes approach).

The data analysis model (figure 1) illustrates a hybrid of data driven inductive approach and deductive a priori template of codes approach that was used to analyze the views of students. At the initial stages of analysis extracts from the interview transcripts were categorized into the different themes as free nodes. The extracts contained in free nodes were then further subdivided into sub-themes contained in tree nodes. The free nodes were subdivided into two or three sub-themes (tree nodes). Each of these tree nodes was further sub-divided to reflect differences in views from the different schools. As the sub-themes increased, the details in data analysis also increased resulting in better interpretation of the results.

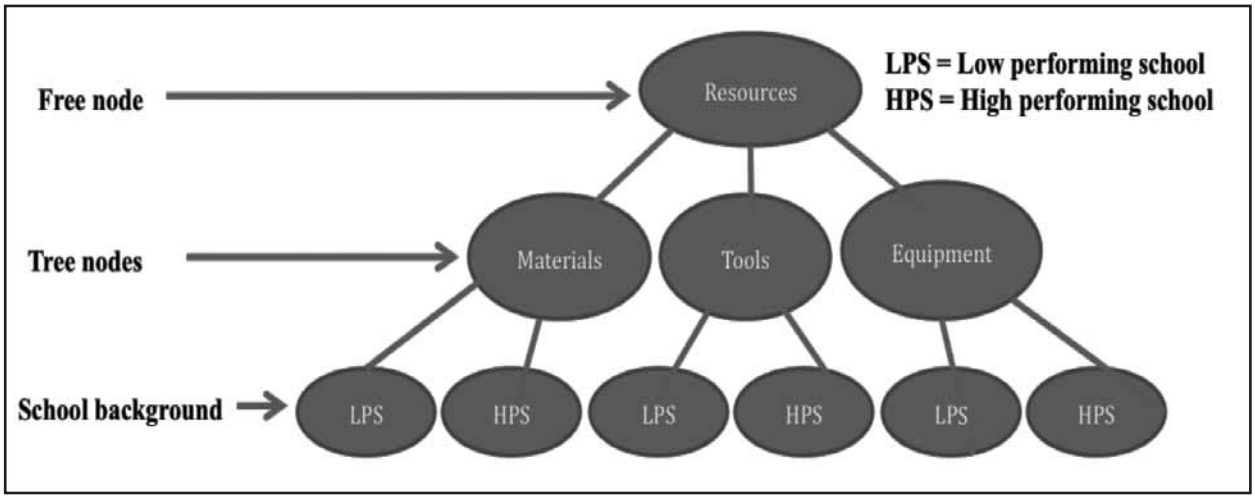

Figure 1. Data analysis model

Findings

Findings indicated that lack of resources impacted on the overall attitudes and perceptions of students towards design and technology. Availability of materials, tools and other equipment also affected students' enjoyment and perceived level of difficulty of design and technology, as reflected in the following typical comments made during the focus group interviews:

> Yes it's difficult because the problem is there is lack of tools. (Ngwako/School 4)

> I think it's a great subject but I am not happy with a lot of things in our school such as shortage of materials and tools. (Robert / School 1)

Resources in design and technology include tools, equipment, machinery, materials, workshops and other specialist rooms. Resource constraints include shortage of resources as well as poor or insufficient maintenance of such resources.

Asked if they had enough tools and equipment in their schools, 33 students out 47 indicated that there was shortage of resources in Design and Technology. Shortage of tools was the most coded at 30 of the 33 comments indicating that there was lack of resources. There was an indication also that some of the tools available were not safe to use due to poor or insufficient maintenance, for example, one student commented that:

> Even the tools which are there, some of them are just not safe to use even though we just use them. (Anita/School 1)

The problem of shortage of tools was spread across the five case study junior secondary schools as shown in figure 2 below.

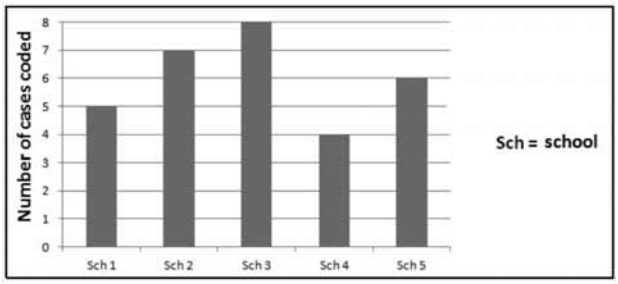

Figure 2. Shortage of tools – coding by school

The next most coded after shortage of tools was shortage of equipment and other machinery in Design and Technology. Unlike shortage of tools, shortage of equipment and machinery was not spread across the case study schools. Figure 3 shows that low performing village school five was the most affected by this problem.

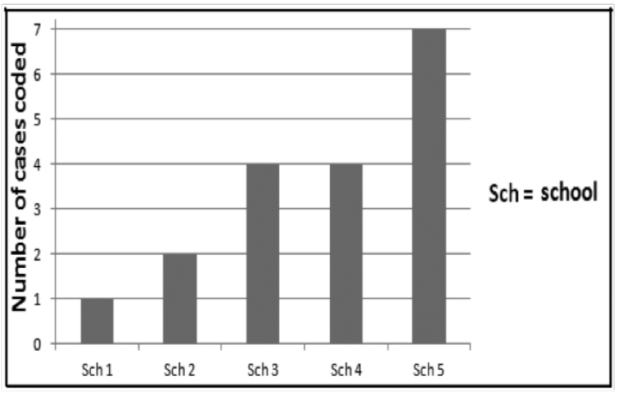

Figure 3. Shortage of equipment and machinery – coding by school

RESEARCH

These results seem to suggest that case study schools one and two, in Gaborone, the capital city were the least affected. This could be explained by the location of the schools because even when funding is available, in areas where there are no suppliers of design and technology equipment, tools and materials such as in villages, the procurement procedure of having to get five quotations makes it impossible to purchase equipment and other things. The only other way to make purchases would be to rely on suppliers from urban centres, in which case it may be a lengthy process. The following comment made during the focus group interviews from school 5 confirms this problem:

> Design and technology it is difficult when it comes to making projects there could be shortage of material. Then we take a lot of time waiting for materials to be brought to school. (Mokgabo/School 5)

Shortage of materials was the least coded, at six of the 33 comments indicating that there was lack of resources. Interestingly, none of this perception came from the two high performing schools three and four as indicated in figure 4. Although shortage of materials was only mentioned in six comments, in each of these six cases it was mentioned in conjunction with shortage of tools or shortage of equipment. This suggests that shortage of materials is not as acute as shortage of tools and equipment, possibly because materials do not need regular maintenance and servicing as would be tools and equipment.

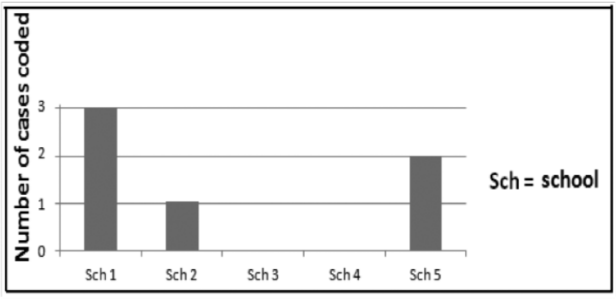

Figure 4. Shortage of materials – coding by school

These results confirmed the results of the questionnaire survey (Gaotlhobogwe, 2010) which indicated that all attitude groups disagreed or strongly disagreed with the assertion that there were enough resources for Design and Technology available. These perceptions, as shown in figure 5 were prevalent across the five case study schools.

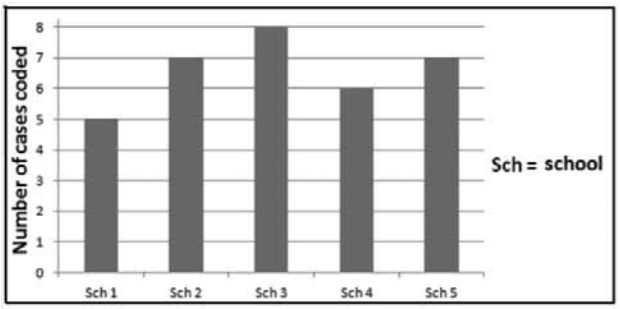

Figure 5. Students' perceptions about lack of resources – coding by school

Comments made during the focus group interviews indicated that lack of resources influenced attitudes and perceptions towards the subject. For example, the two comments below related to the fact that finishing tasks or projects took too long as students had to queue for tools and other machinery, resulting in poorly finished or unfinished work. Poorly finished or unfinished work affects student's performance, which in turn affects their interest and perception about the subject's level of difficulty.

> I also enjoy D&T but the problem is the practical, due to lack of tools and other materials it makes it kind of difficult and takes a lot of time so I have a problem with that. (Ngwako/School 4)

> Design and technology is difficult on the project because sometimes there is a shortage of material so we must spend a lot of time waiting for the material to be brought in the school. (Gomolemo/School 5)

Discussion

Existing pertinent research (Van Rensburg and Ankiewicz, 1999; Becker and Maunsaiyat, 2002; Ankiewicz and Van Rensburg, 2001) attributes disposition of pupils towards technology to various determinants such as: gender; technological nature of family's professions; existence of technological toys and facilities at home. This study has shown that resource availability in design and technology is an important determinant that impacts upon disposition of pupils towards technology.

Resource constraints appear to have had a negative impact on students within the subject and those outside the subject through peer influence as observed by Indoshi, Wagah and Agak (2010). The findings indicated that lack of resources has a negative impact on attitudes and perceptions of students towards design and technology. Comments about the subject being difficult expressly linked the difficulty of the subject to lack or shortage of

resources such as tools, material and equipment. This is evidence that lack or shortage of resources has an impact on how students perceive the level of difficulty of the subject. Hendley, Stables, and Stables (1996) pointed out that pupils valued design and technology for its creative potential and so finishing work might be seen as a sign of fulfilling one's creative potential within it. Lack or shortage of resources also impacted on one of the important dimensions of a classroom climate necessary for creativity in design and technology. Affording students the necessary freedom to generate and realize creative solutions to problems is a motivational attribute in design and technology classrooms, and the lack of resources undermines this dimension. The lack of prospects of passing the subject due to its difficulty and the compromised freedom to generate and realize creative solutions to problems would definitely work against the uptake of the subject. Lack of resources also compromised safety as students reported that they had to use unsafe tools; the lack of assurance of safety due of unsafe tools could be a militating factor working against the uptake of the subject.

An important observation from these findings is that the problem of shortage of tools (excluding equipment, machinery, and materials) is not peculiar to certain schools but it is a system wide problem which requires a system wide solution. This is evidence of a discrepancy within the system of design and technology education in Botswana. Identifying this discrepancy would go a long way in addressing the problem of shortage or lack of design and technology tools in schools. One of the many ways to improve this situation would be to train more teachers to take up supervisory and management positions as well as in-service training on issues of resource management and record keeping.

Sufficiently providing the necessary resources for all aspects of the subject would be a step in the right direction and could help address the problem of declining enrolments. Clearly, some aspects of the subject; for example, portfolio and craft-work, are an unnecessary burden for particular groups of students, and removal or reduction of such aspects for those particular groups would relieve the strain on the subject's resources. This relief would help tackle the problem of declining enrolments by reinforcing perceptions of design and technology as an enjoyable life-skill. The classification of design and technology as a practical subject in the junior secondary school curriculum is assumed to be synonymous with vocational education. As such, much emphasis is on simple resistant material's motor skills, this could act as a deterrent for most students.

Conclusion

Design and technology remains one of the most exciting areas of study that is in touch with every aspect of human nature. It is this responsibility that technology education carries that makes it a priority area of study. However, the lack of resources appears to be a major obstacle to the development of this important area of study. Despite positive encouragement by government design and technology in Botswana junior secondary schools has declined in uptake over 10 years by up to 6% per year (Gaotlhobogwe, 20100).

Evaluation reports (Republic of Botswana, 2004a; 2009) noted the comprehensiveness of the subject content and the lack of time to complete the syllabus within the given time but failed to report on how this impacted upon resources as well. One of these reports however, noted that teachers reported acute shortage of equipment for technology including power tools, hand tools and models for concretising concepts in Mechanisms and Electronics and Electricity (Republic of Botswana, 2004a: 70). It is inevitable that comprehensiveness of subject content for a resource intensive subject such as design and technology would impact upon its resources. While the decline in uptake of design and technology cannot be attributed to lack of resources alone, the findings of this study have shown that lack of resources play a major role in influencing students against the subject. The area of resources in design and technology has been neglected for years; particular attention is needed to address this shortcoming. If not, creativity, innovativeness, and flexibility will remain elusive in our design and technology classrooms.

References

Ankiewicz, P., and Van Rensburg, S. (2001) Assessing the Attitudinal Technology Profile of South African Learners: A Pilot Study. *International Journal of Technology and Design Education*, 11, 93 -109.

Bame, A.E., and Dugger, W.E. Jr (1989) Pupils' Attitudes Towards Technology: A First Report of The Findings. PATT – USA.

Barlex, D.(Ed) (2007) *Design and Technology for The Next Generation*. Cliffeco Communications: Shropshire.

Becker, K.H., and Maunsaiyat, S. (2002) Thai Students' Attitudes and Concepts of Technology. *Journal of Technology Education*, 13, 2. http://scholar.lib.vt.edu/ejournals/JTE/v13n2/becker.html (accessed 18.10.11)

Boser, R.A., Palmer, J.D., and Daugherty, M.K. (1998) Students Attitudes Towards Technology in Selected Technology Education Programmees. *Journal of Technology Education*, 10, 1, 4 – 19.

Dagan, O. and Mioduser, D. (2002) The Effect of Alternative Approaches to Design Instruction (Structural or Functional) on Student Perceptions of Technological Problem Solving Processes. *The Design and Technology Association Education & International Research Conference*, Loughborough.

De Vries, M. J. (1988) 'Pupils' Attitudes Towards Technology', Report Exploratory Research in Virginia.

De Vries, M.J. (1996) Technology Education: Beyond "The Technology is Applied Science" Paradigm. *Journal of Technology Education*, 8, 1, 7-15.

Gaotlhobogwe, M (2008) Perceptions of Junior Secondary School Students Towards Design and Technology in Botswana. *PATT – 20 Conference Proceedings*. Tel Aviv, Israel.

Gaotlhobogwe, (2010) *Assessing Students' Attitudes to Design and Technology*. VDM Verlag Dr Muller: Saarbrucken: Germany.

Gawith, J., O'Sullivan, G., and Grigg, N. (2007) Technological Literacy in New Zealand: Two Paradigms a Swing Apart. In Daker, J.R., Dow, W.J. and de Vries, M.J (eds), *Pupils Attitudes Towards Technology Annual Conference 2007*. Glasgow: University of Glasgow.

Gibbs, G. (2007) *Analyzing Qualitative Data*. Sage Publications: London.

Ginestiẽ, J. (2005) *Teacher Training, Preparing Young People for Their Future Lives: An International Study in Technology Education*. IUFM Aix – Maseille: Chile.

Hendley, D., Stables, A. and Stables, S. (1996) Pupils Subject Preferences at Key Stage 3 in South Wales. *Education Studies*, 22, 2, 177-189.

Indoshi, F.C., Wagah, M.O., and Agak, J.O. (2010) Factors That Determine Students' and Teachers' Attitudes Towards Art and Design Curriculum. *International Journal of Vocational and Technical Education*, 2, 1, 9 -17.

Ivanov, D. (2006) *The Past, Present and Future in The Perspective of Dialectical Theory*. Durban, South Africa.

Keirl, S. (2007) '*The Politics of Technology Curriculum*', in Barlex, D (Ed) Design and Technology for The Next Generation, 60 – 73, Cliffeco Communications: Shropshire.

Kumar, K.L. (2002) Impact of New Technology on Teaching and Learning in Technology Education. *Design and Technology Association International Research Conference Proceedings*, 119 – 130.

Levin, I., and Kojukhov, A. (2008) Virtualization and Educational Technology in Post-Industrial Society. *PATT - 20 Conference Proceedings*. Tel Aviv, Israel.

McLellan, R., and Nicholl, B. (2008) The Importance of Classroom Climate in Fostering Student Creativity in Design & Technology Lessons. *The Design and Technology Association Education & International Research Conference*, Leicestershire.

Van Rensburg, S., and Ankiewicz, P. (1999) Assessing South Africa Learners' Attitudes Towards Technology by Using the PATT (Pupils' Attitudes Towards Technology) Questionnaire. *International Journal of Technology and Design Education*, 9, 137-151.

Meide, J.B. (1997) Pupils' Attitudes Towards Technology: Botswana. *PATT - 8 Conference Proceedings*, 17 – 22 April, 208 – 213.

Moalosi, R. (2001) Botswana's Tertiary Design and Technology Curriculum Model. *International Technology Education Forum 2001*: Durban, South Africa.

Mottier, I. (1999) Impacts of Technology Education: Introduction to the Conference, in Mottier, I ., and de Vries, M.J. (eds) *Pupils Attitudes Towards Technology Annual Conference*.

Ndaba, N.N. (1994) The Effects of the Shift From Traditional Craft Subjects to Design and Technology – The Botswana Experience in *IDATER 94*, Loughborough University of Technology.

Neale, J.G. (2003) A Longitudinal Study of Pupils' Attitudes to Design and Technology at Key Stage Three and Four in the National Curriculum, in Daker, J.R. and de Vries, M.J (eds). *Pupils Attitudes Towards Technology Annual Conference*. Glasgow: University of Glasgow.

Owen-Jackson, G. (2002) *Teaching Design and Technology in Secondary Schools*. London: Open University Press.

Republic of Botswana (1994a). *A Report on The Evaluation of The Three-Year Junior Certificate Programme*. Department of Curriculum Development and Evaluation, Gaborone, Botswana.

Republic of Botswana (1994b). *The Revised National Policy on Education*. Government Printers: Gaborone, Botswana.

Republic of Botswana (1996a). *Design and Technology 3-year Junior Secondary Syllabus*. Department of Curriculum Development and Evaluation, Gaborone, Botswana.

Republic of Botswana (2009). *Final BGCSE Evaluation Report*. Department of Curriculum Development and Evaluation, Gaborone, Botswana.

Steeg, T. (2008) Makers, Hackers and Fabbers: What is the Future for D&T. *The Design and Technology Association Education & International Research Conference*, Leicestershire.

Tabulawa, R.T. (2009) Education Reform in Botswana: Reflections on Policy Contradictions and Paradoxes. *Comparative Education*, 45, 1, 87-107.

Van Rensburg, S., Ankiewicz, P., and Myburg, C. (1999) Assessing South Africa Learners' Attitudes Towards Technology by Using the PATT (Pupils' Attitudes Towards Technology) Questionnaire. *International Journal of Technology and Design Education*, 9, 137 -151.

Welch, M., Barlex, D., and Taylor, K (2005) I Don't Enjoy Making the Folder: Secondary Students' Views of Portfolios in Technology Education. *The Design and Technology Association International Conference*.