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CONTENTS

ATTITUDES OF ZIMBABWEAN SECONDARY SCHOOL STUDENTS AND TEACHERS TOWARDS TECHNICAL DRAWING AS A SCHOOL CURRICULUM SUBJECT

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ABSTRACT

This is a study of attitudes towards Technical Drawing and the state of Technical Drawing in Zimbabwean Secondary Schools (Form I to Form VI) conducted in November 1988. The purpose of this study was to find out headmasters', teachers' (teachers of technical subjects in secondary schools) and secondary school students' attitudes towards Technical Drawing and to compare them to the state of Technical Drawing in the country.

Data was collected through questionnaires and interviews. The study indicates that attitudes towards Technical Drawing in the schools studied are positive. However, the study also points out that schools face problems, e.g. shortage of books and qualified teachers, which threaten the state of the subject and also attitudes towards the subject.

The study also gives some recommendations and suggestions for the improvement of the subject in Zimbabwean schools. Although the results of this study are not representative of the situation in all schools in the country, they at least indicate areas which need some consideration and provide an indication of what may be expected in similar schools. The results should form a basis for future studies.

INTRODUCTION

Traditionally, Technical Drawing has included plane and solid geometry, orthographic projection and common pictorial projections. The drawings have mostly been workshop-based, related to craft subjects like Metalwork, Woodwork and Building. Over the years, Technical Drawing has developed to such an extent that it now includes topics far removed from craft: it has become a subject in its own right.

As Technical Drawing divorced itself from the craft subjects and became a subject in its own right, people began to question its purpose in the school curricula. This question is still unresolved in many countries and it does seem to influence some people's attitudes towards the subject. Two view points exist: There are those who believe that even if Technical Drawing is afforded full subject status, it should continue to have very close links with practical subjects. This means that Technical Drawing students should also study subjects like Woodwork, Metalwork, Building or other related engineering subjects. The argument is that unless Technical Drawing is related to practical subjects, students will have difficulty in understanding the subject. Technical Drawing needs to be linked to practical subjects to give it relevance. The Chief Examiner (Technical Drawing) (1989) of the University of Cambridge, argues that Technical Drawing is essentially a tool of the engineer or craftsman and should not be regarded as a separate entity or be self-contained. He further argues that Engineering drawings, are not produced just to be drawings, they are produced to enable the Civil Engineer, the Production Engineer, the Carpenter, etc., to make something. It is essential that all future engineers or technicians are able to think in three dimensions. The ability to visualise, record and give shape and structure to images is an important requisite of every engineer or technician. Technical Drawing is an essential means of communicating design concepts and details of shape and size which cannot be communicated by written or verbal language or by the language of Mathematics. Giesecke et.al., (1986, p.9) assert that:

> Today the intimate conncection between engineering and science and the universal graphic language is more vital than ever before, and the engineer, scientist, or technician who is ignorant of or deficient in the principal mode of expression of his or her technical field is professionally illiterate ... training in the application of technical drawing is required in virtually every engineering school in the world.

The second point of view is that it is not necessary to link Technical Drawing to subjects like Metalwork, Woodwork or Building. Technical Drawing can be taught as an independent general education subject. As a general education subject, emphasis is on the cognitive development of the student including the development of manipulative skills. Specialisation is purposely avoided, for it is argued that in today's fast changing technological world, no skills are valued indefinitely. The aim in general education is to equip the child with the necessary tools which will enable him to cope with the events of this world. The only tool which can assist him is the ability to think and adjust to changing circumstances. The child must therefore be taught to 'learn how to learn' (Krane and Dyson,1981). As a general education subject, Technical Drawing is not only a subject of the future draughtsman, technician or engineer, but a subject for all students regardless of gender or future career aspirations. The function of Technical Drawing as a general education subject is clearly explained by Krane and Dyson (1981, p.14):

> Drawing enables the learner to develop a method of visualising ideas and concepts through visual thinking. Graphic means can be used for developing the learner's capacity to discriminate, recall, organise, imagine and express knowledge and information ... it is a means of processing thinking and making learning more meaningful.

Technical Drawing assists students to initiate and develop thoughts and to communicate these to others. Drawing, like any language, is a necessary means of communication. Drawing is not only important as a means of communication as Green (1985, p.43) argues:

> The skills involved in manipulating spatial concepts and ideas through graphic analysis and their contribution to the development of the thinking process, have long been underated in education. ... Drawing is not simply a passive recording of what we see, it is a dynamic experience of the transfer of thinking into visual terms without the unnecessary intermediate stage of words. Thus graphical development provides for direct visual analysis and the formation of relationships.

From the arguments given, it seems attitudes towards Technical Drawing are influenced by the way people see the purpose of secondary school education. Some people believe that the true purpose of education at this stage is to broaden the mind, to offer children the widest possible range of choices and they believe that the only way to achieve this is through liberal education. To this group a subject like Technical Drawing should be offered as a general education subject with emphasis on the cognitive development of the learner. On the other hand, there are those who believe that education has always been influencing life rather than participating in life. This group believes that students should be prepared for the world of work and one way to achieve this is to make sure that students are given the opportunity to apply their Technical Drawing knowledge and skills in other related practical subjects.

In Zimbabwe, schools offer Technical Drawing as an independent subject. It is not necessary for students to take Technical Drawing and a related practical subject - an approach which some people find difficult to accept.

Over the years, changes have taken place in Zimbabwean schools. Some schools which once offered the subject up to G.C.E. Advanced Level no longer do so whilst at the same time a good number of schools have just started offering the subject. There are schools which have been provided with equipment to enable them to start a few classes of Technical Drawing but in some cases the equipment is not in use. There are also schools which have been offering the subject for a number of years but do not have permanent teachers for the subject. These schools rely on student teachers who are at the school for only a year.

The Technical Drawing syllabus used in Zimbabwe appears not to have been revised for a long time. Its relevance to the present situation in Zimbabwe has not been assessed. At the moment the Ministry of Education and Culture is in the process of localising all examinations. This means preparing syllabuses which are well suited to the Zimbabwean situation. Unfortunately this exercise is being carried out without conducting a nationwide evaluation of the current curricula. A study of students', teachers' and headmasters' attitudes towards Technical Drawing is a valuable part of such an evaluation.

Recently, there has been a sudden increase in the number of schools offering Technical Drawing in Zimbabwe up to the Ordinary level (i.e. the first four years of secondary education). One wonders whether the sudden increase means a corresponding increase of genuine interest in the subject or mere compliance with government policy on technical subjects. On the other hand, lack of equipment, suitable drawing room furniture, the drastic drop in the number of schools offering 'A' level Technical Drawing, the Technical Drawing kits gathering dust in the store-rooms of some schools and the fact that Technical Drawing is offered as an independent general education subject make it imperative to determine existing attitudes towards Technical Drawing.

Objectives Of The Study

The main objectives of the study were:

(i) To find out headmasters', teachers' and students' attitudes towards Technical Drawing and to compare them to the state of Technical Drawing in their respective schools.

(ii) To find out whether headmasters, teachers and students prefer Technical Drawing as an independent subject with emphasis on the cognitive development of the child, or as a pre-vocational subject offered to students taking either Metalwork, Woodwork or any other related technical subjects.

(iii) To establish teachers', headmasters' and students' views on the content of the present 'O' and 'A' level Technical Drawing syllabuses, and their suggestions for the improvement of the subject content and the teaching of the subject.

METHODOLOGY

Description Of Method

In order to determine attitudes towards Technical Drawing and also to determine the possible factors which influence these attitudes, it was decided to limit the study to a small group. For this reason, a Case Study was considered to be the best design. Although results of a Case Study cannot be generalised, it was felt that this was the best method to use in order to bring to light factors and relationships which can be further studied using other methods. A Case Study method also enables one to carry out a close study of issues which may not be possible in a large scale study. According to Bell (1987, p.6):

> The great strength of the case study method is that it allows the researcher to concentrate on a specific instance or situation and to identify, or attempt to identify the various interactive processes at work. These may remain hidden in a large scale survey but maybe crucial to the success or failure of systems or organisations.

Subjects

To carry out a close study of attitudes towards Technical Drawing, two boys' high schools were chosen. One of these schools initially operated as a technical high school. Academic subjects were, however, also part of the school curriculum. The other school has a strong academic background, although here too technical subjects have always been part of the school curriculum. Today these schools are no longer categorised as academic or technical high schools. They are simply high schools offering both academic and technical subjects. The schools have the same responsible authority, which puts them on the same footing financially. They have both been teaching Technical Drawing for over twenty years and now offer the subject up to Advanced Level (Form 6).

In the ensuing discussion, the two schools will be referred to as school (A) and School (B). School A has a longer technical background while school B has a longer academic background. Although these schools now offer both academic and technical subjects with no preferred emphasis on either area, school B has a smaller technical department.

The study was limited to these two neighbouring schools in order to facilitate quick distribution and collection of questionnaires, and frequent visits. The schools were also selected to see whether there were any differences in attitudes towards Technical Drawing after controlling for administrative factors such as demands of the responsible authority and financial inputs.

Respondents in these two schools included students, teachers of technical subjects, i.e. Technical Drawing, Woodwork, Metalwork and Building. Headmasters were also chosen as subjects. In the case of students, these included in school A, students in Forms 1 and 3. Forms 2, 4 and the Upper Sixth Form were not included in either school because they were busy with their end of year examinations. The number of students in school A was 148 in Form 1 and 118 in Form 3, making a total of 266. School A did not have a Lower Sixth Form class in 1988. Out of the possible 266 students, 227 (85%) participated in the study.

In school B, the respondents included 35 Form One, 69 Form Three and 16 Lower Sixth Form students making a total of 120 students. Out of the possible 120 students, 84 (70%) participated in the study. Of the 84, fourteen were lower sixth form (Form 5) students.

In both schools, only classes which had Technical Drawing as one of their technical subjects participated in the research.

A total of 6 technical subject teachers and the headmaster were chosen as subjects in school A. In school B, 4 teachers out of a possible 5 were able to participate. This included the head of department and the headmaster.

Instruments

A Liket-type pretest attitude scale was prepared for students. The scale consisted of twenty items. For each item students had to indicate their degree of agreement or disagreement with the statement by underlining the words: Strongly Agree; Agree; Undecided; Disagree; and Strongly Disagree. The highest score for each statement was 5 and the lowest was 1. For a positive statement, the allocation of points was: Strongly Agree - 5; Agree - 4; Undecided - 3; Disagree - 2; and Strongly Disagree - 1. The opposite applied to negative statements for which 'strongly disagree' represented a positive attitude.

The group which was used for the pretest came from the same schools. A total of ten students from each of the eleven classes (7 from School A and 4 from school B) were randomly selected to give a sample of 110 students.

Out of the 110 pretested students, 28 students, which is about 25% of the total, with the highest scores and another 28 students with the lowest scores were selected. The mean for each item in both the top 25% and the bottom 25% was calculated and the differences between them found. Items selected as those which differentiated best between the two extreme groups were those with the highest differences. The final test consisted of 10 items (see Appendix A).

In addition to the attitude scale, students had five other items concerning their perception of Technical Drawing, syllabus content, teaching methods used by teachers and their career aspirations.

Questionnaires And Interview Schedules

The teachers' questionnaire consisted of twenty open-ended questions. The interview schedule for headmasters consisted of items in the teachers' questionnaire.

FINDINGS
STUDENTS' ATTITUDES RESULTS

Students' Perception of Technical Drawing:

In order to determine students' views towards Technical Drawing it was decided to ask them to indicated whether the following subjects: Mathematics, English, Geography, History, Woodwork, Metalwork, Shona, Technical Drawing, French, Physics, and Biology are useful or not by placing them on a scale of 1 to 5 with the degree of usefulness ranging from 1 (very useful) to 5 (useless). This would give an indication of students' perception of

Technical Drawing by showing (a) the total number of students who felt that Technical Drawing was a very useful subject and those who felt that it was a useless subject and (b) the position of Technical Drawing in relation to the rest of the subjects. (The subjects listed are the common subjects offered in these two schools).

In the following tables, only alternative 1 (Very Useful) and alternative 5 (Useless) were considered because they represented definite stand points. School subjects were ranked on the basis of the responses under the category 'Very Useful'.

TABLE 1
School A, Frequencies and Percentages of Students indicating Subjects as Very Useful or Useless.
(N = 227)

Subject	Very useful Frequency	%	Useless Frequency	%	Rank based on Very useful
Maths	197	86.8	0	0	1
English	145	63.9	4	1.8	2
Geography	83	36.6	10	4.4	7
History	45	19.8	43	18.9	10
Woodwork	68	30.0	13	5.7	8
Shona	47	20.7	33	14.5	9
Technical drawing	116	51.1	8	3.5	3
French	13	5.7	122	53.7	11
Physics	97	42.7	9	4.0	5
Metalwork	89	39.0	9	4.0	6
Biology	98	43.2	10	4.4	4

The data show that out of a total of 227 students, 116 which is 51.1% thought that Technical Drawing was a very useful subject and 8, which is 3.5% felt that the subject was useless. This places Technical Drawing in third position with Mathematics and English in first and second positions, respectively.

TABLE 2
School B, Frequencies and Percentages of Students forms One and Three indicating Subjects as Very Useful or Useless.
(N = 70)

Subject	Very useful Frequency	%	Useless Frequency	%	Rank based on Very useful
Mathematics	66	94.3	0	0	1
English	51	72.9	0	0	2
Geography	25	35.7	0	0	4
History	12	17.1	2	2.9	7
Woodwork	9	12.9	0	0	8
Shona	7	10.0	8	11.4	9
Technical drawing	30	43.0	2	2.9	3
French	0	0	4	5.7	10
Physics	20	28.6	0	0	5
Biology	18	25.7	2	2.9	6

Data in Table 2 show that 30 out of 70 students which is 43.0% felt that Technical Drawing was a very important subject whilst 2 out of 70 students, which is 2.9% believed that Technical Drawing was a useless subject. This makes Technical Drawing the third most important subject.

Results of the Attitude Scale

For each item students had to indicate their degree of agreement or disagreement with the statement by underlining the words: Strongly Agree; Agree; Undecided; Disagree and Strongly Disagree.

The attitude scale consisted of both positive statements and negative statements. Students who indicated agreement with a positive statement had a score of 4 or 5 depending on the degree of agreement (5 for Strongly agree and 4 for Agree). Students who indicated disagreement with a positive statement had a score of 1 or 2 depending on the degree of disagreement (1 for Strongly Disagree and 2 for Disagree). Students who indicated disagreement with a negative statement measuring a positive attitude obtained a score of 4 or 5 depending on the degree of disagreement (5 for Strongly Disagree and 4 for Disagree). Students who indicated agreement with a negative statement obtained a score of 1 or 2 depending on the degree of agreement (1 for Strongly Agree and 2 for Agree). Finally students who indicated in either case that they were undecided had a score of 3. Appendix A contains a listing of the 10 items used.

TABLE 3
School A, Attitude Mean Scores Per Item.

ITEM	MEAN
1	3.7
2	4.3
3	3.5
4	4.3
5	3.2
6	3.7
7	3.6
8	3.9

9	4.0
10	2.9
Total mean score:	37.1

TABLE 4
School A, Percentages of Students Indicating Negative and Positive Attitudes and Indecision. (N = 227)

Item	Negative	Undecided	Positive
	%	%	%
1	18.1	17.2	64.8
2	7.9	2.6	89.4
3	25.6	10.0	64.8
4	7.1	7.5	85.5
5	34.8	14.1	51.1
6.	22.9	9.7	67.4
7	23.3	10.6	66.1
8	13.7	9.7	76.7
9	11.5	13.5	75.3
10	44.9	9.3	45.8

TABLE 5
School B, Attitude Mean Scores Per Item.

Item	Mean
1	3.6
2	4.4
3	3.8
4	4.1
5	3.2
6	3.7
7	3.8
8	3.9
9	4.0
10	3.5
Total mean score:	38.0

TABLE 6
School B, Percentages of Students Indicating Negative and Positive Attitudes and Indecision. (N=84)

Item	Negative %	Undecided %	Positive %
1	21.4	16.7	61.9
2	1.2	6.0	92.9
3	13.1	16.7	70.2
4	7.1	7.1	85.7
5	28.6	26.2	45.2
6	14.3	21.4	64.3
7	15.5	10.7	73.8
8	15.5	10.7	73.8

9	11.9	17.9	70.2
10	33.3	9.5	57.1

The data in tables 3 and 5 indicate that the average total score for school A was 37.1 out of a possible total score of 50 which was an indication of a positive attitude. In school B the total average score was 38 out of a possible score of 50 which was also an indication of a positive attitude. In this study a total score of 35 to 50 was considered as an indication of a positive attitude and a total score of less than 30 as an indication of a negative attitude.

From the data in tables 4 and 6 an average of 68.9% of the students in school A indicated a positive attitude as opposed to about 21% who indicated a negative attitude. In school B an average of 69.5% of the students indicated a positive attitude whilst 16.2% indicated a negative attitude. There seemed to be no difference in attitudes between schools A and B.

SUMMARY OF STUDENTS' AND TEACHERS' RESPONSES

Teachers' and Students' Perceptions of Technical Drawing: Objective (i)

Since only 2 headmasters provided information for the study, their responses have been presented together with those of the nine teachers. No statistical tables have been used to describe the teachers' responses because of the small number of respondents.

The state of Technical Drawing in the two schools reflected the teachers' attitudes towards the subject. In school B Technical Drawing was on the verge of being phased out until the arrival of a new headmaster and the recruitment of a very keen teacher. Technical Drawing was offered as an optional subject in school B. The number of students opting for Technical Drawing

was dwindling but the teacher's enthusiasm and the headmaster's keen interest in the subject recaptured the students' interest. At the time of this study the number of students taking Technical Drawing had increased. In 1987 the school had only 6 Lower Sixth Form (Form 5) Techncial Drawing students. The number more than doubled in 1988 to 16. In Forms 1 to 4 the subject was now offered to the A and B streams which were the most able streams. (In school B Forms 1 and 2 students were streamed according to their Grade 7 results (Final end of Primary school results) and in Forms 3 and 4 streaming was based on the students' Junior Certificate (Form 20) Mathematics, Geography, English and Science results).

In school A Technical Drawing was a compulsory subject in Forms 1 to 4. This was because the teachers realised the relevance of the subject to all Technical subjects offered in the school. 'A' level (Forms 5 and 6) Technical Drawing which had been discontinued because teachers qualified to teach the subject at this level were not available was re-introduced in 1986 after an absence of five years.

The developments of Technical Drawing in these schools mirrored the teachers' positive attitudes towards the subject. However, these attitudes seemed to be dampened by factors which the teachers had no control of. The shortage of equipment and books can be described as serious. Since books and equipment are essential for the teaching and learning of the subject, something needs to be done so that these items are available at reasonable prices. The shortage of qualified teachers is very critical. In particular teachers capable of teaching the subject at 'A' level are not available.

Technical Drawing as an allied subject (allied toWood - work, Metalwork and Building) and as a general education subject: Objective(ii)

On whether Technical Drawing should be offered as a general education subject or as a subject closely related to practical subjects no definite opinion prevailed. Teachers had mixed feelings in this respect. Generally they all felt that Technical Drawing should be a subject with its own syllabus and examination. At the same time they felt that the subject should have very close links with practical subjects. Teachers were convinced that it should be offered as a subject of study in its own right so that more areas in graphics could be covered.

Generally, the idea of offering Technical Drawing as a pre-vocational subject with close links to practical subjects seemed to find favour with all the teachers. They felt that Technical Drawing prepared students for further training in either industry or technical colleges and universities.

Students gave an indication that they valued both the educational and vocational aspects of Technical Drawing. The majority of the studcnts (75%) indicated an interest in careers related to Engineering and believed that Technical Drawing would be instrumental in the achievement of their goals. Students claimed that Technical Drawing improved their ability to visualise objects. Students also expressed an appreciation of the importance of the link between Technical Drawing and Mathematics. It seems students accepted Technical Drawing both as a general education subject and as a pre-vocational subject.

A Form 3 student tersely summed up his pre-vocational perception of Technical Drawing as follows:

> I would like to be a mechanical or electrical engineer. I feel that Technical Drawing will help me a great deal. I can picture many machine

components in my mind without any problems. This enriches my imagination and actually makes me feel like I'm with the machine in real life.

Generally, it seems Technical Drawing as a general education subject which helps in the cognitive development of the child was not receiving as much emphasis as its pre-vocational aspect. However, in an answer to a question which required teachers to give a list of aims for Technical Drawing, teachers included a number of general education aims such as: (i) to promote the development of curiosity, enquiry, initiative, ingenuity and discrimination; (ii) to encourage inspiration and technological awareness and to foster attitudes of social responsibility.

Syllabus Content And Teaching Method: Objective (iii)

Both teachers and students expressed satisfaction with the present 'O' and 'A' level Technical Drawing syllabuses. Four teachers pointed out that they were aware of alternative drawing syllabuses but stressed that they would not be willing to change to these 'new' syllabuses. The reason given was that the alternative syllabuses are not as closely related to engineering as the current Technical Drawing syllabuses. Five teachers were not aware of other Graphics syllabuses. This could be the reason why most of them were satisfied with the present syllabuses. Neither teachers nor students suggested many changes to the present syllabuses. However, teachers pointed out that if changes had to be made, then topics like "*lines in space*" and "*Auxiliary views*" could be removed. The reason given was that these had no immediate application and that students found them difficult. Students did not mention "Lines in Space" as the most difficult. In fact 75% of the students pointed out that they liked difficult topics because they see them as a challenge.

As a way of improving the teaching of Technical Drawing, students expressed the need for relevance. It seemed students were not happy to draw diagrams of unfamiliar objects. Students

suggested frequent visits to engineering industries. This means there is need for liaison with industry.

Although the results of this study are not representative of the situation in the whole country, they at least give a rough picture of what can be expected in a good number of schools in the same category. Further studies need to be carried out in order to obtain conclusive results.

Results of this study should be seen as a foundation on which future studies may be based. However, plausible implications may be inferred from the results of this study.

Implications and Recommendations

Technical Drawing in Zimbabwean schools is taught mainly for its pre-vocational aspect. Teachers feel that this is the best way if it is to benefit the country. Teachers did not comment on the fact that Technical Drawing is offered as an independent subject and that students taking Technical Drawing are not required to study a related practical subject. Teachers must be aware that Technical Drawing would probably be more useful if its cognitive aspect is also taken into account. To produce an 'educated' person it is necessary to emphasise both the vocational and cognitive aspects of any subject.

If the subject is to help in the technological development of the country, then it can be suggested that curriculum designers should not only produce syllabuses which emphasise craft based Technical Drawing, i.e. Technical Drawing based on the fitting and turning, and building trades but also syllabuses which emphasise Engineering Design Graphics. It may be necessary to make it conditional that Technical Drawing should be taken together with subjects like Engineering Science and Applied Mathematics especially at advanced level (Forms 5 and 6).

For these reasons it is necessary that Zimbabwe takes a definite stand on the question of offering Technical Drawing as a general education subject at one stage and as a vocationally oriented subject at a another stage. An attractive proposition for Zimbabwe is probably to offer the subject as a general education subject in the early years of secondary education, in the form of Technical Graphics (Graphic Communication) which is a broad based subject with emphasis on the educational aspects of learning such as the ability to think visually and communicate graphically. Later on, students can specialise either in engineering or architectural drawing. This will make it possible for students to obtain a broad knowledge of general graphics before specialising in specific areas. This will also enable students to benefit from both the cognitive and vocational aspects of the subject.

At higher levels, Technical Drawing should be offered as a vocationally oriented subject. This means that although the subject is offered as an area of study in its own right, it is linked to particular branches of engineering. At this level, schools should have close contacts with industry and also the Faculty of Engineering at the University.

Teachers pointed out that one of the reasons schools offer 'A' level Technical Drawing is that Technical Drawing prepares students for further training in industry and technical colleges. Knowledge of the subject is also seen as necessary for the Mechanical Engineering degree at the University.

If the subject is taught as a pre-vocational subject preparing students for industry, the syllabus should be up-dated to keep up with developments in industry. If teachers have a positive attitude towards Technical Drawing then surely they want to see the subject develop. It is worrying to realise that some teachers are not aware of the existence of other Graphics syllabuses and that those who are, would rather keep to the current syllabuses. Sensitivity to curricular changes is essential if teachers and schools have to play an important role in preparing students for further studies and the world of work. Cummings (1985) argues that

one of the reasons why technical subjects in schools are not considered by industrialists as suitable preparation for industrial employment is because the skills taught in schools are out of date. Schools cannot keep abreast of technological changes. If the subject is offered as a pre-vocational subject, then formalised links with industry will guarantee relevance of the subject.

The inclusion of design drawing should be considered seriously. While Technical Drawing deals with the acquisition and application of established graphical facts and techniques, design drawing stimulates creativity in students.

Changes in the syllabus also affect teaching methods. Teachers need to be exposed to what is happening in other parts of the world so that they are in a better position to evaluate their teaching methods and the syllabuses they use. Workshops and seminars need to be organised to familiarise teachers with the latest developments. Teachers need to reconsider some of the teaching methods they use. Relaxation of rules, especially during the initial years (Forms One and Two), giving students an opportunity to apply the knowledge acquired and also permitting them to incorporate their own ideas are methods which have captured students' and teachers' approval in other countries.(HMI Publication, 1987).

Students felt that visits to industries should be arranged so that they familiarise themselves with some of the objects which they often see in the form of diagrams only. It should be noted however, that working on diagrams of unfamiliar objects can also improve one's ability to imagine and visualise objects instead of relying on recall.

Students indicated they were interested in pursuing careers in engineering or architecture and hoped that Technical Drawing will play a part in their achievement of these expectations. It appears that schools do not give the student an option to choose between engineering and building drawing. Schools in rural areas

tend to offer building drawing whilst those in urban areas offer engineering drawing. It would suit students' aspirations better if schools offered both, thus giving the students the option to choose.

This study provides a picture of what may be expected in one type of school, namely, the Group A schools (former White only government schools). Similar studies need to be carried out in other types of schools, i.e. Group B urban and rural schools (former Black only government schools), district, mission and trust schools. Since Group B and rural schools are generally not as well equipped as Group A schools and since trust schools generally have sufficient funds to provide adequate and modern equipment and facilities, attitudes towards Technical Drawing may be different.

REFERENCES

Bell, J. (1987) *Doing Your Research*. Philadelphia: Open University Press.

Cummings, C., Davis, M., Lillis, K. and Nyagah, B. (1985) *Practical Subejcts In Kenyan Secondary Schools*. Background Papers.

Dyson, D. and Krane, H. (1981) *Graphical Communication: An Interdisciplinary Education*. Melbourne: Victoria Education Department.

Giesecke, F.E., Alva, M., Spencer, H.C., Hill, L., Dygdon, J.T. (1986) *Technical Drawing*. New York: MacMillan.

Green, D. "Back to Leornardo" *Times Educational Supplement*. (29 November 1985).

HMI (1987) *Design and Communication An Approach for CDT Departments in Schools*. London: Department of Education and Science.

Chief Examiner - Technical Drawing, University of Cambridge (1989), (Private Correspondance).

APPENDIX A

ATTITUDE SCALE

1. The most useful technical subject in this school is Technical Drawing.

   StronglyAgree/Agree/Undecided/Disagree/StronglyDisagree

2. If all students had a free choice, nobody would study Technical Drawing because it is a useless subject.

   StronglyAgree/Agree/Undecided/Disagree/StronglyDisagree

3. Students should spend most of their study time studying English, History, Mathematics, Geography and Science instead of Technical Drawing.

   StronglyAgree/Agree/Undecided/Disagree/StronglyDisagree

4. Technical Drawing will be very useful to me if I should decide to continue with my studies up to Form Four/Advanced level/University.

   StronglyAgree/Agree/Undecided/Disagree/StronglyDisagree

5. Technical Drawing helps me to understand Mathematics better.

   StronglyAgree/Agree/Undecided/Disagree/StronglyDisagree

6. All students should study Technical Drawing, even girls, because it is a very useful subject.

   StronglyAgree/Agree/Undecided/Disagree/StronglyDisagree

7. Technical Drawing is not an interesting subject because it has very strict rules and I am not free to apply my own ideas.

StronglyAgree/Agree/Undecided/Disagree/StronglyDisagree

8. I hate Technical Drawing because I spend most of my time drawing diagrams of machine parts which I have never seen.

StronglyAgree/Agree/Undecided/Disagree/StronglyDisagree

9. I wish our Technical Drawing course included more graphics topics like electrical drafting, maps and computer graphics.

StronglyAgree/Agree/Undecided/Disagree/StronglyDisagree

10. Most of my friends lose interest in Technical Drawing because there are too many strict rules, especially for beginners. I am expected to be able to draw lines which are perfectly straight and often the lines must be of different densities depending on what they represent. The lettering should be perfect; letters must be of the same size and must be carefully printed. We are also expected to keep the drawing paper immaculately clean as if it has not been used. I think these rules must be relaxed for beginners.

StronglyAgree/Agree/Undecided/Disagree/StronglyDisagree