

A STUDY OF THE EFFECTS OF THE IMPLEMENTATION OF
INDIVIDUALISED INSTRUCTION IN FORM FOUR OF THE MOTOR
VEHICLE COURSE IN THE TECHNICAL SECONDARY SCHOOLS OF KENYA

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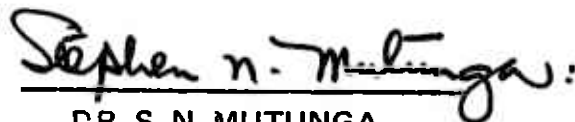


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ABSTRACT

This research was an investigation into the implications of the introduction of individualised instruction into Form Four of the Motor Vehicle Technology course in the Technical Secondary Schools in Kenya. It included consideration of teachers' ability and preparedness, curriculum revision, cost, equipment and supplies, and especially the attitudes of students, teachers and administrators toward the introduction of such innovation in teaching methodology.

The Motor Vehicle Technology course was selected as an area in which to test the methodology for several reasons. The Motor Vehicle shop not only lent itself best to the individualised method of instruction (the work station concept) but also in comparison to other technical courses it had the greatest need in the area of teaching materials; visual aids, handouts, reference texts, related materials, equipment specifications, etc. Further, this area of technical education suffered most from the shortage of trained technical teachers.

In the larger context, the entire concept of such skill training in secondary schools was under question in many educational circles because of the much higher cost per student in vocational education as compared with academic education. There was pressure to have skill training removed to industry or special government institutes where it may have been done more effectively and economically. Educators were being challenged to make technical education less costly (ie. more efficient).

The research was in response to two hypotheses:

1. There will be no significant improvement in practical application, retention, or motivation of Form Four students in the Motor Vehicle Technology course for Secondary Technical Schools when the method of instruction is individualised instead of traditional.
2. Teachers of technical subjects show no significant difference in attitude toward change and innovation than teachers in other subject areas or than non-teacher professionals.

A set of individualised instruction modules of the 'adjunct' type was obtained and extensively modified to coincide with the Ministry of Education

Scheme of Work. They were disseminated to five of the six secondary schools offering the Motor Vehicle Course. They contained pretests and posttests with answer sheets, learning objectives behaviourally expressed and focussed on practical application, worksheets, and attachments of related materials. Headmasters concerned were familiarised with the experimental materials and in-service training was given to teacher users of the materials. Visits were made frequently to the schools concerned, interviews arranged with students in the experimental groups and continuous assistance given to teacher users.

Experimental groups of 3 to 8 students were selected from each school, making a total of 29 students from all levels of ability, and a comparable control group of 29 students was selected using the Motor Vehicle Form Three grades. The materials were used by the experimental groups over the entire three terms of Form Four. The change in practical ability of the students was measured by the two relevant Form Four Motor Vehicle phase tests given by the Inspectorate. Retention was measured by the results of the EACE Motor Vehicle Theory examination given at the end of Form Four, and motivation was measured by personal interviews with the students and interviews with the teachers.

Results showed an 11% improvement in practical grades and a 14% improvement in theory grades on the part of the experimental group as compared with the control group. Statistically this was an improvement at the 1% and the 5% confidence level for practical and theory grades respectively. There was a very marked improvement in motivation on the part of the experimental group of students as shown by personal interviews, questionnaires and reports from teachers. The cost to achieve this degree of improvement was KS47.00 per student.

The attitudes of teachers toward acceptance of this kind of innovative change in methodology was examined by an attitude test instrument which was derived from the Rokeach Dogmatism Scale, the California F. Test and the Gough-Sanford Rigidity Test, extensively revised, tested for reliability with consideration of cross cultural differences and validated. The orientation to change of technical teachers was measured using the instrument and compared with the orientation to change

of other non-technical teachers and non-teacher professionals.

Results indicated that technical teachers were not significantly different than other non-technical teachers nor than non-teacher professionals from a statistical analysis. Technical teachers were however, in every case of comparison except one, more resistant to change and innovation than other groups, and in the case of comparison with university students, that resistance was almost at the 5% confidence level. While statistically the resistance cannot be proven, the tendency is evident. Personal subjective experiences with the administration and Inspectorate showed a similar disinclination.

In conclusion, it was shown that Form Four students were capable of successfully using the individualised instruction, that the resultant improvement in both theory and practical work was very significant, and costs were not unreasonable. Teachers were similarly capable of using the methodology but required training and continuing support. A number of related problems, particularly economic, in technical education could have been partially alleviated by the use of this technology of learning, but there was a determined resistance to it within the educational system outside the classroom and workshop. Any consideration of the implementation of such innovation would require the strongest of direction and dedication from the top.

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The Headmasters of the five technical secondary schools were most receptive and encouraging toward the new methodology and the teachers of the Motor Vehicle Technology course carried out the basic experiment at considerable cost to their time and work load.

Professor P. M. Mbithi, Chairman of the Department of Sociology, Dr. J. Van Doorne and Dr. D. Kayongo - Male assisted in the development and test of the attitude measuring instrument.

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R. H. BALSDON

CHAPTER ONE

INTRODUCTION

The development of more effective strategies for teaching skill subjects in the secondary schools of Kenya is a very real need. The Report of the National Committee on Educational Objectives and Policies in Kenya¹ has stressed the need as has the National Development Plan for 1979 - 1983². Both reports have indicated plans for the expansion of technical and vocational education in the future, with emphasis on better use of facilities and equipment³. Both planning and assessment in this sector imply the need for the design and implementation of a more effective and efficient technology of Education.

THE PROBLEM

In the period 1971 to 1975, a completely revised syllabus was introduced into Forms One to Four in the eight subject areas of the 820 EACE technical programme. The Kenya Institute of Education Subject Committees reworked existing schemes of work which were available in draft form to the classroom teachers and as experience in teaching the new material was gained, complete and approved schemes of work were circulated by the Ministry of Education. The Automotive Technology⁴ Scheme of Work was the last to be developed, tested, revised, and distributed, reaching the specialist teachers in its final form in late 1976.

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1. Government of Kenya, Report of the National Committee on Educational Objectives and Policies. Nairobi, Government Printer, 1976.
 2. Government of Kenya, National Development Plan 1979 - 1983. Nairobi, Government Printer, 1978, Education Section, para. 5.2.
 3. *ibid.*
 4. The terminology Automotive Technology and Motor Vehicle Technology are used interchangeably in the Ministry of Education literature. The Automotive Technology is used more frequently and has been adopted for use by the International Standards Organization.

The reasons for its delay in development are many. A prime factor was the acute shortage of technical teachers which was particularly critical in the Automotive Technology area, making necessary the temporary recruitment of expatriate teachers, largely from the volunteer agencies. These teachers were neither prepared for, nor had the time available for such curriculum development. Secondly, The relatively high cost of equipment in the Automotive Technology shops left them inadequately equipped for such expansion into a more detailed Scheme of Work. Thirdly, the rapid increase in the numbers in the technical programmes and the change in quality of the teaching materials placed a heavy responsibility on the Inspectorate in the Technical Section, from which source a great deal of assistance was needed in the Scheme of Work development. Finally the Automotive Technology course was offered in only five of the then nine technical secondary schools, making the need for Scheme of Work development less than highest priority.

In addition to the finalised Schemes of Work distributed to the schools in late 1976, automotive teachers had available for their use a copy of the City and Guilds of London Worksheets for the comparable course. These worksheets were very sketchy, not entirely relevant, and most lacking in support material. Almost no other support material was available. Recently, these worksheets were reprinted by the East African Examinations Council with little more than a change in title. Although all five schools had the recommended text books, they had limited class sets of the first¹ and a few reference copies only of the second².

This lack of course content material placed a heavy responsibility on the already too few speciality teachers who have had to devise their own materials,

- 1 Mudd, S. C. Technology for Motor Mechanics, Volumes I, II, III and IV London: Edward Arnold, 1971.
- 2 Hillier, V. A. W. and F. W. Pittuck, Fundamentals of Motor Vehicle Technology. London: Hutchinson, 1966 and 1972.

where used, produce their own visual aids, and write and develop evaluation schemes, tests, etc.

The result has been a degree of frustration amongst motor vehicle teachers, an almost total lack of audio visual materials, a shortage of teaching aids, dissatisfaction with text books, and a dearth of in-service courses, all at the very time when there is an increasing demand for better performance on the practical phase tests and on the East African Examinations.

In sum, neither financial resources, time, nor manpower resources have been available to conduct the type of scientific study and development of curriculum, curriculum materials, and teaching strategies that the course itself, the students, and the teachers deserve and need.

The physical distances between the technical secondary schools and the very limited numbers of motor vehicle teachers precludes opportunities for exchanges of information, and the sharing of ideas and problems so essential to good staff development. There exists no professional organisation nor journal which can be vehicles for new developments in teaching methodology or in the trade. Motor vehicle teachers are, in fact, left a great deal on their own with limited and basic teacher training, and with very little possibility of professional development.

The phasing out of the Technical Teacher Training Programme at the Kenya Polytechnic and its introduction at the K.T.T.C., with all the related staffing and development difficulties has precluded all possibility of in-service training, should the necessary resources have been made available.

The Technical Secondary School Graduate Follow-up Study produced in October, 1976 stated, 'the majority of students feel that teachers' method of presentation should be improved. Technical subjects are very likely to appear difficult to students if the teachers do not use sequential and explicit techniques that could easily be followed. However, with improved in-service programmes

for teachers, this problem should be avoided.¹ The in-service programmes have not occurred.

Some considerable expansion of facilities and equipment has taken place in the past few years and continues to take place through the efforts of the International Development Agency (I.D.A.) of the United Nations (U.N.), the Swedish International Development Agency (S.I.D.A.), the Ministry of Education, and others. If this assistance is to be effectively integrated into the teaching programme, some research must be conducted in the teaching of learning strategies. Some highly successful in-service courses have been conducted in other subject areas recently under the planning and direction of the Inspectorate. The motor vehicle speciality remains yet to be upgraded.

In 1972, the World Bank supported an extensive cost analysis of education in Kenya by Hans H. Thias and Martin Carnoy of Stanford University.² There is little evidence to show that the conclusions and recommendations have ever been followed up, or that any study has ever been attempted on the production aspect of schools in Kenya. Such a study would prove beneficial in the schools with vocational options. There is little doubt that it would stress the need for greater efficiency in the learning process.

The recognition of most of these needs is not new. As far back as the conference on Engineering Education in Kumasi, Ghana, in 1968,³ educators were stressing the need for immediate use of every possible form of instructional aid. They were pressing for education relevant in every way to the African scene. They were stressing that specialists should be produced in the shortest possible time, that traditional time frameworks should not have to be rigidly adhered to, but that courses and methods should be developed that are shortest and most effective for Africa.⁴

1 Ministry of Education, Technical Secondary School Graduate Follow-Up Study, Technical Education Section, October, 1976, p. 17.

2 Thias, H. H., and Carnoy, M., Cost-Benefit Analysis in Education - A Case Study in Kenya. Baltimore and London: International Bank for Reconstruction and Development, 1972.

3 McNowan, John S., Technical Education in Africa. Nairobi: East African Printing House, 1970, pp. 53 - 59.

4 *ibid.*

The need for a review of the aims and achievements of the technical programme has not escaped the attention of the Ministry of Education. Although funds have been designated for such an enquiry, and proposals made for the deployment of an independent consultant, no action has yet been initiated.¹

A basic element of the S.I.D.A. project was the initiation of a review to look at aims and achievements of both technical and industrial education. While funds have been allocated for this, personnel have not been available.²

Notwithstanding these recommendations and proposals, and notwithstanding the express needs of teachers from the field, the awaited response with respect to the motor vehicle course has not come.

The reasons are many. They are restated here in point form:

- 1 The revised 820 syllabus for technical subjects was introduced between 1972 and 1976, requiring the full attention of the very personnel who would otherwise devote time to the innovations of the Kumasi Conference recommendations.
- 2 The number of technical secondary schools has increased from nine in 1972 to thirteen in 1977, and will reach fifteen by 1980, using both the financial and manpower resources that might otherwise have been used to upgrade the technology of learning.
- 3 The Inspectorate, Section of Technical and Industrial Education, has remained with an establishment of three persons throughout this time, and not all posts have been continuously filled. The Technical Inspectors are dedicated, hardworking, and skilled in their areas, but the limited manpower has not allowed enough time for development work in the proposed innovations of the Kumasi Conference.
- 4 In-service training courses, through which innovations might be introduced, are the responsibility of the already over-extended Technical Section of the Inspectorate.

1 Information from the Inspectorate, Technical Section.
2 Information from the S.I.D.A. office, Nairobi.

- 5 There is an acute shortage of teachers in the technical areas of the secondary schools, and in particular, in the automotive technology area. It is a recognised fact that many of the better technical teachers have been enticed into the private sector with the prospects of better opportunities for advancement and for higher salaries.
- 6 The fact that the teacher education courses for technical teachers is being revised, enlarged, and moved from the Kenya Polytechnic to the K.T.T.C. has precluded any involvement on the part of those institutions in the development and implementation of such innovations.

While these factors explain the lack of development in this area of education, there are a number of other factors which increasingly point the way to the urgent need for an improvement.

The National Development Plan, 1979 to 1983 states that, 'Improvements of standards through curriculum change and refinement will be geared towards the opening up of more avenues of advancement of technical students.'¹

In the very near future, the effects of the S.I.D.A. upgrading will manifest themselves in better facilities and better and more serviceable equipment. The educational system as a whole will provide more and better prepared students for technical education. The technology of learning and teaching remains singularly unexplored and underdeveloped.

A great deal of the educational research that is required to develop these changes has been conducted in other educational jurisdictions at no little expense, and could with a modest amount of additional effort be applied to the Kenyan situation.

As noted previously, the funds for some of this development have been made available both within the Ministry of Education and the S.I.D.A.,

¹ Government of Kenya, National Development Plan (Draft), 1979 - 1983, Paragraph 5.2, Educational Section.

but have not, to date, been used.

This research is an attempt to try out an individualised instruction programme in Form Four of the automotive technology course and to assess, not only the response of the students and their resultant achievement, but also the attitudes of the students and the teachers with regard to such a new and innovative teaching methodology.

PURPOSE OF THE STUDY

The purpose of the study is to investigate the implications (including student achievement, required training, curriculum, attitudes, and costs) of introducing individualised instruction into the Secondary Technical School Motor Vehicle Technology Programme at the Form 4 level. In the light of such findings, suggestions will be made either for the implementation of such a methodology in the educational system, or for its rejection.

The main objectives of the study are:

1. To modify a complete package of individualised instruction modules to embrace the entire Form 4 Motor Vehicle Technology Course. Each package will include:
 - a. A statement of purpose for the module.
 - b. Behavioural objectives in keeping with the Kenya Institute of Education Scheme of Work for the Motor Vehicle Technology Course.
 - c. A pretest and posttest.
 - d. Reading activities from materials available in the secondary school shops or libraries.
 - e. Attachments of additional reading materials to support ob-

jectives where existing materials are insufficient.

f. Work sheets to guide theoretical and practical work for teacher evaluation.

2. To train secondary school teachers in the Motor Vehicle Technology Course in the objectives and methods of individualised instruction.
3. To supervise, through the teachers, the use of the individualised instruction materials by an experimental group of students in Form Four of the Motor Vehicle Technology Course in five Technical Secondary Schools throughout the three terms of one school year.
4. To watch the attitudes and motivation of students and teachers continually through the school year and to statistically compare the EACE results in both theory and practical work of the five experimental groups with those of the five control groups.
5. To develop, validate and use an attitude test instrument to measure the orientation to change and innovation of technical teachers as compared with non-technical teachers and non-teacher professionals.
6. To consider the attitudes of all users, (students, teachers, headmasters and administrators) toward the use of individualised instruction in the Motor Vehicle shop.
7. To consider the cost effectiveness of the use of individualised instruction.
8. To consider the over-all effect of the implementation of individualised instruction in Form Four of the Motor Vehicle Course in the Technical Secondary Schools.

HYPOTHESES

- 1. There will be no significant improvement in practical application, retention, or motivation of Form Four students in the Motor Vehicle Technology Course for Secondary Technical Schools when the method of instruction is individualised instead of traditional.**

- 2. Teachers of technical subjects will show no significant difference in attitude toward change and innovation than teachers in other subject areas or than non-teacher professionals.**

BACKGROUND: THE HISTORY OF TECHNICAL EDUCATION IN KENYA

Technical Education in Kenya has its roots in early vocational training which has existed in Kenya almost as long as formal schools have existed. The religious missions from overseas supplied the early training mainly in the building trades such as carpentry and joinery, bricklaying, and masonry.

The first industrial training school was opened at Kabete in 1924 under the name 'Native Industrial Training Depot', and offered courses in carpentry/joinery, masonry, bricklaying, blacksmithing, welding, electrical installation work, fitting and turning, motor vehicle mechanics, tailoring and leatherwork including shoe making¹.

Between 1924 and 1946, a number of other training schools were established by the railways, the post office, the police, the prisons, and the army to meet their own requirements for skilled artisans. A number of private companies trained people for specific skills in their own field of specification². Often a certain amount of elementary education in reading, writing, and arithmetic was added.

A number of government trade schools and two technical high schools were established between 1950 and 1960, and these admitted pupils who had completed eight years of primary education. The emphasis was on the acquisition of manual skills with 80% of the time spent on practical activities. The result was that the students found themselves locked into the artisan grade and their lack of knowledge on related studies and sciences denied them any opportunity of improving themselves³.

-
1. Mutiso, G.C.M. 'Technical Education in Kenya', East Africa Journal, Vol. 8, Aug. 71, p. 28.
 2. Mtula, H. F. 'Technical Education: Variety and Value in Kenya', The Builder Journal. Jan., 1978, p. 11.
 3. *ibid.*

In 1965, Kwale was integrated into the Mombasa Technical Institute¹. By 1966, the trade programmes had been replaced by secondary trade and junior technical programmes in Kabete, Eldoret, and Thika. In 1967, Machakos and Sigalagala followed, all offering three year secondary vocational trade courses and four year junior technical courses.

A number of studies were carried out during 1963 and 1964, but only the Ominde² and Toloni³ Reports were published. It was the Toloni Report that led to the reduction from four to two years of the vocational school programme. It was intended that the National Industrial Vocational Training Centre (Ministry of Labour) should complete the craft training. This did not materialise⁴.

The Secondary Vocational School, as it was called in 1966, offered academic training in the first two years and craft training in the third. A small percentage of the pupils were selected at the end of form two for what was termed a Pre-technician Course which lasted two further years (four in all).

The schools at that time did not offer the academic (School Certificate) option. There were two levels of trade schools. Meru and Mawego remained as Junior Trade schools and Eldoret, Kabete, Machakos, Sigalagala and Thika were Secondary Trade Schools. Machakos and Kaboi offered tailoring, carpentry, masonry, painting, metalwork, motor vehicle mechanics, and plumbing in two and three year courses⁵. All six Secondary Trade Schools offered three year pre-craft training in motor mechanics, electricity, agricultural mechanics, fitting and machining. Mombasa Polytechnic and Kabete only offered the four year general pre-technical training in building, mechanical and electrical

1. Mutiso, op. cit., p. 29.

2. Government of Kenya, Kenya Education Commission Report. Nairobi, English Press, 1964.

3. Government of Kenya, Education Commission Report. Nairobi, English Press, 1966.

4. Mtula, op. cit. p. 11.

5. Mutiso, op. cit. p. 29.

engineering.

In addition to those mentioned, in 1962 there were four Secondary Technical Schools under the Asian Section of the Ministry of Education. The Technical High School Mombasa and the Technical High School Nairobi were predominantly Asian. The Mombasa Institute for Muslim Education and the Secondary Technical Course at Kabete had lesser enrolments.

Nakuru Secondary School was established in 1964 by removing those courses from Kabete. Kenya Polytechnic had a technical secondary programme in 1964, and in 1966, Sigalagala was added to the list. The Mombasa Institute of Muslim Education was converted into a technical institute around 1966, at which time both that institute and the Kenya Polytechnic began to phase out their technical secondary programmes. By 1970, there were only four schools offering the school certificate programme with technical subjects.¹

'For a variety of reasons, neither programme (the two year or the Pre-technician Programme) could be termed successful.'² Pupils entering the employment market at the end of form 3 encountered serious difficulties in getting jobs.³ Form four schooling was in high demand and preference was given to graduates from the academic schools with their better standards of mathematics and science. Graduates of the Pre-technician Programme fared little better for different reasons. They adopted a selective attitude regarding the type of employment they would accept, and consequently the group developed a poor reputation which led to them being rejected.⁴

1 Mutiso, *op. cit.* p. 28.

2 Mtuja *op. cit.* p. 11.

3 *ibid.*

4 *ibid.*

The current programme in the technical secondary schools dates back to 1971 when the programme was considered in depth by the Ministry of Education in an attempt to:

1. Improve the quality and the status of the secondary school leaver.
2. Provide status/esteem equivalent to that of the academic school leaver.
3. Improve the facilities and equipment in the secondary schools.
4. Improve the quality and status of the teachers.

The deliberations resulted in the following decisions:¹

1. With effect from 1972 - 73, the technical school would provide a full four year course.
2. Pupils would sit the East African Certificate Exam, and
3. The curriculum would be structured to provide a sound academic course together with either the basic engineering or basic building subjects.

Cuncurrently, the Swedish Government was approached for financial assistance in developing the technical school facilities to meet the demands of the new curriculum. The Swedish International Development Agency (.i.D.A.) responded with a plan involving new workshops, equipment, support services, laboratories and dormitories. The complete programme of technical and Industrial education assistance undertaken by the S.I.D.A. originally consisted of approximately KS 100 million, and will probably by the end of it's five year term in 1980, have surpassed KS 130 million². In the years 1975 - 76, the S.I.D.A. In cooperation with the International Development Agency (I.D.A.) of the United Nations (UN) supplied a substantial amount of equipment to technical secondary schools.

During the years 1976 - 77, the S.I.D.A. made detailed assessments of the equipment requirements of all technical education and all industrial

1. Mtula, op. cit. p. 11.

2. Information from S.I.D.A. offices, Nairobi.

education workshops, compiled lists of required equipment, drew up specifications, submitted lists for tender, and procured equipment to the value of almost KS 10 million. By August, 1978, the bulk of this equipment had arrived and was being distributed to the workshops of both the 13 technical secondary schools and 17 industrial secondary schools from the staging warehouse at Kabete.

Concurrent with the equipment procurement programme was a building programme which involved a selection of small additions and modifications to existing technical and industrial schools, five extensive expansions at the technical secondary schools at Mawego, Meru, Sigalagala, Thika and Machakos in the amount of up to KS 10 million each, as well as initial plans for the complete construction of new technical secondary schools at Kitale and Mombasa which will be completed by 1980.

A significant aspect of the S.I.D.A. undertaking was the establishment in 1976 of an equipment procurement and repair depot at Kabete Technical School to buy supplies in bulk for distribution, and to make repairs to technical equipment more readily and at lower cost than could be done commercially.

The contribution of the Swedish government in terms of buildings, equipment and services is most significant and will without doubt create a marked improvement in the quality and quantity of technical / industrial graduates in the near future.¹

The Canadian government was also approached² in the early 1970s

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- 1 Information received from the S.I.D.A. offices, Nairobi.
 2. The Ministry of Education, Kenya, through the Ministry of Foreign Affairs approached the Canadian Government through C.I.D.A. office, Nairobi.

to provide a new technical teachers college. The Canadian International Development Agency (C.I.D.A.) responded with a plan to include a building complex, a scholarship scheme for Kenyanisation, a technical assistance package, and an educational programme amounting to about KS 150 million (KS 115 million grant - in - aid and the remainder long term loan). The buildings were occupied in December, 1977. The initial student intake was in September, 1976, in temporary facilities so that the first output is anticipated in mid 1979 (with the exception of short courses mounted for the Ministry of Labour and the Ministry of Housing and Social Services). The Technical Teacher Training Programme formerly at the Kenya Polytechnic has been transferred to the Kenya Technical Teachers College (K.T.T.C.), the Business Teachers Training Programme formerly at Kenyatta University College (K.U.C.) has been moved to the K.T.T.C., and the Industrial Teachers Training Programme formerly at the Kenya Science Teachers College (K.S.T.C.) has been transferred also to the K.T.T.C.¹

By the early 1980s the vocational programmes within the secondary schools (technical education, industrial education, and business education) should begin to feel the qualitative and quantitative effects of the new teachers and of the teachers from the scholarship programme abroad who are surplus to the K.T.T.C. needs.

In early 1978 there were 13 technical secondary schools located throughout the country all offering a complete four year secondary course and all preparing candidates for the East African Examinations Council (E.A.E.C.) O level examinations. Nine offer the basic mechanical, electrical, automotive, agricultural mechanics, and welding of the engineering trades;

¹ Information from the C.I.D.A. offices, Nairobi.

three offer the basic carpentry / joinery, masonry, bricklaying, plumbing, and surveying of the building trades; and Kabete offers both.¹ The current Technical Secondary School Curriculum is shown in Figure 1.

At Independence these schools were turning out 400 students per year. In 1973, 1200 students completed their technical training², and in 1977, 1500 students sat for their E.A.E.C. technical examinations. Enrolment in 1977 in the technical programmes was 6,300.³

The syllabus in the technical secondary schools combines a strong academic core with basic technical studies. The established timetable for forms three and four is:

English	8 periods per week.
Mathematics	6 periods per week.
Physical Science	6 periods per week.
Geography	3 periods per week.
Technical Drawing	5 periods per week.
BET / BBT Theory ⁴	3 periods per week.
BET / BBT Practical	14 periods per week.
TOTAL	45 periods per week.

This subject combination offers the maximum opportunity on the successful completion of studies. The emphasis is on trainability.⁵

1 Mtula op. cit. p. 11.

2 King, K. 'History of Technical Education,' Bureau of Educational Research Staff Seminar Series, 1974 - 75, p. 25.

3 Mtula op. cit., p. 11.

4 BET represents Basic Engineering Trades, BBT - Basic Building Trades.

5 Mtula op. cit., p. 11.

FIGURE 1

TECHNICAL SECONDARY SCHOOL CURRICULUM

FORM 1		FORM 2		FORM 3		FORM 4	
Maths	7	Maths	7	Maths	6	Maths	6
Science	6	Science	6	Science	6	Science	6
English	8	English	8	English	8	English	8
Swahili	5	Swahili	5				
History	3	History	3				
Geography	3	Geography	3	Geography	3	Geography	3

Drawing	3	Drawing	3	Drawing	5	Drawing	5
Woodwork	5	Woodwork	5				
Metalwork	5	Metalwork	5				

ENGINEERING
OPTION

Mech. Eng.	8
Electrical	4
Motor Vehicle	5

Mech. Eng.	17
Electrical	17
Motor Vehicle	17
Agr. Mech.	17
Welding	17

or

CONSTRUCTION
OPTION

Carp/Joinery	9
Masonry	4
Plumbing	4

Carp/Joinery	17
Masonry	17
Plumbing	17

Not all graduates from the technical secondary school programme go into apprenticeship programmes. Figure 2 indicates career paths in post primary education. In addition to apprenticeship, students may continue in any of the following areas of study:

1. Apprenticeship through the Directorate of Industrial Training (D.I.T.) in the National Industrial Vocational Training Centre (N.I.V.T.C.) at Nairobi, Kisumu, or Mombasa.
2. Technical Training through the D.I.T. at either the Mombasa Polytechnic or the Kenya Polytechnic at Nairobi.
3. Form five and Six studies in science subjects.
4. Technical teacher training at the K.T.T.C.
5. Private industrial training programmes.
6. Private or harambee post-secondary institutes.

At the end of the 1975 school year, 11.6% of the technical secondary school graduates continued on to Form five while the majority were taken on in the N.I.V.T.C. programmes.¹ From the technical high schools, however, (not the technical secondary schools) the majority continued into form five, while the small minority went to the N.I.V.T.C.s.² In 1977, the Cambridge programmes in these four high schools were replaced by the EACE 820 technical syllabus to bring them in line with the nine technical secondary schools.

Today, technical secondary schools are national schools and enroll candidates from all parts of the country. The standard of entry, the Certificate of Primary Education (C.P.E.) is high and compares favourably with the best

1 Fretwell, D. Tracer Project; 1976 Technical Secondary School follow-up Report. Nairobi: Ministry of Education, 1975, p.15.
2. ibid.

secondary academic schools.¹ Today technical secondary schools offer a programme and standards very similar to the academic secondary schools. Some elective subjects offered in the latter (for example languages, some sciences, music, etc.) are not offered in the former to make available the large block of time for technical studies in the latter.

In all forms the recommended class size is 36 for classroom and drawing room periods, and 18 for workshops and laboratory periods. In the 1977 school year there were approximately 227 students at the Form Four level in the Motor Vehicle Technology programme being prepared for the O Level examinations. There were 14 specialist teachers in the motor vehicle speciality teaching both Form Three and Form Four.

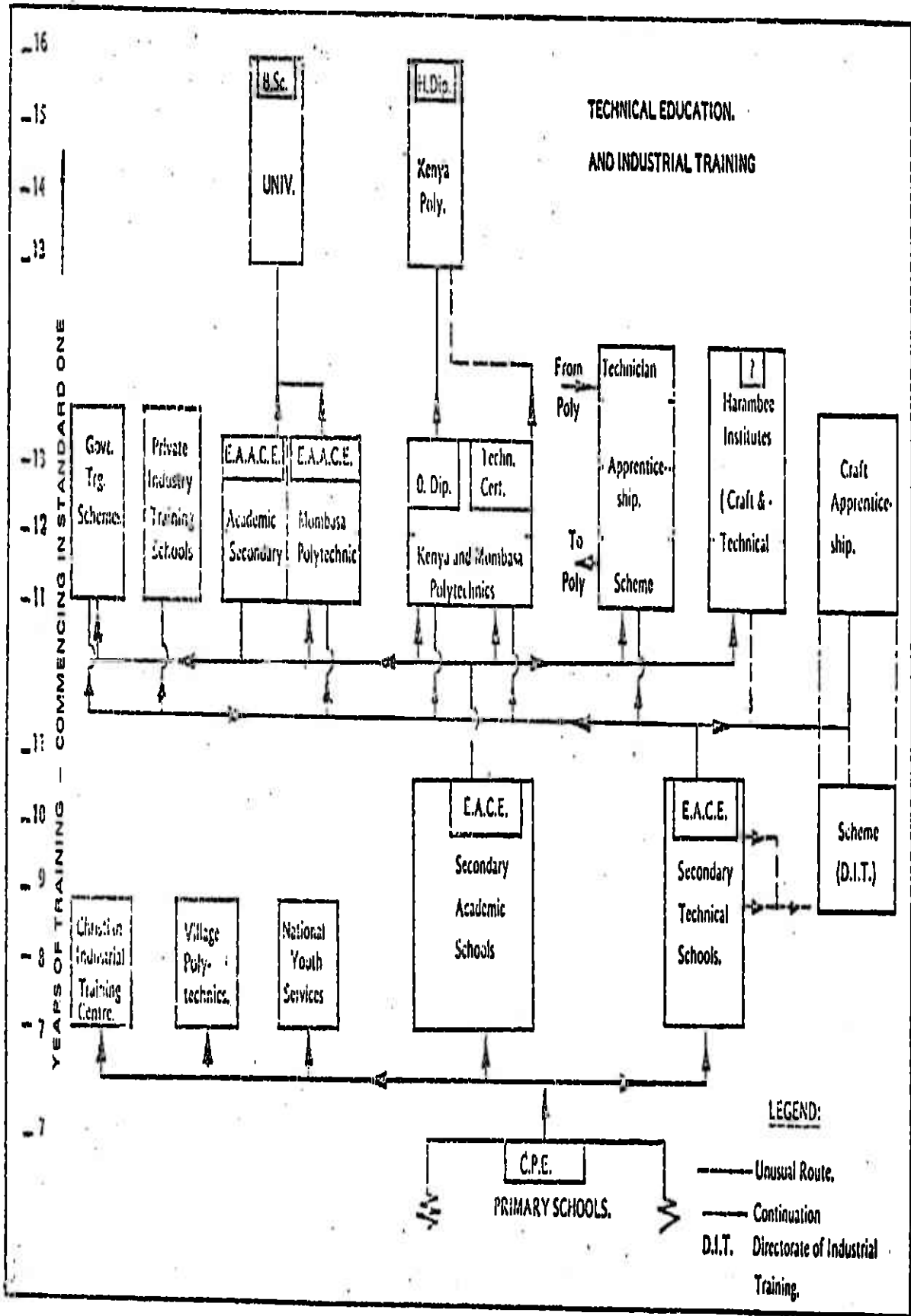
Since Independence, or more specifically, since the introduction of the new syllabus in 1971, the academic and skill levels of technical education has risen appreciably, the number of students enrolled in technical education has increased dramatically, and the calibre of the technical specialist teachers has improved significantly, notwithstanding the large attrition in the numbers to industry and to upgrading scholarship programmes. Few of these scholarship teachers return to the secondary school; most are engaged by the polytechnics or the Ministry of Education itself.

The first graduates from the revised technical programme began to enter training institutes and industry at the end of 1976. The strengths and the weaknesses of the revised programme will no doubt be revealed in the near future through the curriculum development committees, the Secondary School Follow-up Programme, and through the newspapers.

1 Mtu!a, op. cit. p. 12.

FIGURE 2

CAREER PATHS IN POST PRIMARY EDUCATION



IMPORTANCE OF THE STUDY

Since the days when educators began to study the learning process as a science, they have attempted to so present the content material that the learner might teach himself; a methodology to be entitled, 'Programmed Learning'. In recent years educational research has refined the science to a high degree and employed it to suit learners' specific needs and abilities thereby producing what is now known as 'Individualised Instruction', a method that is accepted as routine procedure in schools in many countries.

There is an opinion amongst some educators in Kenya that individualised instruction could achieve a number of the goals proposed by the Kumasi Conference for improvement of Engineering Technology Education in Africa.¹ Further, much individualised instruction may have an important role in the area of technical education where expensive industrial equipment is limited, where students, of necessity, must work individually or in small groups at various levels of learning, moving from one practical learning station to another, and where the instructor's time is in such great demand for individual help. Individual instruction would appear to be the answer to many of the needs of technology education.

The method of individualised instruction is not cheap. It has been estimated by one author² that the programmed instruction for one hour of lecture would require one hundred to one hundred and fifty hours of preparation and would cost KS 16,000/00, a cost far in excess of available resources.

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1. McNown, John S. Technical Education in Africa. Nairobi: East African Printing House, 1970, pp. 53 - 59 and Kenya Institute of Education, Minutes of meeting of the Educational Technology Panel, July, 1977.
 2. Hartley, J. Strategies for Programmed Instruction: An Educational Technology. London: Batterworths, 1972 p. 132.

Programmes need not be developed for Kenya, however. Existing and proven packages from the U.S.A., Canada, or the U.K. may be procured and modified to suit local needs at very significant cost savings. Word levels of learners would have to be considered as well as the assumptions of their previous technical experience. Language would have to be modified to Kenyan usage as would technical expressions such as transmission for gear box, wrench for spanner, etc. References to text books may have to be changed to conform to those available in Kenyan schools, and equipment would have to be specified that was familiar to the local scene, for example, four cylinder engines instead of V-8 engines, manual gear boxes instead of automatic transmissions, etc.

Before such a learning methodology could be deployed in any permanent fashion, it would be necessary to examine the attitudes of teachers and administrators, as well as students, toward its acceptance. It may be that certain biases would have to be met and overcome, that in-service courses would have to be mounted for practising teachers, that curriculum of training colleges would have to be modified, and that students' study habits in lower forms would have to be changed.

A most important factor to be considered would be the effect on motivation of students and their ability to work independently.

Should this study indicate that individualised instruction can, in fact, achieve some of the recommendations of the Kurnasi Conference, , these factors would have to be given serious consideration by the training colleges and by the Kenya Insitute of Education.

Further, should individualised instruction prove to be of significant

benefit, programmes for other technologies may well be developed for use, not only in the Secondary Technical Schools, but also in the post-secondary Polytechnics, the Harambee Institutes of Technology, the Village Polytechnics, and the National Industrial Vocational Training Centres.

DEFINITION OF TERMS

1. Programmed Learning

Programmed Learning is a method of self-instruction designed to lead a learner step by step through a sequence of learning experiences with clearly defined instructional objectives to a larger terminal objective. The method includes software (stepped instructions, self-administered pretests and posttests, immediate feedback, etc.) and hardware (Flipcharts, reference books, 35mm slides, filmstrips, microfilm, computers, models, etc.) Its strength lies in its ability to lead learners at an accepted learning rate through small learning steps with clearly defined goals, employing all the findings of Educational Technology and Psychology.

2. Individualised Instruction

Individualised Instruction is the deployment of Programmed Learning in a manner that permits each student to work toward objectives that are comfortable and appropriate for him and at a pace that is acceptable to him. He would be encouraged to work on an objective until he has reached it, or changed to one that is more appropriate to his ability.

3. Individualised Instruction Package

An Individualised Instruction Package is a complete set of software (written pamphlets, brochures, charts, films, referenced texts, etc) comprising step by step learning units leading to enabling objectives, which in the final analysis lead to the terminal objectives of a complete course of study.

4. Linear Programming

Linear Programming is that type of programmed instruction attributed largely to B.F. Skinner of Harvard University. It consists of a linear sequence of small carefully designed steps, each with its contingency of reinforcement, (immediate

feedback to responses), designed to avoid error, well selected prompts that are designed to be withdrawn (fade) progressively to shape the learning experiences of the student. It was originally used with mechanical machines such as rotating drums or later computers, but in recent years has been more often in the form of texts.

5. Branched Programming

Branched Programming is that type of programmed instruction usually attributed to Norman Crowder who developed it while working with the United States Air Force during the 1950s largely to train electronic technicians in troubleshooting. Branched Programming is not unlike Linear Programming except that it does not try to avoid mistakes but designs the use of mistakes into its learning steps. When wrong multiple choice answers are selected by the learner, he is directed into a sub-programme to explain the mistake he has made, and redirected back to the main programme. Subject matter is sequenced in reasonable sized frames to teach, stimulate, and enrich the learning. It has proven very popular for use on a computer, but is most common in book form, directing the learner to different pages depending on his choice of answer.

6. Auto Instruction

Auto Instruction is a form of programmed learning largely attributed to Sydney L. Pressey of Ohio State University during the 1920s and 1930s. It differs from the former types of programming in that it is designed in modules not composed of small incremental steps, but in assignments based on behavioural objectives, including reading material in text books, research matter in libraries, supplementary films, filmstrips, etc., worksheets, learning experiences usually in a practical area, pretests and posttests. It has found its greatest degree of success in the area of skill training. It is very flexible, and easily modifiable.

7. Innovation

Innovation in this context refers to an idea, practice, or programme with potential in education which is not implemented on a general basis.

8. East African Certificate of Education

The East African Certificate of Education (EACE) is awarded by the East African Examinations Council for successful completion of the required work at O-Level. The initials EACE will be used in this report.

9. East African Examinations Council

The East African Examinations Council, (EAEC) is the regulating body in Kenya/Uganda for courses and examinations at O and A-Level. The initials EACE will be used in this report.

DESIGN OF THE STUDY

The design for this research involves the development, test and utilisation of two items:

1. Individualised instruction packages for the Form Four Automotive Technology course, and
2. An attitude test instrument to measure acceptance of change and amongst technical teachers.

Individualised instruction packages.

Thirty-five individualised instruction modules based on the Ministry of Education Automotive Technology Scheme of Work, approved in 1976, were used in Automotive Technology classes in five technical secondary schools. The modules were designed according to the pattern of Auto Instruction of Sydney L. Pressey of Ohio State University, consisting of behaviourally expressed learning objectives, pretests, lists of resource materials, information sheets. The modules were pretested in one of the technical secondary school Automotive Technology courses before their introduction in the research programme.

Experimental and control groups of from 4 to 8 students were selected from the Form Four Automotive Technology course. They represented a cross-section of students from high ability to low ability and from good practical aptitude to poor practical aptitude. Progress of these students through the twelve months of the school year was monitored by frequent visits, interviews with teachers

and students, and by written questionnaires. The final retention test was the EACE O-Level Examination, both theoretical and practical, at the end of the school year. Only the relevant two parts of the practical examination were considered.

Statistical analysis of the EACE O-Level results in the Automotive Technology Course were used to test the hypothesis as well as more subjective evaluation results.

The Attitudinal study

The instrument used to study the orientation of technical teachers to change and innovation, compared to other teachers and non-teacher professionals was a development of the Rokeach Dogmatism Test with modifications from the California F. Test and the Gough - Sanford Rigidity Test¹. Cross-cultural factors were considered in the development of the tests, and the tests were evaluated using the Thurstone Method of equal-appearing intervals² and scored with a modified Likert procedure³. Test groups were selected from the Technical Teacher Training programmes, the Graduate Teacher Training programme, technical secondary school teachers, and non-teacher undergraduate university students.

Reliability studies were conducted using the split half method, and validity studies were conducted using both the peers as judge and teachers as judge.

Results of the attitude test were analysed using statistical tests of significance to test the hypothesis.

Attitudes of both teachers and students involved in the individualised instruction research were taken through the use of questionnaires as well as the use of the attitude test instrument to allow for factors that may not have been obvious in the statistical analysis of other results.

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1. Rokeach, M., The Open and Closed Mind. New York: Basic Books Inc., 1960, pp. 416 - 418.
 2. Fishbein, M. and Aizen, I., Belief Attitude Intention, And Behaviour. Massachusetts, Addison-Wesley, 1975, p. 68.
 3. *ibid.* p. 72.

SCOPE AND PROCEDURE

The research programme was conducted as follows:

1. The individualised instruction packages were compiled and pretested at Kabete and Machakos Technical Secondary Schools.
2. Training in the use of individualised instructional materials was given to teachers of the automotive technology course in four of the five technical secondary schools that offer that speciality and in the Starehe Boys Centre Secondary Section. These were:
 - Kabete Technical School.
 - Machakos Technical School.
 - Rift Valley Technical School.
 - Kisumu Technical School.
 - Starehe Boys Centre.
3. Experimental and control groups of students were selected from the five Form Four classes, from three to eight students from each school for the experimental group and an equal and matched number for the control group. Experimental and control group members were matched on the basis of practical ability as well as theoretical, and selections were made from both the most capable and the less capable students.
4. The experimental group of students completed as many of the programmed modules as time permitted in the school year, allowing for phase tests and materials that were taught as a class group.
5. Records of term tests, practical tests, and phase tests were kept throughout the school year.
6. Concurrently, the Rokeach Dogmatism Scale (attitude test) was modified using selected items from the California F Test, the Gough Sanford Rigidity Test, and others. The test was adjusted for cultural and language differences.

7. The revised attitudinal test (entitled General Opinion Survey to avoid revealing the purpose of the test to respondents) was studied for reliability using the split half method amongst teacher trainee groups, and analysed on the University of Nairobi computer using the ICL XDS3 correlation programme.
8. The test was validated using peer members of the teacher trainees of step no. 7, and teachers of those same trainees.
9. The final test was taken by groups of technical and academic teachers technical teacher trainees, and non-teacher professionals.
10. The results of the test were statistically analysed for significance to support or reject hypothesis no. 2.
11. Teachers and students involved in the individualised instruction experiment were asked to complete questionnaires to identify opinions about the use of such instruction in the classroom and workshop.
12. The results of the EACE O-Level examinations in both theory and practical were statistically studied to test hypothesis no. 1.

ORGANISATION OF THE STUDY

The study is organised here in five chapters as follows:

- 1; Chapter One contains an outline of the problem, a history of technical education in Kenya, importance and purposes of the study, the hypotheses, definition of terms, design, scope and organisation of the study.
2. Chapter Two reviews related literature and gives a theoretical foundation to the several aspects of the study.
3. Chapter Three outlines the development and implementation of the study. It includes development of the individualised instruction modules, development of the attitudinal test instrument, costing of the modules, the choice of the experimental and control groups, procedure for the development of the attitudinal test instrument, and

the non-statistical aspect of the study.

4. Chapter Four presents the results and assessment of the study including the statistical and non-statistical information. The two hypotheses are tested for significance and an assessment is made of the findings.
5. Chapter Five contains conclusions drawn from the results in Chapter Four, recommendations based on those conclusions, and suggestions for further study made as a result of this research.

CHAPTER TWO

REVIEW OF RELATED LITERATURE AND THEORETICAL BASIS
OF THE STUDY

This chapter brings into focus some of the current literature relevant to the science of educational technology, economics of education, programmed and individualised instruction and attitude testing. The chapter attempts also to identify clearly the importance of attitude and disposition to the success of any educational innovation.

REVIEW OF RELATED LITERATURE

Economic studies have emphasised a number of factors in education, particularly in education for developing countries. The application of the production function¹ has highlighted some crucial issues:

1. The question of measuring educational output, cost, and ultimately, production².
2. Cost-effectiveness decisions in teacher recruitment, training, and retention³.
3. Economies of scale in school operations⁴.
4. Input - output analysis and relationship to academic achievement⁵.

Hartley⁶ has identified five problems facing educationalists today: the population explosion, the demand for higher education, the information explosion, the teacher shortage, and the existing limitations and priorities of nations and systems.

Kenya shares all these problems with the world at large. The population continues to expand at a rate that is considered by many to be too high⁷. The

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1. Rogers, Daniel C. and H. S. Ruchlin, Economics and Education, Principles and Applications. New York: The Free Press, 1971, p. 119.
 2. Ibid. 3. Ibid., p. 120. 4. Ibid., p. 120. 5. Ibid., p. 121.
 6. Hartley, J. Strategies for Programmed instruction: An Educational Technology. London: Butterworths, 1972, p. 10.
 7. Court, D., and D. Ghai, op. cit., p. 311.

information explosion is compounded by the need to import technological knowledge. There is a need for specialised higher education to meet the pressing manpower requirements of the development plans. There is an acute shortage of teachers in technical education, a shortage which extends into the Harambee Schools critically. Costs of education in Kenya are high in proportion to other needs. Hartley has reiterated the same general conclusion that many other writers have expressed, 'Education will have to be more efficient.'¹

The Ministry of Education has conducted two Technical Secondary School Follow-up Programmes (Tracer Project); in 1975 and in 1976. Both reports, in response to questions asked of students, have indicated that large numbers of students have requested that an improvement be made in the presentation methods of teachers.² This served to confirm what the author of the UNESCO book on educational planning has stated;³ that there is a need for creative leadership in the schools, and that an effort must be made to break the attitude of tradition, defensiveness and conservatism of teachers. Teachers resist accepting help because it reveals how poor they are and it reveals their lack of materials.⁴

The UNESCO study goes on to identify and outline studies on 23 cases in 17 countries where the new media are being used, including programmed instruction, to make education more efficient and more effective. Correspondence courses using programmed materials have been successful in New Zealand,

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1. Hartley, J. Strategies for Programmed Instruction: An Educational Technology. London: Butterworths, 1972, p. 11.
 2. Fretwell, D. Tracer Project, 1976 Technical Secondary Follow-up Report. Nairobi: Ministry of Education, 1977, p. 13.
 3. Schramm, W., P. Coombs, F. Kahnert, The New Media, Memo to Educational Planners. Paris: UNESCO, IIEP, 1967, Introduction.
 4. Ibid.

Canada, Australia and Japan. The Chicago University of the Air has been successful with radio as has the Open University in the U.K.. Radio forums in Togo, Nigeria, India and other countries have been successful with the added use of programmed materials. Teachers have been trained in Columbia, Algeria and American Samoa with television and programmed materials. There are many others.

In 1972, Martin Carnoy of Stanford University and Hans Thias produced a cost - benefit analysis study of education in Kenya based largely on the theoretical foundations of the cost-benefit methods of Mark Blaug of the University of London School of Economics.¹ Their results indicated, amongst other things, that a straight forward increase in school expenditure would probably not produce an improvement in examination scores, but alluded to the fact that economies and efficiencies could be made in methodologies that would improve such grades.²

The implementation of innovations in Educational Technology to achieve the economic benefits described by many writers is contingent upon the acceptance of such innovation and change by administrators and teachers. Paul Saettler described two experiments in programmed instruction after which he concluded, 'In both the Denver and Manhasset cases, it is clear that teacher attitudes toward programmed instruction proved to be a critical factor in the success of programmed instruction.'³

UNESCO produced a book in 1971 on the methods of implementation

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1. Carnoy, M. and H. Thias, H. Cost Benefit Analysis in Education: A Case Study in Kenya. London: IBRD Press, 1972
 2. Ibid.
 3. Saettler, Paul, A History of Instructional Technology. New York: McGraw-Hill, 1968, p. 160.

of innovation in education. The authors noted the 'key to change in any system is the classroom teacher.'¹ Several lines of approach were noted:

- a. Technician assistance should be offered in the school.
- b. The teacher should be involved in curriculum development.
- c. Good work should be identified and advertised.
- d. The teacher should be allowed and encouraged to try out new material.
- e. Short courses for teachers should be offered outside the school.

A large portion of UNESCO's book deals with the methods of developing attitudes amongst teachers, administrators and the public for the purpose of successful implementation of programmed instruction.

In study upon study, little room is left for doubt that teacher attitudes are paramount in the implementation of any educational innovation.

A. C. Crocker² has compiled a very comprehensive study of research on teachers' attitudes and their relationship to teaching success. Attitudes can be used as a predictor of teacher success, and attitudes can be determined through testing. Crocker discusses the use of the Minnesota Teacher Attitude Inventory³ and studies of the authoritarian and non-authoritarian personality similar to the studies undertaken by Milton Rokeach.⁴ He wrote, 'If we know something about the way a person believes, it is possible to predict how he will

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1. O.E.C.D., Centre for Educational Research and Innovation, Educational Technology. The Design and Implementation of Learning Systems, Paris: UNESCO, 1971 p. 60
 2. Crocker, A. C. Predicting Teacher Success. Windsor, U.K.: NFER Publishing Company Limited, 1974.
 3. Ibid., p. 67.
 4. Rokeach, Milton, Op. cit.

go about solving problems that have nothing to do with his ideology.'¹ Although attitude is far from being the sole determinant of behaviour, the importance of attitudes in the actions of men is, without question, of major importance. Halloren² emphasised the need for determining individual attitudes and understanding their relation to behaviour: 'If we know something about an individual's . . . attitudes, then not only do we have a brief summary of what has gone before in the individual's experience that may affect his behaviour, but we may also be able to say something useful about his aspirations, his motivations, his striving toward his goals and to know something about why, along the way, he deals as he does with a great variety of social objects and values. In short, despite its limitations, it is a step in the right direction of reducing the complex to the simple, it helps to make sense and give meaning to individual behaviour and in all probability it is the best basis for prediction yet devised.'³

Rokeach described dogmatism as a state of mind that determines the extent to which a person can receive, evaluate, and act on intrinsic merits of relevant information, un-encumbered by irrelevant factors. Rokeach suggested that the Dogmatism Scale effectively measures security - insecurity, which has been used as a personality characteristic by several researchers in attempts to predict attitudes toward change generally.

Lin et al⁴ and Mechling⁵ found that teachers who scored low on the

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1. Rokeach, Milton, op. cit., p. 70.
 2. Halloren, J. D. Attitude Formation and Change. Leicester, England: Television Research Committee, Working Paper No. 2, Leicester University Press, 1967.
 3. Ibid., p. 28.
 4. Lin, N., D. J. Leu, E. Rogers, and D. Schwartz, The Diffusion of an Innovation in Three Michigan High Schools. Michigan: State University, Institute for International Studies in Education, Dec., 1966.
 5. Mechling, K. A Strategy for Stimulating the Adoption and Diffusion of Science Curriculum Innovations Among Elementary School Teachers. Pennsylvania: State College Office of Education, 1969.

Dogmatism Scale tended to be predisposed to accepting educational innovations. A low dogmatism score indicated openmindedness.

Carlson¹ from the point of view of an educational administrator reported the barriers to the adoption of innovations arise when they threaten a teacher's competence in an established area of self - esteem. When programmed instruction was introduced in a school system, students were better able to progress at individual rates but teachers were then unable to 'perform' and resisted the need to re-orient the teacher role.

These theories and research strongly suggest that not only must more effective strategies for learning and teaching be developed, and that individualised instruction is one significant strategy, but also that any attempt to implement such strategy in a school must consider at the same time the attitudes of the teachers toward change in instructional programmes.

THE ECONOMICS OF TECHNICAL EDUCATION

Since the publication by Schultz of his work in the U.S. in the late 1950s,² followed by the work of Blaug in the U.K.³ interest in the economics of education has soared. The economics of technical education has not escaped the mathematical scrutiny of the numerous writers and researchers.

Production and the production function are familiar concepts to economists. The production function is a mathematical relationship between the factors of production; land, labour, and capital, and the outputs of production. Three commonly accepted concepts associated with the production function are:

1. Constant returns to scale is defined as a condition wherein all

1 Mtula, op. cit. p. 12.

2 Schuitz, T.W., The Economic Value of Education, New York: Columbia University Press, 1963.

3 Blaug, M., The Economics of Education, London: Pergamon Press, 1966.

factors of production are increased by the same multiple, output is increased by that multiple.

2. Decreasing (increasing) returns to scale is defined as a condition when all factors of production are decreased by the same multiple, output is decreased by a larger (smaller) multiple.
3. Law of decreasing marginal returns to a factor is expressed as: as we add more and more of one factor, holding all others constant, there will be less and less additional output produced.¹

The application of these theories of production functions to education is one of the newer developments in educational research. The studies have highlighted some crucial issues in education-

1. The question of measuring educational output, costs and ultimately production.
2. Cost-effectiveness decisions in teacher recruitment and retention.
3. Economies of scale in school operation.²
4. Input - output analysis and relationship to academic achievement.³

Woodall and Blaug in British higher education⁴, Levin in teaching effectiveness,⁵ and Riew in economies of scale in high school operation,⁶ have produced three recognised studies. The Equality of Educational Opportunity Report in the United States, commonly known as the Coleman Report after its principle author (1964) has as its foundation the production function in education.⁷

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1. Rogers D. and Ruchlin, H., Economics and Education. Principles and Applications. New York: The Free Press, 1971, p. 108.
 2. ibid. p. 119.
 3. Levin, H. Economics of Education. London: Pergamon Press, 1969, p. 56.
 4. Rogers, D. and Ruchlin, H., op. cit. p. 120. 5. ibid. p. 121. 6. ibid.
 7. Cohn, E. The Economics of Education. Cambridge, Mass: Ballinger 1975, p. 240.

The school, according to the educational economists, is a complex social system which is in continual process of resource interchange with its environment. The central concept is productivity; the relationships between the outcomes of education, in terms of learning achievement, social growth, and other factors which must be quantified, and the human and material resources which education consumes, again quantified. Education is in reality a process of production with the school as a firm.¹ and there are a number of alternative productive methods which lead to the necessity of resource allocation.

In contrast to the study of economics which simply looks at education in relation to the national income, the production function tends to look at the profitability, in terms of all the outputs, of various curricula, or alternative instructional or organisational methods.² The mathematical relationship between outputs and inputs can be expressed as an equation called a production function':

$$Y_1 = f(X_1, X_2, X_3, \dots) \quad 3$$

where Y_1 is the output in terms of academic achievement and social growth, and X_1 represents the school environment, X_2 represents the home environment, X_3 represents the teachers' salaries, etc.

The concept of production function allows one to look at the inputs in a school system as variables, and the process enables an administrator to make decisions from alternative proposals. A proposal, for instance, might be the implementation of individualised instruction in a skill training area, as opposed to the alternative method of traditional teaching. Outcomes would be measured in terms of practical application, retention, motivation, and other quantifiable factors.

1 Cohn, E, op. cit. p. 235.

2 Allan, T. J., The Productive School, A Systems Analysis Approach to Education Administration. New York: John Wiley and Sons, 1971, p. 4.

3 *ibid* p. 10

These procedures provide a conceptual basis for budgetary practice which is particularly useful when program budgeting is introduced.¹

Two procedures have been used in calculating costs and benefits: present value analysis, and the analysis of internal rate of return. The former reduces streams of income and streams of costs to present value using a reasonable interest rate. The latter evaluates rates of return against the cost of amortization. By the former method, an investment in an increment of education, or in a methodology of teaching is worthwhile if the present value of the additional benefits associated with the increment is greater than the present value of the additional costs.² By way of example, if the formula for systems analysis were developed in Kenya's educational system, and if quantitative values had been determined for skill development, motivation, etc., the present value of the future benefits of the use of individualised instruction could be determined using a regression formula, and that value compared with the cost of implementation. This would assist educators in making a decision to implement or not, or to choose one technology instead of another.

As a management tool, the production function has been used in the area of micro analysis of systems involving costs, salaries, time, and space allocation, as well as equipment and facilities. The allocation of time for teachers is a priority since their salaries, at least in the United States, constitute up to 70% of costs.³ Combined with time of students, this represents an item of some

1 Allan, T. J., op. cit., p. 23.

2 *ibid.* p. 24

3 *ibid.* p. 63

consequence. Scheduling processes now assigned to computers can facilitate the use of space and the best use of manpower. Homework increases the use of student time. Technologies of learning, such as individualised learning can make use of student homework time. A study of the appropriate mix of student and teacher time could give an optimal marginal return. Studies can provide information on the optimal length of period, periods per week, terms per year, and years per subject. The same marginal analysis can be applied to the purchase of equipment (workshop and audio - visual), as well as to library and software materials.

'Resources should be allocated among the various inputs in a school until the marginal product divided by the unit price is the same for each input. If it were possible to apply this rule, it would then be a relatively simple matter to determine how much should be spent for each of the inputs, ie. books, equipment, teachers' salaries, and so forth that contribute to students' learning.'¹ An improvement in productivity may be the result of any one of a number of factors: a technological innovation, as for instance educational television or programmed instruction, an increase in the quality of the teacher, an economy of scale, etc..

One difference in education and in industry is that in almost every industry new and more efficient methods of production have been introduced, while the technology of teaching has remained almost unchanged.² Out of this use of the production factor and systems analysis in education, however, a number of significant changes have occurred: class sizes in higher education have increased after several such studies in the United States.

¹ Allan, T. J. , op. cit. p. 73.

² Rogers, D. and Ruchlin, H., op. cit. p. 133.

Samuel Bowles has written critically of technical education in this respect¹. From an economic studies point of view, the manpower requirements approach seems to demand very rapid rates of growth of this type of (technical) schooling, and it is partly for this reason that in many parts of the world, technical education is regarded as the prime, if not the only contribution of education to economic development². Not all studies have noted the same result. Some studies have indicated 'the social profitability of secondary technical education is low relative to general education'³. The reason, almost entirely, is cost. Technical education by its very nature is costly. Kenneth King⁴ raises two points about technical education in Kenya. It is going to become increasingly difficult to maintain the position where the technical secondary schools lead directly to craft apprenticeship. Students are interested in opportunities for upward mobility, and pressures are going to be building up to change the technical secondary school programme from a craft orientation for which it is designed to a technician orientation. He points out also that secondary schools with their high costs and with their concomitant high expectations for wages may not be the place to train skilled workers. If the secondary technical schools cannot reduce the costs of training and if they cannot maintain the craft orientation of their courses, their future in skill training will be in question, if, in fact, it is not already so.

Every effort must be made to reduce the costs of technical secondary programmes through efficiencies in the educational system: through educational technology in its broadest sense, that is to say through the scientific application of methodology to the maximisation of the learning process. Programmed and individualised instruction, while only one of the process, is a significant one.

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1. Bowles, S., Planning Educational Systems For Economic Growth. Cambridge: Harvard University Press, 1969, p. 198.
 2. *ibid.*
 3. *ibid.* p. 200.
 4. King, K. The African Artisan. London, Heinemann, 1977, pp. 88 and 81.

THE HISTORY OF PROGRAMMED INSTRUCTION

The concept of programmed instruction can probably be traced to the Elder Sophists of ancient Greece.¹ Comenius anticipated programmed instruction 500 years ago, and Maria Montessori produced physical teaching devices in the late 19th century. It was, however, Sydney L. Pressey of Ohio State University who began the modern movement in programmed instruction with his self scoring, record keeping machine presented to the American Psychological Association in 1925.² 'In more recent years he has urged what he calls adjunct auto instruction which calls for a whole array of instructional media- textbooks, film, television, etc.- to be used in conjunction with programmed instruction.'³

Norman A. Crowder developed a programmed instruction approach similar to Pressey's in the 1950s working with the United States Air Force. His method became known as the 'scrambled' approach because of its design. After reading the text, the learner chooses an answer from a multiple choice question. If it is incorrect, he is directed to information designed to overcome the cause of his error and is then returned to the step where the error occurred. In this way the programme simulates a teacher.

B. F. Skinner of Harvard University stimulated a new surge of interest in programmed instruction in the 1950s. His teaching machines and related

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1. Saettler, P., A History of Instructional Technology. New York: McGraw Hill, 1968, p. 252.
 2. *ibid.* p. 251
 3. *ibid.* p. 252.

software programmes were based almost exclusively on work he and his colleagues had done in animal laboratory research.¹ His book, 'The Science of Learning and the Art of Teaching'² outlines his approach to programmed instruction. It is based on the notion of operant conditioning in which the learner's responses are 'shaped' to be produced correctly. Thus a relatively small unit of information called a frame is presented to the learner as a stimulus. The learner is then required to make a response to this information by completing a statement or answering a statement about it. By a feedback system he is informed as to the correctness of his response. If he has been wrong he may even be told why; if he is correct his response is reinforced. The learner is then presented with a second frame and the stimulus-response reinforcement cycle is repeated until a series of hundreds or thousands of frames present a complete programme in a logical sequence of information. Skinner is credited with setting the stage for a closer relationship between the behavioural sciences and instructional technology.³

Evans, Glaser, and Homme of the University of Pittsburgh pioneered the rise of programmed instruction in higher education in 1954 using a unique book format designed to simulate the characteristics of a teaching machine.⁴

Gordon Pask of the Systems Research Laboratory in London, England, developed the first adaptive individualised instruction machine in 1953. The best known of the adaptive type teaching machines is the one by Pask to train card punch operators, known as SAKI (Self-organising, Auto-

1 Saettler, P., op. cit. p. 253.

2 *ibid.*

3 *ibid.* p. 254.

4 *ibid.* p. 256.

matic Keyboard Instructor)¹. in brief, it is an adaptive computer which senses the characteristics of the trainee and adjusts the training routine to suit his requirements.²

A further development of the adaptive teaching machine was produced by Lewis and Pask which provided a 'controlled environment in which students are invited and encouraged to develop interaction patterns that enable them to become their own best instructors.'³

Building on Pask's work, Moore, in New Haven, Connecticut developed an autotelic responsive machine to teach children as young as two years old to read and type.⁴

INDIVIDUALISED INSTRUCTION

Individualised instruction is programmed learning that has been specifically designed to cater for individual difference so that each individual student may learn at a pace comfortable to him and learn material that is new and relevant to his needs. Like programmed learning it is a complete system of teaching. The basic principles of what students do when learning by the method of individualised instruction are:

1. The student works with a machine, or programmed book, individually and at his own rate.
2. He works through a carefully ordered sequence of items (usually

1 Lewis, B. & Pask, G., 'The Theory and Practice of Adaptive Teaching Machines,' in Glaser, R., editor, Teaching Machines and Programmed Learning II. National Education Association of the United States, 1960, p. 242.

2 *ibid.* p. 253.

3 Pask, G., 'Interaction Between a Group of Subjects and an Adaptive Automaton to Produce a Self Organising Systems for Decision Making,' in Yovits, M., Jacobi, G., & Goldstein, G., Ed. Self Organizing Systems. Washington: Spartan Books, 1962, p. 259.

4 *ibid.*

short) which ask him to respond in some way by writing answers down, pressing appropriate buttons, etc.).

3. The material (or programme) is so designed that the student makes few errors.
4. At each stage the student is immediately informed whether or not his responses are correct.¹

Presentation Methods

There is generally considered to be two basic types of presentation strategy in programmed instruction: the configurationalist stimulus centered approach of S. L. Pressey, N. Crowder, and R. F. Mager, and the connectionist or response centered approach of B. F. Skinner and T. F. Gilbert.² The individualised instruction packages of this research project are based on the former, which were systematised by Sydney L. Pressey at Ohio State University in the 1920s. His method he called adjunct auto instruction³ based on the learning principles of Edward L. Thorndike using the laws in particular of recency and frequency. What happens is this: the student first undergoes a short learning experience by reading a brief chapter, or section of a chapter in a book, watching a film, or attending a field excursion. He then reviews the experience selectively for major or difficult points before he turns to a series of questions designed to enhance the clarity and stability of cognitive structures by correcting misconceptions.⁴

Adjunct programmers are not interested in developing an intricate and self sufficient set of items so well cued that the student falls into little or

¹ Hartley, J., Strategies for Programmed Instruction: An Educational Technology. London: Butterworths, 1972, p78.

² ibid. p. 83.

³ ibid. p. 84.

⁴ ibid. p. 85.

no error. The purpose of the programme is to help the student to determine whether or not he has mastered the material, whether he needs additional help from a teacher or whether he simply needs to review the material.

An advantage of this type of programming over other types of programming lies in the fact that it can be prepared relatively easily and quickly and it can make use of textbooks and manuals already available to the student and teacher.¹

This type of learning is particularly adaptable to vocational education since 'student motivation increases as a function of the amount of control he is allowed to exercise over the learning experience, probably because a set of greater participation is achieved.'²

Individualised Instruction

Programmed instruction that is individualised exhibits two particular attributes; the facility for students to proceed at their own comfortable rate of learning, and the ability for the programme to circumvent material with which the student is familiar, and select material with which he is not. The former is not difficult to achieve once the programmed material is made available to each individual student and once the teacher is prepared to deal with a much more flexible and complicated timetable. In skill learning areas its implementation is contingent upon the provision of sufficient work stations.

The latter facility depends upon the design of pretests and posttests to determine what learning may be omitted, and upon the design again of a great enough variety of work stations to allow for the flexibility required.

1 Hartley, J., op. cit. p. 85.

2 *ibid.* p. 89.

EVALUATING THE INSTRUCTIONAL METHOD

The comparison of programmed versus conventional learning requires a number of assumptions and considerations. Chervis¹ claimed that the content should be identical and that both presentations should be optimal, and that the effectiveness of the instructive technique should be measured by accurate measures of the learning time, and by an unbiased criterion test. In this research, the individualised instruction modules were designed on the Ministry of Education Scheme of Work for the course under consideration, the same scheme of work from which the teacher prepared his lesson. Also, the same teacher conducted the learning of the experimental group as presented the traditional teaching to the control group. Some of the material was, by design, taught traditionally to both groups. Both groups received the same number of periods per week and the same number of weeks per year. It is assumed that Chervis' criteria was adequately met.

Hartley² added further criteria: that the experimental report should include a statement about the length and type of programme used (how it was presented), the number of students involved in each condition, and as a further measure of efficiency, the results of a retention test. In this research the length of the test was one school year. Since members of the experimental group progressed at their own speed, the amount of material completed was different between members of the experimental group and between the experimental and control groups. The number of students involved was 29 in each of the experimental and control groups. While larger sample sizes would offer more reliable statistical results, 30 cases is the approximate point in the distribution curve beyond which it is essentially normal. The limited number of schools and the limited number of students in the Form Four Automotive course precluded a larger sample size. The retention test referred to by Hartley was the EACE O Level examination, both theory and practical. It was assumed that the examination measured the retention of both groups without bias, and that it was a valid retention test.

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1. Chervis, 1964, in Hartley, J. op. cit. 1972, p. 271.
 2. *ibid.*

ATTITUDES

Following the recommendations of the Kenya Education Commission Report (the Ominde Report)¹ education in Kenya has attempted to synthesize the most relevant values of pre-independence education and 'the aspirations and cultural values of an independent African country.....'²

Individualised instruction is an attempt to recognise the individual differences in learning abilities of students and to use these differences in a positive manner to facilitate the learning process. The implementation of such a technology of instruction fulfills in part the recommendations of the Kumasi Conference.³ Notwithstanding, individualised instruction, with its emphasis on independence of thinking, questioning, discovering, problemsolving and transferring knowledge, is not entirely compatible with traditional educational concepts which taught individuals to be members of an authoritative society.⁴ A question which must be faced by this research is whether secondary school students today, or perhaps more to the point, whether secondary school teachers today are able to accept the style of operation of individualised instruction with its inherent challenge to the teacher and to the traditional concepts of authority and unity of society.

The style of this technology of instruction challenges the teacher to relinquish most of his traditional presentation of subject matter, to become an information resource person, answering questions for which he may not be prepared, accepting challenges to concepts he has always believed, making value judgements where he has not before exhibiting flexibility in resource utilization he has never believed possible, and much more.

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- 1 Government of Kenya, Ministry of Education, Kenya Education Commission Report, Part 1. Nairobi: English Press, 1964.
 - 2 Mutua, R., Development of Education in Kenya. Nairobi: East African Literature Bureau, 1975, p.9.
 - 3 McNoun, J., Technical Education in Africa. Nairobi: East African Printing House, 1970, pp.53-59.
 - 4 Ghai, D., 'Towards a National System of Education in Kenya', in Education, Society and Development. Ghai, D. and Court, D. ed., Nairobi: Oxford University Press, 1974, p335.

In general, the basic functions of education in any country can be broadly defined as follows:

1. The preservation and transmission of culture.
2. The inculcation of appropriate values and attitudes.
3. Skill formation.
4. Promotion of innovative, creative, and critical abilities.¹

This research deals with items three and four in particular. It is concerned with skill formation and methods of conducting such skill formation more efficiently and effectively through the deployment of innovative and creative methods. 'The effective performance of these functions depends not only on the responsiveness and flexibility of the educational system, but also on the extent to which they are spelled out in a coherent fashion.'² Increasingly the goals of technical and vocational education are being spelled out in a coherent fashion. The specific objectives of the Motor Vehicle Course 820, as the current revision has been numbered, are spelled out in the Scheme of Work as shown in Appendix B. The objectives are more clearly defined than previously, but, notwithstanding the much more detail, the objectives have not been defined in a behavioural or a performance fashion as required to indicate the depth of study and the standard of performance. Individualised instruction requires just that expression of behavioural and performance objectives.

As Ghai and Court have noted, 'it is not an easy task to change the educational system in the desired directions. Not only must the vested interests of those involved in the running of the system be contended with, but also the resistance offered by the inertia of past practices. While it may not be a

1 Ghai, D. and Court, D., op. cit. pp.325 ff.

2 *ibid.*

difficult task to prescribe in general terms the changes needed in the educational system, it is far more difficult to translate them into operational terms. This may involve far reaching changes in such matters as the language of instruction, teaching materials, curriculum, teaching methods, and the structure of the educational system.¹

In summary, the implementation of individualised instruction tends to challenge and to undercut the traditional, safe, and comfortable methods familiar to students and their teachers, and it tends at the same time to confront the vested interests and the inertia of the established system.

The second hypothesis of this research asks the question 'Assuming individualised instruction can produce more efficient and effective education, are the human resources within the system capable of accepting and supporting these changes, or are vested interests the inertia of the system, the insecurity of the teaching body, and the calibre of the students such that the innovative changes required are not likely to be accepted?'

In short, can individualised instruction be effective, and will the system allow it to be used?

ATTITUDE STUDIES

'The concept 'Attitude' . . . denotes . . . the sum total of a man's inclinations and feelings, notions, fears, threats and convictions about any specified topic.'² The vast amount of research in conceptions of attitudes in recent years has shown that there is 'a causal chain linking beliefs, formed on the basis of available information to the person's attitudes, and attitudes to

1 Ghai, D., and Court, D., op. cit. p. 329.

2 Thurstone, L., 'Attitudes Can Be Measured,' from Summers, G. F. Attitude Measurement. Chicago: Rand McNally, 1970, p. 128.

intentions, and intentions to behaviour. Since the performance of behaviour may provide the person with new information that again influences his or her beliefs, the causal chain starts all over again.¹

Most investigators agree² that attitude can be described as 'a learned predisposition to respond in a consistently favourable or unfavourable manner with respect to a given object.'³ The response is in the evaluative or affective dimension⁴ on which attitude measurement relies.⁵ 'Knowledge of a person's attitude, therefore, permits prediction of one or more specific behaviours,⁶ or at least, a general behaviour.⁷

Of the four conceptual distinctions concerning attitudes- affect (feelings, evaluations), cognition (opinions, beliefs), conation (behavioural intentions), and behaviour (observed overt acts), Fishbein reserves the term 'attitude' for affect.⁸

Measurement of Attitude

This definition of 'attitude' requires a measurement procedure whereby a person assigns some concept to a position on a bipolar evaluative dimension.⁹ 'Single response scales' . . . and . . . 'unipolar scales' . . . 'should not be viewed as measures of attitude'¹⁰. Both Thurstone and Guttman developed attitude -- scaling procedures to order items along the evaluative dimension. 'Thurstone's scaling, however, goes beyond ordinal measurement and attempts to locate the position of items on an equal interval scale.'¹¹ By far the most popular and widely used Thurstone scaling procedure is the method of equal appearing

1 Fishbein, Martin and Ajzen, Icek, Belief, Attitude, Intention, and Behaviour. Massachusetts: Addison-Wesley, 1975, p. vi.

2 ibid. p. 6.

3 ibid.

4 ibid. p. 7.

5 ibid. p. 8.

6 ibid.

7 ibid.

8 ibid. p. 12.

9 ibid. p. 56.

10 ibid.

11 ibid. p. 68.

intervals.¹

Thurstone's Equal Appearing Interval Scale

Thurstone developed the method of equal appearing intervals as an approximation to the more sophisticated paired - comparisons technique.² A pool of items collected by the investigator is given to a pool of judges whose attitudes are to be assessed. The judges sort each item into one of eleven categories considered to be equal intervals along the evaluative dimension ranging from favourable through neutral to unfavourable. He proposed the 'criterion of ambiguity'³ a large inter-quartile range or standard deviation for rejection of items. A subject's score is computed by obtaining the median or mean of the scores.⁴ Thurstone further used a criterion of irrelevance to eliminate items that would lead to an imbalanced measurement.⁵

Likert's Method

According to Likert's Method, 'subjects are asked to respond to each item in terms of a five point scale defined by the labels: agree strongly, agree, undecided, disagree, disagree strongly.'⁶ For inclusion, items should have an internal consistency. 'According to this criterion, the more favourable a person's attitude, the more likely he should be to endorse favourable items'⁷ and vice versa. 'The twenty or so items with the highest correlations (or the most discriminating items) constitute the Likert Scale.'⁸ The Likert Scale ensures that ambiguous items as well as items that elicit responses based on factors other than the attitude under consideration are eliminated.⁹

Likert's Scale is qualitative with neutral items removed, linear in

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|---|-------------------------------------|---|--------------|
| 1 | Fishbein and Ajzen, op. cit. p. 69. | 2 | ibid. p. 68. |
| 3 | ibid. p. 69. | 3 | ibid. p. 70. |
| 4 | ibid. p. 71. | 5 | ibid. p. 72. |
| 6 | ibid. | 7 | ibid. p. 73. |
| 8 | ibid. | | |

traceline and ordinal in response quantification.¹ Neutral items, according to Likert, are valid indicators of attitude.²

'In Likert Scaling, each item is assumed to indicate either a favourable, (+1), or unfavourable, (-1), attitude, and responses are given on a five point scale ranging from strong agreement, (+2), to strong disagreement, (-2).³ The attitude score is the sum of the above product for all questions.⁴

Although it is usually assumed that there is symmetry about zero when a favourable statement is converted into an unfavourable statement by the use of a negation, the assumption may not always be warranted.⁵ However, it is generally accepted that 'across a large number of items, the errors will tend to cancel out, and the obtained attitude score will approximate the 'true' attitude score.'⁶

Response Consistency

Two types of consistency of response are recognised. First, a person's response to one statement should be consistent to responses to other statements. Secondly, persons with the same attitude score should exhibit the same response consistency.⁷

Reliability

'Reliability refers to the degree to which a measure is free or variable error.'⁸ 'There is abundant evidence that standard attitude scales are highly reliable, yielding comparable results when administered on different occasions.'⁹

Validity

'Validity refers to the degree to which an instrument measures the

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| 1 | Fishbein and Ajzen, op. cit. p. 80. | 2 | ibid. p. 82. |
| 3 | ibid. p. 81. | 4 | ibid. p. 87. |
| 5 | ibid. | 6 | ibid. |
| 7 | ibid. | 8 | ibid. p. 107. |
| 9 | ibid. p. 108. | | |

'true' score it was designed to measure.'¹ 'If an instrument is a valid measure of attitude toward some object, it should correlate highly with another measure of attitude toward the same object; that is, the two instruments should exhibit convergent validity.'² It should also be shown 'that when the same method or instrument is used to measure different variables (e.g. attitudes to different objects), different results are obtained.'³ This is discriminant validity.

Number of Test Items

A factor that influences the reliability of a scale is the number of items on the scale. The relationship of the number of items on the scale and the reliability is described by the Spearman-Brown prophecy formula:

$$r'_{xx} = \frac{mr_{xx'}}{1 + (m-1)r_{xx'}}$$

where r'_{xx} is the estimate of the reliability of a scale m times as long as the original scale, and $r_{xx'}$ is the observed reliability of the original scale.⁴

Fishbein⁵ indicates that 20 or more items will produce a more reliable result.

Internal Validity

Internal validity is 'the degree to which an experimental design is free from . . . uncontrolled factors - that is, the degree to which changes in the dependant variable can be confidently attributed to the experimental manipulations. High internal validity, therefore, eliminates possible alternative explanations of the observed effect.'⁶

The simplest way to deal with uncontrolled factors is to introduce a control group whose attitudes are measured at the same point in time.⁷

Further, if possible, the pretest may be eliminated as a possible source of sensitizing the experimental group to later influences.⁸

1 Fishbein and Ajzen, op. cit., p. 108. 2 ibid. p. 109.
 3 ibid. 4 ibid. p. 113.
 5 ibid. p. 114. 6 ibid. p. 115
 7 ibid. p. 116. 8 ibid. p. 117.

Certain other phenomena such as the realisation that one is taking part in a test, or the experimenter's expectation may have an affect on the experimental results. This characteristic is known as reactive effects.¹ 'Little can be done about experimental effects in most experimental settings.'²

External Validity

A test must have generalisability (external validity) across the experimental population.³ In research that is primarily descriptive, this is a problem, but where psychological processes are under consideration it is not.⁴

Demand Characteristics

'At some level (the subject) sees it as his task to ascertain the true purpose of the experiment and respond in a manner which will support the hypothesis being tested. Viewed in this light, the totality of cues which convey an experimental hypothesis to the subject becomes significant determinants of subjects' behavior.'⁵ Orne called the sum total of these cues the 'demand characteristics of the experimental situation.'⁶

Evaluation Apprehension

A further testing phenomenon is the tendency for a subject to believe that it is the emotional stability, intelligence or mental health that is being evaluated and will try to behave in a manner that will win the approval of the experimenter. This has been noted as Evaluation Apprehension.⁷

Experimenter Bias Effects

Cues that may allow the subject to form beliefs about the purpose

1 Fishbein and Ajzen, op. cit. p. 117. 2 ibid.

3 ibid. p. 118. 4 ibid.

5 Orne,

6 ibid

7 Fishbein and Ajzen, op. cit. p. 119.

of the experiment, as well as beliefs about the experimenter's expectations may be provided by the experimenter's behaviour. This is known as 'Experimenter Bias'¹ effect. This is significant when a test is given twice and the subject becomes aware that difference in response is expected.

This is a prime reason for the use of the split-half test in these situations. The split-half method is employed when it is not feasible to construct parallel forms of the test nor advisable to repeat the test itself. This situation occurs with many performance tests as well as with questionnaires and inventories dealing with personality variables, attitudes and interests.² . . . Many personality tests (as for example, the Rorschach) cannot readily be given in alternate forms, nor repeated, owing to changes in the subjects' attitudes upon taking the test for the second time.³

Tests of Significance

Fishbein points out the necessity of using tests of significance on psychological testing data.⁴ Data that does not fall within the significance level can only be treated as a function of chance and should be reported as non-significant. 'Although we are aware that the five percent significance level is an arbitrary convention, its utility is evidenced by the literature.'⁵

ATTITUDE TESTS

'Attitudes are usually measured by assessing a person's beliefs.'⁷ A distinction can be made between beliefs in the existence of an object (e.g. belief in the existence of God) and beliefs in the existence of a relationship linking the

1 Fishbein and Ajzen, op. cit. p. 120.

2 Garrett,

3 *ibid.*

5 *ibid.*

4 Fishbein and Ajzen, op. cit. p. 125.

7 *ibid.* p. 131.

object to some attribute (e.g., a belief about God, such as God is omnipotent). However, beliefs in the existence of an object can also be viewed as beliefs about the object, i.e., as beliefs linking the object to the concept of existence (e.g., God exists). Thus, without any loss in generality, beliefs in an object may be viewed as a special case of beliefs about the object.¹

People variously can be measured in their beliefs: political beliefs, religious beliefs, scientific beliefs, or humanistic beliefs to exhibit certain attitudes. At the extremes, these attitudes are authoritarian, high dogmatic, conservative, rigid, closed - minded, OR non - authoritarian, low dogmatic, flexible, liberal, and open minded.² These represent extremes and not absolute categories into which everyone can be placed. The properties considered here represent a continuum along which people fall from one extreme to the other.³

'Classical psychoanalysis has tried to account for man's behavior by seeing him as id - driven, egotistical, rationalizing, and sublimating. In recent years psychologists have become increasingly dissatisfied with this negative view. In addition to Asch, . . . let us also draw attention here to the writings of Allport (1955), Fromm (1947), Maslow (1954), Rogers (1951), Tolman (1954), and White (1959). These writers prefer to place a greater emphasis on man's cognitive needs and his tendencies toward growth, productiveness, and self-actualization.⁴

It is therefore assumed that all belief - disbelief systems serve two powerful and conflicting sets of motives at the same time: the need for a

1 Fishbein and Ajzen, op. cit. p. 131.

2 Rokeach, M. The Open and Closed Mind. New York: Basic Books
1960, p. 7. p. 7.

3 *ibid.* p. 5.

4 *ibid.* p. 68.

cognitive framework to know and to understand and the need to ward off threatening aspects of reality.¹ For most persons in most situations; both sets of needs operate together to one degree or another.² A person will be open to new information or new methods of operation (teaching, for example) in so far as possible (as his belief system will allow), and will reject it, screen it out, or alter it, in so far as necessary.³ While the closed and dogmatic mind is resistant to change it is the psychological protection the mind exerts to allay anxiety and threat. The more closed the belief - disbelief system, the more do we conceive it to represent in its totality, a tightly woven network of cognitive defences against anxiety.⁴

Rokeach described his Dogmatism Scale in such a way as to suggest its usefulness in predicting attitudes toward change.⁵ He defined dogmatism as a state of mind that determines the extent to which a person can receive, evaluate, and act on intrinsic merits of relevant information, unencumbered by irrelevant factors. Rokeach suggested that the Dogmatism Scale effectively measures security - insecurity, which has been used as a personality characteristic by several researchers in attempts to predict attitudes toward change generally.

Lin et al and Mechling⁶ found that teachers who scored low on the Dogmatism Scale tended to be predisposed to accepting educational innovations. A low dogmatism score indicated open-mindedness. In a study of the attitudes of 406 University of Missouri Extension staff members toward institutional change, Apel⁷ concluded that the Rokeach Dogmatism Scale was

1 Sarnoff and Katz, (1954) and Smith, Brunner and White(1956) also recognised this duality of function in the analysis of the motivations served by attitudes and opinions.

2 Rokeach, M., op. cit. p. 68.

3 *ibid.*

4 *ibid.* p. 69.

5 *ibid.* p. 183.

6 Lin, N and Mechling, K., A Strategy for Stimulating the Adoption and Diffusion of Science Curriculum Innovations. U.S. Department of Health, Education and Welfare- Clarion State College, 1969.

7 Apel, J., Prediction of Adult Educator's Attitude Toward Change. PhD. Dissertation. University of Chicago, 1936.

effective in measuring predisposition toward change, but could not adequately assess specific attitudes toward change. He indicated that while attitudes toward change in general vary among persons, a more important factor is an individual's attitude toward specific changes. People usually react in different ways to different changes rather than automatically rejecting or accepting all changes. They discriminate between ideas they consider 'good' or 'bad' and react in terms of their perceptions and the relative importance they attach to the 'goodness' or 'badness' of each change. Thus Apel's study supported the theories that a single measure of personality is less adequate than an individual's perception of the effect of specific changes in the prediction of his attitudes toward change. There is, of course, no assurance that, although a teacher is predisposed toward change, he will automatically accept all change, or more specifically, that he will accept individualised learning as a method to be used in his laboratory. Carlson reported on the barriers to the adoption of innovations when they threatened a teacher's competence in an established area of self-esteem. When programmed instruction was introduced in a school system, students were better able to progress at individual rates, but teachers were then unable to 'perform' and resisted the need to re-orient the teacher's role. This entirely supported Rokeach's contention of 'cognitive defenses against anxiety.'²

Consideration of these factors indicates that although it may be found that teachers are inclined to change, if that change is to be brought about in certain areas, there must be adequate preparation and motivation for the changes to actually be brought about. The disposition itself is not enough.

1 Carlson, R., Adoption of Educational Innovations. Eugene: University of Oregon, 1965.

2 Rokeach, M., op. cit. p. 347.

ATTITUDE TESTING

As noted previously, attitudes have a very significant role to play in the prediction of a person's behaviour. The belief has been affirmed by a number of researchers including Rokeach¹, Halloren², Sherif³, and others. It was assumed that the Dogmatism Scale developed in the U.S. by Rokeach, and used successfully there and in the U. K. could, with modifications, be used in Kenya to measure orientation to change and innovation amongst teachers and non-teachers.

It has been noted⁴ that an individual will react to an attitude statement differently if it is one in which there is self interest (ego involvement) than he will to a statement which does not stir personal involvement. Changes were of necessity made in the test instrument to ensure that cultural differences did not preclude personal involvement and to ensure that the involvement was not so influenced by custom and tradition as to create an erroneous measure. The reliability and validation studies precluded cultural biases as far as possible.

The concept of the ability of attitudes to predict action is in its infancy in the field of psychological testing. It must be recognised that such test instruments must be developed for specific groups in specific situations, and that results can be applied only in general terms, to groups, and not to specific individuals.

CONCLUSION

In summary, educational economists insist that education, and technical education in particular, must be made more economical. Many new technologies of learning, including programmed and individualised instruction, have proven successful in experiments conducted in a number of countries and especially successful in skill training. Essential, however, to any implimentation of such a technology is the need to consider attitudes to change and innovation amongst educators.

1. Rokeach, Milton op. cit.

2. Halloren, J. cp. cit.

3. Sherif, C. and M. Sherif, Attitude, Egc Involvement and Change. New York: Wiley and Sons, 1967

4. *ibid.*, p. 137.

CHAPTER THREE

DEVELOPMENT AND IMPLEMENTATION OF THE STUDY

This chapter includes a detailed description of the development of the individualised instruction modules and their costing as well as a detailed description of the development and test of the attitudinal study. It includes also the methodology of the research in detail.

DEVELOPMENT OF THE INDIVIDUALISED INSTRUCTION MODULES

Selection of the Modules

The individualised instruction modules used in this research project were selected elements of a set of modules developed, tested, and produced by the University of Oregon. Request for permission and the authority to use the modules is shown in Appendix A. The style of the programmed instruction was Adjunct Programming using available teaching text books, resource materials, worksheets, detailed explicit behavioural objectives, and pretests and posttests.

Thirty two modules were selected and extensively modified to conform to the EACE Automotive Technology Course, Part C, for use at the Form Four level. References and language were also modified to suit the Kenyan educational scene. A list of the modules developed for this research is given in Table 1, following. The Scheme of Work, Part C is shown in Appendix B.

Not all material in the Scheme of Work, Part C was developed into individualised modules for two reasons:

1. Some of the material can be more readily dealt with using traditional techniques. Safety in the workshop is an example.
2. Some material would require an amount of development time not available at present. An example of this is the course work pertaining to compression ignition engines.

TABLE 1

LIST OF INDIVIDUALISED INSTRUCTION MODULES
AUTOMOTIVE TECHNOLOGY COURSE
PART C, FORM FOUR

- | | |
|--|--|
| 1. Engine Overhaul Pretest. | 17. Removing and Installing Carburetors. |
| 2. Engine Disassembly. | 18. Carburetor Overhauling. |
| 3. Engine Valves. | 19. Automotive Bearings. |
| 4. Camshaft, Timing Gears and Valve Lifters. | 20. Gear Box, Gear Ratios, and Torques. |
| 5. Engine Crankshaft. | 21. Gear Identification. |
| 6. Pistons, Rods and Rings. | 22. Differential Carrier Assembly. |
| 7. Engine Cylinder Block Service. | 23. Clutch Service. |
| 8. Engine Bearings. | 24. Clutches. |
| 9. Engine Lubricating System. | 25. Steering Linkage. |
| 10. Lubricants and Fluids. | 26. Steering Gears. |
| 11. Engine Reassembly. | 27. The Brake System. |
| 12. Engine Cooling System. | 28. Brake System Repair. |
| 13. Distributor. | 29. Brake Cylinders. |
| 14. Primary Ignition Circuits. | 30. Fuel and Vacuum Pumps. |
| 15. Secondary Ignition System. | 31. Servicing Automotive Batteries. |
| 16. Chokes Service and Adjustment. | 32. Lighting and Accessory Circuits. |

Composition of the Module

Each module was designed to include the following:

1. A title page with a general statement of the purpose of the module.
2. A list of the specific performance objectives the majority of which involve 'hands - on' practical experience in the motor vehicle workshop.
3. A reference to the Scheme of Work for the Automotive Technology Course, Part C, Form Four, including the relevant paragraph and subparagraph.
4. Learning activities matched to each of the performance objectives which include:
 - a. Each specific performance objective restated.
 - b. A chart of activities, predominantly reading, but also including films, film strips, student - teacher conferences, and other related material.
 - c. A statement of purpose for each of the listed activities in b.
 - d. A worksheet detailing precisely what is to be done by the student, and including in most cases a chart to be completed by the student and approved by the teacher before work is continued.
5. A pretest to be undertaken before the work of the module is begun. Good results from the pretest may preclude the student from having to complete the module, at the discretion of the teacher. In such a case he would continue with another module assigned by the teacher according to his recognition of the needs of the student and availability of equipment.
6. A posttest with answer sheet which should be completed by the student to the satisfaction of the teacher before the next module is attempted. These posttests serve as excellent review material to be used before the EACE examination.

In fifteen of the thirty two modules the practical expertise demanded dictated that the pre and posttest be a practical assessment of the work of the student by the teacher and not, as in the others, an objective type of written test.

A sample module is included in Appendix C. Permission to reproduce sections from Stockel, M. Auto Service and Repair. is found in Appendix D.

Pretesting of Modules

Sixteen of the thirty two modules were extensively modified and developed for use in the technical secondary schools during the school years 1975 and 1976 as part of the Proposal for this research project, and as prototypes for the development of further modules to complete the entire syllabus at the Form Four level. A number of observations were made during the development stage:

1. Technical school libraries were not well enough supplied with books relevant to the Automotive Technology programme. To enable the individualised instruction modules to be used it was imperative to add a substantial package of supplementary reading material to almost every package.
2. Most of the schools offering the Automotive Technology programme were not well supplied with reference books¹. Of the 31 recommended texts and reference books, only two recommended texts books² were found with regularity in the schools. Both these text books were small and dwelt more on theory and principles of operation while the revised Scheme of Work was directed to a considerable amount of practical exercise. Since the revision, the Scheme of Work and the text books had become somewhat incompatible. The book by Stockel was selected for attachment material because it was fundamentally very practical.

1 A list of recommended books can be found in the Scheme of Work, Basic Engineering Course, Automotive, 1976, pp. 26.ff.

2 These have been noted in Chapter One, p. 2 of

3. None of the motor vehicle workshops was equipped with all the equipment required to complete all the modules and thereby the prescribed course of study. Most of them lacked a number of tools and testers. The exercises involving such missing pieces of equipment were nevertheless left in the materials with the suggestion to specialist teachers that they should borrow the equipment for demonstration, visit a local automotive shop for demonstration, procure the items if the budget should allow it, or arrange a field trip to one of the teacher training colleges for demonstrations and perhaps 'hands - on' experience. One school, the Rift Valley Technical School did make such a trip to the K.T.T.C in June, 1977. The students, through the questionnaires they were asked to complete, complained frequently of the lack of tools and equipment, but it was noticed by a few teachers that at least the students did come to recognise the need and purpose for items they might not otherwise have heard of.
4. None of the specialist teachers had had any knowledge or experience of programmed learning or individualised instruction. The entire concept of such learning was foreign to them, and the layout of the motor vehicle shops was not especially conducive to the method of individualised instruction. It was crucial to train the teachers involved and give considerable guidance in the use of the materials. A considerable amount of time was given by the writer to familiarise teachers with the procedures.
5. Timetables in all the schools concerned were designed to offer 14 periods of practical work and 3 periods of theory each week. During the three periods of theory, other students were scheduled into the workshop areas, a fact which made it impossible for students in the experimental group to work at their own pace, and necessitated them

being included in the traditional theory periods. Nevertheless, the members of the experimental group were able to take their materials to their hostels in the evenings in preparation for the practical work of the following day, and they were able to cover more practical work than the control group.

6. There was a problem identified early in the development of the modules of deterioration of the handouts due to the dirt and oil of the workshops. A number of modules had to be supplied to account for attrition of this nature. In one instance, a module was covered with thin plastic by hand as a sample. The procedure proved too time consuming and burdensome to do by hand with the other additional duties brought about by the experiment and was not pursued.
7. The revised (1976) Scheme of Work for the Automotive Technology Course included more material and at a greater depth than did the previous scheme of work. This, along with the increased time required for the phase tests from the Inspectorate and the time required for revision in October prevented students from covering all the material. Teachers had to be selective about the material they considered to be a priority. Given the present circumstances there is not enough time in the 13 periods per week, less the time for the items noted above, to complete the 32 modules. Over a period of usage, familiarity with the modules, modification of the timetable, and redesign of the workshop layout may allow for the completion of all modules.
8. The experimental materials required the students to make regular use of the specifications for most of the equipment. In a large number of cases these were not available. Some were located by the writer and distributed.

To assist in the effectiveness of the experimental materials, five copies of the referenced text, Stockel, M. W., Auto Service and Repair. Illinois: Goodheart - Wilcox, 1975, were purchased in mid 1977 and donated to the five schools involved.

The costs of development of the individualised instruction materials is given in Appendix. E

EXPERIMENTAL AND CONTROL GROUPS

The method used to statistically evaluate the effectiveness of the experimental materials was that of an experimental group and a control group both of whom had all other factors in common except for the one under consideration. For the experimental group, three to eight students were selected from each of the five schools participating. Care was taken to ensure that a cross-section of high, mediocre, and low achievers was selected.

The students for the experimental group were selected by the classroom teachers. The only criterion used was that participants be from all achievement levels. These students and only these students used the experimental materials.

An equal number of students was selected from each school as an experimental control group. The following factors were considered in the selection of the control group:

1. The Motor Vehicle grades in Form Three were used to match the control to the experimental group.
2. The mechanical aptitude as shown in the practical grades from phase tests in Form Three of the control group as compared to the experimental group, were used where the matching in 1 was not clear or there were tie scores.

The students in the control group were carefully selected by means of a personal conference with the Motor Vehicle teachers in March, 1977, before any particular differences in achievement had manifested themselves.

The Form Three grades in the Motor Vehicle course for both the experimental and control groups are given in Table 2. It is noted that in the case of Starehe Boys Centre, the term one grades in Form Four have been used because Form Three grades were not available. There was a shortage of a teacher during the latter part of the year.

A statistical analysis of the grades establishing the control group gives a correlation (r_{xy}) of $+0.7$ which is much beyond significance at the 1% confidence level for a sample of 29.

PROCEDURE FOR THE INDIVIDUALISED INSTRUCTION STUDY

Following the modification and production of the individualised instruction modules, the dissemination of the modules to the schools was conducted continuously, but in two phases; the test phase during the latter months of 1976, and the experimental phase during the twelve months of 1977.

Personal visits were made to each of the five schools where the materials were to be tested and interviews conducted with the Headmasters. Sample modules were presented and the purposes of the experiment were outlined. In every subsequent visit to the schools, the Headmasters were visited and informed of the progress. The exception was at Starehe Boys Centre where this communication was with the Technical Director.

In one of the schools, on each visit the Headmaster called in the teacher concerned and discussed the progress with him and the researcher.

The following is a resume of the progress of the experiment.

TABLE 2

FORM THREE AUTOMOTIVE GRADES USED IN THE SELECTION OF
EXPERIMENTAL AND CONTROL GROUPS

SCHOOL	EXPERIMENTAL	GRADE	CONTROL	GRADE
KABETE	E1	81	C1	87
	E2	68	C2	65
	E3	38	C3	41
	E4	53	C4	53
	E5	74	C5	74
	E6	72	C6	72
KISUMU	E7	50	C7	50
	E8	56	C8	55
	E9	29	C9	29
	E11	18	C11	17
	E12	35	C12	37
MACHAKOS	E13	84	C13	82
	E14	86	C14	90
	E15	64	C15	64
	E16	76	C16	76
	E17	76	C17	76
	E18	90	C18	90
RVTS	E19	60	C19	60
	E20	50	C20	50
	E21	58	C21	60
	E22	73	C22	73
	E23	60	C23	60
	E24	82	C24	81
	E25	76	C25	76
	E26	32	C26	34
STAREHE*	E27	64	C27	66
	E28	69	C28	69
	E29	64	C29	60

* First term Form Four grades were used for Starehe because Form Three grades were not available. There was no teacher in the latter part of the year

Permission from the Chief Inspector of Schools

Permission to conduct a research project involving curriculum and method in the technical secondary schools was obtained from the Chief Inspector of Schools, then Mr. A. Getao. A copy of the request and permission is included in Appendix F.

Kabete Technical School

In a visit to Kabete Technical School in March 1976, permission was granted by the Headmaster to use the motor vehicle shop there for such research. Three modules were left with Mr. H. Ngang'a, Head of Department, for his consideration. In July an additional thirteen modules were submitted. Visits were made in October and November, 1976 to discuss changes to the materials.

On 18 January, 1977, three copies each of a set of 24 modules was delivered to the school along with a guide for the implementation of individualised instruction. On a visit to the school on 27 January, two boys were observed using the Engine Disassembly module. It was agreed that for the first few attempts at this method of learning students might more profitably work in pairs to enable them to adapt and to give them some additional confidence.

Further visits were made to the school on 24 March, 4 May, and on numerous occasions in September, October, and November, 1977. Continuous assessment grades and comments of students in response to questionnaires were gathered and observations made on students using the experimental material.

The teacher was cooperative and in general convinced of the value of individualised instruction, but he was limited in the attention he was able to give to the testing programme because of work load. The second motor vehicle teacher completed his contract in April, 1977 and was not replaced until early 1978.

Machakos Technical School

Machakos Technical School was first visited on 14 September, 1976, at which time the Headmaster offered to assist in the experiment with individualised instruction and the two motor vehicle teachers (the Head of Department included) were quite enthusiastic. Thirteen modules were left for testing. Two further modules were left for development on a visit in October, 1976.

On 13 January, 1977, two complete sets of 24 modules were left for introduction to the experimental test. A number of suggestions for improvement were made by the instructors, some of which were:

1. More drawing of diagrams such as required by the EACE examinations.
2. The word tappets should be used in lieu of valve lifters which is not a familiar term here.
3. Pictures on the information sheets should be made clearer.

A visit was made on 9 February, 1977, and again on 9 March when the experimental and control groups were fixed. Further visits were made in May, June, September, October, and November. Continuous assessment grades were received, and students involved in the experimental group were asked to complete a questionnaire. The Department Head was transferred to Nyeri at the end of term two, but his successor carried on the testing programme for the third term.

Thika Technical School

Thika Technical School was visited on 23 September, 1976, at which time the Headmaster was enthusiastic about the experimental materials. The Head of Department and the other automotive instructor agreed to try out the new materials. Thirteen modules were left for their examination and experimentation. Further visits in October, 1976, and January, 1977, indicated that the Head of Department had no intention of using the experimental material, notwithstanding the interest of the other teacher and the Headmaster.

The experimental programme at this school was discontinued.

Mombasa Polytechnic

A visit was made to the Mombasa Polytechnic on 19 October, 1976 at which time the Principal and Deputy Principal gave their permission for the automotive technology teacher to use the experimental materials. However, the teacher had just completed the development of some new curriculum materials of his own, and felt it would be difficult to test two types of materials at the same time.

For this reason, and partly because the distance from Nairobi to Mombasa almost precluded the requisite number of visits for such an experiment, the Mombasa Polytechnic was not included in the study.

Nyeri Technical School

A visit was made to the new Nyeri Technical School on 18 November, 1976. Both the Headmaster and the Department Head for Automotive Technology were interested in the study, but would not be teaching Form Four students until January, 1978. The school was not included in the study.

Rift Valley Technical School

On 11 January, 1977, a visit was made to the Rift Valley Technical School to seek its participation in the study. The Headmaster, the Deputy Headmaster, the Head of Department, and the other automotive teacher were enthusiastic. In addition to the one module sent previously by post, thirteen modules, three copies of each, were left as well as the directions for the implementation of individualised instruction.

An experimental group of eight students was selected immediately and the modules were tested by both teachers quite comprehensively. Visits were made to the school in March, May, September, and November, 1977. A number of problems were identified in the implementation of the experimental materials, for example:

1. The school had no ridge reamer, radiator pressure tester, plastigage, condenser tester, ignition oscilloscope, ring expander, ring groove cutting tool, valve guide knurling tool, and the valve grinding machine was unserviceable.
2. The modules became dirty and illegible too quickly.
3. Questions from previous examinations should be included in the posttests.
4. More sketching should be required to acquaint the students with the requirements of the EACE examinations.

An arrangement was made in June, 1977, to have the teacher and his 38 Form Four students visit the automotive workshops at the K.T.T.C. to familiarise themselves with the equipment lacking in their own workshops.

There was an obvious enthusiasm on the part of both teachers and students for the experimental materials. On two occasions the eight experimental students met with the writer on Saturday morning visits to the school to discuss interests and problems.

Kisumu Technical School

Kisumu Technical School was visited on 9 October, 1976, at which time three modules were left. The Headmaster, Head of Department and one automotive technology teacher were quite interested in the study.

Further modules were posted on 3 January, 1977, and a visit was made on 10 January, 1977. Visits were also made on 12 February, 7 May, 25 June, in September and in November.

Six students were selected for the experimental group. The writer met with them for discussions on two Saturday morning visits to the school. A number of helpful suggestions were offered and a considerable amount of enthusiasm was shown for the method of instruction.

Sagana Technical School

In response to a recommendation from the Technical Section of the Inspectorate, a visit was made to Sagana Technical School to enlist interest for the testing of the experimental materials. The Headmaster and two of his automotive teachers were interested and encouraging, but had only themselves developed similar materials that were in the midst of being tested. The suggestion was offered by the teachers that the reading associated with the individualised instruction modules was too deep for students at the Form Four level.

Starehe Boys Centre

Starehe Boys Centre was visited on 9 November, 1976, at which time the Principal, the Technical Director, and the one automotive technology teacher agreed to use the materials as part of the study. The teacher was untrained and felt that the materials may give him some assistance in his teaching.

On 14 January, 1977, two complete sets of fourteen modules were delivered to the Centre, and a considerable amount of time, extending over several visits was taken to familiarise the teacher with the materials and their application. Visits were also made to the workshop on 25 January, 12 February, 4 March, and in May, June, September, October, and November. Three students, out of a class of eleven, were selected to use the experimental materials.

Progress of the experiment was difficult because of the lack of learning the students had had in Form Three when they had been without a teacher for part of the year. There was also a serious lack of equipment and tools as well as a lack of experience on the part of the teacher although he was most cooperative and hardworking.

The assignment of a practice teacher from the Kenya Polytechnic during the last half of the first term of 1977 and the assignment of an untrained teacher but skilled craftsman from Uganda in the final term of 1977 was of considerable assistance to the project.

DEPLOYMENT OF MODULES

In the final analysis, testing of the experimental individualised instructional materials was conducted over a twelve month period from January, 1977 to December, 1977, at five secondary schools involving 29 students and seven teachers. Complete records were kept of their continuous assessment, their personal subjective responses to the materials, their EACE examination results, and the teacher subjective responses to the method of teaching. The findings and assessment of findings are contained in Chapter Four.

NON STATISTICAL STUDIES

Questionnaire for Participating Students

At the conclusion of the 12 month test of the individualised instructional materials, a questionnaire was given to all students of the experimental groups. Appendix G is a sample questionnaire for users of the individualised instruction modules. A compilation of the answers and discussion is included in Chapter Four.

Questionnaire for Participating Teachers

Also at the conclusion of the 12 month study of the individualised instruction modules, a questionnaire was given to all participating teachers. The findings from that questionnaire and a discussion are found in Chapter Four and a copy of the questionnaire is found in Appendix H.

DEVELOPMENT OF THE ATTITUDE TEST INSTRUMENT

Theory of the Instrument

The primary purpose of the test was to measure group differences in openness or closedness of belief systems, in general authoritarianism, and in resistance to innovation.

The basic test used in the research was the Rokeach Dogmatism Scale¹

1 Rokeach, M., op. cit. p. 73.

extensively modified to deal particularly with cultural determinants. The Dogmatism Scale consists of 'statements that express ideas familiar to the average person in his everyday life. Above all, each statement in the scale had to be designed to transcend specific ideological positions in order to penetrate to the formal and structural characteristics of all positions.¹ Persons adhering dogmatically to an ideology, Capitalism or Communism, Catholicism or anti-Catholicism, notwithstanding their diverse viewpoints, should all stand at one end of the scale, in a direction opposite to those having equally diverse yet undogmatic viewpoints.²

Instructions

The Dogmatism Scale, and the test used in this research were preceded by instructions which were the same as those used with the California F Scale (one of the earliest authoritarian personality tests - 1950),³ viz.

The following is a study of what the general public thinks and feels about a number of important social and personal questions. The best answer to each statement following is your personal opinion. We have tried to cover many different and opposing points of view: you may find yourself agreeing strongly with some of the statements, disagreeing just as strongly with others, and perhaps uncertain about others. Whether you agree or disagree with any statement, you can be sure many people feel the same as you do.

Mark each statement in the space at the left according to how much you agree or disagree with it. Please mark every one. Write the following numbers depending on how you feel about it.

+1: I agree a little.
+2: I agree on the whole.
+3: I agree very much.

—1: I disagree a little.
—2: I disagree on the whole.
—3: I disagree very much.

1 Rokeach, M. op.cit. p.72.
2 ibid.
3 ibid. p.359.
4 ibid. p.72.

The Original Rokeach Scale, before modification, is shown in Appendix I.

Reliability

Reliability of the attitude test was established by creating a second set of questions, equal in meaning but different in wording, randomly interspersing these throughout the original set of questions, and conducting a correlation study on each pair as a split half test. The results of the test and development of the attitude instrument are given in Chapter Four.

Discrimination

Discrimination of the test was conducted by considering the results of each question individually across a group of respondents (for example, thirty answers to question one) with respect to the mean and the variance. Questions which did not exhibit a moderate degree of discrimination were rejected.

Questions Outside the Belief System

Fishbein noted that the method used in attitude testing 'should permit any belief in the hierarchy to be elicited, and it should not elicit beliefs that are not part of the person's belief system.'¹ To avoid this possibility, each question was discussed with a number of professional persons and with students who had completed the test. Questions that appeared to be outside the normal belief system of Kenyan youth were deleted. This purging included items identified as ambiguous according to Likert.²

Reactive Effect

Fishbein described the reactive effect amongst persons participating in any research programme.³ 'Subjects may form beliefs about the purpose

1 Fishbein, op. cit. p. 99.

2 Reference p. 36 of this report.

3 Fishbein, op. cit. p. 117.

of the experiment or about the experimenter's expectations; their responses may then be in part a function of these beliefs rather than of the manipulation itself.¹ Although Fishbein concluded that there was nothing that could be done about the phenomenon² the title in this case was changed from the Dogmatism Scale to the General Opinion Survey to avoid suggesting the purpose of the test to the subjects. Further, the reversal of favourable and unfavourable questions, approximately 50% of the time, had partially as its object the concealment of the purpose of the test.

Evaluation Apprehension

'Rosenburg, (1956) has argued that subjects that formed such beliefs,' (that their emotional stability or other factors are being assessed) 'will try to behave in the experiment in a manner they think will win the experimenter's approval.'³ He called this phenomenon 'Evaluation Apprehension'. In an effort to reduce this effect, the words were added to the preamble to the test, 'Give your own opinion, not what you think the author wants.'

Selection of Questions

Although the basic questions were taken from the Rokeach Dogmatism Scale, a number of additional questions were selected from the California F Test and the Gough - Sanford Rigidity Test.⁴ The California F Test is shown in Appendix J and the Gough - Sanford Rigidity Test is shown in Appendix K. Some further questions were compiled from questions that had been used in a study of young people in the secondary schools of Kenya and Tanzania.⁵

After the larger test of 78 questions was analysed with respect to reliability, validity, and discrimination, the test was reduced to a set of forty questions which in turn was used in comparative studies of groups from the K.T.T.C., the K.S.T.C, the Kenya Polytechnic, the University of Nairobi, and the technical secondary schools, both academic and technical teachers.

1 Fishbein, op. cit. p. 117.

2 ibid.

3 ibid.

4 Rokeach, M., op. cit. p. 416.

5 Prewitt, Kenneth, ed. Education and Political Values: An East African case study. Nairobi: East African Printing House, 1971.

Validation

Validation studies were conducted using both peer groups of students and teachers to identify subjects who were considered to be most oriented to change and innovation. A more complete discussion is given in the Procedure for the Development and Test of the Attitude Instrument later in this chapter.

ANALYSIS OF QUESTIONS

A critical analysis of individual questions in the attitude test instrument took place over a period of 18 months; from August 1976, until February, 1978, when the final forty question test instrument was devised.

Evaluation of Questions

Questions in the test instrument were either modified or deleted for one or more of several reasons:

1. On a correlation test the item and its matching item scored lower than 0.30 indicating that the item was not reliable. (0.30 represents the five percent significance level for a number of items between 30 and 45.)
2. The item did not show sufficient discrimination to make its inclusion effective. (An arbitrary minimum variance of 1.1 on a scale of 6 was used.)
3. On a validity test, the item scored lower than a 0.30 correlation using numerical values above and below the mean compared with persons chosen as closed-minded or open-minded.

Modification of Questions

Questions that did not meet with the above three criteria were analysed for English usage, English construction, cultural biases, and unclarities. The following persons, or groups of persons were enlisted on different occasions to critically examine each question:

1. An Education Officer (Technical) from the Ministry of Education.
2. A Kenyan medical doctor.
3. A teacher of Psychology of Education at the University of Nairobi.
4. Selected students in training at the KTTC.

Guidelines for item modification

Questions were analysed and modified according to a number of different criteria, the most notable of which were as follows-

1. Items that referred to American or European political or economic situations were revised to refer to Kenyan equivalents, or omitted.
2. Questions that had over-riding local connotations were rejected. This included questions that implied a certain respect for authority which would elicit a different answer than anticipated by the author.
3. Religious questions that frequently had difficult and subtle meanings were rejected.
4. Questions with double negatives were deleted.
5. Questions which put forward two ideas, either one of which may require an opposite answer were deleted. An example of this is, 'I never buy newspapers which are just propaganda.'
6. Questions that contained colloquial expressions that are not commonly used in the conversation of the respondents were deleted. An example of this is, 'Most people don't give a damn for others.'
7. Questions that appeared to be outside the belief system of the respondents were deleted. An example of this is, 'Most people are failures and it is the system that is responsible for this.'

Response Set

The original tests; the Rokeach Dogmatism Scale, the California F Test, and the Gough - Sanford Rigidity Test are all designed such that agreement with items leads to a high score, which in turn establishes a position on a dogmatism scale. Due to concern for 'Response Set' (the tendency for persons to always answer in a positive direction, or always answer in a negative direction) half the questions were inverted. With respect to this approach, Rokeach wrote, 'We have been generally unsuccessful in our attempt to construct statements

worded in the opposite direction.¹ The attempt in this thesis to construct statements worded in the opposite direction created a number of problems, some of which are dealt with under item modification.

Test Scoring

In the final scoring of the attitude tests it is first necessary to negate those questions which have been inverted. The sum of the scores from the forty questions, as with Rokeach, represents the score of the respondent.

PROCEDURE FOR THE DEVELOPMENT AND TEST OF THE ATTITUDE INSTRUMENT

The attitude test instrument underwent a number of tests, revisions and retests in the course of its development. A brief description of this process follows.

The Original Draft

The original instrument was almost identical to that given by Rokeach in his book² except for a few obviously necessary modifications. It was tested on a group of 17 students in the Industrial Education Teacher Training Course at the K.T.T.C. in September, 1976. This first draft of the General Opinion Survey is shown in Appendix L and a discrimination study made on it is shown in Appendix M

This same test was given two months later to the same group to provide documentation for a reliability study shown in Appendix N. At this stage of development it was considered unnecessary to submit the results for computer analysis. An estimated assessment was used.

1 Rokeach, M., op. cit. p. 405.

2 *ibid.* p. 73.

The First Revision

The original General Opinion Survey was revised using the comments given by the student respondents of that instrument, the advice of a professional person (in this case a Kenyan medical doctor) , and an education officer to identify English language usage that was unfamiliar and ideas that may have been outside the belief system of the respondents. At this time, also, in order to eliminate the phenomenon of Response Set, and to use the split-half method of reliability study, one half the questions were inverted to the negative, and a second set of questions using different words but similar meaning was created and interspersed with the original 55 questions (reduced from sixty six). Because of the length (now 110 questions) the test was divided into three tests which are shown in Appendix O.

This revised three part questionnaire was given to a group of 12 students (of which none were from the original group of 17) in the Industrial Education Teacher Training Course at the K.T.T.C. The questionnaire was examined for reliability.

While it was recognised that four persons completing each section of the questionnaire was far from adequate for statistical analysis, it was sufficient to identify difficulties in meaning through discussions with the students, and to permit changes and eliminations where necessary. No attempt was made at this stage to assess validity. A non-statistical assessment of the three part test is shown in Appendix P.

The Second Revision

A third attitude questionnaire was devised from the 110 questions consisting of 78 questions (39 questions with a second set of 39 questions equal in meaning for the split half study). This questionnaire was given to 35 students completing the one year Technical Teacher Training Course at the Kenya Polytechnic. A copy of this revision of the General Opinion Survey is found in Appendix Q.

Reliability study. A reliability study was conducted of the results of this third questionnaire by calculating the correlations between equivalent questions on the split half design. The University of Nairobi ICL computer with the ICL XDS3 Correlation and Regression Package was used.

Validation Study. The validation study was an attempt to identify a subgroup of the larger group considered by peers to be open-minded and a subgroup considered by peers to be closed-minded. At the completion of the General Opinion Survey, each student in the group was given a number from one to thirty three. These numbers were displayed prominently on the desks and they were written on the cover page of the questionnaire. (Names were not used in order to guard anonymity and to thereby elicit more realistic answers.)

Respondents were then asked to turn the questionnaire over and indicate the answers to two questions presented by the examiner. The group was told in general the purpose of the questionnaire. It was suggested that the purpose might be to assist in the selection of persons who would become good teachers, and to perhaps even determine from amongst practising teachers those who would become good teacher trainers. One of the fundamental characteristics of a teacher trainer in particular, is that he be open-minded to new ideas, ready to try out innovative and new ideas, and not be bound by tradition. That person need not necessarily be a strong leader. The characteristics of innovativeness and creativity, in this case, were considered most important. Respondents were then asked to identify and to indicate by number on the reverse side of the questionnaire, the one person within the group each one felt to be the most apt to fit that requirement.

Secondly, respondents were asked to indicate which one person in the group might be most apt to fit the opposite description, that of non-innovativeness and non-creativity.

A study was made of the total scores of the respondents in each of the two groups, comparing the difference between means of the two groups

The Third Revision

The General Opinion Survey was revised again, deleting some of the questions which had a reliability coefficient (correlation) lower than +0.30 and modifying others which appeared close to the acceptable limit. It should be noted that for 30 to 45 degrees of freedom approximately, the value of $r = +0.30$ is the critical value at the statistical 5% level of significance.

To supplement the remaining questions, further questions were selected from the California F Test, shown in Appendix J, the Gough Sanford Rigidity Test, shown in Appendix K and questions from a survey conducted by Kenneth Prewitt on socialisation in the schools in Kenya and Tanzania.¹ These questions were also reworded and half of them inverted to the negative to conform to the split half format. This fourth version, shown in Appendix R, was subsequently given to thirty six members of a class in Business Education Teacher Training at the K.T.T.C. in February, 1978.

Reliability study. The results of this study were similarly statistically analysed on the University of Nairobi ICL computer using the ICL statistical XDS3 Correlation and Regression package for reliability.

Validation study As in the case of the study at the Kenya Polytechnic, a validation study was conducted using the peer group as judges to identify open minded persons. In this case, the peers were asked to select only the innovative and creative persons, and not the negative of those characteristics to avoid asking students to report negatively on their fellows.

A further study was made using the teachers as judges, and in this case selections were requested from both the innovative and non-innovative respondents. The questionnaire completed by the teachers to make this selection is

1 Prewitt, K. op. cit.

shown in Appendix S. Validation was confirmed using the statistical t test for homogeneity of variance ¹ to substantiate that the instrument did, in fact, identify high and low innovative groups.

Because of the writer's intimate knowledge of this group of respondents from the K.T.T.C. in February, 1978, it was possible to have very detailed discussions on conflicting answers from the split-half study. The feedback from this detailed analysis was most significant in the selection of those questions for the final questionnaire. The number of questions was reduced from 78 to 40. It should be noted that Rokeach in his Opinion Studies used 40 questions frequently, and in some cases, 32 questions. ² The time taken to reply to 40 questions is close to the attention span of the respondents. The time for 78 questions is too great. There is a notable lack of application toward the end of the long test.

In order to use consistent data, the scoring on the specific 40 questions was selected from amongst the scoring on the 78 question test, and used for analyses, interpretations, and comparisons found in Chapter Four.

The Fourth Revision

The fourth and final revision of the attitude test instrument was used for the attitude studies related to hypothesis number two. This final Questionnaire is found in Appendix T. Using this version of the General Opinion Survey, the following studies were conducted:

1. K.T.T.C. on 8.2.78 - 36 second year Business Education Teacher trainees.³
2. The Kenya Polytechnic, 10.7.78 - 23 graduating teacher trainees from the one year Technical Teacher Training Course.
3. K.S.T.C. on 28.7.78 - 43 final year teacher trainees of the three year

¹ Chase, C. op. cit., pp. 164 - 165.

² Rokeach, M. op. cit., p. 93 and p. 95.

³ As previously noted, by selecting the data of the 40 questions on the final test from amongst the data of the 78 question test, statistical comparisons are possible with future tests.

Science Teachers Training Course.

4. Kabete Technical School, June, 1978, 30 teachers of both academic and technical subjects.
5. Machakos Technical School, June, 1978, 30 teachers of both academic and technical subjects.
6. Rift Valley Technical School, July, 1978, 15 teachers of both academic and technical subjects.
7. Kisumu Technical School, June, 1978, 33 teachers of both technical and academic subjects.

The results of the development and the application of these tests are given in Chapter Four.

CONCLUSION

The entire procedure for the study in individualised instruction and related attitudes extended over a period of thirty two months. The Research Proposal with sample individualised modules was submitted in November, 1975. The modules themselves were developed during the twelve months of 1976, and the study made during the 12 months of 1977. The EACE O level results were available for analysis and hypothesis testing in April, 1978.

The attitude study was conducted concurrently, and non-statistical information was gathered continuously until September, 1978.

The attitude instrument was first tested in September, 1976. Four revisions were subsequently developed, and studies with the final revision took place between February, 1978, and September, 1978.

CHAPTER FOUR

DATA ANALYSIS

The entire research project was conducted over a period of thirty four months during which time a large amount of both statistical and non- statistical data was compiled. This chapter is a presentation of both types of data and an assessment with respect to the two hypotheses contained in the proposal and in Chapter One.

STATISTICAL RESULTS AND ASSESSMENT

Individualised Instruction Modules Completed

A listing of the individualised instruction modules completed over the 12 month school year of 1977 is shown in Table 3.

An examination of Table 3 will reveal a large variation in the number of modules completed. The reasons for the variations are several and manifest themselves often only very subtly in discussions with teachers:

1. The modules which relate directly to the phase tests are the most relevant from the teachers' and students' points of view, and are usually done completely and at an early date. For example, modules 2, 3, 5, 8, 11, 14, 15, 17, 20, 27, show more than 20 completions. Engine Disassembly (2), Valves, (3) Engine Reassembly (11) Primary and Secondary Ignition (14 and 15), all pertaining to the two phase tests (valves and Ignition) are amongst the highest in completion.
2. Modules for which there is little or no equipment or specifications are usually omitted. For example, modules 7, 10, 12, 16, 18, 26 and 30 show less than 2 completions. Most workshops lacked:
 - (a) Crack detection and cleaning methods (Module 7)
 - (b) Viscosity meters (Module 10)
 - (c) Radiator Pressure Testers (Module 12)

TABLE 3

**INDIVIDUALISED INSTRUCTION MODULES
COMPLETED IN 12 MONTH STUDY**

MODULE	KABETE	STAREHE	KISUMU	MACHAKOS	RIFT VALLEY	TOTAL
1. Engine Overhaul Pretest	1	0	0	0	2	3
2. Engine Disassembly	6	3	6	6	8	29
3. Engine Valves	6	2	6	5	7	26
4. Camshaft	2	0	3	2	5	12
5. Engine Crankshaft	4	3	6	5	8	26
6. Pistons, Rods, Rings	4	1	3	4	8	20
7. Engine Cylinder Block Service	1	0	0	0	0	1
8. Engine Bearings	3	3	5	6	8	25
9. Engine Lubricating System	3	0	4	3	6	16
10. Lubricants and Fluids	0	0	0	0	0	0
11. Engine Reassembly	6	3	6	6	8	29
12. Engine Cooling System	0	0	0	0	0	0
13. Distributor	3	3	5	2	6	19
14. Primary Ignition Circuits	6	3	6	6	8	29
15. Secondary Ignition System	6	3	6	5	8	28
16. Chokes: Service and Adjustment	0	0	0	0	0	0
17. Removing and Installing Carburetors	4	2	6	5	8	25
18. Carburetor Overhauling	0	0	0	0	0	0
19. Automotive Bearings	1	0	3	2	5	11
20. Gear Box	6	3	6	5	8	28
21. Gear Identification	1	0	2	0	3	6
22. Differential Carrier Assembly	2	0	1	0	4	7
23. Clutch Service	3	0	2	1	2	8
24. Clutches	2	0	1	0	4	7
25. Steering Linkage	0	0	3	0	6	9
26. Steering Gears	0	0	1	0	0	1
27. Brake System	6	3	6	6	8	29
28. Brake System Repair	4	3	2	5	6	20
29. Brake Cylinders	4	0	2	5	2	13
30. Fuel and Vacuum Pumps	0	0	0	0	0	0
31. Servicing Automotive Batteries	4	0	5	1	3	13
32. Lighting and Accessory Circuits	1	0	0	0	2	3
TOTAL	89	35	96	80	143	443

- (d) Operational carburetors with chokes (Modules 6 and 18).
 - (e) Operational fuel and vacuum pumps (Module 30)
3. Modules with which the teacher is unfamiliar are usually deferred. These correspond to those listed in 2.
 4. Teachers preferred, in some cases, to teach the material to the class as a group in the traditional fashion. This placed a limit on the time available for work on the modules.
 5. When theory periods are designated on the timetable (4 out of 17 during the week) a classroom is usually set aside and the workshop is allocated to another group. This lack of time in the workshop limits the number of modules that can be covered by a student by about 20%.

More familiarity on the part of the teacher with the requirements of the modules, refinement of the modules, better shop organisation, and more effective time-tabling would permit more modules to be completed in the time available.

None of these requirements except refinement of modules would involve any cost. The result would almost certainly be more coverage of the course materials by the students, better understanding and greater motivation on the part of students.

Examination Results

The results of the E.A.C.E. examinations at the end of 1977 in the Motor Vehicle Technology course for the experimental and control groups are shown in Tables 4, 5, 6, 7 and 8. A statistical analysis of the null hypothesis is given in Appendix U, Calculations for Test of Significance.

Test of the Null Hypothesis - Theory Grades

The examination scores for both theory and practical studies were tested using the difference between means when observations are correlated between

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1. A statement of the null hypothesis is given on p. 9

TABLE 4

E.A.C.E EXAMINATION GRADES – AUTOMOTIVE TECHNOLOGY – EXPERIMENTAL AND CONTROL GROUPS

KABETE TECHNICAL SECONDARY SCHOOL

EXPERIMENTAL GROUP	THEORY *	PRACTICAL *	CONTROL GROUP	THEORY	PRACTICAL
E1	4	4	C1	6	5
E2	6	3	C2	8	5
E3	6	5	C3	9	8
E4	6	6	C4	8	6
E5	2	3	C5	6	4
E6	3	5	C6	3	4

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* These grades are the stanine grades used by the EACE assessors. Grade 1 is highest and grade 9 is a failure.

TABLE 5

E.A.C.E EXAMINATION GRADES – AUTOMOTIVE TECHNOLOGY – EXPERIMENTAL AND CONTROL GROUPS

KISUMU TECHNICAL SCHOOL

EXPERIMENTAL GROUP	THEORY	PRACTICAL	CONTROL GROUP	THEORY	PRACTICAL
E7	8	6	C7	8	3
E8	7	3	C8	5	8
E9	7	7	C9	8	6
E10	9	6	C10	8	3
E11	9*	9	C11	9	7
E12	6	7	C12	7	3

06

*Absent for examination. Grade based on mock examination and comparison with control group partner.

TABLE 6

E.A.C.E EXAMINATION GRADES – AUTOMOTIVE TECHNOLOGY – EXPERIMENTAL AND CONTROL GROUPS

MACHAKOS TECHNICAL SCHOOL

EXPERIMENTAL GROUP	THEORY	PRACTICAL	CONTROL GROUP	THEORY	PRACTICAL
E13	6	6	C13	6	5
E14	3	3	C14	5	6
E15	8	7	C15	9	7
E16	8	6	C16	9	3
E17	7	7	C17	8	8
E18	5	3	C18	3	7

TABLE 7

E.A.C.E EXAMINATION GRADES – AUTOMOTIVE TECHNOLOGY – EXPERIMENTAL AND CONTROL GROUPS

RIFT VALLEY TECHNICAL SCHOOL

EXPERIMENTAL GROUP	THEORY	PRACTICAL	CONTROL GROUP	THEORY	PRACTICAL
E19	5	5	C19	8	6
E20	4	6	C20	9	7
E21	7	6	C21	5	4
E22	8	5	C22	6	7
E23	3	6	C23	6	6
E24	3	6	C24	9	6
E25	3	5	C25	3	6
E26	9	6	C26	9	6

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TABLE 8

E.A.C.E EXAMINATION GRADES – AUTOMOTIVE TECHNOLOGY – EXPERIMENTAL AND CONTROL GROUPS

STAREHE BOYS CENTRE

EXPERIMENTAL GROUP	THEORY	PRACTICAL	CONTROL GROUP	THEORY	PRACTICAL
E27	7	6	C27	7	7
E28	8	3	C28	6	6
E29	8	3	C29	8	7

samples¹. The value of 't' for grades in the theory examination was calculated to be 2.44. The minimum value required for 't' at the 5% level of significance is 2.048². Chase states that when 'we have a very good reason to believe that our treatment will produce an effect in one direction only; then our conception of the world indicates that a one-tailed test is appropriate'³ in this case, the limiting value of 't' at the 5% level of significance is 1.701. In either case, the calculated value of 2.44 indicates a rejection of the null hypothesis. It is therefore accepted that there was a significant improvement in the theory grades of the experimental group as compared with those grades of the control group.

Test of the Null Hypothesis - Practical grades

The value of 't' for grades in the practical examination was calculated to be 0.95. This was below the minimum value of 't' at the 5% level of significance. Therefore, the null hypothesis, in this case, is accepted. There was slight improvement in the practical grades of the experimental group, but it cannot be attributed with any degree of certainty to the method of individualised instruction any more than to chance.

Analysis of Phase Tests

The practical grades dealt with here are calculated using an average of the grades on six phase tests extending over a two year period; three in Form Three and three in Form Four. Only two of these are in the Automotive skill area, the other four are in the Electrical and Mechanical skill areas. Any improvement or deterioration in the Automotive skill grade may well be negated by a change in the grades in the other two areas, reducing the validity of the final EACE practical grade as an indicator of skill improvement in the Automotive Technology course.

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1. Chase, C.I., op. cit., p. 167
 2. ibid. p. 172
 3. ibid. p. 243

To correct for this, a comparison was made of the two Automotive phase tests between the experimental and control groups. The comparison is shown in Appendix V. An analysis comparing the means of these two sets of grades using the t test indicates that the experimental group grades are significantly better than the control group grades at the 1% confidence level. H_0 (Hypothesis number one) is therefore rejected for practical grades as well as for theory grades. It can therefore be stated that there was a significant improvement in the practical work of the experimental group as compared with the control group.

Assessment of Individualised Instruction Results

These points are noted in assessing the objective results of the use of the individualised instruction modules:

1. On the average, each student participating in the experiment completed 15 individualised instruction modules out of a possible total of 32. This was low considering that the student had available about 612 periods during the three terms of Form Four in which to complete his work. The low number can be attributed to several factors:-
 - a. This was the first attempt at the experimental materials. It is to be expected that it would take more time than when the material and the method is more familiar.
 - b. Approximately 110 of those periods were not available to be used on the experimental materials. These periods were scheduled for theory which had to be taken by all students, including the experimental group, and the workshop was scheduled for other students.
 - c. Equipment supplies, specifications and related learning materials were either not available or had to be located, a situation which

consumed a considerable amount of time.

- d. The two phase tests for the Motor Vehicle course were held during regular teaching periods, a fact which not only caused the loss of several periods for the student, but even a greater loss of time for the teacher who was not then able to give the students direction, grade the post and pretests, or in general keep the experiment moving.
- e. In some cases the teacher preferred to teach some sections of the course of study by the traditional group method, thereby repeating some of the experimental material and reducing the time available for the individualised work.

2. Consideration of the EACE O level examination grades in the Motor Vehicle course Theory Section, indicated that there was a significant improvement (at the 5% level of confidence) for those students using the experimental individualised instruction materials. A number of influencing factors should be noted:

- a. There was undoubtedly a Hawthorne Effect. The 29 students using the experimental materials knew they were using special materials, that they were being studied as to their results, that they were expected to achieve more highly, and, as a result, they were highly motivated. There is no way to measure the effect of this phenomenon, and few ways to counteract it. The fact that the experiment extended over a period of three school terms,

during which some of the novelty of the method would be exhausted, would undoubtedly serve to reduce that Hawthorne Effect. Other counterbalancing effects are noted.

- b. In a number of cases, teachers using the experimental materials used some materials which they considered to be particularly relevant for the teaching of the entire class. On occasion they allowed entire modules to be used. The result was to reduce the difference in achievement between the two groups, although probably raising the overall achievement level.
- c. The lack of sufficient reference material in the schools reduced the amount of reading to a level below that required by the modules and thereby held down the possible achievement level of the students in the experimental group.
- d. The experimental materials need to be revised to be more in line with the requirements of the EACE examinations. The need to include sketching and labelling of certain parts has been noted. Such modification would again increase the possible achievement of the students in the experimental group.
- e. There was almost no use of such software material as films, slides, film strips, wall charts, posters, models or audio tapes. They were, in fact, omitted from the module to avoid confusion. The development, production and use of some of these would serve again to raise the achievement of the experimental group. While they would serve to improve the learning of all students, they would be more effective with those of the experimental

group because of their use at the precise moment when problems and questions have been presented.

3. Consideration of the two Automotive phase tests indicated that there was a very significant improvement in the practical work of the experimental group as compared with that of the control group. A number of factors should be noted with respect to that.
 - a. The individualised instruction modules were designed to be as practical as possible, requiring the student in almost every case to conduct some practical work and report his findings. This required a workshop with a large number of work stations for individuals. In most cases the number of stations would be one for each student in the experimental group plus an extra to allow for self pacing, and two to allow the remainder of the class to continue in the traditional learning method. At a school with six in the experimental group, the number of stations required would be nine. The workshops are not set up in this way. To do so would be costly and involve some planning and work. The lack of sufficient work stations was a detriment to the practical aspect of the research. With better work stations, the improvement in practical work would have been greater.
 - b. Although equipment in the workshops has been improved both in quality and quantity by the S.I.D.A. project, there was still a considerable shortage. For example, almost all workshops were lacking specifications for much of the equipment, radiator pressure gauges, ring ridge removers, valve grinders, plastigage, etc., all of which were required on the list of minimum equipment prepared by the KIE panel for the Motor Vehicle Curriculum. In the traditional group learning method, the students are told the information that will be required for the written portion of the

practical examination. The guided discovery method as used in the experimental materials requires a full range of equipment, supplies, and resources for its effective operation. This lack was a limiting factor to better grades.

- c. The traditional large group method of teaching dwells almost exclusively on that aspect of practical learning that will be required of the students on the phase tests: viz, the cylinder head and valves, the ignition system, and welding. (Welding is at present taught in the Motor Vehicle shop although not part of the course of study, but is being removed). The experimental individualised instruction teaches the practical work associated with all items in the scheme of work, not simply the two areas to be examined. The method of assessment does not include any method to measure this additional learning on the part of the students in the experimental group. A random selection of two tests, rather than a fixed sampling would create a more valid assessment and would probably create higher grades in the experimental group.
- d. The final grade in the Theory Section is determined entirely by the final examination. All improvements in learning throughout the year will be reflected fully in the examination. On the other hand, the final grade in the Practical Section is determined by a weighted average of six phase tests over two years. The measurement of practical skill improvement for this report has been based on only the two relevant Automotive phase tests, which has made the calculation more valid, but still leaves room for improvement. The two phase tests being considered are conducted in June and in September. At the time of the first test, any improvement due to the experimental method will be more measurable, but its full effect would not be entirely measurable until the end of the

12 month period. Therefore, while there was a very significant improvement in the practical work of the experimental group, that improvement might have been greater had the measurement been final rather than the average of two earlier tests.

Power of the Individualised Instruction Method

A comparison of the experimented and control group grades, both theory and practical is given in Table 9. The theory grades are those from the EACE O Level examination and are on the stanine scale (1 highest and 9 failure) averaged for each participating school, and for the overall of each group of 29 students.

The practical grades are an average of the two relevant Automotive phase tests given in June and September of the Form Four year. The grades are in a percentage figure averaged for each participating school, and for the overall of each group of 29 students.

The percentage improvement is calculated by subtracting the control group grades from the experimental group grades and comparing with the control group grades.

The following comments are noted:

1. The power of the experimental materials to improve grades is shown, in general, by the overall percentage improvement. In theory grades, the improvement was 14% which represented one stanine grade (7.0 to 6.0) In practical grades the improvement was 11%. It must be noted that the stanine grades are not all of equal interval (9 is a failure and represents a large interval) and precludes a direct comparison of the 14% and 11% figures.
2. The largest improvement shown was in the theory grades at Kabete. This may have been a reflection of the fact that the development work had been conducted at Kabete, creating a headstart in familiarity with the materials, and the fact that Kabete is situated in Nairobi and received more

TABLE 9

COMPARISON OF THE EXPERIMENTAL AND CONTROL GROUP GRADES
AUTOMOTIVE THEORY AND PRACTICAL

	THEORY			PRACTICAL		
	Experimental Stanine	Control Stanine	Improvement Percent	Experimental Percent	Control Percent	Improvement Percent
KABETE	4.5	6.7	+33	75.8	75.1	+ 1
KISUMU	7.7	7.5	- 3	60.7	53.1	+14
MACHAKOS	6.2	6.7	+ 7	68.2	52.8	+29
RIFT VALLEY	5.3	6.9	+23	57.8	54.6	+ 6
STAREHE	7.7	7.0	- 10	73.3	68.0	+ 8
OVERALL	6.0	7.0	+14	65.6	59.3	+11

visits from the writer. On the other hand this school suffered more than others from a teacher shortage and lack of equipment. Both situations are reflected in the low practical improvement (1%).

3. There were two deteriorations in theory grades; at Kisumu (-3% and at Starehe (-10%). Starehe figure may have been a reflection of the fact that the teacher was untrained but a skilled craftsman, not strong in ability to deal with theory, but capable in craftsmanship. No explanation is offered for the Kisumu grade.
4. An analysis was made of the improvement in both theory and practical grades by the one highest student and the one lowest student in each school, based on the Form Three grades. The result indicated for the group of five highest students an improvement of 7% in theory and 13% in practical grades. For the lowest group of 5 students the improvement was 9% and 19%. The poorer students achieved the greater improvement in both cases, and appreciably so in practical, much higher than the average of 11% improvement.

Statistical Results of the Attitude Study

Results of Reliability Studies. Reliability studies of early prototypes of the test instrument have not been included in this report. The final test instrument had four reliability and validity studies made. These were:

1. K.T.T.C. 22.2.78. From the third revision of the test, 40 questions were selected for the fourth and final revision, and were used in this reliability and validity experiment involving 36 students.
2. The Kenya Polytechnic, 10.7.78. Twenty three completing students from the one year Technical Teacher Training course were used in this reliability and validity experiment.
3. K.T.T.C., 18.7.78. Thirty students, completing the first year of the three and a half year Technical Teacher Training Programme were used in this experiment.

4. The Kenya Science Teachers College, (K.S.T.C.) 28.7.78. Forty three students from the final year of the three year Science Teachers Training course were used in this experiment.

The results of the Four Correlation Studies on the Attitude Test Instrument using the split-half method to determine reliability are given in Table 10. The mathematical analysis was conducted on the University of Nairobi ICL Computer model 2901 using the ICL XDS3 Correlation and Regression software package.

Results of Validation Studies. Validation studies were conducted on the same four groups as were reliability studies. With the K.T.T.C. study of 22.2.78 both the teachers and the peers were used as judges to establish a reference with which to compare the numerical results. In the other three tests only the peers were used as judges.¹ The statistical calculations of the results of these validation studies are given in Appendix W, and the compiled results are given in Table 11, Validation Study, Comparison of Innovative and Non-innovative Groups.

In all cases the one tailed *t* test was used² and all cases were significant at the 5% level. Two of the cases were significant at the 1% level of confidence. It is accepted, therefore, that the attitude test instrument does, in fact, measure orientation to change and innovation.

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1. Rokeach believed that peers were a more reliable measure of each other's character than were professors in front of whom students often showed a different character than their real one. Reference Rokeach, *op. cit.*, p. 106.
 2. Chase recommends the one tailed test when the outcome is anticipated in one direction. Reference Chase, *op. cit.*, p. 172. Rokeach, *op. cit.*, p. 104, used the one tailed test for his validation studies.

TABLE 10

RESULTS OF FOUR CORRELATION STUDIES
ON THE ATTITUDE TEST INSTRUMENT

Question No.	Test No.			
	1	2	3	4
1 - 12	0.36	0.47	0.40	0.60
2 - 35*	0.40	0.48	0.45	0.22
3 - 15*	0.37	0.35	0.45	0.30
4 - 36	0.35	0.42	0.57	0.14
5 - 16	0.64	0.46	0.34	0.62
6 - 38	0.35	0.53	0.52	0.75
7 - 18*	0.33	0.30	0.49	0.37
8 - 39*	0.35	0.70	0.54	0.36
9 - 20	0.55	0.81	0.69	0.62
10 - 40*	0.46	0.80	0.34	0.19
11 - 21	0.47	0.57	0.58	0.48
13 - 23	0.32	0.36	0.58	0.46
14 - 24	0.34	0.61	0.48	0.50
17 - 29	0.48	0.15	0.43	0.38
19 - 30*	0.42	0.69	0.04	0.11
22 - 31*	0.38	0.49	0.43	0.42
25 - 32*	0.36	0.59	0.55	0.44
26 - 33*	0.31	0.59	0.43	0.66
27 - 34*	0.44	0.61	0.45	0.35
28 - 37	0.29	0.42	0.31	0.42

* Pairs of questions so marked have been inverted.

Test No. 1 - K.T.T.C. 22.2.78

Test No. 2 - K. P. 10.7.78.

Test No. 3 - K.T.T.C. 18.7.78.

Test No. 4 - K.S.T.C. 28.7.78

TABLE 11

VALIDATION STUDY

COMPARISON OF INNOVATIVE AND NON-INNOVATIVE GROUPS

TEST	NO. OF RESPONDENTS	INNOVATIVE GROUP		NON-INNOVATIVE GROUP		HYPOTHESIS TEST RESULT	CONFIDENCE LEVEL
		Mean	S.D.	Mean	S.D.		
K.T.T.C. 22.2.78	36	-9.54	20.5	10.6	16.2	t = 2.54	Significant at 1%
KENYA POLYTECHNIC 10.7.78	23	0.2	7.4	14.8	18.3	t = 2.27	Significant at 5%
K.T.T.C. 18.7.78	30	0.0	16.2	12.6	13.2	t = 2.10	Significant at 5%
K.S.T.C. 28.7.78	43	-4.57	11.40	8.55	17.9	z = 2.51	Significant at 1%

*t is used for a population of 30 or less and z for a population of more than 30. For KTTC, the population was not 36 but 22, 11 in each sub-group compared.

Test of Null Hypothesis - Attitudes

The statistical test of hypothesis number two consisted of a study of the results of the attitude test from seven separate groups of persons:

1. Practising technical teachers in secondary schools.
2. Practising academic teachers in secondary schools.
3. Technical teacher trainees at the KTTC, who had spent several years in industry and were on a one year pedagogical course.
4. Science teacher trainees at the KSTC in the final year of a three year course.
5. Technical teacher trainees in the first year of a three year course at the KTTC.
6. Business education teacher trainees in the second year of a three year course at the KTTC.
7. Sociology students in the third year of a three year Arts course at the University of Nairobi.

The results of these tests are compiled in Table 12, Attitude Study - Comparative Orientation To Innovation of Technical Teachers and Non-Technical Teachers. A statistical z test to examine the difference between means of the groups has indicated that there does not exist a significant difference between the the means of the practising technical teachers and any other group. The technical teachers show less inclination to innovation than the other groups, but it is not significant at the commonly accepted 5% level of confidence. The null hypothesis is therefore accepted. The mathematics for this analysis is contained in Appendix X, Calculations-For the Test of Hypothesis Number Two.

TABLE 12

ATTITUDE STUDY

COMPARATIVE ORIENTATION TO INNOVATION OF
TECHNICAL TEACHERS AND NON-TECHNICAL PERSONS

GROUP STUDIED	NO. OF RESPONDENTS	MEAN	S.D.
Technical Teachers	47	4.20	16.1
Academic Teachers	37	1.55	18.2
Technical Teacher Trainees (1 year course.)	23	3.78	15.2
Science Teacher Trainees (3rd year)	43	3.58	17.2
Technical Teacher Trainees (1st year of 3 year course)	30	4.32	19.1
Business Education Teacher Trainees (2nd year)	36	1.30	17.4
Non-Teacher Professionals in Training	31	-2.63	15.5

Assessment of the Attitude Study

The following points were noted as a result of the findings of the attitude study:

1. Four studies were made of the final version of the attitude test to determine reliability. There were forty questions in a split-half configuration (ie. 20 questions with 20 other equivalent questions in a scrambled mode). In every case but one, the correlations exceeded + 0.30, the figure that determines a significant correlation at the 5% confidence level for a population of between 30 and 45. In the case where two correlations were less than +0.3, the average was greater than +3.0 and the questions were accepted as reliable.
2. Both the reliability studies and the validation studies were conducted on groups of students numbering 36, 23, 30 and 43. It was accepted that a total of 133 respondents was sufficient to ensure a degree of confidence in the results¹.
3. Although the early versions of the attitude study contained between 66 and 78 questions, the final version of the instrument contained 40 questions which was accepted as sufficient for the study².
4. The same four groups were used for the validation studies as were used for the reliability studies. A total of 133 was accepted as sufficient for such a validation study. The one tailed t test and the one tailed z test were used to examine the difference between means.³ All four tests showed that the differences between means for the innovative and non-innovative groups were significant at the 5% confidence level. Two of the comparisons were significant at the 1% confidence level. The groups were first tested for homogeneity of variance.⁴ External validity was considered not to be a problem in this type of study.⁵

1 Rokeach, op. cit., p. 102. Rokeach used 13 subjects judged to be high and 16 subjects judged to be low in dogmatism for his validation study.

2 A discussion of the number of questions required is found in this report on p. 53

3 Chase, op. cit., p. 172 and Rokeach, op. cit., p. 104. Rokeach used the one tailed test in his validation studies.

4 Chase, op. cit., p. 165.

5 External validity is discussed in this report on p. 54.

5. In the study of comparative orientation to innovation and change, the number of respondents in each group varied from 23 to 45 with an average of 37. The analysis of variance indicated that the technical teachers were from the same population as the others, and a comparison of the means for technical teachers as a group with each of the other groups, academic teachers, teachers in training and undergraduate Arts students, indicated that there was less inclination to change and innovation on the part of the technical teachers but not enough to be significant.
6. The purpose of the attitude study was not discussed with respondents at any time prior to the administration of the instrument, and anonymity was maintained in every case in order that both Demand Characteristics and Evaluation Apprehension should be kept to a minimum.

NON-STATISTICAL RESULTS AND ASSESSMENT

A number of non-statistical studies were conducted concurrently with the statistical attitude studies. Questionnaires were given both to the student participants in the individualised instruction experiment, and to the teachers involved in the experiment. The attitudes of administrators and users of the experimental materials were noted.

Questionnaire for Students of Experimental Materials

A copy of the questionnaire given to the 29 students on the experimental materials, toward the end of the school year, is found in Appendix G 'Questionnaire for Student Users of Experimental Material'. The compiled results of the questionnaire are given in Table 13 'Results of Questionnaire From Student Users of Individualised Instruction'.

It is noted that in response to some of the questions some students gave more than one point so that the numerical addition of the scores did not always equal 29.

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TABLE 13

**RESULTS OF QUESTIONNAIRE FOR STUDENT USERS
OF INDIVIDUALISED INSTRUCTION MODULES**

Questions	Comments	No. of Responses
1. I have completed modules. Average of 16.		29
2. The text books are helpful. Which books?	Yes	17
	Somewhat	12
	No	0
	Mudd	29
	Hillier - Pittuck	0
3. The attachments are... Comments: - American terminology - Wide reading helps a great deal - Helps to answer questions - Contains general information also - Pictures are not clear - Summary is good	Good	26
	Mediocre	3
	Useless	0
		1
		3
		4
		6
		2
		5
	4. The worksheets are . . . Comments: - Good for practical and theory - Designed in the right order	Helpful
Mediocre		0
Poor		0
		3
		1

TABLE 13 (continued)

Questions	Comments	No. of Responses
	Add other things to look at	2
	Help to answer questions on terminal exams	2
	Cannot find enough information	6
	Should be summarised	1
	Not enough text books	8
	We only read them and do not do practical work	1
	Language needs to be simplified	2
5.	The biggest problem I have is . . .	
	There are not enough tools	18
	There is not enough equipment	13 *
	Shortage of reference books	15
	Module refers to things I cannot understand because I have not seen them	1
	The module makes me work harder but I learn more	1
	The modules are difficult to understand	2
6.	The thing I like best is . . .	
	I learn more by reading and seeing	2
	It makes me to refer to more books	3
	I learn more by working alone	10
	I get more practical work	8
	I gain extra useful information	5
	I like working at my own speed	2
	I cover more work practically and theoretically	2
* Some respondents gave more than one point.		

Assessment of Questionnaire for Student Users of
Experimental Materials

The following assessment is made of the answers from the 29 student users:

1. The statement that 'the text books are helpful' drew responses of 17 useful, 12 somewhat, and nil not helpful. Had the students been using a craft oriented book, it would have been found considerably more useful and students would have noticed the difference. The text books were technician oriented while the course was craft oriented.
2. The four volume text book by Mudd was found in class sets in all the schools. The book by Hillier and Pittuck was found only in limited numbers in the schools, and at times the most recent edition was lacking. This was a large factor in students favouring the former text.
3. The similar high score for the value of the attachments should also be interpreted with respect to the students' familiarity with such materials. There was some feeling from the teacher users and from the teachers at Sagana Technical School who studied the materials in some detail that the attachments were above the Form Four level of comprehension. Most of the attachments were from Stockel, Auto Service and Repair, with permission of the publisher¹. The American terminology and references undoubtedly added a degree of difficulty to materials that were written for upper high school level in the United States. The fact that the students indicated the material was very helpful probably underlines their lack of comparable reference material.

1. Stockel, M. op. cit.

4. The worksheets were considered helpful by all 29 students. Since the worksheets were based on the readings from Stockel, Crouse, Motor's Encyclopedia and the manufacturers' specifications, there could not help but be some degree of difficulty. It was reported by teachers that students were very diligent in trying to answer the questions of the worksheet, but could not always find the information in their texts. Some modification will be required in this area should the material be used again.
5. There was a lack of supplies and equipment in the workshops. It had been recommended that teachers attempt to have tools from local commercial establishments demonstrated in their classes, or that, alternatively, the classes visit local workshops or colleges. This was not easy to accomplish for schools not in the vicinity of such establishments, and commercial firms are not very willing to conduct this kind of non-profit exercise.
6. It is notable that without soliciting certain answers, students gave many of the commonly held advantages of individualised instruction:
 - a. More outside reading accomplished.
 - b. References made to more books.
 - c. Better learning by individual work.
 - d. More practical work.
 - e. Better learning at individual rates.
 - f. Greater breadth to learning.
 - g. More work covered in a given time.

Questionnaire for Teachers of Experimental Materials

A copy of the questionnaire was given to the teacher users of the experimental materials, after the end of the school year but before the EACE examination results were out, is found in Appendix G, questionnaire for Teacher Users of Experimental Material'. There were a few changes in the teaching staff during the period of the study. The Department Head, Motor Vehicle, at Machakos Technical School was transferred to Nyeri Technical School at the end of the second term. The experiment was continued by his successor. The Head of Department submitted a questionnaire. His successor did not. The second teacher of the Motor Vehicle course at Kabete Technical School completed his contract at the end of the first term, and the second teacher at Rift Valley Technical School completed his contract at the end of the experimental year. Neither of these completed a questionnaire. A total of six questionnaires was completed.

Assessment of the Questionnaire for Teacher Users of Experimental Materials

The results of the questionnaire for teacher users of the individualised instruction are found in Table 14. The following assessment is made of the answers given by the six teacher users.

1. One third of the questions used in this questionnaire were inverted to counteract the tendency for some respondents to answer more frequently and more strongly in the affirmative. Notwithstanding this, all questions were answered in such a direction as to give positive support to the use of the experimental materials.

TABLE 14

**RESULTS OF QUESTIONNAIRE FROM
TEACHER USERS OF INDIVIDUALISED INSTRUCTION**

<p>1. Individualised instruction has helped my students in the Motor Vehicle course to learn more effectively.</p> <p style="text-align: center;">Average + 1.8:</p> <p>Comments:</p> <ul style="list-style-type: none"> - Particularly sections for which tools were available. - Some boys became very good because of it. - Effectiveness was reduced due to lack of tools and equipment.
<p>2. Individualised instruction could be used to teach students in other courses more effectively too.</p> <p style="text-align: center;">Average + 1.8</p> <p>Comments:</p> <ul style="list-style-type: none"> - May be good in mechanical and electrical. - The principle is good.
<p>3. Individualised instruction is too difficult to use in the Motor Vehicle course.</p> <p style="text-align: center;">Average - 2.2</p> <p>Comments:</p> <ul style="list-style-type: none"> - It can be used at any level.
<p>4. Students are more highly motivated when they use the individualised instruction modules.</p> <p style="text-align: center;">Average + 1.8</p> <p>Comments:</p> <ul style="list-style-type: none"> - Students are motivated when they get results on their own.
<p>5. The pretests and post-tests are not very helpful.</p> <p style="text-align: center;">Average - 0.3</p>

TABLE 14 (continued)

<p>Comments:</p> <ul style="list-style-type: none"> - Questions should be as in E.A.E.C. questions including sketching of diagrams.
<p>6. Students who did not use the individualised instruction modules wanted to use them.</p> <p style="text-align: center;">Average + 0.2</p> <p>Comments:</p> <ul style="list-style-type: none"> - Yes, but not enough modules were supplied and two teachers were not enough to cope.
<p>7. Students who use the individualised instruction modules get more practical experience.</p> <p style="text-align: center;">Average + 2.1</p> <p>Comments:</p> <ul style="list-style-type: none"> - However, expenses increase as students do more practical work.
<p>8. The administration of my school encouraged the use of the modules.</p> <p style="text-align: center;">Average - 0.8</p> <p>Comments:</p> <ul style="list-style-type: none"> - Yes, but did not support funds to those areas they claimed were not on the syllabus. - I think the administration encouraged their use but were not familiar with what they contained.
<p>9. The modules were able to be understood satisfactorily at the form four level.</p> <p style="text-align: center;">Average + 1.6</p> <p>Comments:</p> <ul style="list-style-type: none"> - They were good for those who have read widely. - Modules should be introduced in form three so that students are prepared for them at form four.

TABLE 14 (continued)

<p>10. More research and development on the modules would be a waste of time.</p> <p style="text-align: center;">Average - 2.8</p> <p>Comments:</p> <ul style="list-style-type: none"> - No, there needs to be more material and there needs to be a seminar of all teacher users to improve the content. Perhaps S.I.D.A. or C.I.D.A. would provide funds for its development.
<p>11. The attachments to the modules were helpful to the students.</p> <p style="text-align: center;">Average + 1.4</p> <p>Comments:</p> <ul style="list-style-type: none"> - Correct, they enable the students to read. - Clearer copies of the material would help.
<p>12. There are more problems with children misbehaving in class when individualised instruction is used.</p> <p style="text-align: center;">Average - 2.0</p> <p>Comments:</p> <ul style="list-style-type: none"> - No, it depends.
<p>13. Students who use the modules do more reading out of class.</p> <p style="text-align: center;">Average + 2.6</p> <p>Comments:</p> <ul style="list-style-type: none"> - It depends upon whether or not the students have enough text books available.
<p>14. I personally would like to use individualised instruction for all students in the class.</p> <p style="text-align: center;">Average + 2.4</p> <p>Comments:</p> <ul style="list-style-type: none"> - If the number of students in the class could be reduced to 18, they could be used in two groups.

TABLE 14 (continued)

Please write any other comments you have about the use of this method of teaching below.

1. Very much in favour of individualised instruction but feel co-ordination is necessary so that resources, ie. modules, reference texts, manuals and attachments do not turn to be just another literacy course due to lack of proper tools, equipment, supplies and units or component parts required in carrying out worksheets of the modules.

It is in this field of resources where more research and development is very much needed since without the necessary resources the modules will fail in achieving their objectives.

2. I found the students involved in this programme developed a very good sense of purpose. This resulted in the students being dedicated and confident that they could do a job.

Personally, I believe the programme was more positive than the conventional method when teaching the automotive course.

3. I would be interested in the opinions of other teachers about the need for a general seminar on the individualised instruction.

4. More research is required, especially in the area of diagrams to be used. Those attached to the modules were not very helpful to students because they were not clear at all.

There is no difference between pretest and post-test. This also requires some improvement.

Generally, the modules can be used with a well organised workshop with enough equipment and tools.

2. Tools, equipment, and supplies were a limiting factor, a fact which was substantiated many times in personal discussions and was stressed by the students.
3. The Automotive Technology course had been chosen for this research because it was believed that it would lend itself most readily to individualised instruction and that it encountered the greatest number of problems in being taught in the traditional manner. This belief was reinforced.
4. Teachers were convinced that the materials were not too difficult for use by students at the Form Four Level.
5. Teachers confirmed what the advocates of programmed instruction have always maintained, that the effect of success in one step would supply the motivation to continue to the next step, and that the confidence gained would increase the chances of future success. Motivation was high.
6. Teachers confirmed the need to rework the pretests and posttests. While there was moderate agreement that they were useful, they need to conform more closely with the requirements of the EACE O level examinations.
7. The method of copying the material for module attachments was not good enough to produce clear copies in every case, a fact which created a degree of frustration amongst students in the experimental group.
8. Teachers agreed on the whole that there were no discipline problems with students using the experimental materials. The lack of tools and equipment as well as the lack of manufacturer's specifications created a degree of frustration for the users, which may have been construed to be a lack of discipline.

9. There was strong agreement that students do more reading out of class when they are using individualised instruction in spite of the fact that there was often a lack of related materials:
10. There was strong agreement that teachers would like to use individualised instruction for all their students, but the proviso was in one reply that the class size should be smaller.
11. There was some feeling that students developed more of a purpose in their learning while using the individualised instruction .
12. The lack of a forum for technical teachers where ideas, experiences and problems might be shared was notable in many of the answers given by the teachers.
13. Some teachers commented on the similarity in pretests and posttests.
This may have indicated a lack of understanding that the purpose of the pretest is to discover whether or not the student has enough knowledge of the learning package to permit him to skip it and continue on with others where he is in greater need . The pretests were deliberately designed in this manner.

Attitudes of Administrators

The Headmasters of all five schools were very receptive to any methodology which they believed would enhance learning. The writer's visits to the schools were welcomed, and two of the Headmasters sought out regular verbal reports on the use of the experimental materials. All teachers concerned reported verbal support from their Headmasters; two reported a deeper concern from Headmasters, and one reported a lack of understanding or appreciation for what the methodology was.

The two inspectors of technical subjects expressed interest in the research and the methodology, although both expressed doubt as to the effectiveness of individualised instruction.

The Educational Technology Panel of the Kenya Institute of Education at its meeting of July, 1977, heard a report on the progress of this research. The report was received. No follow-up action was planned and little interest was exhibited. Until the date of this writing the Educational Technology Panel has not held a meeting.

Attitudes of Users

The results of the questionnaire for student users of the experimental materials have been discussed. At each of the five schools involved in the research the writer held periodic meetings with the students of the experimental group. Without fail, there was a high degree of interest and commitment shown on the part of the students. In every case, the lack of specifications, the lack of equipment and supplies, and the shortage of relevant reference books were noted. There were many requests for more handouts and attachments to the modules. Some lack of confidence was expressed in working alone on machines with only a written guide, but after the early stages, this did not appear to be a factor. Many students felt that the materials could benefit from a revision to conform more closely to the EACE examinations and that some of the modules could be combined with other similar modules to reduce the overall number. A majority of the experimental group felt that it was wasteful for them to have to attend classes during the three theory periods when the material had been previously covered in the modules and when they could be profitably working on their practical exercises in the workshop areas.

In general, attitudes toward this type of educational technology on the part of student users were very positive.

The results of the questionnaire for teacher users of the experimental materials have been discussed. It was apparent from the first of the research that teachers had little understanding of or appreciation for the concepts of individualised instruction and programmed learning. After in-service training on the use of the individualised instruction, teachers made some very positive steps to proper use of the materials, but continual monitoring of the programme revealed that teachers tended to allow the participants to work in twos or threes which tendency had to be corrected. In some cases, where the worksheets of the modules were particularly relevant, the teachers reproduced them for use by the entire class, thereby negating some of the experimental results although probably improving overall class results as previously noted.

Some apprehension was expressed by teachers at having to be prepared for questions from many diverse areas of study at any one time and for questions from areas of study where they may not have felt confident. More concern was noted for the lack of specifications for equipment. The use of the individualised materials among six to eight students in the class, along with traditional teaching methods for the rest of the class created substantially more work for the teachers, and this was frequently noted. Disappointment was expressed more than once with the lack of supplies which precluded some aspects of the individualised instruction.

In general, teachers accepted the use of the experimental materials with reservations at first, but increasingly with a better appreciation for the type of learning technology as more interest and understanding was shown

- by their students. All teachers involved answered the questionnaire and all teachers expressed positive attitudes along with their suggestions for improvement.

Assessment of Administrators and Users of Experimental Materials.

The following assessment is made of the non-statistical findings related to students in the experimental group, teachers, headmasters and administrators involved with the experimental materials.

1. The average number of individualised modules completed by students of the experimental group was 16 out of a possible 32. This is an acceptable number for the first attempt considering the factors that prevent maximum effectiveness:
 - a. Phase tests consumed up to 8% of the possible time.
 - b. Duplicate theory classes consumed up to 18% of the remaining time available.
 - c. There was a loss of time in the start up of the programme in January while teachers were familiarising themselves.
 - d. There were many shortages of tools, equipment and supplies.
 - e. There was a shortage of related reading material.
 - f. Worksheets did not relate directly in every case to the available text books, causing a loss of time for searching assigned questions.
 - g. Teachers were not always able to solve problems, mark tests, or assign new modules efficiently due to unfamiliarity with the method and with the materials.

2. The fact that motivation amongst students of the experimental group remained high during the entire year indicates the presence of a degree of Hawthorne Effect. This effect is probably negated by the use of some of the experimental materials by the control group.
3. There was some loss of effectiveness for the experimental materials due to the failure to require methods of answering that were common with the EACE O level examinations.
4. The teachers concerned were entirely unfamiliar with the methods and concepts of programmed instruction and individualised learning. Within the five schools involved in the research three of the teachers were quite enthusiastic and diligent with the experimental materials. The others required encouragement and monitoring. Considering the additional workload involved in conducting the experiment with a small group of students while continuing traditional teaching with the remainder of the class, all teachers were cooperative and obliging. All teachers answered the questionnaire and several offered valid constructive comment. If the Ministry of Education were to undertake a large scale programme of this type, there is every indication teachers would respond positively provided they were given good support and encouragement.
6. All headmasters concerned were hospitable and encouraging although they were largely unfamiliar with the methodology. Several enquired regularly about the progress of the programme.. Most teachers commented that headmasters were not concerned enough to increase recurrent expenditures in the automotive technology by way of support. Any undertaking by the Ministry of Education to expand this type of teaching would require

a great deal of planning and public relations with the senior administrative staff at all secondary schools. The success of any experiment would depend on the commitment made on the part of these personnel.

8. There was virtually no interest shown by the Technical Section nor by the Educational Technology Panel of KIE. Any plan by the Ministry of Education to implement individualised instruction on a larger scale would meet with a considerable amount of disinterest at this level. A very thorough programme of initiation into individualised instruction would be required to enlist the support and produce involvement at this level.
9. The Technical and Industrial Section of the Inspectorate expressed interest in the individualised instruction, but offered very little in the way of constructive criticism of the individualised modules when requested. When the O level results indicated that the learning methodology did, in fact, produce a significant improvement, very little interest was expressed. The concern of the Inspectorate, however, for the implementation of other technologies and training of teachers suggests that with some direction it would support any learning methodology that would improve the quality of the technical school graduate.

In general, most of the users and administrators encountered in the development of the research were obliging, lacking in understanding about the concepts of individualised instruction, and quite skeptical of the ability to produce better results without a substantial improvement in the quality of teachers and a significant expenditure on tools, equipment and supplies. At the basic learning level, enthusiasm and support was the highest, and diminished increasingly at each subsequent level of educational administration.

CHAPTER FIVE

CONCLUSIONS, DISCUSSION, RECOMMENDATIONS

AND

SUGGESTIONS FOR FURTHER STUDY

The main purpose of the study was to investigate the implications (including student achievement, required training of teachers, curriculum revision, attitudes of students, teachers and administrators, and costs) of the introduction of individualised instruction into the Secondary Technical School Motor Vehicle Technology Course at the Form Four level.

The results and the assessment of results are contained in Chapter Four. This chapter contains the conclusions from those results, recommendations, and suggestions for further study.

CONCLUSIONS

The following conclusions are given in the order in which they relate to the two hypotheses.

Hypothesis Number One

There will be no significant improvement in practical application, retention, or motivation of Form Four students in the Motor Vehicle Technology Course for Secondary Technical Schools when the method of instruction is individualised instead of traditional.

Individualised Instruction

A set of 32 individualised instruction modules, corresponding to the Ministry of Education Scheme of Work for the Form Four Motor Vehicle Technology course was developed, tested and distributed to five technical secondary schools (Kabete, Starehe, Machakos, Rift Valley and Kisumu) for use in the teaching programme over a period of one school year. The materials were tested by an experimental group of 29 students, groups of three to eight from each school. The groups comprised students of all ability levels. A control group of 29 students, matched individually to the experimental group on the basis of Form Three grades, continued

its Form Four studies in the traditional manner. The O level EACE examination results from both groups were compared.

At the end of the 12 month period an average of 16 modules had been completed by each student in the experimental group, during a total of 612 Motor Vehicle periods, making 38 periods (approximately two weeks) for the completion of one module. A number of factors had reduced the possible number of modules completed. The timetable allowed only 13 out of 17 periods in the shop when the individualised instruction could be followed. Teachers frequently chose to teach the class in the traditional fashion, delaying the work of the experimental group, and the phase tests, twice during the year, consumed a large number of working periods. In the final analysis the modules required on the average about 25 periods each to complete, a figure that could be reduced by more familiarity with the materials and more appropriate organisation of the Motor Vehicle shop.

The EACE examination results for theory were used as the instrument to measure retention. The improvement in grades for the experimental group as compared with the control group was one stanine grade point (grade 7.0 to grade 6.0) representing a 14% improvement, and an improvement over the control group that was statistically significant at the 5% level of confidence.

The EACE practical grades were rejected as a valid instrument to measure practical improvement because this grade was the weighted average of six phase tests over a two year period, only two of which were relevant to the Motor Vehicle course. Instead, the average of these two relevant Motor Vehicle phase tests was used. The result indicated an 11% improvement in the experimental group compared with the control group which was statistically significant at the 1% level of confidence. Several factors were identified which prevented a larger improvement on the part of the experimental group. The two phase tests were conducted in June and in September, about half way through the school year. Had the tests been at the end of the year as the theory examinations were, the difference would have been more marked and would have been a better reflection of

the improvement created by the experimental materials. Further, the students in the control group spent a large proportion of practical work time on exercises related to the two phase tests while the members of the experimental group experienced a much larger cross-section of the practical requirements from the Scheme of Work. Had the phase tests been two random tests out of a larger selection of tests the control group grades would, in all probability, have been lower, and the difference between the experimental and control group grades would have been a more valid measure of learning.

The average cost per student to achieve this improvement was KS325.00 based on total costs divided by 29 experimental students. However, enough materials had been produced to allow all Form Four Motor Vehicle students to engage in the individualised method. Assessed on this basis, the cost would have been KS47.00 for each of the 201 students in the five schools.

A number of weaknesses were discovered in the individualised instruction modules. The written materials were vulnerable to dirt, oil and grease. There were insufficient worksheets, pretest sheets and posttest sheets. The wording of the modules and the attachments was sometimes difficult for Form Four students, and the tests lacked some of the types of questions common to the EACE examinations.

Questionnaires completed by teacher and student users of the experimental material indicated that morale was higher amongst the members of the experimental group. In general, students of the experimental group did more outside reading than did other members of the class, and discipline problems were less. The questionnaires also identified several problems encountered by the experimental group such as lack of equipment, lack of specifications and lack of resource reading materials.

The physical layout of the workshop areas did not allow for the best use of the experimental materials: they were arranged for group instruction. A redesign of the workshop into about 20 work stations to conform to the needs of individualised instruction would improve the results.

The teachers demonstrated a marked lack of understanding of the concepts and methods of programmed and individualised instruction. On the job training in this respect by the writer tended to off-set this shortcoming, but training in these methods in the initial teacher education courses would improve the final results.

Note was made of the fact that there was a Hawthorne effect but that it was off-set to a degree by the use on some occasions of the experimental material by members of the control group. This was particularly true of the multiple choice tests at the end of most modules which were convenient for revision purposes.

It was notable that the poorer students, as indicated by their Form Three grades, had the greater improvement in both theory and practical grades, but especially in practical grades. The group of the highest students (one from each school) had improvements of 7% theory and 13% practical compared with the group of five lowest students (one from each school) who had corresponding improvements of 9% and 19%. These results indicated that the advantages of individualised instruction were not limited to any particular capability group.

On the basis of these findings, hypothesis number one was rejected.

Hypothesis Number Two

'Teachers of technical subjects will show no significant difference in attitude toward change and innovation than teachers in other subject areas or than non-teacher professionals.'

The Attitude Study

An attitude test instrument was developed to measure the comparative orientation to innovation and change of technical teachers, academic teachers and other non-teacher professionals. The instrument was a composite of 40 questions largely from the Rokeach Dogmatism Scale supplemented with a few from the Gough-Sanford Rigidity Test and the California F Test, divided into two equal sets of 20 questions for purposes of split-half comparison, and with 50% of the questions inverted to neutralise the effect of Set in subject answering.

After preliminary testing to remove cross-cultural effects, four reliability and four validation studies were conducted using both teachers and peers as judges of the qualities of orientation to change and innovation in the subjects.

Tests of comparison conducted at KTTC, KSTC, the Kenya Polytechnic and the University of Nairobi indicated that technical teachers have a lower inclination to change and innovation than others, and in some cases a very marked difference, close to the 5% level of significance.

It must be noted, however, that the usually accepted level of confidence (that the difference is not due to chance) is 5%. Had it been 6%, the hypothesis would have been rejected on the basis of comparison with the third year University students. These limits are arbitrary. By agreement of researchers, when the element of chance as a cause of a statistical difference becomes 5% or less, it is accepted that another factor has caused the statistical difference. In this study the element of chance is a 6% possibility. The fact of a real difference in attitudes exists is a 94% possibility. While low inclination to change cannot be statistically proven, neither can the possibility be ignored.

Although the cooperation of teacher users of the experimental materials was high, a great deal of encouragement and monitoring was required, a fact which is supported by the results of the attitude study. The resistance to such innovation in the technology of education increased in proportion to the distance administrators were from the classroom and shop.

Headmasters exhibited little understanding of the philosophy of individualised instruction but they were willing to support any methodology that would improve the learning process particularly if it did not involve budget considerations or personal involvement. The Automotive Teachers felt, in general, that the Headmasters did not support them in their efforts to use the individualised instruction, particularly with respect to funds for recurrent needs. There was a decided lack of communication amongst technical teachers from different schools in speciality subject areas. The need was frequently expressed for an organisation amongst teachers that would permit and encourage the exchange of problems and ideas. There was little support shown for this methodology of learning on the

part of the Inspectorate or the Kenya Institute of Education.

It was evident that the implementation of any innovative programme such as individualised instruction in the technical schools would require a very serious concurrent programme on the part of the Ministry of Education to produce a commitment to such change at all levels of teaching and administration.

On the basis of the statistical findings hypothesis number two was accepted. There was, however, enough other evidence to indicate that the hypothesis should be used only with reservation.

DISCUSSION

Two significant movements in the development of education internationally have influenced this research: first the need for greater consideration of the economics of education in skill training areas, and secondly, the increasing need for a better, more scientific consideration of the technology of learning, in its most recent form; the systems approach to learning using all the findings of the educational psychologists on effective cognitive and behavioural learning patterns.

This dissertation has attempted to contribute to both areas. It is evident from the results that the method of individualised instruction has the power to improve the learning, both practical and theory, in the Motor Vehicle course, and probably in other technologies as well. Based on the costs considered in this research, an improvement of one stanine grade in the Motor Vehicle Technology course theory and practical could be achieved for about KS47.00 per student. This cost would be reduced and the improvement would be increased in subsequent years due to factors that have been discussed elsewhere in this thesis.

Concern has been expressed by educators as to whether the place for skill training should be in the secondary school, or whether it should be left to industry or the specialised Ministry of Labour Training Institutes.¹ Concern has also been expressed that if it is retained in the secondary schools, the natural tendency to raise future job expectations would force the curriculum to become less craft-oriented and more technician oriented. The result would be to produce the type

1. King, Kenneth, *op. cit.*, 1977, pp 81 ff.

of skilled person industry does not want, and will not employ. Most industry wants basic skilled craftsmen. Industry will select and train its own managers from amongst these craftsmen. If the secondary schools can offer the kind of broad basic skill training that is saleable to industry for final specific skill training in a short time, it is a viable thing. The method of individualised instruction requires an increasing reliance of the student on himself and his ability to question and search, to proceed on his own, to read more widely than required by the traditional approach, and finally to personally and individually do practical work. The result should be to produce a student with good skill, but also the ability to assess his skill, improve it on his own, understand how it relates to other skills, and in general to have a broader base, and be more trainable by industry than his counterpart, and ultimately to be the material from which the higher levels of manpower are selected. But initially, the skill training should be of the type industry can use and is prepared to hire.

The tendency of the secondary school course to move from craft orientation to technician and technologist orientation is very real as more work goes into theory at the expense of practical work. These programmed instruction modules used in this study are designed with the practical aspect in mind, and were they used seriously they would produce a much more practical bias than is now evidenced in the schools.

Just as significant as the measurable grade improvement produced by the introduction of the modularised material would be the probable side effects of its introduction, which would have a multiplying effect on results. The attachments to the modules would alleviate to a degree the dearth of resource reading material. The visits of inspectors to the schools to help with the implementation of the learning technology would have a motivating effect on the teachers. The necessity of improving the modularised instruction through meetings of users at KIE would offer the much needed forum for Automotive Teachers for the exchange of ideas, problems, and solutions. The requirements of students for speci-

fications and special tools will make teachers and administrators more aware of shortages which cannot as easily be ignored as when the teaching method is traditional. The practical work required covers the entire syllabus and not simply that work associated with the two phase tests. Students are required to read more, question more, solve problems on their own, and in general become more self-reliant in their learning, a fact which will produce better graduates and more successful teachers.

Should the result of this improved performance and satisfaction serve to stem the flow of technical teachers from the profession to industry, even moderately, it will have made a significant contribution to a solution of the economic problem of technical education.

According to the popular taxonomy of educational objectives as proposed by Benjamin Bloom¹ there are three major categories of learning; Cognitive, Affective, and Psychomotor. The traditional type of learning in the Motor Vehicle shop tended to stress limited Psychomotor learning and lower Cognitive learning (knowledge, understanding and application). The individualised instruction used in this research attempted to embrace more of the taxonomy than the traditional method. The requirement for each student to work independently, making decisions himself, searching for answers in the library or elsewhere, developing self-motivation and discipline and using the teacher only as a resource person tended toward the type of personality development, and more mature relationships with teachers and peers contained in the Affective Domain. Growth in the Affective Domain is difficult to teach, usually being achieved by example or as in this case by style of methodology. Evaluation in this domain is difficult and conducted only occasionally.

This requirement also forced each student to personally use tools and equipment effectively rather than as in group learning, allowing him to watch a

¹ Bloom, Benjamin S. Taxonomy of Educational Objectives. New York. David McKay, 1956, 1971.

teacher or peer use the tools and equipment. This very important aspect assured growth of the student in the Psychomotor Domain. The worksheets continually placed the student in a problem-solving situation, not taking anything away from lower Cognitive learning, but pressing him into higher aspects of analysis, synthesis and evaluation. The learn-by-rote criticism that has often been made of secondary school education has been to some degree reversed by this technology of learning.

The establishment of the effectiveness of the individualised instruction method of teaching may lead to enquiries into the best mix of individualised learning, individualised learning in pairs and traditional learning to be most effective. Research may be encouraged into the use of this type of instruction in the other technologies in Secondary Schools, Harambee Schools and Polytechnics. The use of the methodology will encourage the development of more complete libraries of teaching aids such as booklets, filmstrips, slides, audio tapes, charts, jackdaws of information for individual rather than class use. The modification of the Automotive shops into the work station arrangement would increase the effectiveness of the learning. All of these related factors could be a part of the solution to the high costs of technical education.

RECOMMENDATIONS

Based on the findings of both the statistical and the non-statistical studies, and the conclusions drawn from those findings, the following recommendations are made:

1. The Ministry of Education should endorse the use of individualised instruction in the Automotive Technology Course at the Form Four level in the Technical Secondary Schools.
2. The Ministry of Education should reinforce this endorsement with strong and committed leadership and support through the Inspectorate, K.I.E., and administrators.

3. Teachers should be encouraged to use the individualised instruction materials and to experiment with them to achieve optimum results - ie., using students in pairs instead of individually, integrating some parts with the traditional approach, encouraging student small group seminars, enlisting outside resource persons, etc.
4. The use of technicians should be encouraged to assist teachers using the individualised instruction materials.
5. Workshops in the Automotive Technology area should be reorganised in the work station concept conducive to the individualised instruction method.
6. The Inspectorate should mount in-service training courses designed to teach the use of individualised instruction materials and Teacher Training Colleges should include individualised instruction in their curricula.
7. Encouragement should be given to the development of national professional subject councils within the Kenya National Union of Teachers or within the Ministry of Education for the exchange and development of ideas and motivation.
8. The Kenya Institute of Education should undertake to revise, reprint, and disseminate the modularised instructional materials making maximum use of teachers who have used the materials in the field.
9. The K.I.E. should undertake a continual examination of these particular materials and of the methodology of individualised instruction to make it more effective in the nation's schools.
10. The equipment, tools, supplies and written resources necessary for the effective use of the individualised materials should be identified and efforts made to procure them. In this regard the Swedish International Development Agency which is involved in this development programme should be consulted.

SUGGESTIONS FOR FURTHER STUDY

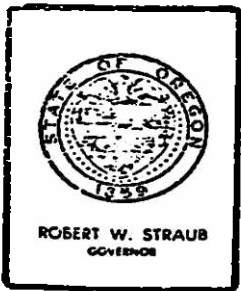
This research, specifically directed to the two hypotheses, has revealed a number of areas where further research might profitably be conducted. The following areas are noted:

1. Studies should be conducted to further refine the adjunct type of programming used in the individualised modules. Language levels, technical expressions, relevant types of questions, and performance objectives are a few possible areas of need. Workshops for teacher users and specialists in curriculum development are recommended.
2. Studies should be further conducted to identify the best method of integration of individualised instruction, traditional methods of instruction and special methods of instruction.
3. Studies should be made into the possibility of students using individualised type of learning, but working in pairs.¹ This could possibly increase the confidence of students without reducing the effectiveness, and it may reduce the cost by reducing the required number of work stations.
4. Studies should be conducted into the use of individualised instruction in other technologies such as electrical, mechanical, and building construction.
5. A study should be conducted to consider the use of the results of the post-tests and worksheets from the individualised instruction modules as a replacement for the three fixed phase tests presently used for assessing practical work. These results could give a better measurement of achievement and in much less time.
6. The attitudinal test instrument should be further refined and studies made of its possible use as an instrument to assist in the selection of students for technical teacher training and of technical teachers for training as technical teacher educators.

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APPENDIX: A

PERMISSION TO USE STATE OF OREGON
DEPARTMENT OF EDUCATION
INDIVIDUALISED INSTRUCTION MODULES



State of Oregon
DEPARTMENT OF EDUCATION
942 LANCASTER DRIVE N.E., SALEM, OREGON 97310

August 9, 1978

Mr. Ronald H. Balsdon
P. O. Box 44600
Nairobi, Kenya

Dear Mr. Balsdon:

Per your request of August 1, 1978, permission is granted for you to reproduce 32 of our individualized learning modules in Automotive Technology.

Cordially,


Donald Austen
Curriculum Specialist

DA:jt

APPENDIX B
THE AUTOMOTIVE ENGINEERING SCHEME OF WORK AND TEACHERS GUIDE, PART C

DEFINITION OF TOPIC	THEORY	PRACTICE
<p>1.1.1 Describe reasons for using more than one cylinder at a time as well as advantages and disadvantages of different engine types according to</p> <p>(a) Number and arrangement of cylinders</p> <p>(b) Valve arrangements.</p>	<p>2.1.1 Discuss reasons for multicylinder engines including</p> <p>(a) brake power</p> <p>(b) balance</p> <p>(c) rpm</p> <p>2.1.2 Discuss advantages and disadvantages of different cylinder arrangements including</p> <p>(a) in line arrangements</p> <p>(b) V type</p> <p>(c) horizontal</p> <p>(d) radial</p> <p>2.1.3 Discuss advantages and disadvantages of different valve arrangements including</p> <p>(a) side valve</p> <p>(b) overhead valve</p>	<p>3.1.1 Externally examine engines having different cylinder and valve arrangements. Note differences and be able to identify each type.</p>

DIVISION OVERHAUL PROCEDURES

DEFINITION OF TOPIC	THEORY	PRACTICE
<p>1.1.2 Discuss General Procedures for engine dismantling, inspection, assembly and running adjustments on a spark ignition and/or compression ignition engine.</p> <p>(NOTE: This is to be a general treatment and not specific detailing of individual components of overhaul as outlined in following topics)</p>	<p>2.1.2.1 Discuss basic differences between two and four strokes engines as well as between spark and compression ignition engines including:</p> <ul style="list-style-type: none"> (a) differences in fuel systems (b) differences in ignition systems (c) differences in valve gear (d) differences in size of parts and materials between spark and compression ignition engines <p style="text-align: center;">.../3</p>	<p>3.1.2.1 Visually examine 2/4 stroke and spark/compression ignition engines to review differences.</p>

DIVISION OVERHAUL PROCEDURES (contd.)

DEFINITION OF TOPIC	THEORY	PRACTICE
	<p>2.1.2.2 Outline basic engine overhaul procedures including</p> <ul style="list-style-type: none"> (a) Importance of cleanliness and protection of parts so they are removed. (b) Safety: electrical, fuel, personal and safety of other people. (c) Removal and replacement of electrical components. (d) Draining, removing and replacing of cooling system components. (e) Removal and replacement of fuel system components. (f) Removal of lubricants. (g) Removal and replacement of engine from vehicle including separation of engine from transmission. (h) Removal and replacement of engine parts including cleaning and use of torque wrenches. (i) Instruction on correct tightening procedure to ensure correct clearance and where applicable tightening sequences. 	<p>3.1.2.2 Remove engine from chassis dismantle and maintain correct procedures during dismantling, inspection and reassembly of 2/4 stroke spark ignition and/or compression ignition engine</p>

DIVISION OVERHAUL, VALVES

DEFINITION OF TOPIC	THEORY	PRACTICE
<p>1.2.1 Detailed description of different types of valve gear and component parts.</p>	<p>2.2.1 Describe and identify each part of the valve gear including:</p> <ul style="list-style-type: none"> (a) camshaft (b) valve lifters (c) crankshaft and camshaft sprockets (d) timing chain/chain tensioner (e) valves (f) push rods (g) rocker arms (h) valve springs and retainers (i) cylinder head including parts and valve seats (j) oil galley (k) valve guides and oil seals <p>The description should include reference to each of the components and its use in different types of valve gear.</p> <p style="text-align: center;">.../3</p>	<p>3.2.1 Examine valve components in a partially disassembled engine. Note relationships between parts and overall operation.</p>

DIVISION OVERHAUL, VALVES (contd.)

DEFINITION OF TOPIC	THEORY	PRACTICE
<p>1.2.2 Describe and demonstrate basic overhaul procedure for an overhead valve assembly engine</p>	<p>2.2.2 Describe and demonstrate, using correct tools, the inspection and maintenance procedures for valve train components including:</p> <ul style="list-style-type: none"> (a) Valve cleaning, head cleaning and checking (b) identifying valve damage (c) grinding valves and valve seats (d) testing valve springs (e) push rod service (f) checking camshaft wear (visual) (g) checking cam gear (sprocket) wear (h) cleaning + checking valve lifter (i) head tightening procedures (j) setting valve clearances (k) checking valve guides. 	<p>1.2.2 Overhaul an overhead valve cylinder head of a spark ignition and/or diesel engine completing all operations outlined and demonstrated under 2.2.2.</p>

DIVISION OVERHAUL, ENGINE BLOCK

DEFINITION OF TOPIC	THEORY	PRACTICE
<p>1.3.1 Describe and identify different features of engine blocks and component parts</p>	<p>2.3.1 Describe and identify the following features of an engine block</p> <ul style="list-style-type: none"> (a) block assembly (b) oil passages (c) water passages (d) oil and water galley core plugs (e) bearing supports <p>This description should include reference to varying arrangements of parts on different types of engine blocks.</p>	<p>3.3.1 Examine engine blocks to identify various features of the engine block</p>
<p>1.3.2 Describe and demonstrate maintenance procedures for engine blocks</p>	<p>2.3.2 Describe and demonstrate using current tools, the inspection and maintenance procedures for engine blocks including</p> <ul style="list-style-type: none"> (a) checking for cylinder wear (b) cleaning and inspecting engine block (c) cylinder service - ridge removal and honing (d) removing + replacing sleeves 	<p>3.3.2 Inspect and perform required maintenance procedures on an engine block</p>

DIVISION OVERHAUL, PISTON ASSEMBLIES

DEFINITION OF TOPIC	THEORY	PRACTICE
1.4.1 Describe and identify parts of the engine piston assembly	2.4.1 Describe and identify the following components of the piston assembly including <ul style="list-style-type: none"> (a) piston and piston features (b) piston rings (c) gudgeon pin (d) connecting rod (e) oil gallery (f) connecting rod small end bearing 	3.4.1 Examine piston assembly and identify various components. Note differences between different piston types
1.4.2 Describe and demonstrate maintenance procedures for piston assemblies	2.4.2 Describe and demonstrate, using correct tools, the inspection and maintenance procedures for piston assemblies including <ul style="list-style-type: none"> (a) piston removal and dismantling (b) cleaning and inspecting pistons (c) fitting piston rings and installing pistons in cylinders (d) measuring clearance between piston and cylinder wall (e) checking removal and replacement of small end bearing 	3.4.2 Inspect and perform required maintenance on a piston assembly including checking of piston fit in cylinder, and installing piston in cylinder.

DIVISION OVERHAUL, CRANKSHAFT AND BEARINGS

DEFINITION OF TOPIC	THEORY	PRACTICE
<p>1.5.1 Describe, and demonstrate maintenance and inspection procedures for crankshafts</p>	<p>2.5.1.1 Describe and identify main components of crankshaft including:</p> <ul style="list-style-type: none"> (a) main bearings (b) connecting rod bearings (c) crankpins (d) oil passages (e) thrust bearing surfaces (f) oil seals and oil retainers <p>2.5.1.2 Describe and demonstrate procedures for: cleaning crankshaft, checking, crankshaft journals for out of round, taper and wear using an outside micrometer</p>	<p>3.5.1 Identify parts of crankshaft and complete inspection of a crankshaft including measurement of wear on crank pin and journal</p>
<p>1.5.2 Describe and demonstrate shell bearing inspection and maintenance procedures</p>	<p>2.5.2.1 Describe the main components of shell bearings including: types of materials used, methods of lubrication, oil clearances and allowable wear tolerances</p> <p>2.5.2.2 Demonstrate</p> <ul style="list-style-type: none"> (a) removing and replacing shell bearings on a crankshaft (b) checking bearing clearances with plastigate (c) replacing oil seals 	<p>3.5.2 Remove, inspect, check tolerances and replace main, connecting rod shell bearings.</p>

DIVISION COOLING SYSTEMS

DEFINITION OF TOPIC	THEORY	PRACTICE
<p>1.6.1 Description and comparison of two major types of engine cooling systems.</p>	<p>2.6.1 • Describe and compare air and water cooling systems for engines including reference to specific parts as applicable including:</p> <ul style="list-style-type: none"> (a) fan and fan drives (b) coolant types (c) coolant pumps (d) thermostats and methods of regulating temperature (e) coolant flow through system (f) types of engine materials and design for cooling e.g. fins (g) radiator construction <p>• Simple treatment only</p>	<p>3.6.1 Inspect air and water cooling systems to identify parts.</p>
<p>1.6.2 Description and demonstration of maintenance of cooling system components.</p>	<p>2.6.2 Demonstrate maintenance of air and water cooling system components including:</p> <ul style="list-style-type: none"> (a) cleaning of the interior and exterior of the system (b) pressure testing a water cooled system (c) testing thermostats (d) dismantling a water pump (e) checking and adjusting fan belt tension 	<p>3.6.2 Perform maintenance and inspection procedures on an air and water cooled system as outlined in 2.6.2</p>

DIVISION LUBRICATION

DEFINITION OF TOPIC	THEORY	PRACTICE
<p>1.7.1 Description of the basic properties and classification of lubricants Refer to the selection of lubricants for various conditions and purposes in the motor vehicle engine, gearbox and chassis.</p>	<p>2.7.1.1 Discuss the main function of oils</p> <ul style="list-style-type: none"> (a) Coolant (b) Lubricant (c) Cleaner <p>2.7.1.2 Discuss the desirable properties of oils used in engine, gearboxes and differentials.</p> <ul style="list-style-type: none"> (a) Viscosity rating (b) Detergent (c) Corrosion inhibitor (d) Foam inhibitor (e) Heat and pressure resistance <p>2.7.1.3 Discuss the selection of oils for different engine types and for use in gearboxes. Refer to the suitable selection of viscosity rating for each condition</p> <p>2.7.1.4 Demonstrate procedure for checking and changing engine and gearbox oil</p>	<p>3.7.1 Select appropriate engine oils, gearbox lubricants and greases for a given motor vehicle and check and/or change lubricants as necessary</p>

DIVISION FUEL SYSTEMS (Contd.)

DEFINITION OF TOPIC	THEORY	PRACTICE
	<p>2.8.1.3 Describe in detail the operation, testing and maintenance of fuel pumps including</p> <ul style="list-style-type: none"> (a) description of all parts (b) tracing fuel flow (c) testing and replacing diaphragm and spring (d) testing fuel pump pressure 	<p>3.8.1.3 Disassemble, reassemble and test a fuel pump.</p>

DIVISION FUEL SYSTEMS (C.I. ENGINE)

DEFINITION OF TOPIC	THEORY	PRACTICE
<p>1.8.2 Identify and describe the components of a compression ignition engine fuel system and demonstrate testing of selected components</p>	<p>2.8.2.1 Identify and provide a basic description of the following diesel engine fuel systems:</p> <ul style="list-style-type: none"> (a) jerk pump system (b) distributor system <p>2.8.2.2 Identify and provide a basic description of a jerk pump or distributor system including:</p> <ul style="list-style-type: none"> (a) fuel tank (b) fuel filter (c) fuel pump (d) high pressure pipes (e) injectors (f) return-pipes (g) governor <p>Include in discussion visual checks for damage or wear.</p> <p>2.8.2.3 Describe and identify differences between single, multi, pintaux and pintle hole injectors and demonstrate testing and maintenance procedures including:</p> <ul style="list-style-type: none"> (a) removal of injector (b) cleaning holes (c) testing and adjusting injector pressure. 	<p>1.8.2.1 Identify different types of systems in the school workshop</p> <p>1.8.2.2 Identify components of a diesel fuel system and make visual inspection for wear and/or damage</p> <p>1.8.2.3 Remove, clean, test adjust injection pressure and replace an injector</p>

DIVISION FUEL SYSTEMS

DEFINITION OF TOPIC	THEORY	PRACTICE
<p>1.8.3 Discuss characteristics of fuels and their effect on engine performance</p>	<p>1.8.3.1 Discuss the basic composition of automotive engine fuel. Discuss specific characteristics and the effect on engine performance including:</p> <ul style="list-style-type: none"> (a) Volatility (b) anti-knock value (c) octane rating (d) fuel additives 	

DIVISION ELECTRICAL SYSTEMS

DEFINITION OF TOPIC	THEORY	PRACTICE
<p>1.9.1 Describe the basic function of the major electrical circuits on a motor vehicle</p>	<p>2.9.1 Describe the function and major components of the following automotive electrical equipment.</p> <ul style="list-style-type: none"> (a) storage battery (b) starting motor circuit (c) charging circuit (d) ignition circuit (e) lighting circuits (f) accessory circuits 	<p>3.9.1 Identify the different circuits on a motor vehicle and trace each circuit components.</p>
<p>1.9.2 Describe and demonstrate maintenance procedures for electrical cables, connectors, fuses and switches</p>	<p>2.9.2 Describe and demonstrate the maintenance of electrical components including:</p> <ul style="list-style-type: none"> (a) a discussion of cable sizes and current carrying capacity (b) advantages of stranded vs. single wire cable (c) demonstrate cable joints using soldered connections (d) demonstrate cable joints using different types of connectors (e) a discussion of switch types including: mechanical, magnetic and vacuum (f) inspection and replacement of fuses and circuit breakers (g) colour coding. 	<p>3.9.2.1 Make up cables using different types of connectors and using soldered joints.</p> <p style="text-align: right;">.../17</p>

DIVISION ELECTRICAL SYSTEMS (Contd.)

DEFINITION OF TOPIC	THEORY	PRACTICE
		3.9.2.2 Select cables for various purposes 3.9.2.3 Inspect and change fuses and switches 3.9.2.4 Trace electrical faults.

DIVISION ELECTRICAL SYSTEM - LIGHTING

DEFINITION OF TOPIC	THEORY	PRACTICE
<p>1.9.5 Describe the components and operation of a typical lighting circuit</p>	<p>2.9.3.1 Identify and describe the operation of the following components of a lighting circuit (simple treatment)</p> <ul style="list-style-type: none"> (a) headlights (b) high beam indicator (c) dip switch (d) circuit breaker (e) parking lights (f) ammeter (g) battery (h) instrument lights (i) tail lights (j) brake lights and switch <p>This discussion should include a description of the operation of the system on a wiring diagram</p> <p>2.9.3.2 Demonstrate methods of tracing electrical faults in a lighting circuit</p>	<p>3.9.3 Identify the components of a lighting system on a vehicle and change bulbs/headlights as necessary</p> <p>3.9.3.2 Trace electrical faults in a lighting circuit</p>

DIVISION ELECTRICAL SYSTEMS, IGNITION

DEFINITION OF TOPIC	THEORY	PRACTICE
<p>1.9.1 Identify and describe the 7 components of a coil ignition system including the interrelationships and operation of those components</p>	<p>2.9.4.1 Describe and identify the following components of a coil ignition system:</p> <ul style="list-style-type: none"> (a) Battery (b) Switch (c) Resistor or Resistance Wire (d) Coil (e) Distributor including: cap, rotor, points condenser, cam and advance mechanisms (f) High Tension Leads (g) Spark Plugs <p>2.9.4.2 Describe and demonstrate the operation of the coil ignition system including:</p> <ul style="list-style-type: none"> (a) Flow of current through the primary circuit (b) Relationship between the primary and secondary circuits in the coil and distributor, theory operation (c) Flow of current through the secondary circuit (d) Ignition timing (e) Operation of vacuum and centrifugal advance mechanism 	<p>3.9.4.1 Identify components of a coil ignition system</p> <p>3.9.4.2 Note the operation of the ignition system on a model or on a running engine.</p>

DIVISION ELECTRICAL SYSTEMS, IGNITION

DEFINITION OF TOPIC	THEORY	PRACTICE
<p>1.9.5 Describe and demonstrate the adjustment, maintenance and testing of the coil ignition system.</p>	<p>2.9.5 Describe and demonstrate the maintenance, checking and adjustment of the coil ignition system including:</p> <ul style="list-style-type: none"> (a) Cleaning, setting and testing spark plugs (b) Cleaning and setting contact points using feeler gauges (c) Testing of condensers (d) Testing of high tension wires (e) Visual inspection of all ignition system components (f) Setting of ignition timing (g) Checking operation of vacuum and centrifugal advance mechanisms 	<p>1.9.5 Complete inspection, maintenance, adjustment and testing of ignition components on an operational engine</p> <p>NOTE: ENGINE must be test run before and following maintenance.</p>
<p>1.9.6 Identify the components of a lead-acid storage battery and describe the construction and purpose of each part.</p>	<p>2.9.6.1 Describe and give the purpose of the following lead-acid battery components:</p> <ul style="list-style-type: none"> (a) Battery chemicals (electrolyte) (b) Plates, both negative and positive (c) Separators (d) Container (e) Terminal posts and connectors <p>2.9.6.2 Describe the chemical action and activity in a lead-acid battery</p>	<p>3.9.6 Identify components of a lead-acid battery on a cut-away model</p>

DIVISION ELECTRICAL SYSTEMS - IGNITION (Contd.)

DEFINITION OF TOPIC	THEORY	PRACTICE
<p>1.9.7 Describe and demonstrate the inspection, maintenance and testing of a lead-acid storage battery</p>	<p>2.9.7 Describe and demonstrate the following battery maintenance procedures:</p> <ul style="list-style-type: none"> (a) Battery cleaning procedures (b) Checking electrolyte (c) Checking with hydrometer (d) Checking with high discharge tester 	<p>3.9.7 Complete full maintenance and testing of a battery including both cleaning and testing with a hydrometer and high discharge tester.</p>

DIVISION CLUTCH

DEFINITION OF TOPIC	THEORY	PRACTICE
<p>1.10.1 Description of the principles and components of a dry plate clutch and demonstrate correct procedures for the removal inspection and replacement of clutch components.</p>	<p>2.10.1.1 Describe the principles of clutch operation and identify basic components and inter-relationship including:</p> <ul style="list-style-type: none"> (a) Clutch pedal and linkage (b) Clutch fork (c) Thrust bearing (d) Pressure plate and Springs (e) Friction disc. (f) Flywheel (g) Transmission primary shaft <p>2.10.1.2 Describe and demonstrate correct procedures for:</p> <ul style="list-style-type: none"> (a) Clutch removal and replacement (b) Inspection of clutch parts including: <ul style="list-style-type: none"> i) Pressure Springs ii) Pressure plate iii) Friction Disc. <ul style="list-style-type: none"> - facings - cushion springs - uslines iv) Thrust bearing v) Pilot bearing in crankshaft (c) Clutch pedal adjustment 	<p>3.10.1.1 Identify components of a clutch assembly and note operation</p> <p>3.10.1.2 Remove, inspect and replace a clutch assembly including clutch pedal adjustment</p>

DIVISION DRIVE LINE

DEFINITION OF TOPIC	THEORY	PRACTICE
<p>1.11.1 Describe the basic function and components of the gearbox, propeller shaft and differential</p>	<p>2.11.1.1 Describe the function and components of the gearbox including: selector mechanism assembly, sliding and constant mesh gears, gear types (bearingbox)</p> <p>2.11.1.2 Describe the function, components and types of propshafts including: open, closed and use of universal joints</p> <p>2.11.1.3 Describe the function and components of a differential including the use of hypoid, bevel and worm gearing</p> <p>2.11.1.4 Demonstrate the removal, inspection and replacement of propshaft universal joints.</p>	<p>3.11.1 Identify different types of gearing used in the gear box and differential and verbally explain the power flow through each unit</p> <p>3.11.1.4 Remove, inspect and replace a universal joint.</p>

DIVISION STEERING

DEFINITION OF TOPIC	THEORY	PRACTICE
<p>1.12.1 Revise steering system geometry and basic components of the steering gear assembly</p>	<p>2.12.1 Identify and describe the basic components of a steering gear assembly and describe the function of the following steering geometry angles:</p> <ul style="list-style-type: none"> (a) caster (b) camber (c) toe in/out (d) ackerman principle 	<p>3.12.1 Note the relationship of steering gear components and identify the various parts and steering geometry angles</p>
<p>1.12.2 Provide a detailed description of three steering gear assemblies and demonstrate inspection and adjustment procedures</p>	<p>2.12.2.1 Identify and describe the components, operation and inspection of the following steering gears:</p> <ul style="list-style-type: none"> (a) Worm and Sector (b) Worm and Peg (c) Rack and pinion <p>2.12.2.2 Discuss and demonstrate steering gear adjustments including:</p> <ul style="list-style-type: none"> (a) road play (b) backlash adjustment 	<p>3.12.2 Disassemble and re-assemble a steering gear box then adjust the gear correctly.</p>

DIVISION BRAKES

DEFINITION OF TOPIC	THEORY	PRACTICE
<p>1.13.1 Hydraulic principles as they apply to the motor vehicle brake system and components of two major types of brake systems.</p>	<p>2.13.1.1 Review Pascals Law as it applies to motor vehicle brakes</p> <p>2.13.1.2 Review and describe the major components of the disc and drum brake systems used on motor vehicles including:</p> <ul style="list-style-type: none"> (a) Disc assembly components (b) Drum assembly components (c) Master cylinder components (d) Wheel cylinder component 	
<p>1.13.2 Maintenance and adjustment of M.V. brakes.</p>	<p>2.13.2.1 Describe and demonstrate the removal inspection and servicing of motor vehicle brakes including:</p> <ul style="list-style-type: none"> (a) Removal, inspection, and replacement of brake shoes and/or pads. (b) Removal, inspection, and replacement of wheel cylinders (c) Removal, inspection and replacement of master cylinders (d) Drum/disc inspection (e) Wheel bearing removal cleaning checking and adjustment (f) Adjustment of drum brakes (g) Adjustment of handbrakes (h) Flushing and bleeding of a hydraulic brake system. 	<p>3.13.2.1 Perform full maintenance and adjustment of motor vehicle brakes including:</p> <ul style="list-style-type: none"> (a) brake shoes/pads (b) wheel cylinders (c) master cylinder (d) drum/disc inspection (e) adjust and bleed brakes

SAMPLE INDIVIDUALISED INSTRUCTION MODULE

INDIVIDUALISED INSTRUCTION

MOTOR VEHICLE

DIFFERENTIAL CARRIER ASSEMBLY

PURPOSE

The driving axle in the automobile must have some means of allowing the drive wheels to travel different distances when making turns. This is accomplished by making use of a differential unit. There are two basic types of differential units; non-locking and locking. This package is to acquaint the student with the purpose and the operation of these two types of differential units.

OBJECTIVES:

Upon completion of this learning package, you will be able to do the following:

1. Given a differential carrier assembly with a non-locking differential type of unit, disassemble the differential unit, research the construction, operation, purpose and service requirements of the unit.
2. Given a differential carrier assembly with a locking type differential unit, identify the style of locking device, properly disassemble, inspect, and reassemble the locking device. . Research the service requirements.

REFERENCE:

Ministry of Education,
Scheme of Work,
Automotive Engineering,
Part C,
Paragraph- 2.11.1.3 .

OBJECTIVE NO. 1

1. GIVEN A DIFFERENTIAL CARRIER ASSEMBLY WITH A NON-LOCKING TYPE DIFFERENTIAL UNIT, DISASSEMBLE THE DIFFERENTIAL, RESEARCH THE CONSTRUCTION, OPERATION, PURPOSE, AND SERVICE REQUIREMENTS OF THE UNIT.

ACTIVITIES	PURPOSE
Read- Hillier and Pittuck, pp. 399-403 Mudd, Vol. 2 pp. 133 - 144 Mudd, Vol. 4 pp. 147 - 148	Theory of differentials, operation, and construction.
Read- Automotive Transmission and Power Trains. Crouse.	
Read- Automobile Manufacturers' Repair Manuals.	Service requirements of the particular differential units.
Read- Auto Mechanics Fundamentals, Stockel. - (attached)	The action of the differential in driving.
Do- Worksheet No. 1	Listing and recording of information concerning demonstrated unit.

WORKSHEET NO. 1

1. Using proper manual, disassemble the rear end and differential assembly.

2. List number of differential pinions used.

3. What type of thrust bearing was used for differential pinion gears?

4. What type of thrust bearing was used for the differential side gears?

5. List the method recommended for checking differential gear backlash.

6. Reassemble the unit, adjusting ring gear and pinion properly.

Instructor's Approval

OBJECTIVE NO. 2

GIVEN A DIFFERENTIAL CARRIER ASSEMBLY WITH A LOCKING TYPE DIFFERENTIAL UNIT, IDENTIFY THE STYLE OF LOCKING DEVICE: PROPERLY DISASSEMBLE, INSPECT, AND REASSEMBLE LOCKING DEVICE. RESEARCH THE SERVICE REQUIREMENTS.

ACTIVITIES	PURPOSE
Read: Auto Mechanics Fundamentals, Stockel.	The differential action and designs of different makes and models.
Read: Automotive Encyclopedia, Motor's Service.	
Read: Auto Repair and Service, Stockel. (attached)	Service requirements of differentials.
Read: Automotive Transmissions and Power Trains, Crouse.	The Theory of operation of locking type differentials.
Read: Motor's Auto Repair Manual National Service Data Manufacturers' Manual	Specific data concerning adjustment, procedures, specifications, special service procedures and illustrations.
Do: Worksheet No. 2	Listing of the types and trade names of locking devices.
Do: Worksheet No. 3	Listing the testing and service requirements.

WORKSHEET NO. 2

**List three styles of differential locking devices and their method of locking.
(List by trade names if necessary.)**

1.

2.

3.

WORKSHEET NO. 3

List one easy method of testing the locking type differential without removing from the automobile.

- 1.

List five precautions to take when inspecting and reassembling a locking differential unit.

- 1.
- 2.
- 3.
- 4.
- 5.

List the lubrication requirements for locking type differentials.

- 1.
- 2.
- 3.

POST – TEST

REAR AXLE DIFFERENTIALS – IDENTIFICATION, INSPECTION, AND SERVICE REQUIREMENTS

Answer on a separate page. There may be more than one right answer.

1. Three parts found in locking type differentials that are not used in standard differentials are:
 1. differential pinion cross (spider).
 2. clutch plate.
 3. brake cone.
 4. pressure spring.
2. The locking device in a differential causes the 'spinning' wheel to:
 1. stop.
 2. slow down.
 3. speed up.
 4. none of the above.
3. When servicing a multiple plate clutch type locking differential, the clutch plates must be.
 1. well lubricated at assembly.
 2. kept free of all oil or grease.
 3. installed in proper order.
 4. aligned before tightening case bolts.
4. The drive axle that has a locking differential requires the use of a:
 1. multi - purpose gear oil.
 2. heavy duty engine oil.
 3. special type gear oil.
 4. extreme pressure gear oil.
5. In the conventional, non - tractional differential, when one wheel spins:
 1. no driving force is applied to the other wheel.
 2. all the driving force is applied to the other wheel.
 3. the driving force is equally divided.
 4. it causes both wheels to spin.

6. The purpose of a differential in a driving axle is:
 1. to permit equal pulling effort to each wheel.
 2. to permit one wheel to turn more than the other without loss of drive force to either.
 3. to reduce wheel slippage or skidding on turns.
 4. it has no real purpose in straight-ahead driving.
7. In the conventional , non - tractional type differential, the gear thrust may be carried by:
 1. thrust washers between gear and case.
 2. ground surfaces on the gear and case.
 3. thrust roller bearings between gear and case.
 4. ball thrust bearings between gear and case.
8. The adjustment on the clutch plates in a locking type differential is:
 1. made with adjustment screws.
 2. made with adjustment shims.
 3. made with a combination of shims and screws.
 4. made only with replacement of the clutch plates.
9. In the cone brake type of locking differential, the cone is kept pre-loaded by:
 1. adjustment screws.
 2. coil springs.
 3. flat springs.
 4. concave springs.
10. The bevel gears on the rear axle shafts, in both the locking and non-locking differentials, are always in mesh with:
 1. the clutch plates.
 2. the cone brakes.
 3. the differential pinions.
 4. the drive pinion.

REAR AXLE DIFFERENTIALS – IDENTIFICATION,
INSPECTION AND SERVICE REQUIREMENTS

ANSWER KEY

PRETEST AND POST – TEST

- | | | | | |
|-----|----------------------------------|----------------------------------|----------------------------------|----------------------------------|
| 1. | 1 | <input checked="" type="radio"/> | <input checked="" type="radio"/> | <input checked="" type="radio"/> |
| 2. | 1 | <input checked="" type="radio"/> | 3 | 4 |
| 3. | <input checked="" type="radio"/> | 2 | <input checked="" type="radio"/> | <input checked="" type="radio"/> |
| 4. | 1 | 2 | <input checked="" type="radio"/> | 4 |
| 5. | <input checked="" type="radio"/> | 2 | 3 | 4 |
| 6. | <input checked="" type="radio"/> | <input checked="" type="radio"/> | <input checked="" type="radio"/> | <input checked="" type="radio"/> |
| 7. | <input checked="" type="radio"/> | <input checked="" type="radio"/> | 3 | 4 |
| 8. | 1 | 2 | 3 | <input checked="" type="radio"/> |
| 9. | 1 | <input checked="" type="radio"/> | 3 | 4 |
| 10. | 1 | 2 | <input checked="" type="radio"/> | 4 |

APPENDIX D

PERMISSION TO REPRODUCE SECTIONS FROM
STOCKEL, M. AUTO SERVICE AND REPAIR

P. O. Box 44600
Nairobi, Kenya,
1 August, 1978

The Goodheart - Wilcox Co., Inc.,
South Holland,
Illinois

Dear Sir:

Request for Permission
to Reproduce Small sections of the book:
Stockel, M. W. ,Auto Service and Repair, 1975

I am conducting a post-graduate research program for the University of Nairobi in individualized instruction in the Automotive Technology Course in form 4 of the Technical Secondary Schools in Kenya.

I would be grateful for permission from you to reproduce some sections of the Book "Auto Service and Repair", 1975, by M. Stockel to be used as information sheets with the programmed modules. The sections concerned are:

Section: 13 - 1 to 13 - 20
14 - 3 to 14 - 8
15 - 11 to 15 - 15
16 - 2 to 16 - 3
19 - 3 to 19 - 20

With permission, 30 copies of these sections would be used only for the purpose of the research and inclusion in the thesis. It is entirely non-profit. Five copies of the book itself have been purchased and donated to the five technical schools concerned, and several copies of the book have been purchased by the Kenya Technical Teachers College for the in-service training of teachers.

I would appreciate your favourable response.

Thank you.

Yours truly,

Ronald H. Balsdon
Ronald H. Balsdon

APPENDIX D (CONTINUED)

Goodheart-Willcox

123 W. Taft Drive • South Holland, Ill. 60473
Phone 312 333-7200



August 16, 1978

Mr. Ronald H. Balsdon
P.O. Box 44600
Nairobi, Kenya

Thank you, Mr. Balsdon,

for your letter of August 1st relative to reproducing material from our book AUTO SERVICE AND REPAIR.

You have our permission to reproduce the material as outlined in your letter.

We wish you the best of luck with this project.

Using G-W Books Pays,


George A. Fischer
President

GAF:kg

APPENDIX E

COSTS OF REPRODUCTION OF
INDIVIDUALISED INSTRUCTION MODULES

1.	Purchase of one set of individualised instruction modules from the State of Oregon, Department of Education	KS 1500/
2.	Stencils (Gestofax) Average module of 15 pages X 32 modules X KS 10/ per stencil including ink and supplies.	4800/
3.	Paper 73 gram white A4. Average module of 8 sheets X 32 modules X 30 of each module X KS 40/ per ream of 500 sheets	614/
4.	Photocopying and printing information sheets: 50 photo copies, 50 stencils and paper.	500/
	TOTAL COST*	<u><u>7414/</u></u>

* Calculations for cost per student were based on 201 students in Form Four. The total cost was KS 7414.00 plus KS 2000.00 for administration (printing, distribution, etc.). Costs for visits of the Inspectors and for KIE panel meetings are regular recurrent expenses and are not included.

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APPENDIX F

AUTHORISATION FROM THE CHIEF INSPECTOR OF SCHOOLS



MINISTRY OF EDUCATION
JOGOO HOUSE
HARAMBEE AVENUE
P.O. Box 30040
NAIROBI

6th April 19.76

Telegrams: "EDUCATION"
Telephone. 28411
When replying please quote

Ref. No. T/5/15/4/105
and date

Mr. R. Balsdon,
Kenya Technical Teachers College,
P.O. Box 44600,
NAIROBI

Dear Sir,

I am writing to confirm what I said during our discussion on your intention to carry out a research project on individualised instructions for Automotive engineering under the supervision of the University of Nairobi. You can go ahead with the project and best wishes.

Yours faithfully,

A handwritten signature in dark ink, appearing to read 'A. N. Getao'.
(A. N. GETAO)

CHIEF INSPECTOR OF SCHOOLS

APPENDIX G
QUESTIONNAIRE FOR STUDENT USERS OF
EXPERIMENTAL MATERIALS

NAME.....

INDIVIDUALISED MODULES

1. I have completed _____ modules.
2. The text books are helpful. Yes
 Somewhat
 No.....
 Which books
3. The attachments are: Good.....
 Mediocre.....
 Useless.....
 Comments.....
4. The worksheets are: Helpful.....
 Mediocre.....
 Poor.....
 Comments.....

5. The biggest problem I have is-

6. The thing I like best is-

APPENDIX H

QUESTIONNAIRE

FOR TEACHER USERS OF EXPERIMENTAL MATERIALS

These questions are an attempt to assess the effectiveness of the individualised instruction modules used in the Motor Vehicle classes during 1977. Please mark each statement in the left margin according to how much you agree or disagree with it. Write the following numbers depending on how you feel in each case.

- | | | | |
|----|----------------------|----|-------------------------|
| +1 | I agree a little | -1 | I disagree a little |
| +2 | I agree on the whole | -2 | I disagree on the whole |
| +3 | I agree very much | -3 | I disagree very much |

GIVE YOUR OWN OPINION AND NOT WHAT YOU THINK OTHERS WANT TO HEAR.

Comments may be added in the space after each question.

- 1. Individualised instruction has helped my students in Motor Vehicle to learn more effectively.
- 2. Individualised instruction could be used to teach students in other courses more effectively also.
- 3. Individualised instruction is too difficult to use in the Motor Vehicle course.
- 4. Students are more highly motivated when they use the individualised instruction modules.
- 5. The pretests and posttests are not very helpful.
- 6. Students who did not use the individualised instruction modules wanted to use them.

APPENDIX H (CONTINUED)

- 7. Students who use the individualised instruction modules get more practical experience.
- 8. The administration of my school encouraged the use of the modules.
- 9. The modules were able to be understood satisfactorily at the Form Four level.
- 10. More research and development on the modules would be a waste of time.
- 11. The attachments to the modules were helpful to the students.
- 12. There are more problems with students misbehaving in class when the individualised instruction is used.
- 13. Students who use the modules do more reading out of class.
- 14. I personally would like to use individualised instruction for all students in the class.

Please write any other comments you have about the use of this method of teaching below.

APPENDIX I

THE ORIGINAL ROKEACH DOGMATISM SCALE

The following is a study of what the general public thinks and feels about a number of important social and personal questions. The best answer to each statement following is your personal opinion. We have tried to cover many different and opposing points of view: you may find yourself agreeing strongly with some of the statements, disagreeing just as strongly with others, and perhaps uncertain about others. Whether you agree or disagree with any statement, you can be sure many people feel the same as you do.

Mark each statement in the space at the left according to how much you agree or disagree with it. Please mark every one. Write the following numbers depending on how you feel about it.

- +1: I agree a little.
- +2: I agree on the whole.
- +3: I agree very much.

- 1: I disagree a little.
- 2: I disagree on the whole.
- 3: I disagree very much.

(1) Accentuation of differences between the belief and the disbelief systems.

1. The United States and Russia have just about nothing in common.
2. Communism and Catholicism have nothing in common.
3. The principles I have come to believe in are quite different from those believed in by most people.

(2) The perception of irrelevance.

4. In a heated discussion people have a way of bringing up irrelevant issues rather than sticking to the main issue.

(3) The coexistence of contradictions within the belief system.

5. The highest form of government is a democracy and the highest form of democracy is a government run by those who are most intelligent.
6. Even though freedom of speech for all groups is a worthwhile goal, it is unfortunately necessary to restrict the freedom of certain political groups.
7. While the use of force is wrong by and large, it is sometimes the only way possible to advance a noble ideal.

APPENDIX I (CONTINUED)

8. Even though I have a lot of faith in the intelligence and wisdom of the common man I must say that the masses behave stupidly at times.

(4) Relative amount of differentiation in belief and disbelief system.

9. It is only natural that a person would have a much better acquaintance with ideas he believes in than with ideas he opposes.

10. There are certain 'isms' which are really the same even though those who believe in those 'isms' try to tell you they are different.

(5) Beliefs regarding the aloneness, isolation, and helplessness of man.

11. Man on his own is a helpless and miserable creature.

12. Fundamentally, the world we live in is a pretty lonesome place.

13. Most people just don't give a 'damn' for others.

14. I'd like it if I could find someone who would tell me how to solve my personal problems.

(6) Beliefs regarding the uncertainty of the future.

15. It is only natural for a person to be rather fearful of the future.

16. There is so much to be done and so little time to do it in.

17. Once I get wound up in a heated discussion I just can't stop.

18. In a discussion I often find it necessary to repeat myself several times to make sure I am being understood.

19. In a heated discussion I generally become so absorbed in what I am going to say that I forget to listen to what the others are saying.

20. In a discussion I sometimes interrupt others too much in my eagerness to put across my own point of view.

(7) Beliefs about self-adequacy and inadequacy.

21. It is better to be a dead hero than to be a live coward.

22. My hardest battles are with myself.

23. At times I think I am no good at all.

APPENDIX I (CONTINUED)

24. I am afraid of people who want to find out what I am really like for fear they'll be disappointed in me.

(8) Self-agrandizement as a defence against self-inadequacy.

25. While I don't like to admit this even to myself, my secret ambition is to become a great man, like Einstein, or Beethoven, or Shakespeare.
26. The main thing in life is for a person to want to do something important.
27. If given the chance I would do something of great benefit to the world.
28. If I had to choose between happiness and greatness, I'd choose greatness.
29. Its all too true that people just won't practice what they preach.

(9) Paranoid outlook on life.

30. Most people are failures and it is the system which is responsible for this.
31. I have often felt that strangers are looking at me critically.
32. It is only natural for a person to have a guilty conscience.
33. People say insulting and vulgar things about me.
34. I am sure I am being talked about.

(10) Authoritarianism.

35. In the history of mankind there have probably been just a handful of really great thinkers.
36. There are a number of people I have come to hate because of the things they stand for.
37. A man who does not believe in some great cause has not really lived.
38. It is only when a person devotes himself to an ideal or cause that life becomes meaningful.
39. Of all the different philosophies which exist in this world there is probably only one which is correct.

APPENDIX I (CONTINUED)

- 40. A person who gets enthusiastic about too many causes is likely to be a pretty 'wishy-washy' sort of person.
- 41. To compromise with our political opponents is dangerous because it usually leads to the betrayal of our own side.
- 42. When it comes to differences of opinion in religion we must be careful not to compromise with those who believe differently from the way we do.
- 43. In times like these, a person must be pretty selfish if he considers primarily his own happiness.
- 44. To compromise with our political opponents is to be guilty of appeasement.

(11) Intolerance.

- 45. The worst crime a person could commit is to attack publicly the people who believe in the same thing he does.
- 46. In times like these it is often necessary to be more on guard against ideas put out by people or groups in one's own camp than by those in the opposing camp.
- 47. A group which tolerates too much differences of opinion among its own members cannot exist for long.

(12) Toward the disbeliever.

- 48. There are two kinds of people in this world: those who are for truth and those who are against truth.
- 49. My blood boils whenever a person stubbornly refuses to admit he is wrong.
- 50. A person who thinks primarily of his own happiness is beneath contempt.
- 51. Most of the ideas which get printed nowadays aren't worth the paper they are printed on.
- 52. I sometimes have a tendency to be too critical of the ideas of others.

(13) Interrelations among primitive, intermediate, and peripheral beliefs.

- 53. In this complicated world of ours the only way we can know what's going on is to rely on leaders or experts who can be trusted.

APPENDIX I (CONTINUED)

54. It is often desirable to reserve judgement about what's going on until one has had a chance to hear the opinions of those one respects.
55. In the long run the best way to live is to pick friends and associates whose tastes and beliefs are the same as one's own.
56. There's no use wasting your money on newspapers which you know in advance are just plain propaganda.
57. Young people should not have too easy access to books which are likely to confuse them.

(14) Attitude to the past, present, and future.

58. The present is all too full of unhappiness. It is only the future which counts.
59. It is by returning to our glorious and forgotten past that real social progress can be achieved.
60. To achieve the happiness of mankind in the future it is sometimes necessary to put up with injustices in the present.

(15) Knowing the future.

61. If a man is to accomplish his mission in life it is sometimes necessary to gamble 'all or nothing at all'.
62. Unfortunately, a good many people with whom I have discussed important social and moral problems don't really understand what's going on.
63. Most people just don't know what's good for them.
64. There's nothing new under the sun.
65. To one who really takes the trouble to understand the world he lives in, it's an easy matter to predict future events.

(16) Belief in force as a way to revise the present.

66. It is sometimes necessary to resort to force to advance an ideal one strongly believes in.

APPENDIX J

THE CALIFORNIA F SCALE

1. Obedience and respect for authority are the most important virtues children should learn.
2. A person who has bad manners, habits, and breeding can hardly expect to get along with decent people.
3. If people would talk less and work more, everybody would be better off.
4. The business man and the manufacturer are much more important to society than than the artist and the professor.
5. Science has its place, but there are many important things that can never possibly be understood by the human mind.
6. Young people sometimes get rebellious ideas, but as they grow up they ought to get over them and settle down.
7. What this country needs most, more than laws and political programs, is a few courageous, tireless, devoted leaders in whom the people can put their faith.
8. No sane, normal, decent person could ever think of hurting a close friend or relative.
9. Nobody ever learned anything really important except through suffering.
10. What the youth needs is strict discipline, rugged determination, and the will to work and fight for family and country.
11. An insult to our honor should always be punished.
12. Sex crimes, such as rape and attacks on children, deserve more than mere imprisonment; such criminals ought to be publicly whipped, or worse.
13. There is hardly anything lower than a person who does not feel a great love, gratitude, and respect for his parents.
14. Most of our social problems would be solved if we could somehow get rid of the immoral, crooked, and feeble-minded people.
15. Homosexuals are hardly better than criminals and ought to be severely punished.
16. When a person has a problem or worry, it is best for him not to think about it, but to keep busy with more cheerful things.
17. Every person should have complete faith in some supernatural power whose decisions he obeys without question.
18. Some people are born with an urge to jump from high places.

APPENDIX J (CONTINUED)

19. People can be divided into two distinct classes: the weak and the strong.
20. Some day it will probably be shown that astrology can explain a lot of things.
21. Wars and social troubles may someday be ended by an earthquake or flood that will destroy the whole world.
22. No weakness or difficulty can hold us back if we have enough will power.
23. It is best to use some prewar authorities in Germany to keep order and prevent chaos.
24. Most people don't realize how much our lives are controlled by plots hatched in secret places.
25. Human nature being what it is, there will always be war and conflict.
26. Familiarity breeds contempt.
27. Nowadays when so many different kinds of people move around and mix together so much, a person has to protect himself especially carefully against catching an infection or disease from them.
28. Nowadays more and more people are prying into matters that should remain personal and private.
29. The wild sex life of the old Greeks and Romans was tame compared to some of the goings-on in this country, even in places where people might least expect it.

APPENDIX K

THE GOUGH-SANFORD RIGIDITY SCALE

1. I am often the last one to give up trying to do a thing.
2. There is usually only one best way to solve most problems.
3. I prefer work that requires a great deal of attention to detail.
4. I often become so wrapped up in something I am doing that I find it difficult to turn my attention to other matters.
5. I dislike to change my plans in the midst of an undertaking.
6. I never miss going to church.
7. I usually maintain my own opinions even though many other people may have a different point of view.
8. I find it easy to stick to a certain schedule, once I have started it.
9. I do not enjoy having to adapt myself to new and unusual situations.
10. I prefer to stop and think before I act even on trifling matters.
11. I try to follow a program of life based on duty.
12. I usually find that my own way of attacking a problem is best, even though it doesn't always seem to work in the beginning.
13. I am a methodical person in whatever I do.
14. I think it is usually wise to do things in a conventional way.
15. I always finish tasks I start, even if they are not very important.
16. I often find myself thinking of the same tunes or phrases for days at a time.
17. I have a work and study schedule which I follow carefully.
18. I usually check more than once to be sure that I have locked a door, put out the light, or something of the sort.
19. I have never done anything dangerous for the thrill of it.
20. I believe that promptness is a very important personality characteristic.
21. I am always careful about my manner of dress.
22. I always put on and take off my clothes in the same order.

APPENDIX L

GENERAL OPINION SURVEY NO. ONE

The following is a study of what the general public thinks and feels about a number of important social and personal questions. The best answer to each statement following is your personal opinion. We have tried to cover many different and opposing points of view: you may find yourself agreeing strongly with some of the statements, disagreeing just as strongly with others, and perhaps uncertain about others. Whether you agree or disagree with any statement, you can be sure many people feel the same as you do.

Mark each statement in the space at the left according to how much you agree or disagree with it. Please mark every one. Write the following numbers depending on how you feel about it.

+1: I agree a little.
 +2: I agree on the whole.
 +3: I agree very much.

-1: I disagree a little.
 -2: I disagree on the whole.
 -3: I disagree very much.

Give your own opinion, not what you think the author wants. Although some questions may seem to be repeated, the purpose is to find shades of opinion. Do not check back. Indicate your answer and continue on.

- 1. Most people just don't give a damn for others.
- 2. For people with any sensitivity at all, it is only natural to suffer with feelings of guilt.
- 3. The principles I have come to believe in are quite different than those believed in by most people.
- 4. Of all the different interpretations of religion there is really only one right one.
- 5. The highest form of government is a democracy and the highest form of democracy is a government run by those who are most intelligent.
- 6. It is important that young people are protected against literature that is likely to distort their outlook.
- 7. While the use of force is wrong usually, it is sometimes the only way possible to advance a noble ideal.
- 8. I am sure people talk about me in an unpleasant way when I am not around.

APPENDIX L (CONTINUED)

- 9. Fundamentally the world we live in is a pretty lonesome place.
- 10. It is only natural for a person to dislike those who stand for completely different ideals.
- 11. Politically and economically Kenya and South Africa have nothing in common.
- 12. To compromise with one's political opponents is to be guilty of sacrificing one's principles.
- 13. I'd like it if I could find someone who would tell me how to solve my personal problems.
- 14. Strong differences of opinion within any organisation is the beginning of the end for that organisation.
- 15. It is only natural for a person to be afraid of the future.
- 16. There seems to be a deterioration in the quality of ideas that one sees on the market these days.
- 17. In a discussion I often find it necessary to repeat myself several times to make sure I am being understood.
- 18. The future is more important than the present, so much so that people may have to accept present sufferings for the sake of future satisfactions.
- 19. In a heated discussion I generally become so absorbed in what I am going to say that I forget to listen to what others are saying.
- 20. Generally speaking, people are self-centered and give little concern for the welfare of others.
- 21. In a discussion I sometimes interrupt others too much in my eagerness to put across my own point of view.
- 22. Most people hold quite different guiding principles in their lives than I have come to accept.
- 23. In a military battle it would be better to die a hero than to escape a coward.
- 24. A democracy is the most highly developed form of government and is most effective when run by the most intelligent.

APPENDIX L (CONTINUED)

- 25. At times I think I am no good at all.
- 26. The end justifies the means; if the goal is good and ideal enough it justifies means that are sometimes not popular.
- 27. I am afraid of people who want to find out what I am really like for fear they will be disappointed in me.
- 28. Life without religious conviction is very lonesome.
- 29. While I don't like to admit this even to myself, my secret ambition is to become a great man like U Thant, Shakespeare or Mao Tse Tung.
- 30. Economically and politically South Africa and Kenya have nothing in common.
- 31. Most people are failures and it is the system that is responsible for this.
- 32. There are times when my personal problems seem to be overwhelming.
- 33. In the history of mankind there have probably been just a handful of really great thinkers.
- 34. It is not surprising that people are apprehensive about what lies ahead in life.
- 35. When it comes to differences of opinion in religion, we must be careful not to compromise with those who believe differently from the way we do.
- 36. When I am in a heated argument I express my ideas usually more than once to get them across.
- 37. The worst crime a person could commit is to attack publicly the people who believe in the same thing he does.
- 38. When I am arguing I find that it is impossible to plan what I want to say while at the same time listening to the other person.
- 39. In this complicated world of ours the only way we can know what is going on is to rely on leaders or experts who can be trusted.
- 40. When I argue I become so intense that I am liable to break into the discussion to express what I believe to be a crucial idea.

APPENDIX L (CONTINUED)

- 41. In the long run the best way to live is to pick friends and associates whose tastes and beliefs are the same as one's own.
- 42. It is a more noble thing to sacrifice your life for your country than to compromise principles to save your life.
- 43. The present is all too full of unhappiness; it is only the future which counts.
- 44. There are moments when I am quite dissatisfied with the way I live my life.
- 45. There is nothing new under the sun.
- 46. If people could read my mind they might be quite disappointed in me.
- 47. It is sometimes necessary to resort to force to advance an ideal one strongly believes in.
- 48. I would be prepared to pay a high price for a life so successful that my name would go down in history.
- 49. If given the chance I would do something of great benefit to the world.
- 50. I believe that the reason so many people are failures is that it is predestined by events.
- 51. I have often felt that strangers were looking at me critically.
- 52. Down through the ages there have been really only a few intellectuals.
- 53. In times like these a person must be very selfish if he considers only his own happiness.
- 54. Compromise is wrong in matters of one's belief in God.
- 55. In times like these it is often necessary to be more on guard against ideas put out by people or groups on one's own side than by those on the opposing side.
- 56. It is an unhealthy sign to see people from the same political party or religious denomination criticising each other openly in the press.
- 57. There is no use wasting your money on newspapers which you know in advance are just plain propaganda.

APPENDIX L (CONTINUED)

- 58. A person should be careful about his own interpretation of the news but should rely on known dependable persons in positions of authority.
- 59. Unfortunately a good many people with whom I have discussed social and moral problems don't really understand what is going on.
- 60. If one picks friends whose attitudes and values are different than his, he will some day find himself confused and compromised.
- 61. It is only natural for a person to have a guilty conscience.
- 62. The trials and difficulties of the present must be accepted as the price of future contentment and success.
- 63. Of all the different philosophies which exist in this world, there is probably only one which is correct.
- 64. The philosophies and politics which are being put forward these days are really nothing more than restatements of what the great minds of the past have already worked out.
- 65. Young people should not have too easy access to books that are likely to confuse them.
- 66. The future will tell that the nations which survive this century are those who have strong discipline and governments that stress law and order.
- 67. People say insulting and vulgar things about me.
- 68. I believe that the highest priority in my life should be the accomplishment of something great.
- 69. There are a number of people I have come to hate because of the things they stand for.
- 70. I often feel nervous in the presence of people I don't know.
- 71. To compromise with our political opponents is dangerous because it usually leads to the betrayal of our own side.
- 72. A person who thinks primarily of his own happiness is most undesirable.

APPENDIX L (CONTINUED)

- 73. A group which tolerates too much difference of opinion among its own members cannot exist for long.
- 74. The person within one's own organisation or group who has radical ideas may be more dangerous in the long run than one's opponents.
- 75. Most of the ideas which get printed these days are not worth the paper they are printed on.
- 76. Newspapers around the world today are nothing more than the propaganda machine for unscrupulous politicians.
- 77. To achieve the happiness of mankind in the future it is sometimes necessary to put up with injustices in the present.
- 78. Social and moral behaviour today is changing so quickly that most people have no understanding of the issues.

APPENDIX M
DISCRIMINATION STUDY

GENERAL OPINION SURVEY NUMBER ONE

QUESTION NO.	RESPONSES						QUESTION NO.	RESPONSES					
							34	2	5	3	1	0	6
1	0	1	6	3	5	2	35	4	8	1	1	3	0
2	1	4	8	1	2	1	36	3	3	3	2	4	2
3	4	3	4	0	3	3	37	4	1	1	3	5	3
4	4	4	2	1	2	4	38	9	0	1	1	2	4
5	3	3	3	2	2	4	39	1	4	2	3	5	2
X 6	7	4	4	0	0	2	40	3	4	3	6	0	1
7	4	3	4	2	2	2	41	1	5	6	2	3	0
X 8	10	6	0	1	0	0	X 42	4	8	2	2	1	0
9	7	4	0	3	2	1	43	5	3	3	1	1	4
10	4	6	2	3	1	1	44	2	6	4	1	4	0
X 11	13	0	0	0	1	3	X 45	7	6	2	1	1	0
12	2	4	3	1	2	5	X 46	6	8	1	1	1	0
13	2	4	4	1	5	1	47	2	2	1	2	3	7
14	4	2	3	0	4	4	48	1	2	3	3	4	4
15	4	5	2	2	4	0	49	1	7	3	1	2	3
16	9	3	2	1	1	1	50	7	3	3	1	1	2
X 17	0	3	0	4	5	5	51	1	3	2	2	3	6
18	1	5	4	2	5	0	52	1	2	3	0	8	3
19	3	3	2	3	3	3	53	4	4	2	4	2	1
20	2	8	3	2	0	2	54	5	6	0	1	2	3
21	7	0	0	1	2	7	55	7	4	2	1	1	2
X 22	9	6	1	1	0	0	X 56	0	0	0	0	3	14
23	4	5	4	1	1	2	57	0	3	3	4	4	3
24	2	3	3	3	4	2	58	3	6	2	2	3	1
25	5	5	2	4	1	0	X 59	5	6	3	1	0	1
X 26	8	5	1	2	1	0	X 60	4	9	1	1	1	1
27	3	4	2	2	3	3	61	2	5	3	2	3	2
28	3	7	0	2	1	4	62	4	6	1	1	2	3
X 29	6	4	3	3	1	0	63	2	1	3	4	6	1
30	2	3	0	3	4	5	64	2	7	0	3	3	2
31	1	1	3	2	5	5	X 65	2	9	3	3	0	0
32	3	4	3	2	5	2	66	1	2	1	2	6	5
33	4	6	3	1	1	2							

X indicates questions deleted because of poor discrimination.

APPENDIX N

RELIABILITY ASSESSMENT OF
GENERAL OPINION SURVEY NUMBER ONE

QUESTION NO.	RELIABILITY	QUESTION NO.	RELIABILITY
1	H	34	M
2	M	35	H
3	M	36	L
4	H	37	L
5	L	38	H
6	H	39	L
7	M	40	M
8	H	41	H
9	M	42	H
10	H	43	L
11	M	44	L
12	M	45	H
13	L	46	M
14	H	47	M
15	H	48	M
16	H	49	M
17	L	50	L
18	H	51	M
19	H	52	M
20	H	53	L
21	M	54	M
22	M	55	M
23	H	56	M
24	M	57	H
25	M	58	M
26	H	59	H
27	L	60	M
28	L	61	M
29	L	62	L
30	M	63	L
31	L	64	L
32	M	65	M
33	H	66	M

H = High Correlation.
* = Reject or Modify.

M = Medium Correlation. L = Low Correlation

APPENDIX O

GENERAL OPINION SURVEY
FIRST REVISION

The following is a study of what the general public thinks and feels about a number of important social and personal questions. The best answer to each statement following is your personal opinion. We have tried to cover many different and opposing points of view; you may find yourself agreeing strongly with some of the statements, disagreeing just as strongly with others, and perhaps uncertain about others. Whether you agree or disagree with any statement, you can be sure that many people feel the same as you do.

Mark each statement in the left margin according to how much you agree or disagree with it. Please mark every one.

Write +1, +2, +3, or -1, -2, -3, depending on how you feel in each case.

- | | |
|---------------------------|------------------------------|
| +1: I agree a little. | -1: I disagree a little. |
| +2: I agree on the whole. | -2: I disagree on the whole. |
| +3: I agree very much. | -3: I disagree very much. |

- 1. Politically Kenya and South Africa have a lot in common.
- 2. Happiness is a more important goal in life than the accomplishment of something great.
- 3. In a heated discussion people have a way of bringing up irrelevant issues rather than sticking to the main issue.
- 4. I always choose friends whose ideas are similar to my own.
- 5. As tempting as it is to resort to the use of force to support a noble ideal, it should never be used.
- 6. I never feel nervous in a group of strangers.
- 7. There are certain ideologies which are really the same even though those who believe in those ideologies try to tell you they are different.
- 8. I often have many difficult struggles in decision making.
- 9. Most people do have a great deal of concern for the well-being of others.
- 10. People often say things about me behind my back.

APPENDIX O (CONTINUED)

- 11. There is so much to be done and so little time to do it in.
- 12. It is only when a person devotes himself to an ideal or cause that life becomes meaningful.
- 13. I find I am able in an argument to plan what I am going to say and at the same time listen to my opponent.
- 14. You cannot really count on a person who supports too many different causes.
- 15. My hardest battles are with myself.
- 16. I often feel a certain anxiety that I cannot get the things done that I would like to because of time.
- 17. While I don't like to admit this even to myself, my secret ambition is to become a great man like U Thant, Shakespeare or Mao Tse Tung.
- 18. In a heated discussion I never fail to hear my opponents view even while forming my own ideas.
- 19. If I had to choose between happiness and greatness, I would choose happiness.
- 20. Generally speaking, most people are unselfish and considerate.
- 21. I have never felt that strangers look at me critically.
- 22. It is not selfish to conduct your life with your own happiness as your goal.
- 23. I am sure I am being talked about.
- 24. Although different political and religious systems have loyal supporters, the systems are often the same.
- 25. A man who does not believe in some great cause has not really lived.
- 26. I accept the ideas of others without giving them enough consideration first.
- 27. A person who gets enthusiastic about too many causes is likely to be an undependable sort of person.

APPENDIX O (CONTINUED)

- 28. I seldom become angry even when a person continues to argue after the truth is obvious.
- 29. It is not selfish to consider only your own happiness.
- 30. In an argument most people resort to introducing irrelevant issues.
- 31. In times like these it is often necessary to be more on guard against ideas put out by people or groups on your side than on the opponents' side.
- 32. It is wrong to force people to live by certain ideals even though those ideals be very right and noble.
- 33. It does not bother me when a person stubbornly refuses to admit he is wrong.
- 34. Politically Kenya and Rhodesia have a great deal in common.
- 35. I am too uncritical of the ideas of others.
- 36. I would be prepared to pay a high price for a life so successful that my name would go down in history.
- 37. In the long run the best way to live is to pick friends and associates whose tastes and beliefs are the same as one's own.
- 38. The dissenter within one's own organisation can be more dangerous than the known opposition.

Part B

- 39. The guiding moral principles of my life conform closely to those of most educated Kenyans.
- 40. I believe a person should set as his life's goal the achievement of something significant.
- 41. Freedom of speech is such an important freedom that no group, no matter how dissident, should be excluded.
- 42. I believe that the reason why so many people are failures is that it is predestined by events.

APPENDIX O (CONTINUED)

- 43. It is simply not true that a person would have a much better acquaintance with ideas he believes in than with the ideas he opposes.
- 44. I always make my own judgements before I allow myself to be influenced by those about me.
- 45. Fundamentally, the world we live in is a pretty lonesome place.
- 46. I am quite certain that others say unpleasant things about me when I am not around.
- 47. Most people face the future with confidence, not fear.
- 48. The idea of dying a hero is not for me.
- 49. In a discussion I often find it necessary to repeat myself several times to make sure I am being understood.
- 50. There seems to be a deterioration in the quality of ideas one finds on today's market.
- 51. In a military battle it would be better to escape a coward than to die a hero.
- 52. There are many religions in the world, no one of which is right, but all have an element of truth.
- 53. If people could read my mind they might be disappointed.
- 54. In order to be clearly understood in an argument I always repeat myself.
- 55. If given the chance I would do something of great benefit to the world.
- 56. It is unnatural for a person to be afraid of the future.
- 57. Most people are failures and it is the system that is responsible.
- 58. Compromise is bad in matters of belief in God.
- 59. People say insulting and vulgar things about me.
- 60. Most people generally find life pretty lonesome.
- 61. There are a number of people I have come to hate because of the things they stand for.
- 62. It is perfectly acceptable to criticise in the newspaper if necessary, those who believe as you do.

APPENDIX O (CONTINUED)

- 63. Of all the different philosophies which exist in the world, most of them are partially right and no one is entirely right.
- 64. Most people would take enough trouble to learn as much about ideas they oppose as the ideas they believe in.
- 65. When it comes to differences of opinion in religion we must be careful not to compromise with those who believe differently from the way we do.
- 66. Freedom to express one's beliefs is a high and noble ideal, and moves to restrict certain questionable groups should be resisted.
- 67. It is not a crime to attack publicly the people who believe in the same thing you do.
- 68. Most of the professional and semi-professional people I know have the same moral principles I have.
- 69. There are two kinds of people in this world: those who are for the truth and those who are against the truth.
- 70. Perhaps people would be disappointed to find out what I am really like.
- 71. Most of the ideas you find in books these days are not worth much.
- 72. It is only natural for a person to dislike those who stand for different ideals.
- 73. It is a good idea to make your own judgement before you allow yourself to be influenced by your friends.
- 74. If one is not for truth then he is against it.

Part C

- 75. Communism and Christianity have nothing in common.
- 76. Increasingly newspapers in the world at large are being able to report the news without political interference.
- 77. The highest form of government is a democracy and the highest form of democracy is a government run by those who are most intelligent.
- 78. People often claim to have high moral codes but don't follow them.
- 79. Even though I have a lot of faith in the intelligence and wisdom of the common man, I must say that the masses behave stupidly at times.

APPENDIX O (CONTINUED)

- 80. Only extremely sensitive people have continuing feelings of guilt.
- 81. Man on his own is not, as some people say, a helpless and miserable creature.
- 82. A person should be careful of accepting news reports from any source, but should rely on known dependable people.
- 83. I would like it if I could find someone who could tell me how to solve my personal problems.
- 84. Down through the ages there have been only a few intellectuals.
- 85. I never allow myself to get so deeply involved in a heated discussion that I cannot stop.
- 86. Usually the will of the majority is good, but it is true that precautions should be taken against mob rule.
- 87. In a discussion I sometimes interrupt others too much in my eagerness to put across my own point of view.
- 88. Compromise does not sacrifice your own group's principles.
- 89. It is a sign of weakness for a person to feel that at times he is no good.
- 90. I always try to avoid deep involvement in an argument.
- 91. It certainly is not the main thing in life to do something important.
- 92. It is only natural for a person to interrupt in an argument to express his own ideas.
- 93. It is all too true that people just won't practice what they preach.
- 94. Most people do need help to solve their personal problems.
- 95. I think it is unnatural for a person to have a guilty conscience.
- 96. To give in, even in a small way, to those who believe differently than ourselves is a sign of weakness.
- 97. In the history of mankind there have probably been just a handful of really great thinkers.
- 98. Man does not need religion.
- 99. I do not believe that compromise with one's opponents leads to betrayal of one's own side.

APPENDIX O (CONTINUED)

- 100. There is nothing wrong with choosing happiness as your goal in life and pursuing it.
- 101. To compromise with our political opponents is to be guilty of appeasement.
- 102. A democracy is a highly developed form of government and operates best when run by the most capable.
- 103. It is a good idea to encourage differences of opinion in an organisation to keep it healthy.
- 104. The Christian faith and the Communist ideology have nothing in common.
- 105. A person who thinks primarily of his own happiness will probably find it.
- 106. The success of a person's life does not depend on some great achievement.
- 107. In this complicated world of ours the only way we can know what is going on is to rely on leaders or experts who can be trusted.
- 108. I never have moments when I feel useless.
- 109. I believe most newspapers today are not controlled by propaganda.
- 110. Differences of opinion in any group will probably in time make it stronger.

APPENDIX P

RELIABILITY ASSESSMENT OF
GENERAL OPINION SURVEY FIRST REVISION

QUESTION NO.	R	QUESTION	R	QUESTION NO.	R
1	M	39 - 34*	R	77 - 102	M
3	H	41 - 30*	M	79 - 86	M
5	M	43 - 26*	R	81 - 98*	M
7	M	45 - 24	M	83 - 24	M
9	M	47 - 20*	R	85 - 90*	M
11	M	49 - 16	M	87 - 92	H
13	M	51 - 18*	H	89 - 108	R
15	M	53 - 8	M	91 - 106*	M
17	M	55 - 36	M	93 - 78	M
19	H	57 - 2	M	95 - 80*	R
21	H	59 - 6	R	97 - 84	M
23	R	61 - 10	R	99 - 88*	M
25	R	63 - 12*	R	101 - 96	R
27	M	65 - 14	M	103 - 110	M
29	M	67 - 22*	M	105 - 100	R
31	R	69 - 38	H	107 - 82	M
33	R	71 - 28	M	109 - 76*	M
35	M	73 - 26*	M		
37	R	75 - 4	M		

* = Inverted Questions.
H = High Correlation.
M = Medium Correlation.
R = Reject or Revise.

APPENDIX Q

GENERAL OPINION SURVEY
SECOND REVISION

The following is a study of what the general public thinks and feels about a number of important social and personal questions. The best answer to each statement following is your personal opinion. We have tried to cover many different and opposing points of view; you may find yourself agreeing strongly with some of the statements, disagreeing just as strongly with others, and perhaps uncertain about others. Whether you agree or disagree with any statement, you can be sure that many people feel the same as you do.

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+3: I agree very much.

-1: I disagree a little.
-2: I disagree on the whole.
-3: I disagree very much.

GIVE YOUR OWN OPINION — NOT WHAT YOU THINK THE AUTHOR WANTS! Although some questions may seem to be repeated, the purpose is to find shades of opinion. Do not check back, indicate your answer and continue on.

- 1. Most people just don't give a 'damn' for others.
- 2. For people with any sensitivity at all, it is only natural to suffer with feelings of guilt.
- 3. The principles I have come to believe in are quite different than those believed in by most people.
- 4. Of all the different interpretations of religion there is really only one right one.
- 5. The highest form of government is a democracy and the highest form of democracy is a government run by those who are most intelligent.
- 6. It is important that young people are protected against literature that is likely to distort their outlook.
- 7. While the use of force is wrong usually, it is sometimes the only way possible to advance a noble ideal.
- 8. I am sure people talk about me in an unpleasant way when I am not around.
- 9. Fundamentally the world we live in is a pretty lonesome place.

APPENDIX Q (CONTINUED)

- 10. It is only natural for a person to dislike those who stand for completely different ideals.
- 11. Politically and economically Kenya and South Africa have nothing in common.
- 12. To compromise with one's political opponents is to be guilty of sacrificing one's principles.
- 13. I'd like it if I could find someone who would tell me how to solve my personal problems.
- 14. Strong differences of opinion within any organisation is the beginning of the end for that organisation.
- 15. It is only natural for a person to be afraid of the future.
- 16. There seems to be a deterioration in the quality of the ideas that one sees on the market these days.
- 17. In a discussion I often find it necessary to repeat myself several times to make sure I am being understood.
- 18. The future is more important than the present, so much so that people may have to accept present sufferings for the sake of future satisfactions.
- 19. In a heated discussion I generally become so absorbed in what I am going to say that I forget to listen to what others are saying.
- 20. Generally speaking people are self-centered and give little concern for the welfare of others.
- 21. In a discussion I sometimes interrupt others too much in my eagerness to put across my own point of view.
- 22. Most people hold quite different guiding principles in their lives than I have come to accept.
- 23. In a military battle it would be better to die a hero than to escape a coward.
- 24. A democracy is the most highly developed form of government and is most effective when run by the most intelligent.
- 25. At times I think I am no good at all.
- 26. The end justifies the means; if the goal is good and ideal enough, it justifies means that are sometimes not popular.
- 27. I am afraid of people who want to find out what I am really like for fear they will be disappointed in me.

APPENDIX Q (CONTINUED)

- 28. Life, without a religious conviction, is very lonesome.
- 29. While I don't like to admit this even to myself, my secret ambition is to become a great man like U Thant, Shakespeare or Mao Tse Tung.
- 30. Economically and politically South African and Kenya have nothing in common.
- 31. Most people are failures and it is the system that is responsible for this.
- 32. There are times when my personal problems seem to be overwhelming.
- 33. In the history of mankind there have probably been just a handful of really great thinkers.
- 34. It is not surprising that people are apprehensive about what lies ahead in life.
- 35. When it comes to differences of opinion in religion we must be careful not to compromise with those who believe differently from the way we do.
- 36. When I am in a heated argument I express my ideas usually more than once to get them across.
- 37. The worst crime a person could commit is to attack publicly the people who believe in the same thing he does.
- 38. When I am arguing I find that it is impossible to plan what I want to say while at the same time listening to the other person.
- 39. In this complicated world of ours the only way we can know what is going on is to rely on leaders or experts who can be trusted.
- 40. When I argue, I become so intense that I am liable to break into the discussion to express what I believe to be a crucial idea.
- 41. In the long run, the best way to live is to pick friends and associates whose tastes and beliefs are the same as one's own.
- 42. It is a more noble thing to sacrifice your life for your country than to compromise principles to save your life.
- 43. The present is all too full of unhappiness; it is only the future which counts.

APPENDIX Q (CONTINUED)

- 44. There are moments when I am quite dissatisfied with the way I live my life.
- 45. There is nothing new under the sun.
- 46. If people could read my mind they might be quite disappointed in me.
- 47. It is sometimes necessary to resort to force to advance an ideal one strongly believes in.
- 48. I would be prepared to pay a high price for a life so successful that my name would go down in history.
- 49. If given the chance I would do something of great benefit to the world.
- 50. I believe that the reason so many people are failures is that it is predestined by events.
- 51. I have often felt that strangers were looking at me critically.
- 52. Down through the ages there have been only a few real intellectuals.
- 53. In times like these a person must be very selfish if he considers only his own happiness.
- 54. Compromise is wrong in matters of one's belief in God.
- 55. In times like these it is often necessary to be more on guard against ideas put out by people or groups on one's own side than by those on the opposing side.
- 56. It is an unhealthy sign to see people from the same political party or religious denomination criticising each other openly in the press.
- 57. There's no use wasting your money on newspapers which you know in advance are just plain propaganda.
- 58. A person should be careful about his own interpretation of the news, but should rely on known dependable persons in positions of authority.
- 59. Unfortunately a good many people with whom I have discussed social and moral problems don't really understand what's going on.
- 60. If one picks friends whose attitudes and values are different than his, he will someday find himself confused and compromised.
- 61. It is only natural for a person to have a guilty conscience.

APPENDIX Q (CONTINUED)

- 62. The trials and difficulties of the present must be accepted as the price of future contentment and success.
- 63. Of all the different philosophies which exist in this world there is probably only one which is correct.
- 64. The philosophies and politics that are being put forward these days are really nothing more than re-statements of what the great minds of the past have already worked out.
- 65. Young people should not have easy access to books that are likely to confuse them.
- 66. The future will tell that the nations who survive this century are those who have strong discipline and governments that stress law and order.
- 67. People say insulting and vulgar things about me.
- 68. I believe that the highest priority in my life should be the accomplishment of something great.
- 69. There are a number of people I have come to hate because of the things they stand for.
- 70. I often feel nervous in the midst of people I don't know.
- 71. To compromise with our political opponents is dangerous because it usually leads to the betrayal of our own side.
- 72. A person who thinks primarily of his own happiness is most undesirable.
- 73. A group which tolerates too much difference of opinion among its own members cannot exist for long.
- 74. The person within one's own organisation or group who has radical ideas may be more dangerous in the long run than one's opponents.
- 75. Most of the ideas which get printed these days are not worth the paper they are printed on.
- 76. Newspapers round the world today are nothing more than the propaganda machine for unscrupulous politicians.
- 77. To achieve the happiness of mankind in the future it is sometimes necessary to put up with injustices in the present.
- 78. Social and moral behaviour today is changing so quickly that most people have no understanding of the issues.

APPENDIX R

GENERAL OPINION SURVEY
THIRD REVISION

NAME _____

The following is a study of what the general public thinks and feels about a number of important social and personal questions. The best answer to each statement following is your personal opinion. We have tried to cover many different and opposing points of view: you may find yourself agreeing strongly with some of the statements, disagreeing just as strongly with others, and perhaps uncertain about others. Whether you agree or disagree with any statement, you can be sure many people feel the same as you do.

Mark each statement in the space at the left according to how much you agree or disagree with it. Please mark every one. Write the following numbers depending on how you feel about it.

+1: I agree a little.

+2: I agree on the whole.

+3: I agree very much.

-1: I disagree a little.

-2: I disagree on the whole.

-3: I disagree very much.

Give your own opinion, not what you think the author wants. Although some questions may seem to be repeated, the purpose is to find shades of opinion. Do not check back. Indicate your answer and continue on.

- 1. Most people just don't care at all for others.
- 2. The most important thing children should be taught is to question traditional ideas of obedience and authority.
- 3. The moral principles I have come to believe in are quite different than those believed in by most people.
- 4. Neat dress, good habits, and proper manners are not absolutely crucial for success today.
- 5. The highest form of government is a democracy, and the highest form of democracy is a government run by those who are most intelligent.
- 6. The banning and censorship of books is wrong. People can select what is good and reject what is bad on their own judgement.
- 7. The use of force is wrong. It should never be used even to enforce a right and noble ideal.
- 8. An insult to our honour should always be punished.

- 9. Fundamentally the world we live in is an impersonal and cruel place.
- 10. If a thing cannot be proven scientifically it does Not exist.
- 11. Politically and economically, Kenya and South Africa have a great deal in common.
- 12. To compromise with one's opponents is not sacrificing one's principles. It is just good sense.
- 13. I must have friends about me who help me to solve my personal, moral, religious and social problems.
- 14. The traditional ideas of discipline, hard work, and unquestioning loyalty to family and country are no longer important today.
- 15. Most people are afraid of the future because there are so many uncertainties.
- 16. There is a deterioration in the quality of the ideas that one hears and reads about today.
- 17. In a discussion I often find it necessary to repeat myself several times to make sure I am being understood.
- 18. Live for today. Let the future take care of itself. Suffering today for future happiness is nonsense.
- 19. In an argument I always become so absorbed in what I am going to say that I miss what others are saying.
- 20. People always look out for themselves and have little concern for the welfare of others.
- 21. Although I become enthusiastic in an argument to put across my point of view, I never interrupt.
- 22. Most people hold quite different moral principles in their lives than I have come to accept.
- 23. It is better to stand up for what you believe, even though you might get killed, than to run away.
- 24. A democracy is the most highly developed form of government, and is most effective when run by the most intelligent.
- 25. At times I think I am no good at all.
- 26. Even though the goal may be noble and honourable, it does not justify the use of force.
- 27. Human nature is basically good. Someday war and conflict will be eliminated.
- 28. In the long run, life is hard and cruel.

- 29. My secret ambition is to become a great man like U Thant, Shakespeare or Mao Tse Tung.
- 30. I enjoy the thrill of doing something dangerous once in a while.
- 31. Astrology, (the belief that the stars influence human affairs) is just foolish superstition.
- 32. There are times when my personal problems seem to be overwhelming but my friends give me a great deal of direction.
- 33. Our social problems would not be solved even if we got rid of the immoral, feeble-minded, and crooked people.
- 34. Many people are afraid about what lies ahead in life when everything is changing and often for the worse.
- 35. When it comes to differences of opinion in politics or religion we must be careful not to compromise with those who believe differently than we do.
- 36. When I am in a heated argument I usually express my ideas more than once to get them across.
- 37. It is dangerous to have faith in a supernatural power whose decisions one follows without question.
- 38. When I am arguing I find it is impossible to plan what I want to say while at the same time listening to the other person.
- 39. In this complicated world of ours the only way we can know what is going on is to rely without question on leaders or experts who can be trusted.
- 40. When I argue I become so intense that I am tempted to break into a discussion to express a crucial idea, but I never do.
- 41. I avoid sticking to a schedule whenever I can. Life is too routine.
- 42. It is a more noble thing to sacrifice your life bravely for your country than to hide to save your life.
- 43. I often change my plans in the midst of an undertaking. It keeps me flexible in my thinking.
- 44. There are times when I think my life is useless and has no aim.
- 45. I never go to church.
- 46. People are not basically evil. Education and civilisation will someday eliminate war and suffering.
- 47. Most problems can be solved in ways other than the traditionally accepted ways, that are just as good or better.
- 48. I would pay a high price to be a famous person.

- 49. I want to do something of great benefit to the world. Given the chance, I would make this my aim in life.
- 50. I and only I am responsible for the success or failure of my life; not the stars or other superstitions.
- 51. Not all laws are just and good. An immoral law ought not to be obeyed.
- 52. Getting rid of the criminals and weak-minded people would not get rid of our social problems.
- 53. If absolutely necessary, a man is right not to pay his taxes so that he can pay his children's school fees.
- 54. Compromise is a sign of weakness in matters of one's political or religious beliefs.
- 55. In times like these it is often necessary to be more on guard against ideas put out by people or groups on one's own side than by those on the opposing side.
- 56. It is irresponsible to follow without question the revealed teachings of a supernatural power.
- 57. There's no use wasting your money on newspapers which you know in advance are just plain propaganda.
- 58. A person should be careful about his own interpretation of the news, but rely on known dependable persons in positions of authority.
- 59. A person with a good education should be given equal respect to a person without any education at all.
- 60. I dislike a rigid routine. I prefer to be a free agent.
- 61. Preserving the traditional customs of respect and authority are far down the list of priorities in a developing country.
- 62. Changing goals in the middle of a project, if the circumstances require it, does not bother me.
- 63. The traditional ideas of neat clothes, good habits, and proper manners are not as important to-day as they used to be.
- 64. I do not believe in any religion.
- 65. Everyone should be free to read or listen to any ideas they wish, even if they are dangerous or in bad taste. It broadens one's education.
- 66. It is a good idea to be looking for new answers to old problems. Because it worked in the past does not mean it will work in the future.
- 67. There are some insults to our reputation and self-esteem that should not go unpunished.
- 68. The highest priority in my life is the accomplishment of something great.

- 69. The real world can be studied scientifically. Things that cannot be are not real.
- 70. If someone believes a law is unjust or immoral he has a right to disobey it.
- 71. Compromise in matters of politics, religion, and morals is the only way to keep society healthy.
- 72. Obedience to laws is necessary, but if there is an important enough reason, a man is right to break the law.
- 73. Unlike in the past, young people today do not accept strict discipline, rugged determination, and the will to work and fight for family and country.
- 74. The person within one's organisation or group who has radical ideas may be more dangerous in the long run than one's opponents.
- 75. As more and more books and magazines are produced, and as they become cheaper, the quality of the ideas that are written goes down.
- 76. Most newspapers in the world today are nothing more than a propaganda machine for unscrupulous politicians.
- 77. The idea of sacrificing today for future satisfactions is a plot of those who want to keep people in submission.
- 78. The government should not listen any more to educated citizens than to citizens without any education.

APPENDIX S
QUESTIONNAIRE FOR VALIDITY STUDY

This is an attempt to establish the validity of an attitude test taken by the Accounts and Secretarial II students as part of a research programme.

The test is designed to distinguish between those who are creative, imaginative, non-conformist, non-authoritarian, non-dogmatic, non-traditionalist, and innovative, and those who exhibit the opposite characteristics.

To establish validity it is necessary to prove a correlation between the score on the attitude test itself and an assessment of the students that is as valid as a personal assessment can be. The students have assessed each other. I would like to add the opinions of the teachers as well.

There is a tendency to attribute the former characteristics to those who are intelligent, handsome, self-confident, natural leaders, or personable, which is not necessarily so. A person may be all of these and be a very traditional and fixed in his attitudes.

As far as possible would you please select three or four students who would fall into the extreme ends of each group.

Creative
Imaginative
Non-conformist
Non-authoritarian
Non-dogmatic
Non-traditional

1 _____
2 _____
3 _____
4 _____

Non-creative
Non-imaginative
Conformist
Authoritarian
Dogmatic
Traditional

1 _____
2 _____
3 _____
4 _____

These will, of course, be confidential. Thank you.

Ronald H. Balsdon
RONALD H. BALSDON:

APPENDIX T

GENERAL OPINION SURVEY
FINAL REVISION

The following is a study of what the general public thinks and feels about a number of important social and personal questions. The best answer to each statement following is your personal opinion. We have tried to cover many different and opposing points of view: you may find yourself agreeing strongly with some of the statements, disagreeing just as strongly with others, and perhaps uncertain about others. Whether you agree or disagree with any statement, you can be sure many people feel the same as you do.

Mark each statement in the space at the left according to how much you agree or disagree with it. Please mark every one. Write the following numbers depending on how you feel about it.

+1: I agree a little.

+2: I agree on the whole.

+3: I agree very much.

-1: I disagree a little.

-2: I disagree on the whole.

-3: I disagree very much.

Give your own opinion, not what you think the author wants. Although some questions may seem to be repeated, the purpose is to find shades of opinion. Do not check back. Indicate your answer and continue on.

- 1. The moral principles I believe in are quite different than those believed in by most people.
- 2. I believe the banning and censorship of books is wrong.
- 3. The use of force is wrong. It should never be used even to enforce a noble and right ideal.
- 4. An insult to our honour should always be punished.
- 5. Fundamentally the world we live in is an impersonal and cruel place.
- 6. If a thing cannot be proven scientifically, it does not exist.
- 7. Sometimes I do things I would not normally do, even dangerous things, just to add a little excitement to my life.
- 8. It is unfortunate that the traditional ideas of discipline, hard work, and unquestioning loyalty to family and country are no longer important in the minds of most young people today.

- 9. In a heated discussion I often find it necessary to repeat myself several times to make sure I am being understood.
- 10. Live for today. Let the future take care of itself. Suffering today for future happiness is nonsense.
- 11. In an argument I always become so absorbed in what I am going to say that I miss what others are saying.
- 12. Most people hold quite different moral principles in their lives than I hold.
- 13. It is better to stand up for what you believe, even though you might get killed, than to run away.
- 14. At times I think I am no good at all.
- 15. Even though the goal may be noble and honourable, it does not justify the use of force.
- 16. I believe that in the long run life is hard and cruel.
- 17. My secret ambition is to become a great man like U Thant, Shakespeare, or Mao Tse Tung.
- 18. I enjoy the thrill of doing something dangerous once in a while.
- 19. Astrology, (the belief that the stars influence human affairs) is just foolish superstition.
- 20. When I am in an argument, I usually express my ideas more than once to get them across.
- 21. When I am arguing I find it impossible to plan what I want to say while at the same time listening to the other person.
- 22. I avoid sticking to a schedule whenever I can. Life is too routine.
- 23. It is a more noble thing to sacrifice your life bravely for your country than to hide to save your life.
- 24. There are times when I think my life is useless and has no aim.

3.

- 25. It is dangerous to have faith in a supernatural power whose decisions one follows without question.
- 26. I never go to church.
- 27. Human nature is basically good. Some day war and conflict will be eliminated.
- 28. I would pay a high price to be a famous person.
- 29. I want to do something of great benefit to the world. Given the chance, I would make this my aim in life.
- 30. I and only I, am responsible for the success or failure of my life; not the stars or any other superstition.
- 31. I dislike a rigid routine. I prefer to be a free agent.
- 32. It is irresponsible to follow without question the revealed teachings of a supernatural power.
- 33. I do not believe in any religion.
- 34. People are not basically evil. Education and civilisation will some day eliminate war and suffering.
- 35. Everyone should be free to read or listen to any ideas he wishes, even if they are dangerous ideas or in bad taste.
- 36. There are some insults to our reputation and self esteem that should not go unpunished.
- 37. The highest priority in my life is the accomplishment of something great.
- 38. The real world can be studied scientifically. Things that cannot be studied scientifically are not real and do not exist.
- 39. Unlike in the past, young people today do not accept strict discipline, rugged determination, or the will to work and fight for family and nation.
- 40. The idea of sacrificing today for future satisfactions is a plot of those who want to keep people in submission.

APPENDIX U

CALCULATION FOR TEST OF SIGNIFICANCE
FOR AUTOMOTIVE TECHNOLOGY EXAMINATION THEORY
EXPERIMENTAL VERSUS CONTROL GROUP

	D	D ²
KABETE	- 2	4
	- 2	4
	- 3	9
	- 2	4
	- 4	16
KISUMU	0	0
	0	0
	2	4
	- 1	1
	1	1
MACHAKOS	0	0
	- 2	4
	- 1	1
	- 1	1
	- 1	1
RVTS	2	4
	- 3	9
	- 5	25
	2	4
	2	4
STAREHE	- 3	9
	- 6	36
	0	0
	0	0
	2	4
	0	0
	<hr/>	<hr/>
	-26	146

$\bar{D} = 0.90$

S.D. = $\sqrt{\frac{146 - \frac{26^2}{29}}{29 - 1}}$

= $\sqrt{4.38}$

= 2.09

S_{DIFF} = $\frac{2.09}{\sqrt{29}}$

= 0.39

t = $\frac{0.90}{0.39}$

= 2.31

With 28 degrees of freedom
t = 2.048 at the 5% level.

The hypothesis is therefore rejected.

APPENDIX V

COMPARISON OF THE EXPERIMENTAL AND CONTROL GROUP
AVERAGE PHASE TEST GRADES

	EXP.	CONTROL	DIFF.	D ²
KABETE	75	78	-3	9
	75	73	2	4
	74	67	7	49
	75	78	-3	9
	81	81	0	0
	75	74	1	1
KISUMU	55	46	9	81
	56	34	22	484
	52	43	9	81
	60	73	-13	169
	75	49	26	676
	66	74	-8	64
	66	71	4	16
MACHAKOS	75	35	12	144
	47	44	26	676
	70	55	16	256
	71	42	24	576
	66	70	10	100
	80	51	-3	9
	80	76	8	64
RVTS	84	57	8	64
	65	48	11	121
	59	53	-11	121
	42	52	1	1
	53	48	7	49
	55	52	4	16
	56	67	0	0
	56	52	4	16
STAREHE	67	74	9	81
	83	63	7	49
	70	63	7	49
			<u>182</u>	<u>3970</u>

D = 6.28

$$S_D = \sqrt{\frac{\sum D^2 - (\sum D)^2}{N}}$$

$$= \sqrt{\frac{3970 - 1142}{28}}$$

$$= 10.05$$

$$S_{diff} = \frac{S_D}{N}$$

$$= \frac{10.05}{5.39}$$

$$= 1.86$$

$$t = \frac{\bar{D}}{S_{diff}}$$

$$= \frac{6.28}{1.86}$$

$$= 3.38$$

t at 1% = 2.756

H₀ is rejected

APPENDIX W

CALCULATIONS FOR FOUR VALIDATION STUDIES

I K.T.T.C. 8.2.78

Of the 36 students who took the test, 11 were selected for the group high in innovation and 11 were selected for the group low in innovation by both the teachers and the peers. The t test for comparing means was conducted as follows:

A	A ²	B	B ²
-40	1600	-12	144
-32	1024	-11	121
-29	841	-8	64
-14	196	-9	81
-13	169	13	169
-18	324	14	196
-3	9	16	256
-2	4	17	289
3	9	22	484
17	289	25	625
27	729	32	1024
<u>-104</u>	<u>5194</u>	<u>117</u>	<u>3893</u>
$\bar{X} = -9.45$		$\bar{X} = 10.6$	

$$S_{diff} = \sqrt{\frac{5194 - \frac{104^2}{11} + 3893 - \frac{117^2}{11}}{11 + 11 - 2} \left(\frac{2}{11}\right)}$$

$$= 7.88$$

$$t = \frac{10.6 - (-9.45)}{7.88} = 2.54$$

At the 1% confidence level, t must be greater than 2.528.

The results are significant at the 1% confidence level. Group B scored significantly higher than group A

APPENDIX W (CONTINUED)

II KENYA POLYTECHNIC 10.7.78

Of the 23 students who took the test, 10 were selected for the group high in innovation by their peers and the remaining 13 constituted the group low in innovation. The t test for comparison of means was conducted as follows:

A	A ²	B	B ²
18	324	13	169
16	256	0	0
15	225	5	25
44	1936	5	25
7	49	4	16
14	196	8	64
24	576	4	16
31	961	10	100
13	169	5	25
21	441	10	100
17	289	—	—
42	1764	2	540
7	49		
—	—		
193	7235		

$$S_{diff} = \sqrt{\frac{7235 - \frac{193^2}{13} + 540 - \frac{2^2}{10}}{10 + 13 - 2} \left(\frac{10 + 13}{10 \times 13}\right)}$$

$$= 6.43$$

$$t = \frac{14.8 - 0.2}{6.43} = 2.27$$

At the 5% confidence level, t must be greater than 1.721.

The results are significant at the 5% confidence level. Group:

$$\bar{X} = 0.2$$

$$\bar{X} = 14.8$$

APPENDIX W (CONTINUED)

III K.T.T.C. 18.7.78

Of the 30 students who took the test, 12 were selected for the group high in innovation by their peers and the remaining 18 constituted the group low in innovation. The t test for comparison of means was conducted as follows:

A	A ²	B	B ²
11	121	-44	1936
14	196	5	25
3	9	9	81
-10	100	8	64
43	1849	5	25
-13	169	-3	9
0	0	11	121
31	961	8	64
13	169	-18	164
29	841	10	100
34	1156	-2	4
33	1089	11	121
9	81		
-7	49	0	2874
5	25		
12	144		
5	25		
14	196		
<hr/>	<hr/>		
226	7180		

$\bar{X} = 0$

$\bar{X} = 12.6$

$$S_{diff} = \sqrt{\frac{7180 - \frac{226^2}{18} + 2874}{18 + 12 - 2} \left(\frac{18 + 12}{18 \times 12} \right)}$$

= 6.00

t = $\frac{12.6}{6.0} = 2.10$

At the 5% confidence level, t must be greater than 1.701.

The results are significant at the 5% confidence level. Group A scored significantly higher than group B

APPENDIX W (CONTINUED)

IV K.S.T.C. 28.7.78

Of the 43 students who took the test, 14 were selected for the group high in innovation by their peers and the remaining 29 constituted the group low in innovation. The Z test for comparison of the means was conducted as follows:

A	A ²	B	B ²
8	64	11	121
3	9	14	196
7	49	1	1
24	576	11	121
20	400	10	100
8	64	16	256
6	36	7	49
18	324	24	576
8	64	10	100
0	0	1	1
30	900	7	49
10	100	11	121
1	1	8	64
5	25	15	225
13	169		
30	900	64	1980
4	16		
23	529	$\bar{X} = -4.57$	
47	2209		
34	1156		
3	9		
31	961		
25	625		
37	1369		
2	4		
6	36		
6	36		
20	400		
9	81		
<hr/>	<hr/>		
248	11112		
$\bar{X} = 8.55$			

$$S_{diff} = \sqrt{\frac{11112 \cdot \frac{248^2}{29} + 1980 \cdot \frac{64^2}{14}}{29 + 14 - 2} \left(\frac{29 + 14}{29 \times 14} \right)}$$

$$= 5.25$$

$$z = \frac{8.55 - (-4.57)}{5.25} = 2.51$$

At the 1% confidence level, z must be greater than 2.06

The results are significant at the 5% confidence level. Group A scored significantly higher than group B.

APPENDIX X

CALCULATIONS FOR HYPOTHESIS NUMBER TWO

Difference Between Means —

Technical Teachers and University of Nairobi Students.

$$\begin{aligned}
 S_{\text{diff}} &= \sqrt{\frac{S_1^2}{N_1} + \frac{S_2^2}{N_2}} \\
 &= \sqrt{\frac{16.1^2}{47} + \frac{15.5^2}{31}} \\
 &= 3.64 \\
 Z &= \frac{\bar{X}_1 - \bar{X}_2}{S_{\text{diff}}} \\
 &= \frac{4.20 - (-2.63)}{3.64} \\
 &= 1.88
 \end{aligned}$$

At the 5% confidence level, Z must be greater than 1.96. Ho is therefore accepted.

Note: Z = 1.88 represents 94% of the area under the normal curve.

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