UNIVERSITY OF CAPE TOWN

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Summative Evaluation of Educational Television Material

A dissertation
presented in partial fulfilment
of the requirements for the Degree of

Master of Education

by

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Abstract:

The following dissertation " Summative Evaluation of Educational Television Material " consists of the following sections:

Section I:

Chapter 1: Introduction to the problem/task.

A brief introduction to the problems of evaluation and research into educational television, with particular reference to the situation in South Africa. A background to the actual evaluation performed is included.

Chapter 2: A detailed account of the planning, design and implementation of a summative evaluation of ETV material. This section is based largely on extracts and recommendations from the available literature, as well as including recommendations and observations by the author.

Section II:

Chapter 3: A summary of the summative evaluation of Episode 1 and Episode 4 of the SABC ETV series "Statistics". The two episodes are compared under various criteria, particularly the degree to which the goals of the series were attained. This chapter may be taken as an example of a typical summative evaluation.

Section III:

Chapter 4: A detailed summative evaluation of Episode 1.

Chapter 5: A detailed summative evaluation of Episode 4.

Chapter 6: A comparison, summary and recommendations arising out of the evaluations above.

Appendix 1: The test instruments used in the evaluation.

Appendix 2: A comprehensive list of references and abstracts. (A result of a literature search on the ERIC databank). Not all the references were used in the dissertation.

Bibliography: A list of source material used by the author in the dissertation.

Preface:

The following dissertation may be considered as consisting of two main sections, viz:

1: A general research investigation into the design and implementation of a summative evaluation of ETV material.

2: A detailed summative evaluation of two episodes of the SABC ETV series "Statistics."

The detailed evaluation of Episode 1 and Episode 4 of the series are included in Chapter 4 and Chapter 5 respectively.There is some lack of continuity in the dissertation, which was unavoidable . The reason for this is that the summative evaluation was commissioned by the SABC, and each evaluation must be considered as a complete, self-sufficient, stand-alone entity.

I have appended the results of a literature search on the ERIC database of educational literature. Apart from being a valuable source of reference for the author of this dissertation, the summary is included in its entirety as a source of references for other researchers into the field of evaluation of ETV material. (Sections of the dissertation have been submitted for publication by the SABC in local and overseas journals, and the complete dissertation will be used as a source of reference by the SABC Educational Television Unit.)

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Chapter 1 Introduction

> "Educational Broadcasting is now a major - and costly - undertaking in most countries of the world, but is no longer regarded as a panacea for the most pressing problems in education. Increasingly, over the last decade, the demand has grown for proper evaluation of the effectiveness of educational television and radio, particularly in cost terms, and for research into ways of bridging the initial separation between producers and users of the broadcast programmes."
> (Bates & Robinson 1977 Frontispiece)

Difference between "evaluation" and "research":

Richard Hooper, Director, National Development Programme in Computer Assisted Learning, London, in summing up the proceedings of the International Conference on Evaluation and Research, 1976, made the following distinction between evaluation and research:

> "Research is more interested in extending knowledge, pushing back the frontiers. Evaluation has a more practical and developmental aim, research a more theoretical aim. Evaluation is more short-term, I would argue, and research more long-term."(Bates & Robinson, 1977, p334)

Professor Emile McAnany, Stanford Institute for Communication Research made the following distinction at the above Conference:

> "So research is referred to as fundamental, long term, a priori, generalizable, university-based, conclusion-oriented, academic in depth, searching for knowledge, based on a very strict scientific method for collecting evidence, etc etc.
> Evaluation is applied, action-oriented, short term, programme-specific, project-based, decision-oriented, assesses the known (whatever that means), quick and dirty, and a few other epithets.
> One person sums it up very well. Perhaps this is not a homourous summary, but I think it's one distinction that we would agree with as a summary phrase:

> Not all research is evaluation, but all evaluation is research." (Bates & Robinson, 1977, p357)

Referring to the above criteria, it would seem that the dissertation that follows may be regarded as a "research" project, as opposed to a simple "evaluation". Certain sections are certainly "programme-specific", but in general the investigation is an in-depth look at summative evaluation as a whole. The terms "evaluation" and "research" are used rather loosely in the dissertation, however, as the distinction between the two is a subtle one.

Some Factors Relevant to Educational Television in South Africa:

Rogers (1974) claims that in most countries, the influence of the elites is so strong that the "communications effects gap" is probably widening. This gap is that which exists between the elites and the remainder of the population. Elites employ communications, including educational broadcasting, to their own advantage more than to the advantage of others, with the result that they enhance and maintain their own privileged position at the expense of others. Thus educational broadcasting may in fact result in the widening of the educational gap, rather than the converse, which is one of the stated aims of the South African Broadcasting Corporation's educational programme.

Educational television may introduce a foreign culture, which may be in conflict with existing cultures. The Indian Satellite project and the Ivory Coast Project (Hawkridge & Robinson, 1982) show cases of severe cultural conflict as classroom teachers' authority is challenged by teachers who are better qualified and, reputedly, more able to teach. In the Ivory Coast it was found that there was a conflict between the national language, French, which is both the medium of instruction and the vehicle of foreign culture, and the local languages. This is certainly a point worthy of consideration in South Africa, where a similar situation applies.

The use of a 'master teacher', resulting in the undermining of the teachers' authority was one of the main reasons why the Mexican educational television programme telesecundaria was recently curtailed. The telesecundaria classroom teachers sought pay equal to that of the better qualified colleagues who taught at conventional schools of the same level, but without educational television. This factor must be borne in mind by planners of future policy regarding the use of educational television in the educationally deprived areas of South Africa, where a parallel situation could conceivably arise.(Hawkridge & Robinson, 1982)

It is generally accepted that there has been a growing awareness of the potential of educational broadcasting as a medium for the upgrading of teaching levels for the educationally disadvantaged: both among children and adults. It is clear that in the South African situation, use should be made of this medium, but that several important principles, which have been demonstrated in many other similar projects should be borne in mind by the designers of a general educational broadcasting programme. These principles would include:

(1) provision must be made for a substantially higher level of resources and a substantially longer developmental period than would be expected for the same output to more privileged levels of equivalent education;

(2) provision should be made at the appropriate pace and level of technology for the community being served, without any ideas of patronizing or condescension;

(3) provision should be made, either by the broadcasting system or by the educational authorities, of an adequate level of well trained local support.

(4) all elements of the programme, including the support, should be tested during the developmental stage, without unduly delaying the development of the project;

(5) arrangements should be made for the continuous monitoring and evaluation of the project, so that it can adapt to changing condition.(Hawkridge & Robinson, 1982)

Background to the Evaluation:

South African Broadcasting Corporation has formed two main educational divisions, viz, Educational Programmes RTV2/3 with Dr P F Erasmus as head, and Educational Programmes RTV1, under the leadership of Dr P J van Zyl.

It is worthy of note that the South African Broadcasting Corporation has divided its education broadcasts into division using the race of the audience as the sole criterion. This is consistent with the overall policy regarding education in South Africa, namely that education for the separate racial groups should remain separate.

The head of Educational Programmes RTV1 approached the University of Cape Town to appoint a researcher to carry out a summative evaluation of the educational television series "Statistics" to be broadcast during 1985. The author, a Masters student in the Education Faculty of the University of Cape Town with formal tertiary qualifications in statistics was appointed as the sole researcher. The appointment of an independent researcher was in accordance with the majority of the recommendations in the literature.

J D C Stupart worked in close collaboration with Dr Aliza Duby, a senior researcher in the South African Broadcasting Corporation Educational Programmes RTV1 unit. Some degree of formative evaluation had been carried out on the series "Statistics" by Dr Duby in collaboration with the production

team, headed by Ms Margaret Landers.

It is important to note, and to bear in mind throughout the following evaluation that the educational television series was designed and broadcast by TV1, thereby implying that the target audience consisted of an elite group, namely affluent members of the "White", and to a lesser extent, "Coloured" population groups. This fact was borne in mind during the construction of the samples for evaluation, and was an important factor influencing the final recommendations and conclusions.

In addition to the summative evaluation of the series "Statistics", the South African Broadcasting Corporation required the researcher to produce a summary of the existing literature relevant to summative evaluation. A literature search of the ERIC data bank was carried out, as well as more conventional methods of inquiry, resulting in the list in the Appendix. Some of the theses mentioned in the ERIC list were unobtainable, and have therefore not been read, but are included for generality and completeness.

It should be born in mind that even though the modern trend in evaluation research is towards a stress on formative evaluation which should be performed in parallel with the development of the educational material, and that in any allocation of resources, top priority should be given to formative evaluation, summative evaluation can still be regarded as being important in the design of a system of educational broadcast programmes. (Mielke, 1973) Mielke states further: "There should always be some form of summative research, but funding here is secondary to a quality formative research." (Bates & Robinson,1977,page 24)

Barbatsis (1978) examines the two bodies of research from the point of view of the theoretical progress achieved by the two different methods of scientific inquiry: summative and formative. Examination of the historical and research context indicates that the approach of summative research has been premature in the field of communications research regarding educational television. Formative research on the other hand, demonstrates the need for the preparatory, exploratory type of study necessary in a field where the testable variables are yet to be discovered.

STAGES OF SUMMATIVE EVALUATION RESEARCH:
(As proposed by Hawkridge & Robinson,1982)

1: Select an Evaluation Team:

Tah Wen (1976) suggests that some of the material should be tried on the subjects away from the influence of the author at an early stage in the research, with a **neutral, unbiased observer being present. (See also Stupart,1985). This** concept is most applicable to summative evaluation, where the idea of using a **neutral observer** is of prime importance. The use of neutral researchers has been used or mentioned in many of the reported summative evaluations. (see Segal & Simco,1972 ; Ball, Bogatz, and Gerry,1973 ; Van Wart,1974 ; Bates & Robinson,1977; Knapper,1980; Mielke,1973).

Mielke (1976) states:

> "Summative research for outside consumption should be assigned on contract to outside, competent, research groups. Control over design of the summative research and the instruments used should remain inhouse with AIT, but once approved the outside group should be autonomous." (Bates & Robinson,1977,p25)

Professor McAnany, however, feels that it is better for the researcher to be involved in the production. He states that "responsibility and involvement were better than was total independence from the project. Most people pointed out that an evaluator is never independent because he is always paid

by someone, presumably, and even if it is by another agency he is dependent on that agency." (Bates & Robinson,1977,p358)

Four of the groups present at the International Conference on Evaluation and Research in Educational Television and Radio, Open University, April 1976, proposed some form of compromise. For formative evaluation they felt that it is almost always better to have the evaluator as being a member of the production team, or with close collaboration between the researcher and the production team. Summative evaluation, however, may be more effective if conducted by an external evaluator. In all cases it was hoped that the results would be openly reported. One group reported that a range of evaluators had proven to be the best solution, with varying degrees of proximity to the production operation.

The evaluation team should contained experts in their fields of study - not only in education in general, but also experts in the field of the material being presented. (Mielke,1973)

Included under the heading of the selection of the evaluation team must be the **training of the evaluation team,** and the provision of the **material resources** necessary for the evaluation research. Hawkridge & Robinson (1982) suggest that the training possibilities for an evaluation team are limited, and that the best training is probably "on-the-project"(p123). This suggestion motivates strongly the inclusion of at least one member on the research team who has had experience in a similar or related project.

The evaluation team must be aware that a conflict situation could conceivably arise between the evaluation of the cognitive processes involved, and the evaluation of the actual production aspects of the ETV material. The evaluation team must therefore be chosen with care in order to create a balance between the evaluation of the two aspects mentioned above.

2: Set Objectives and General Design of the Evaluation:

The following questions must be answered at this stage:
(a) Who wants the evaluation?
(b) For what purpose is the evaluation to be carried out?
(c) How should the objectives be negotiated, and between whom?
(Hawkridge & Robinson,1982 ; Popham & Baker,1970)
In deciding on the answers to the above, the following must be kept in mind:
There are usually three parties involved in any evaluation, namely:
(1) Those who commission the study. This is often the production management, who want informed judgments concerning the project's progress towards fulfilling the desired objectives.

(2) Those who carry out the study. The evaluator(s) would probably have similar aims as those of the production management, but would probably include their own biases.
(3) Those who are evaluated. This group is often neglected in the design of an evaluation. They may well want the educational television project stopped or prolonged, or may want changes made.

It is often the case that the three parties involved are not in agreement over the objectives of the evaluation. Some form of initial discussion or negotiation is often required between the above three parties, so that consensus may be reached over the objectives of the evaluation.

It is essential that at this stage of the evaluation planning the goals both of the summative evaluation as well as the goals/objectives of the educational television material itself be clearly defined to the evaluation team.

A decision must be taken at this stage as to what action (if any) will be taken by the production management, based on the findings of the evaluation. Decisions based on an evaluation include the continuation or modification of existing projects, or the development of new educational television material based on the research findings. (Tah Wen,1976)

Christer Frey, Head of Research, Education Department, Sveriges Radio, states the following:

> "The results must be able to form the foundations for decision-making on the level concerned, e.g. decisions about the possible revision of a program or a series of programs." (Bates & Robinson,1977,p10)

3: Choose test instruments, and general data collection plan:

Test instruments:

An important point of consideration is whether or not to use standardized test instruments in the evaluation. Mielke (1976) presents the following arguments for and against the incorporation of standardized in a summative evaluation of educational broadcasting material:
Supportive arguments include:
(1) a field tested instrument;
(2) there is a common basis whereby the performance of other groups can be measured;
(3) there are national norms established for many of these instruments.
Arguments against standardized instruments include:
(1) many of them are not designed as a measure of programme effects;
(2) there is some possibility that an existing instrument could influence the curriculum by tailoring the objectives to fit the instruments;

(3) most importantly, standardized instruments could have minimal overlap with the total configuration of the programme objectives.

Mielke recommends that original instruments be used to "insure precise reflection of program objectives." (Bates & Robinson,1977,p22)

Models of test design:

Tah Wen gives the following models to be considered in the overall test design:(Bates & Robinson,1977)

(1) Evidence from students: (a) "Tutorial-Clinical Model" - this model involves the intensive study of a few students as they interact with the material. (see also Flagg, et al, 1978). (b) The "Agricultural-Botany Model" - this is a study of a large number of students, usually involving batteries of tests and questionnaires. (see also Webb,1982; Harvey,1976; Johnson,et al, 1980)

(2) Evidence from teachers: (a) A collection of the best "Little Johnny" stories, which could be useful in indicating the kind of effect that the material has, but in general is unreliable and not generalizable. (b) Teacher Opinion Model - This involves the trial of the material to a large number of students, at a large number of schools, and the subsequent collection of the teachers' opinions by means of questionnaires and feedback meetings. (see also Johnson,et al,1980; Harvey,1976)

(3) Evidence from classes: (a) The Interaction Model - based on direct observation of interaction in the classroom. This method is consistent with the concepts of Action REsearch, and avoids the danger of bias and of retrospective rationalization. (b) The Environmental Model - uses direct evidence from visits to the classroom environment. The integration of the material with the other aspects of the curriculum can be observed using this method.

(4) Evidence from Institutions: (a) The Cost-Benefit Model - Who adopts the materials, and why? Does adoption enhance the teacher's prospects for advancement and recognition, or does it enhance the Head's image? (b) The Anthropologist's Model - The 'neutral' observer assesses how innovation changes the structure and value systems of the institution.

(5) Evidence from experts: (a) Desirability Model - Are the likely outcomes desirable and of sufficient priority? (b) Feasibility Model - this is concerned with the achievement of intended outcomes through suggested teaching strategy and consideration of alternate strategies.

Tah Wen (1976) points out that an evaluation is not only concerned with measurement or assessment, in terms of a student's achievement scores, but that value judgments and decision - making must be taken into account. This is very important to be considered when designing test instruments, and is a common thread running through much of the literature.(see Boyd,1974 ; Harvey,1976).

Account should be taken of both subjective and objective data, with the emphasis being placed on intuitive when the test results are interpreted. "This is perhaps a blending of scientific and artistic traditions, appropriate in education and broadcasting." (Hawkridge & Robinson,1982,p125)

Another important aspect of the design of the test instruments is that of the evaluation of the actual production (as opposed to the educational content). Baggely and Duck stress the vital role played by the **presenter** in an ETV production. They state: "Is the presenter worth listening to?; only if he is, may close attention be given to what he is saying." (Bates & Robinson (Eds),1976,p185). Other criteria to be considered in the evaluation of the ETV material are: (a) is the medium being used to its full capacity? and (b) could the material have been presented more efficiently or more successfully using some other medium?

4: Decide on data analysis plan:
Referring to the above considerations, the data can be divided into two main divisions, namely qualitative and non-qualitative (quantitative) sets. A quantitative (statistical) analysis must be performed on the latter sets of data. The statistical methods to be implemented must be taken into account at the time of the test design, as the statistical methods chosen will influence the test items themselves as well as the procedure of administration of the test items. (e.g. whether to employ pretest/post test, control groups, etc). Great care must be taken in the sampling of any test population to ensure that the test samples are representative of the population as a whole. The test samples chosen must be large enough to give statistically significant results when applied to the population.

Non-quantitative (largely subjective) data (e.g. clinical interviews, observations, etc) can be analyzed using the various "Action Research" methods. The research carried out by Mrs B Ras of the University of Pretoria into the effect of pre-school educational programmes in South Sotho and their contribution towards learning readiness is a good example of such applied action research. (Ras,1986). Action research methods are gaining more and more credibility and respectability in the field of research into the human sciences, and should be included to so degree in most models of summative evaluation of educational television material.

During this stage of the design of the summative evaluation consideration should be given towards the practical methods available of handling large amounts of numerical data. For example the choice of a particular statistics "package" to be used on a computer would probably influence the design of the test instruments, to facilitate the data entry. The original aims/objectives of the summative evaluation must however not be compromised to achieve ease of data handling.

5: Carry out data collection, analysis and interpretation:

There must be close collaboration between educators, broadcasters, students and the evaluation team in the provision and the collection of the data.

During the planning stage, the necessary permission for the provision of the data must be obtained from the appropriate education authorities (if school are to be used). Teachers must be informed as to the aims of the summative evaluation as well as to the practical details of the administering of the test instruments. Students (test sample) should be motivated as to the importance of the evaluation. This last point is a vital one, and is a problem that is not easily overcome in the South African Educational system, where any test is usually considered merely as a vehicle for obtaining "marks" on some report or other.

6: Prepare report findings:

After the data collection and analysis, an interim, preliminary report should be prepared, and circulated to members of the summative evaluation team. If the team reaches consensus, a final report is then prepared. The format of this final report is somewhat dependent on the proposed readers thereof, and it could be necessary to produce a summarized version (usually excluding detailed statistical analysis) for some of the interested parties. Schramm(1973) recommends synthetic summaries of research in straight-forward language. Such reports are helpful to both advisors and to decision-makers.

It is most important that it is **only** the format that is influenced by the proposed readership. The research findings themselves must not be changed or modified in any way. This is one of the most important reasons for the appointment of a 'neutral' observer to carry out the summative evaluation.

On preparation of the report, due consideration should be given to the possibility of the future publication of the research findings, either in the complete form, or as a summary

7: Disseminate findings:

The report must be circulated to all those concerned with the evaluation, as well as to the production management. Once again it must be stressed that the researcher(s) should be independent of the production team, and that the report should not be influenced in any way by those to whom the report is sent.

Knapper (1980) states:

> "The results of evaluation are primarily of value in recommending changes for the future, a matter which, however, is frequently beyond the control of the assessment team. Although the method of evaluation may be systematic and objective, the interpretation of results is largely a matter of subjective judgement."(page 84)

The above sums up one of the problems of a summative evaluation , i.e. that it is usually very difficult, or often impossible to ensure that that any of the programme changes recommended in the evaluation are implemented. The task of the evaluator ends with the submission of the research report, after that it is up to the production management to implement any recommendations.

Richard Sherrington sums up the ultimate problem faced by evaluators, i.e. that management seldom in fact carries out recommendations arising from summative evaluation of educational television material:

> "Decisions are rarely made on the basis of facts for one alternative or another. American studies suggest that the internal politics of the organisation and the subjective desires of the decision-makers are more instrumental in deciding his course of action. Executives who make effective decisions know that one does not start from facts. One starts with opinions." (Bates & Robinson, p347)

Emile McAnany gives the following recommendations for the action of the evaluator, which is included in its entirity:

> "Actions for the evaluator-advisor The context of planning new projects will not ordinarily generate new data gathering but rather depend heavily on past studies. The role of the evaluator-advisor is paramount in making the best possible use of knowledge.
>
> *the evaluator-advisor helps the decision-maker to specify the precise decision to be made; often that decision will be for or against using television; however where a sattellite system is justified on other grounds the advisor may

be asked the best way of using television.

*the evaluator-advisor helps the decision-maker to specify the constraints to a decision involving television, constraints that include political, the bureaucratic, the economic, the cultural, etc.

*the evaluator-advisor presents the results of his study in the form of alternatives, but makes a choice among them in terms of concrete recommendations for action (and their justification);

*the evaluator-advisor includes among his considerations for recommendating an action the constraints to making a decision and a strategy for the implementation of the recommendations;

*the evaluator-advisor communicates his final recommendations in a dialogue form with the decision-maker, through a face-to-face meeting, or at least in the form of a personal letter, least of all in report form, even if brief, and never in a long technical report.

The planning and implementation of a 'typical' evaluation has been described under seven headings. It is worthy of note, however, that seldom do these stages follow each other neatly in sequence. There is usually a great deal of interaction between these stages.

Chapter 3 Summary & Comparison of Episodes 1 & 4

Introduction: The video tape of the full, six-part series was made available to the researcher several months before the broadcast date. The researcher was employed as the head of the mathematics department of a secondary school, which facilitated the drawing of test and control samples from the pupils at the said school.

A preliminary research investigation was carried out on a random sample of 54 pupils. This preliminary investigation facilitated the design of the test instruments, as well as the choice of the particular episodes chosen for evaluation.

This preliminary investigation indicated that the series on Statistics could be divided into two main sections, viz:

Section 1:	**Section 2:**
Episode 1	Episode 5
Episode 4	Episode 6
Episode 3	
Episode 4	

Section 1 consists of instruction in descriptive statistics, while Section 2 deals with probability theory.
It was decided to carry out a summative evaluation of Section 1. The reasons for this were, inter alia, that the content of Section 1 is largely covered in the Junior Secondary Mathematics syllabus, and that it seemed from the preliminary investigation, that the conceptual level of the content of episode 5 and episode 6 was too high for the target audience (see later).

The two episodes chosen for detailed summative evaluation were **Episode 1** and **Episode 4.**

Episode 1: "Pie charts, Pictograms, Pictographs"
Episode 4: "Point of view. (or how to lie with statistics)"

The ultimate aim of the evaluation was to determine the degree to which the episodes under investigation succeeded in achieving the goals of the series:

Goals of the Series:
1: To communicate an awareness of elementary statistics.
2: To relate statistics and its uses to everyday life.
3: To provide background and reinforcement to the introduction of statistics to the secondary school syllabus.
4: To indicate to the teacher ways in which statistics can be taught in a lively and relevant manner.
(As laid down by the production manager)

<u>Target Audience:</u> The series was originally designed to be of educational value to all age groups and all reasonable educational levels. The broadcast time however, restricted the target audience to young school pupils. The time slot devoted to the series was 17h15 on a Monday evening. The

time-slot was previously and subsequently devoted to broadcasts of ETV material aimed at primary-school (or possibly junior-secondary) pupils. The exclusion of the programme from the Saturday morning ETV time slot contributed further to the restriction of the target audience. It has not been observed in the literature studied by the researcher, but it should be noted that a feature of the evaluation of educational television material should be the time scheduling of such material. This factor is a most significant one in deciding on the target audience, and hence is a powerful influence in success or failure of the educational television program as a whole.

The fact that the series was broadcast on TV1, which is intended for the "White", "Coloured" and Indian population groups is a clear indication that it was the intention to exclude the "Black" population group from the target audience. The mere fact that the series was via the medium of television excludes the majority of the population, as they are not in the affluent elite class who can receive television at all. This includes the schools of the Black population group, as well as the private individuals.

Test Sample: The samples for the two detailed evaluations were randomly selected from pupils at a secondary school. "Coloured" pupils were reluctantly excluded from the sample due to the "unrest" situation that was prevalent in the Western Cape at the time of the research investigation. The sample is therefore not a random one, and is not representative of the population as a whole. The sample could, however, be considered as being representative of the target group, being drawn from the elite, "White" population group. (See above)

Number	Test	Control	TOTAL
Episode 1	170	22	192
Episode 4	121	130	251
TOTAL:	291	152	443

The "Control" group for Episode 1 is small. At this stage of the research, it was unclear as to whether or not to include a control group at all. The results interpreted from the evaluation of Episode 1, however, convinced the researcher to base the analysis on a test/control situation. The control group for the summative evaluation of Episode 4 was therefore increased to the same order of magnitude as the test group.

The test samples for both the evaluations are statistically large enough to yield significant results when applied to the population.

Administration of the Test

The tests were written by the test and the control groups under strict examination conditions, supervised by a mathematics teacher. Forty (40) minutes was allowed for the test - this time being the typical length of one school period. It is important to choose a test duration that will cause minimal disruption of a school timetable when research is carried out in schools.

The research subjects were motivated to treat the tests seriously by two main methods. They were informed of the purpose behind the summative evaluation, and its importance to both the South African Broadcasting Corporation and to the author. Genuine interest was shown by the pupils in the process of evaluation for educational television material. The "marks" were used as a part of the pupils final reported term mark. This latter motivational force is one that is an unfortunate component of an educational system that is examination-based. The learners expect any activity to be rewarded with "marks" on some form of report. It was felt by the author, acting in his capacity as head of mathematics at a secondary-school, that the results obtained from the evaluation test items would probably be a more reliable measure of understanding of statistics that many of the more traditional methods of testing statistics, which often consist of algorithmic data processing.

Processing of the Test Results

After the tests had been administered, the answer sheets, as well as the question papers were collected, and returned to the researcher. The scripts were scored, and the results analysed. The researcher designed a simple computer program for the analysis of the data.

Test Instruments:

In all the tests ,the results were divided into the following sections:

(1) Question 1 to Question 4. These questions were designed to test the **content** knowledge relevant to the episode under evaluation . In many cases, the test items in this section were taken directly from the educational television script.

(2) Question 5 and Question 6. These two questions were in general designed to test the creativity and the statistical insight of the test samples. These questions required (in general) more divergent, creative thought processes than was required in Questions 1 to 4. It was not always possible to give a quantitative evaluation to these questions. They were at times scored subjectively and qualitatively.

(3) Questions 7 to 10 These questions dealt with the evaluation of the **attitude** of the test sample. These questions were only administered to the test sample, and not to the control group, as they referred specifically to the episode under evaluation. The test items in this section were identical in **all** the tests. (i.e. for the evaluation of all the episodes)

(4) Questions 11 to 14 These items attempted to evaluate the **production** as such, rather than statistics. Once again, these items were only answered by the **test sample** as they are episode-specific.

Before the commencement of the test, each candidate was given an **exam number.** In this number was coded the following:

1. School standard (Numeric 6...9, 0 for Std 10)

2. Assessed mathematical ability. Each member of the evaluation sample was given a rating of 1 (very weak) to 5 (excellent). This rating was obtained by observation of the achievement history of the candidate, as well as personal consultation and discussion with the mathematics teacher of the candidate.

3. Test / Control Sample (0 = Control / 1 = Test)

4. Sex of the candidate (0 = female / 1 = male). This factor was not examined in the evaluation as the tests were only administered to males.

5. 2 digit personal number for each member of the group, used often for follow-up discussions resulting from certain responses in the tests.

(See the attached answer sheet)

An investigation of the effect (if any) of the following factors on the test scores was carried out for the test and control groups:

(1) Assessed Mathematical ability: It was felt that this factor would be highly significant in affecting the test scores. It proved somewhat difficult to give an accurate assessment, as the researcher did not consider that an assessment based purely on "marks" obtained in past class assessments would be an accurate basis of assessment if taken in isolation. A figure (1 - 5) was obtained by consulting with the mathematics teacher of the test candidate. The evaluation results show that this assessment was probably a fair one.

(2) Number of years exposure to "formal statistics": This figure was obtained simply by entering the school standard of the test candidate. In the Cape Province, statistics is included in the syllabus for Junior-Secondary. (Std 6 and Std 7). The content of the Syllabus consists of simple descriptive statistics, with **no probability theory.** Much of the traditional school approach has been the manipulation of data in order to calculate frequency tables, means, bar graphs, histograms, etc. The concept of standard deviation is excluded from the syllabus. There is very little stress in the formal "traditional" classroom situation of interpretation and decision-making resulting from data. Statistics is excluded from the Senior-Secondary Mathematics syllabus (Std 8 - Std 10). It proved to be impossible to determine the exact factor that was being evaluated when investigating the effect of this factor - the researcher was unable to separate the actual exact effect of formal schooling from general and mathematical maturity and experience. In the following evaluation it must be borne in mind that the factor "years formal statistics" in in fact a complex factor containing more significant data than the title would suggest.

(3) The main comparisons in the evaluation must be the effect of the actual Episodes on the test scores. The evaluation was commissioned by the South African Broadcasting Corporation to determine the effect (if any) of the series. This comparison was carried out by the testing of control/test groups. To ensure that the control group had not viewed the educational television material, the tests were performed **before** the actual broadcast dates. Viewing by the test sample was done under controlled conditions, which could have created a somewhat artificial result in the evaluation. (The effect of the material could have been different if the programme had been viewed in informal, home surroundings).

Chapter 4 Evaluation of Episode 1 - Statistics

Introduction:

The following two chapters give a detailed account of the summative evaluation of the South African Broadcasting Corporation educational television series "Statistics", as carried out by J Stupart (solus).

E T V Material to be Summatively Evaluated:

The material to be summatively evaluated is the First Episode of the South African Broadcasting Corporation educational television series "Statistics", broadcast during 1985 on TV1. The content of the educational material in this episode consisted of information concerning the creation and interpretation of pie-charts, pictograms and pictographs.

The goals of this episode are the goals of the series as a whole, namely:
1: To communicate an awareness of elementary statistics;
2: To relate statistics and its use to everyday life;
3: To provide background and information to the introduction of statistics into the secondary-school syllabus.
4: To indicate to the teacher ways in which statistics can be taught in a lively and relevant manner.
The ultimate aim of the evaluation will be to investigate the degree to which the episode succeeded in meeting these goals.

Target Audience:

The original suggested target audience was an extremely wide one, covering children as well as adults, and including the "White", "Coloured" and Indian population groups. (The use of TV1 as the broadcast medium theoretically excluded the "Black" population group. The test group used in the evaluation consisted only of "White" children, for reasons that will be dealt with later. The sample is therefore not truly representative of the population, but is probably representative of the actual target audience, restricted to the elite, upper middle class by the very medium of presentation - television receivers are expensive, luxury items, and are not owned by the majority of the population.

Test Sample:

The sample of 192 subjects was drawn from secondary-school pupils, ranging from Std 6 to Std 9. The sample was drawn from the White population group, as the "unrest" situation in the Western Cape was at its height at the time of the evaluation, precluding the inclusion of "Coloured" pupils in

the test sample. Of the 192 subjects, the test sample consisted of 170 pupils, while a control sample, which did not view the material consisted of 22 pupils. The sample of 192 may be considered as "large" and results arising out of the sample testing may be considered as representative of the population involved.

Research Methodology:

The test items included questions relating to change in content knowledge, as well as change in attitude toward statistics. Questions were included to evaluate the attitude of the test group toward the production as such. (See Appendix I - Research Tools).

The test group (170) were shown the video tape of the Episode before the broadcast date, in order to be certain that the control group was in fact a valid control, having not viewed the material. During screening, a careful note was made by the researcher of the general behaviour of the group, in order to determine the interest generated by the material. Post-viewing interviews/discussions were carried out.

Each candidate was supplied with an "exam number" within which was coded the sex, assessed mathematical ability, years exposure to "formal" statistics, as well as whether the candidate had viewed the episode or not. The test subjects were unaware of the meaning of these codes.

Before administration of the test, the subjects were informed of the purpose of the test. They were further motivated to avoid trivial answers by being told that the "marks" would be used in their end-of term assessment. The latter is an unfortunate indictment of the South African educational system, where the overriding motivation for any activity is "marks" on some report or other.

The Chi-Squared statistical test for contingency tables involving frequencies was generally used to determine whether or no the various independent factors had a statistically significant effect on the test scores.(See Appendix for details of the statistical procedure used).

INTERPRETATION OF THE DATA & DISCUSSION

Content and Ability:

Effect of Assessed Mathematical Ability on the Test Scores:

Table 1: Percentages of correct responses according to assessed mathematical ability.

Math Ability	n	Q1	Q2	Q3	Q4	Tot	Observed Frequencies
1	13	53	69	76	46	5	
2	34	61	79	88	47	15	
3	83	74	91	85	53	42	
4	39	69	97	94	74	21	
5	23	91	100	95	91	14	
Totals	192	71	90	88	60		
r =		0.92	0.97	0.91	0.94	0.99	

Chi-Squared = 11.3 with 12 degrees of freedom.

Referring to Table 1, above, it can be seen that there is a near perfect linear correlation between the percentage of correct responses and the assessed mathematical ability of the candidates ("r" - coefficient of linear correlation)

Using the Chi-Squared Test, however, the null hypothesis that assessed mathematical ability has no effect on the test scores can only be rejected at the 0.50 level, which is **not** significant at an acceptable level. The very high linear correlation coefficients could be explained by the fact that the assumption of normality is not met in this case. Referring to the graphs of the responses vs mathematical ability, it can be seen that the frequencies are nearly perfectly linear, but that the **slopes** of the graphs are not steep, indicating the predicted low significance of the effect of mathematical ability on the test scores.

From the above, we are **not** justified in rejecting the null hypothesis. Mathematical ability does **not** necessarily play a significant role in the test scores. This could be explained by the fact that the content on Episode 1 is very elementary, and does not require any degree of mathematical ability.

The significance levels for rejecting the above null hypothesis for **Questions 5 and 6** however are respectively 0.10 and 0.25 - indicating that mathematical ability has a significant effect in the score in question 5 and 6. (See Table 1(a), below). Referring to the test items (Chapter 3) it may be seen that these two questions required more divergent thinking, and did not require mere mechanical interpretation of simple graphical material.

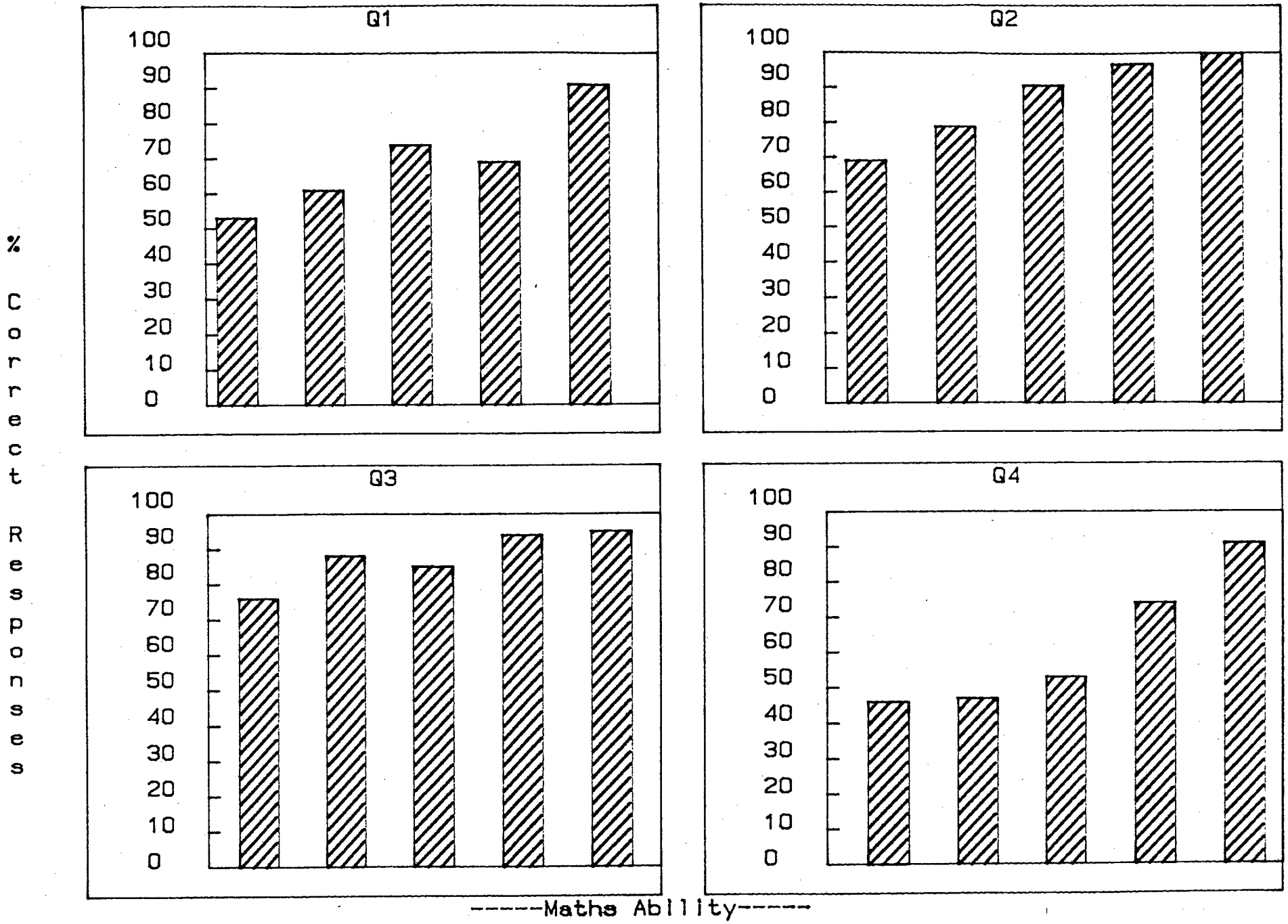

Q1
Q2
Q3
Q4
100
90
80
70
60
50
40
30
20
10
0
% Correct Responses
-----Maths Ability-----

Table 1 (a): **Percentage of candidates in each Mathematics ability group who scored 0 to 5 in Question 5.**

Ability	n	0	1	2	3	4	Mean
1	13	15%	0%	15%	54%	15%	63.5
2	34	9%	0%	24%	38%	29%	69.8
3	83	7%	.1%	13%	42%	36%	74.8
4	39	0%	0%	8%	64%	28%	80.3
5	23	0%	0%	.4%	43%	52%	87.0

Linear correlation: r = 0.999

Table 1 (b): **Percentage of candidates in each Mathematics ability group who scored 0 to 5 in Question 6.**

Ability	n	0	1	2	3	4	Mean
1	13	31%	15%	15%	31%	8%	42.3
2	34	15%	12%	15%	35%	18%	54.4
3	83	13%	8%	18%	37%	23%	62.0
4	39	13%	3%	28%	44%	13%	60.3
5	23	9%	135	22%	17%	39%	66.3

Linear correlation: r = 0.917

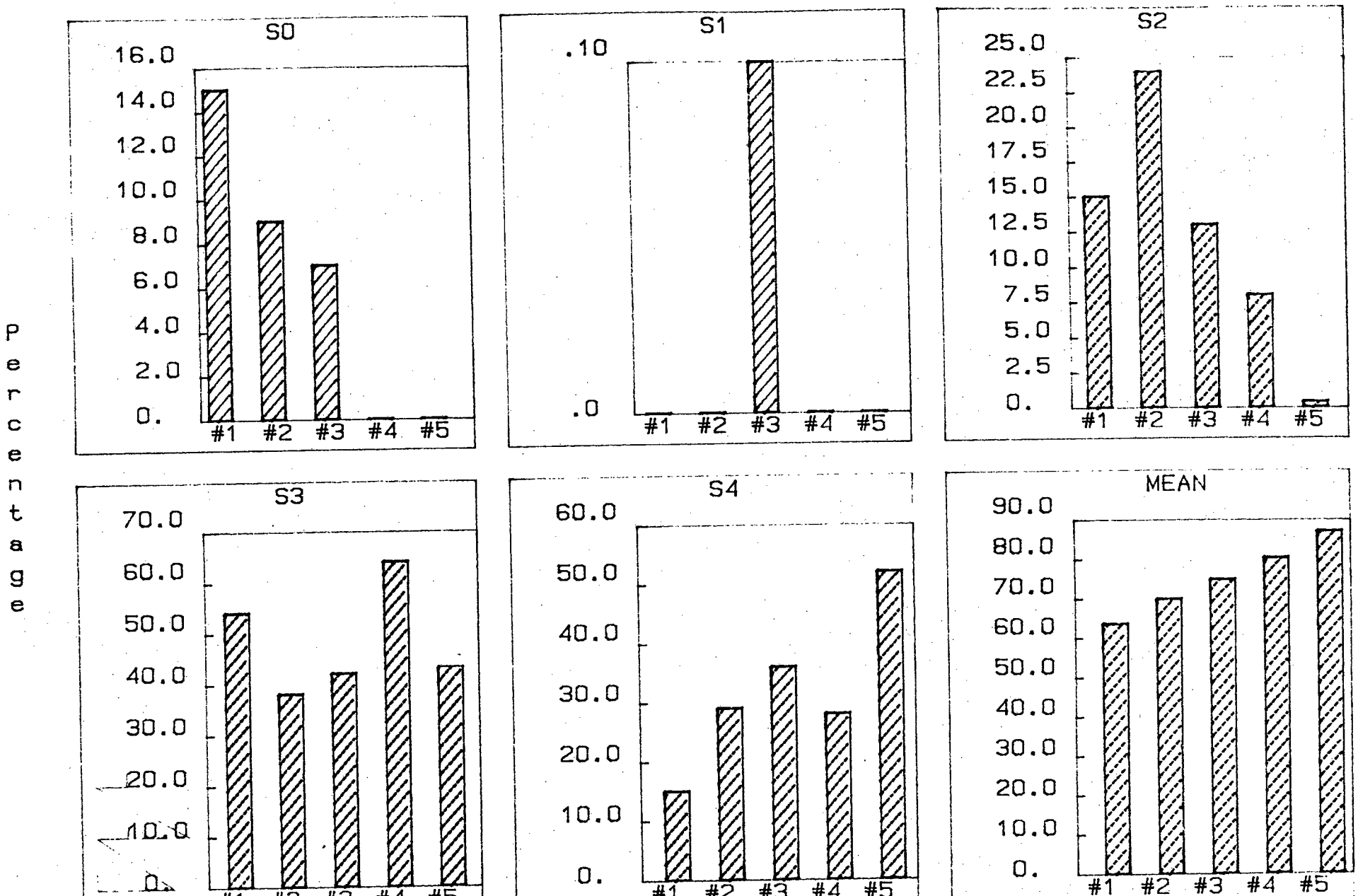
Despite the very high linear correlation between the mean score for the above two questions and the assessed mathematical ability, and the very significant levels for the rejection of the null hypothesis, it is worth noting the discrepancies apparent in the results for Question 6, particularly for those in the high ability group. This might be explained by the fact that the test sample was assessed on their performance in the formal 'traditional' school situation, a situation which often does not encourage divergent, creative problem-solving methods. If one refers to the type of questions in the above, it would seem that some degree of divergent, creative techniques are necessary, and would therefore possibly be difficult for some of the sample who are restricted to algorithmic methods of problem solving, typical of the formal 'educational' system.

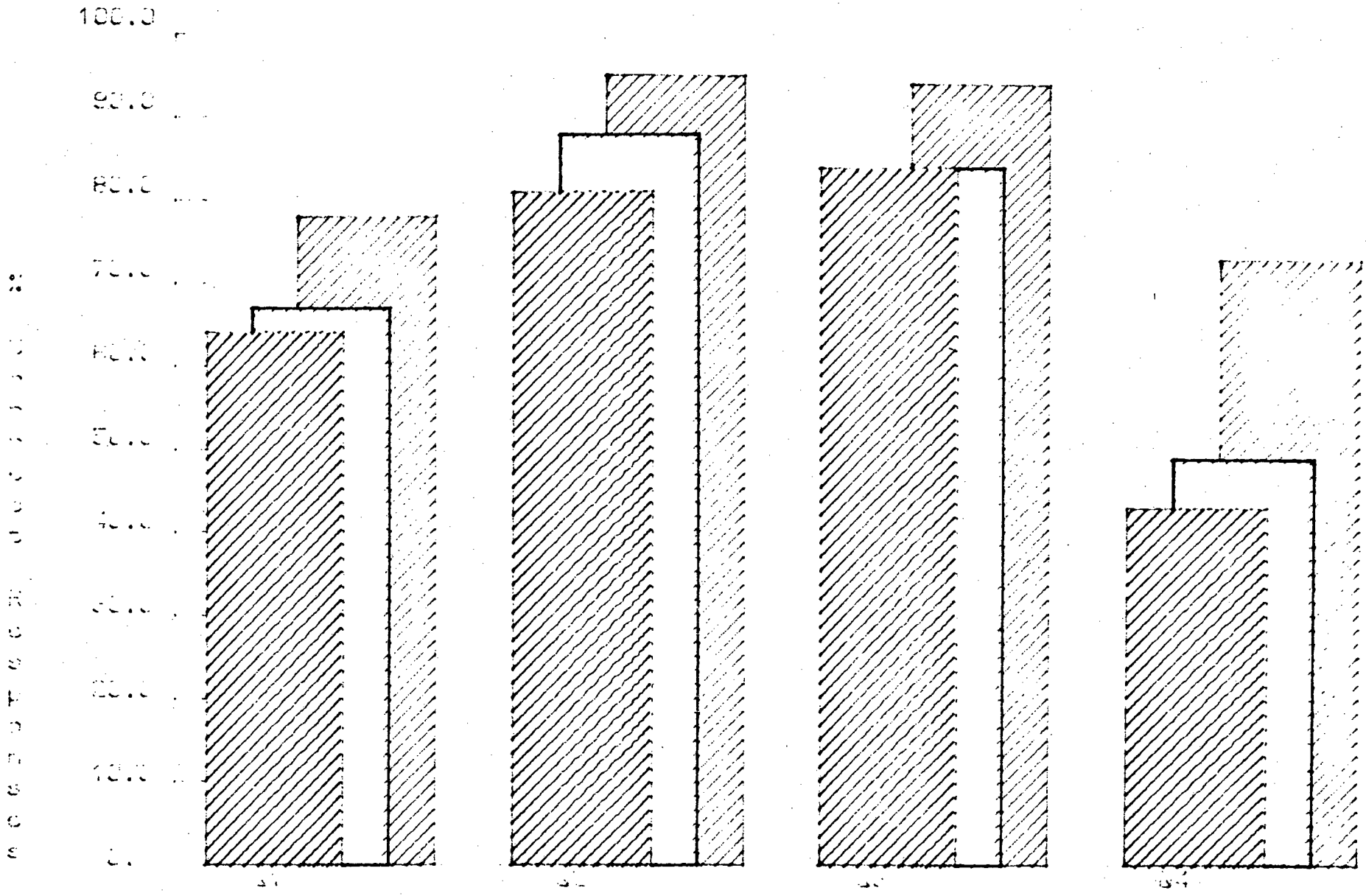
Effect of Formal Schooling on the Test Scores:

Table 2: Comparison of test scores & number of years exposure to formal training/teaching of statistics.

Years formal stats	Q1	Q2	Q3	Q4	TOT
0	64%	81%	84%	43%	26
1	67%	88%	84%	49%	88
2	78%	95%	94%	73%	78

Percentage scoring 0 - 4 in Question 5




Percentage Correct vs Yrs Formal Stats
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.

Chi-Squared = 7,27 (With 6 degrees of freedom)

(The table indicates the percentage of candidates in each group that gave the correct responses to questions 1 to 4)

Referring to the above table, it is apparent that the number of years exposure to 'formal' statistics has an effect on the test scores, particularly in the observed difference between those with one years experience, and those with two years experience.(The latter pupils were either in Std 8 or Std 9). The difference in the test scores is, however, probably explained by the fact that the latter group had considerably more general mathematical 'maturity' and experience, which would certainly result in an enhanced ability to successfully complete the test items, which largely consisted of tests in simple interpretation of graphs.

If the null hypothesis is formulated that number of years formal exposure to statistics has no effect on the test scores, then the null hypothesis can be rejected at the 0,50 level. In other words, we are **not** entitled to reject the null hypothesis with any degree of significance. This low degree of significance could conceivably be explained by the fact that the material presented in Episode 1 was largely of an intuitive, mechanical nature, and that formal training in these topics was not really essential.

Effect of the Viewing of Episode 1 on the test Scores:

Table 3: Comparison of the test scores between the samples that viewed the Episode, and those who did not.

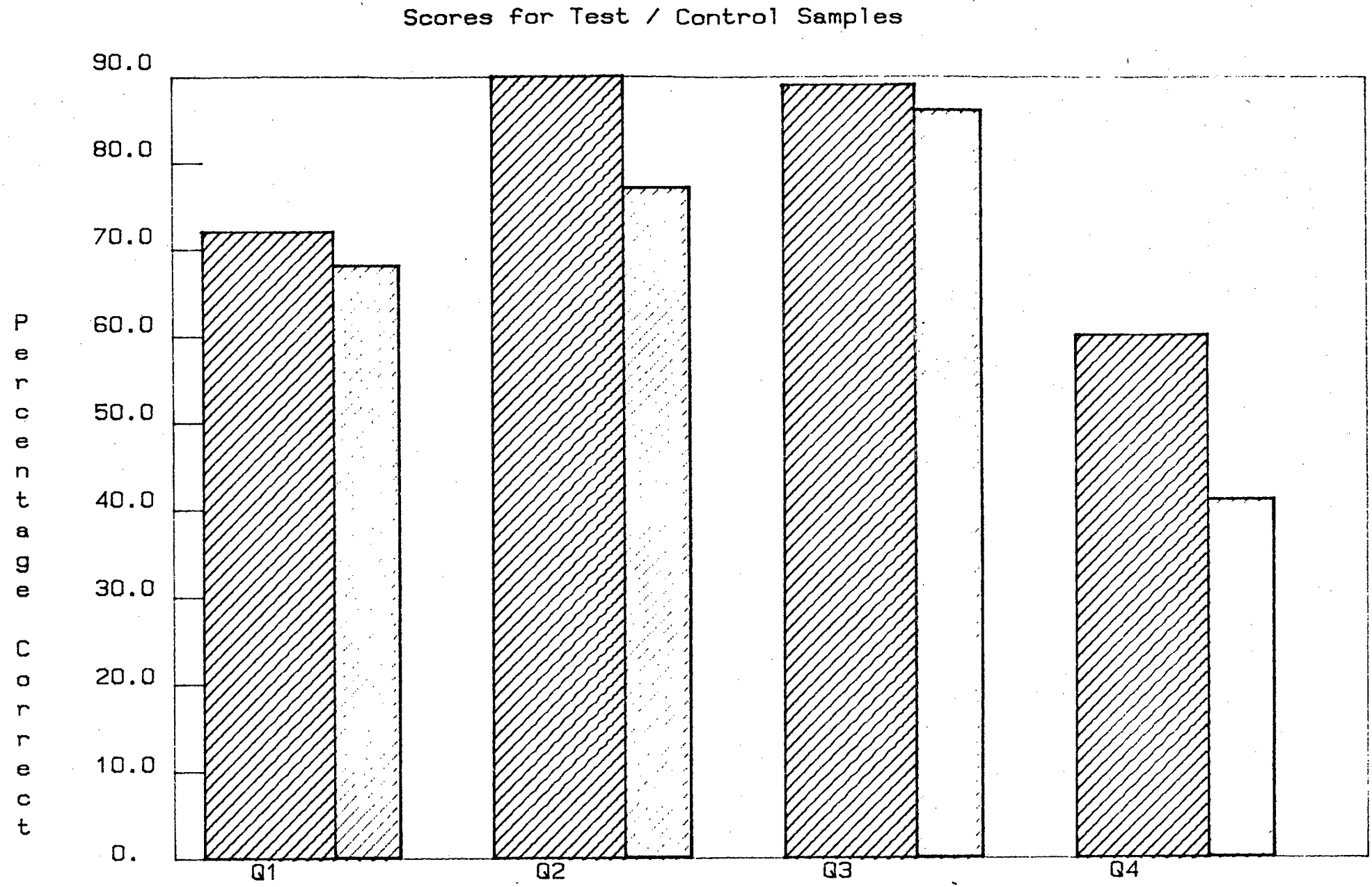
	Q1	Q2	Q3	Q4	n
Viewed Program !	72%	90%	89%	60%	170
Control	68%	86%	86%	41%	22

Chi-Squared = 2,26 (With 2 degrees of freedom)

(The table indicates the percentage of the candidates in each group that gave the correct responses to Questions 1 to 4)

It would appear that the viewing of Episode 1 had very little effect on the scores of Question 1 and Question 3. Question 1 merely involved the reading of a simple pie-chart. No calculation or judgmental ability was necessary - such a question could be answered intuitively, without any understanding of statistics. Similarly Question 3 involved the reading of a pictogram. (See Chapt 3). Once again this question could have been successfully answered intuitively, without any statistical knowledge.

There was a significance difference between the responses for Questions 2 and 4. Both of these questions involved interpretive as well as some mathematical ability. It is in this area, therefore, that the Episode had a significant positive effect.


Scores for Test / Control Samples
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.
Percentage Correct
Q1
Q2
Q3
Q4

If we formulate the null hypothesis that the viewing of Episode 1 had no effect of the scores for items 1 to 4, we can reject the hypothesis at the 0,50 level of significance.

If we formulate the null hypothesis that the viewing of the Episode had no effect on the scores of Questions 2 and 4 **only**, then we can reject the null hypothesis at the 0,25 level. In other words the viewing of the Episode did have a significant effect on these scores.

The situation for Questions 5 and 6, however, is far less positive. The table below gives the mean scores for Question 5 and Question 6 for each of the two groups:

	Q5	Q6
Viewed Program	75%	58%
Control	85%	74%

For these two questions, each of which required a certain amount of divergent, creative thinking ability, it would seem that the viewing of the Episode has a **significantly negative effect** on the test scores obtained. It is possible that the introduction of pre-conceived ideas reduced the test sample's ability at divergent responses to these items.

Evaluation of Episode 1

ATTITUDE TOWARD STATISTICS INFLUENCED BY EPISODE 1

The following is a summary of the responses to Questions 7 to 14:

1. The response to **Question 10** showed a highly positive attitude toward statistics after having viewed the episode.
93 out of 166 responses (56%) indicated that they were "keen to learn more statistics"
Only 27 out of 166 responses (16%) indicated that they "had no desire to learn more statistics"
46 out of 166 responses (28%) "do not care whether they learn more statistics or not."

It is worth noting from the above that 13 out of 19 of the test subjects mentioned had **no formal exposure to statistics,** and that these 13 (68%) indicated that they were "keen to learn more statistics".

2. The response to Question 9 (summarised below) show that in general the test sample felt that the viewing of Episode 1 helped facilitate an understanding of statistics.

Q9. 1 = "no help at all" to 5 = "a great help"

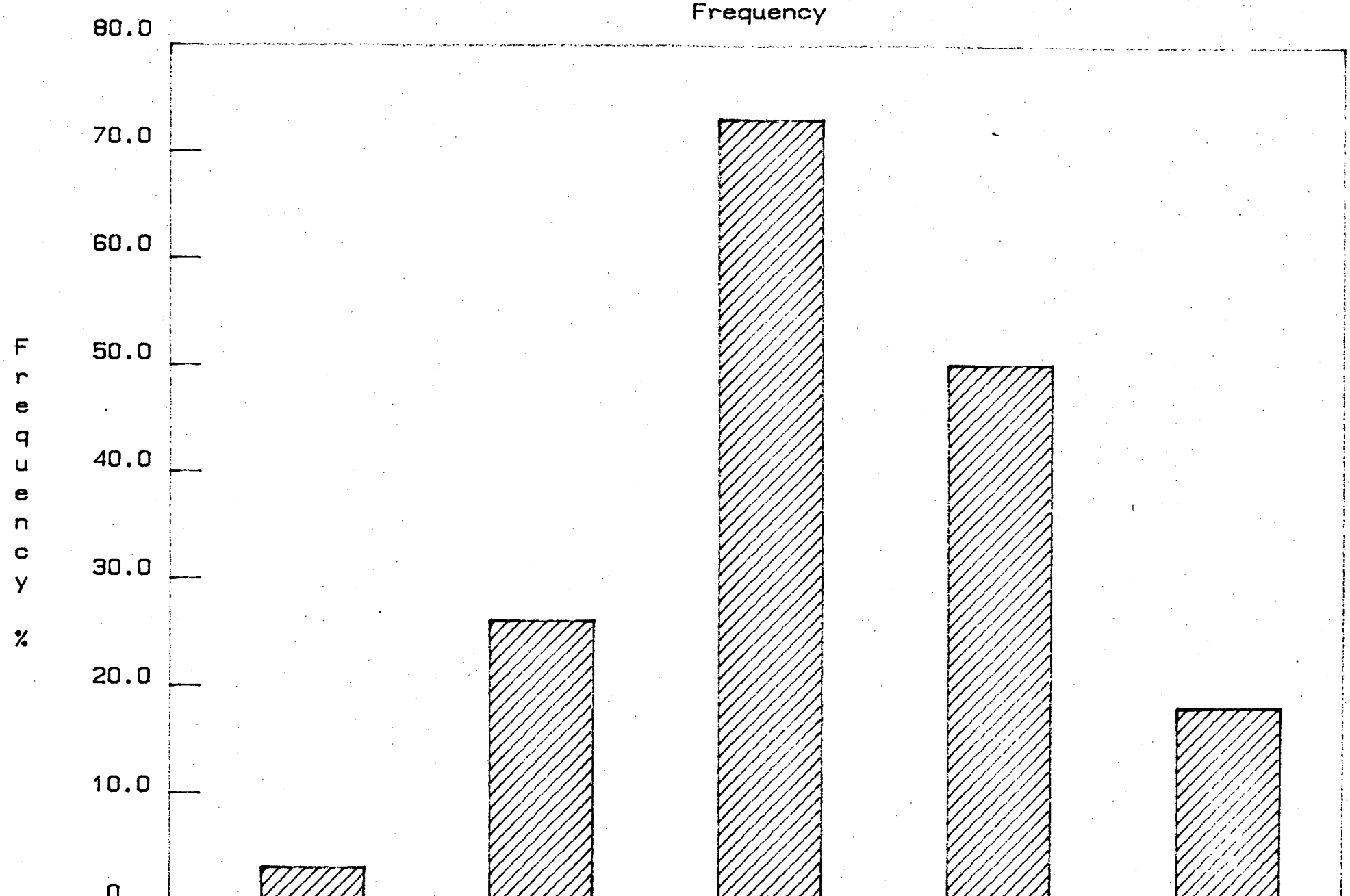
Response	Frequency
1	6 (3%)
2	26 (15%)
3	73 (42%)
4	50 (29%)
5	18 (10%)

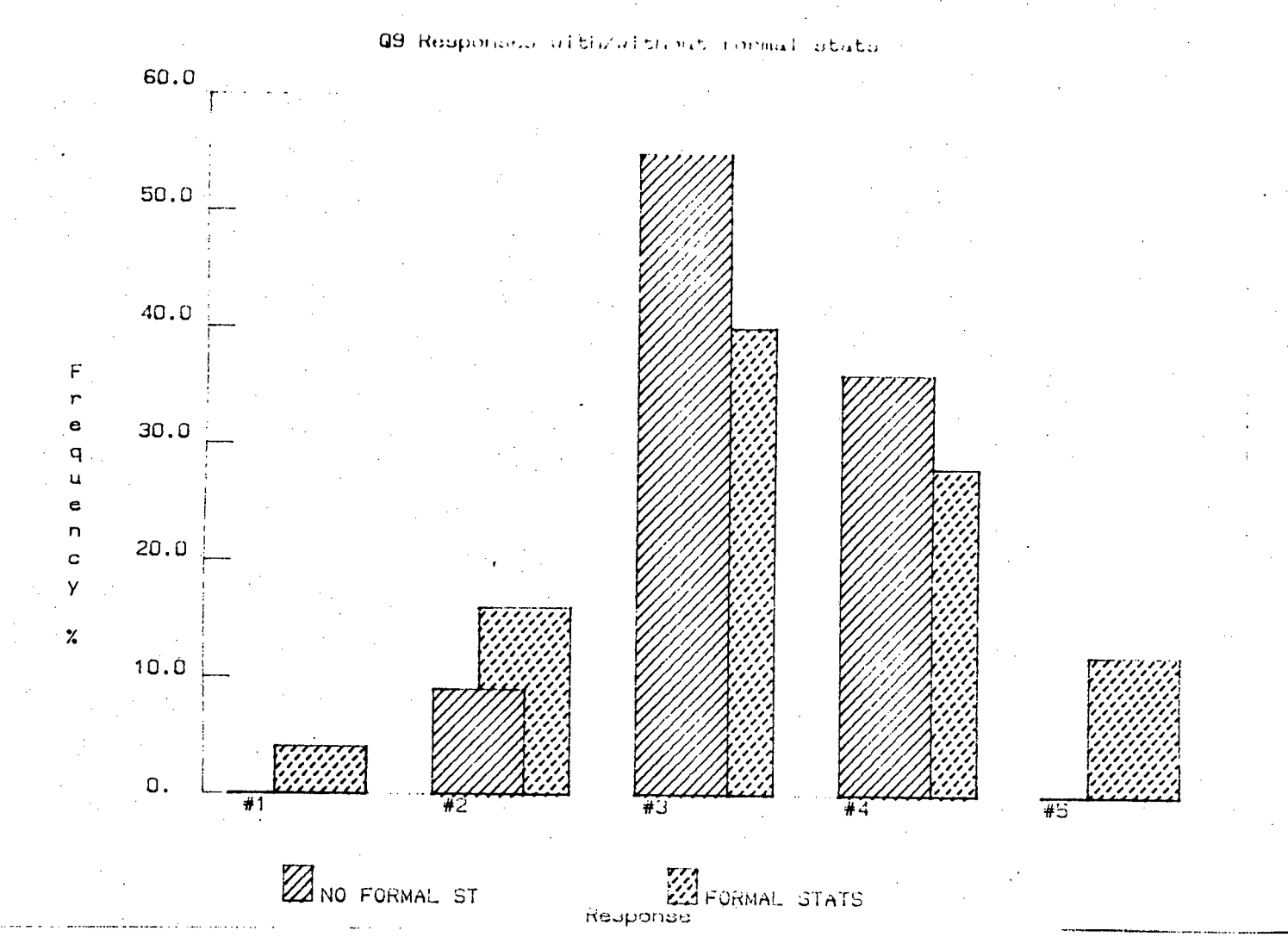
Mean score = 3,38

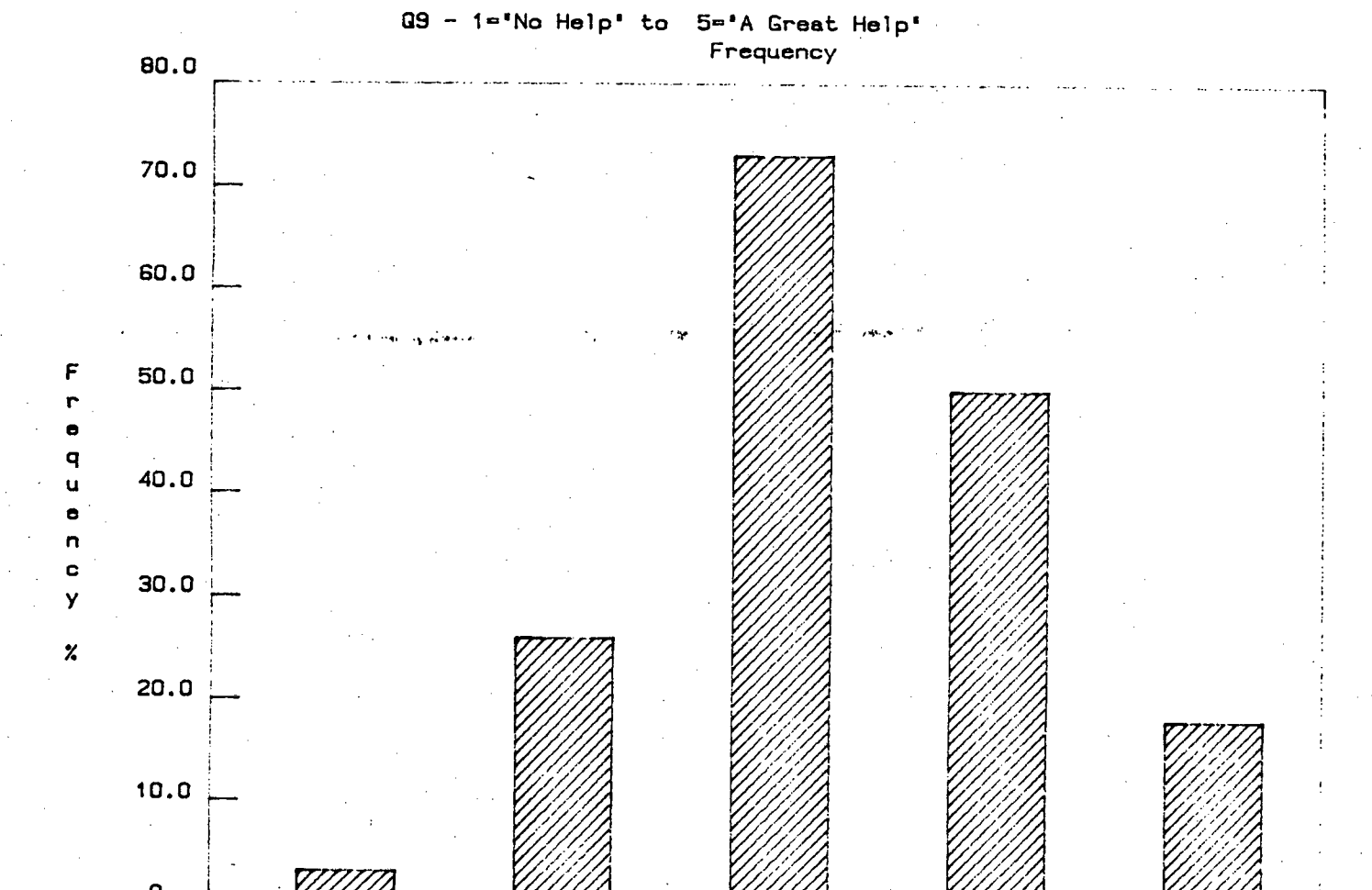
Q9 - Comparison between those with and those without exposure to 'formal' statistics.

Response	1	2	3	4	5	
With	0%	9%	55%	36%	0%	out of 26
Without	4%	16%	40%	28%	! 12%	out of 147

The mean scores for the above two groups show vary little difference (3,27 and 3,28 out of 5 respectively). Despite the negligible difference in the means for those with formal training, and those without formal training in statistics, it can be seen from the above table, and the graph, that there **is a significant difference between the two groups taken as a whole.** We can reject the null hypothesis that there is no difference in response to Question 9 between those with and those without formal training in statistics at the 0,25 level. (ie we are 75% sure that we are not rejecting the null hypothesis when true)


Q9 - 1="No Help" to 5="A Great Help"
Frequency
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0
Frequency %


Q9 Responses with/without formal stats
60.0
50.0
40.0
30.0
20.0
10.0
0.
Frequency %
#1
#2
#3
#4
#5
NO FORMAL ST
FORMAL STATS
Response


Q9 - 1='No Help' to 5='A Great Help'
Frequency
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
Frequency %

The above difference seems to be that there is a far lower deviation from the mean in the group with no formal training in statistics.(The sample standard deviations are 15,7% and 25,0% respectively). The reason for this difference is probably that the group with no previous exposure to formal tuition in statistics were really unaware of some of the inherent difficulties in the understanding of the subject. The elementary (perhaps trivial) nature of the subject matter covered in Episode 1 would suggest to an experienced viewer that there is little need for a deeper understanding of statistics. Most of the viewers already understood the the basic concepts required in Episode 1 (i.e. interpretation of simple graphs), and were unaware of the full scope of statistics.

3. The responses to Question 11 and Question 12 - Likes and dislikes of the **programme** (as opposed to **statistics**)

Question 11: "What were the things that you liked **most** about about the programme?"

Out of 157 responses:

31,2% Liked the **examples** chosen to illustrate the statistical concepts (i.e examples on animal counts and distribution)

17,8% Liked the manner in which the concepts were **explained.**

15,9% Liked the **relevance** of the examples - i.e. showing the importance of statistics in the ´real world´ - something that is seldom done in the ´traditional´ classroom.

13,4% Liked the **general format and presentation** of the programme.

5,7% Liked the use of **diagrams** - i.e. they liked descriptive statistics.

5,7% Liked **nothing** about the programme.

10,2% Liked **miscellaneous factors** eg "the pictures", "the animals", etc

Question 12: "What were the things that you liked **least** about the program?"

Out of 151 responses:

31,8% Disliked the **presenter.** Comments were made that, inter alia, he "treated the audience like young children" ; "he was not lively" ; "female presenter acts stupid (sic)" ; etc. It seemed to the researcher that the presenter was not an expert in statistics, an essential pre-requisite of any teaching activity is that the teacher be an expert in the field of study.

19,9% Found that the program was too **simple,** and that it was aimed at a younger age group. The transmission time-slot would seem to confirm this criticism.

28% Disliked **nothing** about the program.
7,3% Found that the programme was too short. This could be regarded as a positive aspect. (See conclusion)
5,9% Found that the explanations, and particularly the calculation methods lacked clarity. This percentage is low, but the researcher feels that this is a valid criticism, and a very important negative aspect of the programme. It is probable that the majority of the test group were unaware of the alternate methods available for the clarification and explanation of such concepts. (See researcher's subjective evaluation)
6,6% Had various dislikes, including the introduction/titles (5) ; the mathematics involved (2) ; not exciting or active (2) ; broadcast too infrequently (1).

CONCLUSION

1: Is there a valid need for the programme?
There is sufficient evidence from the test data indicating that, although the content covered in Episodes 1 through 4 in the series is included in the Mathematics Syllabus for the Junior Secondary schools, there is a common, and general lack of true conceptual understanding of statistics among the pupils taught under the 'conventional', formal school system. Episode 1 of the Series had an effect in promoting such conceptual understanding. This research therefore indicates that a need for such a programme does exist.

2: Topics covered in Episode 1:
The data shows with a high degree of significance that the volume/complexity of the material covered in Episode 1 was insufficient. The 26 members of the test sample who had no exposure to statistics (22 of whom had no exposure to either formal or non-formal stats) achieved results that were as high as the rest of the group. The concepts of pie-charts, pictograms and pictographs seems to be largely intuitive, and it was therefore unnecessary to devote a complete episode to these topics.

3: Effect of Episode 1 on the test scores:
The Episode only had a significant effect on those test items involving interpretive, rather than mechanical, manipulative skills or techniques. Viewing the Episode had NO effect on the scores in Questions 3, 5 and 6.

4: Attitudinal change motivated by Episode 1:
It is apparent that the viewing of Episode 1 caused a positive change in attitude toward statistics. It is highly significant, and worthy of note that 68% of the test sample had no formal training in statistics, indicated that they had a desire to learn more statistics. The test results showed that the majority of the sample felt that the Episode had helped them in obtaining an understanding of statistics.

5: Strong and weak points of the Episode:

A: **POSITIVE** aspects of Episode 1.
1. The examples chosen, and the application to real-life situations relevant to the real-world of the audience received general acclaim. (About 60% of the responses)
2. A significant proportion (17,8%) liked the way in which the concepts were explained, which reinforces the decision that the Episode facilitated a change in conceptual, rather than mechanical understanding.
3. 28% of the test sample found nothing that they did not like. This is a most positive and important factor, particularly as the test sample consisted exclusively of school children, who are often over-critical when evaluating educational methods.

4. 7,3% disliked the fact that the episode was too short. This aspect, although seemingly a negative criticism, can be in fact regarded as a most positive factor. It indicates clearly that the Episode stimulated interest, and that the desire to learn more about the subject matter was stimulated.

B: **NEGATIVE** aspects of Episode 1:
1. A high proportion of the test sample disliked the presenter. (31,8%) The criticisms included the opinion that the presenter 'spoke down' to his viewers. The impression was created that the male presenter was not an expert in the field of statistics - a sound knowledge (or in fact expertise) of the subject matter is an essential pre-requisite in any teaching situation, be it formal or non-formal.
2: A very significant proportion (19,9%) found that Episode 1 was too simple, and that it was aimed at a younger target group. This impression was reinforced by the behaviour of the presenters. The time of broadcast, particularly when the program previously occupying the time slot is taken into account, would suggest that the episode was intended for primary-school viewers. (Out of a random sample of 35 Std 10 secondary-school pupils, only three (3) had viewed any of the episodes in the series. The majority had been unaware that such a series of educational episodes was to be broadcast at all.)
3: A fairly low percentage indicated that the explanations and the calculation methods had not been well explained.
4: The following miscellaneous 'dislikes' were also noted: poor introduction and titles ; the mathematics involved ; not exciting or active, etc.

Evaluation of Episode 1

SUBJECTIVE EVALUATION BY THE RESEARCHER

The following are the **PERSONAL VIEWS OF THE RESEARCHER**, and will stress the educational and methodological aspects of Episode 1. Some of the following evaluative conclusions are based on non-quantitative research methods. Interviews with individuals, group discussions and observations were used to reach some of the conclusions. Such conclusions are not justified statistically, but may nevertheless be regarded as valid and significant.

Positive features of Episode 1:

The general attitude of the viewers was favourable. During the viewing of the Episode the sample was carefully observed, without interference by the researcher. It was apparent that the episode held the attention of the audience. At no stage was any disruptive behaviour or other symptoms of boredom or disinterest noted. There was a general keenness to view the other episodes of the series. (Substantiated from the test data)

Methodology: The outstanding aspect of Episode 1 was the example chosen to illustrate the statistical methods. The sequence showing animal census stimulated the interest of the test sample, being highly relevant to the test group's own real-life sphere of interest. It is regrettable that this theme could not have been continued through the series as a whole.

Negative features of Episode 1:

Content: The researcher feels that it was a mistake to restrict the content of Episode 1 to the handling of the elementary concepts of Pie-Charts, Pictograms and Pictographs. It is substantiated from the test data, that Pictograms, in particular are largely intuitive concepts, requiring little or no detailed explanation. It is a fact that such forms of descriptive statistical representation are being used less and less in practice, mainly because of the inherent danger of misinterpretation of such methods. It would have been better policy to devote more time to bar-charts and histograms, which are used far more in practice.

Methodology: Apart from the visual material of the Kruger Park, the Episode did not make sufficient use of the considerable potential for an exciting presentation that is available to the SABC.

Location: Far too much of the programme duration (throughout the series, not just for Episode 1) was spent in the same room, which in itself was unimaginative and dull. More use should have been made of outdoor locations.

Evaluation of Episode 1

Diagrams/Charts: (1) The explanation given for the method used to calculate the angle required for the construction of a pie-chart was too hurried, and was oversimplified. (The data given was too simple, and did not illustrate clearly the method that should be used for more general data.) The script did not give enough emphasis on the importance of the key concept that the **ratio** of the particular animals to the total number, is the same as the ratio of the particular angle to the the angle of a full revolution. The "short-cut" method used merely led to confusion, and has only limited applications in real-life situations.

(2) Use should have been made (for example) of computer-aided graphics for the generation of the charts, rather than the crude methods employed. (Using a marker pen on sheets of paper, often indistinctly). The advantages and facilities inherent in the medium of television were not employed at all in this respect. The very important **dynamic** aspect of the creation of the symbolic charts was entirely ignored, whereas this aspect could have been clearly illustrated and reinforced by proper and imaginative use of the medium.

(3) The presenter tended to 'talk down' to his audience. This may have been acceptable had the target audience been, say 6 to 8 year old children. Such behaviour tends to be irritating to the viewers, and creates antagonism and resistance to the process of learning.

(4) It seemed to the researcher (later confirmed by the producer of the series) that the presenter was not an expert in Statistics. It is a generally accepted axiom in educational theory that a teacher must have an expert knowledge of the subject being presented (at least at the level of presentation), and that the teacher must show enthusiasm for the subject, irrespective of the medium of instruction. This proficiency and enthusiasm must be observed by the target audience. In Episode 1 this was **not** the case.

Subjective Conclusion:

It may seem from the above that the researcher feels that Episode 1 of the Series is altogether educationally unsound. This is **by no means the case.** There are certainly weaknesses in the Episode, but the Researcher, acting in his capacity as Head of the Mathematics Department at a prominent Secondary School, insisted that the mathematics staff show the series to all their junior-secondary pupils, thus indicating the general approval of the Series by the Researcher.

The programme has proved in practice to be a most helpful educational aid to facilitate the understanding of basic statistics, particularly when used in parallel with other, more "conventional" methods of teaching. It proved necessary to provide ample follow-up periods, where opportunity was given to the target group to discuss the Episodes of the Series.

TABLE 1: SCORE VS ASSESSED MATHEMATICAL ABILITY

OBSERVED FREQUENCIES:

Math Ability	n	Q1	Q2	Q3	Q4	TOT
1	13	7	9	10	6	32
2	34	21	27	30	16	94
3	83	62	76	71	44	253
4	39	27	38	37	29	131
5	23	21	23	22	21	87
TOT	192	138	173	170	116	597
Correllation:r=		.918	.917	.911	.940	.997

In order to calculate the CHI-SQUARE statistic, it is necessary to calculate a table of EXPECTED frequencies - frequencies that would be expected if math ability had no effect on the test scores.. for example, the number of correct responses for Q1 for ability group 3 would be [138/192] X 83 = 59.7...etc

EXPECTED FREQUENCIES:

Math ability	n	Q1	Q2	Q3	Q4
1	13	9.3	11.7	11.5	7.9
2	34	24.4	30.6	30.1	20.5
3	83	59.7	74.8	73.5	50.1
4	39	28.0	35.1	34.5	23.6
5	23	16.5	20.7	20.4	13.9

If e_i = expected frequencies, and
o_i = observed frequencies,
then
$$\chi^2 = \sum \frac{(e_i - o_i)^2}{e_i}$$
In this case:
$\chi^2 = 11.3.$
No of degrees of freedom = (v-1)(u-1)
where v = no rows,
u = no columns

TABLE 1(a): SCORES VS ASSESSED MATHEMATICAL ABILITY FOR QUESTION 5

OBSERVED FREQUENCIES OF SCORES:

		SCORE Q5					
Math ability	n	0	1	2	3	4	MEAN
1	13	2	0	2	7	2	2.54
2	34	3	0	8	13	10	2.79
3	83	6	1	11	35	30	2.99
4	39	0	0	3	25	11	3.21
5	23	0	0	1	10	12	3.48
TOTAL	192	11	1	25	90	65	3.03

EXPECTED FREQUENCIES OF SCORES (e_i):

	SCORE Q5				
Math ability	0	1	2	3	4
1	.74	.07	1.69	6.09	4.40
2	1.95	.18	4.43	15.9	11.5
3	4.76	.43	10.8	38.9	28.1
4	2.23	.20	5.08	18.3	13.2
5	1.32	.12	2.99	10.8	7.79

χ^2 = 20.57 with 12 degrees of freedom.

From tables, $\chi^2_{0.90}$ = 18.5

H_o: Mathematical ability does not influence the scores in Question 5.

From the above reject H_o with a significance level of 0.90.
(i.e The probality of rejecting H_o when it is true is 0.10)

TABLE 1(b): SCORES VS ASSESSED MATHEMATICAL ABILITY FOR QUESTION 6

OBSERVED FREQUENCIES OF SCORES:

	SCORE Q6						
Math ability	n	0	1	2	3	4	MEAN
1	13	4	2	2	4	1	1.69
2	34	7	4	5	12	6	2.18
3	83	11	7	15	31	19	2.48
4	39	5	1	11	17	5	2.41
5	23	2	3	5	4	9	2.65
TOTAL	192	29	17	38	68	40	2.38

EXPECTED FREQUENCIES OF SCORES (e_i):

	SCORE Q6				
Math ability	0	1	2	3	4
1	1.96	1.15	2.57	4.60	2.71
2	5.13	3.01	6.73	12.0	7.08
3	12.5	7.35	16.4	29.4	17.3
4	5.89	3.45	7.72	13.8	8.12
5	3.47	2.04	4.55	8.10	4.79

$\chi^2 = 18.34$ with 12 degrees of freedom.

From tables $\chi^2_{0.90} = 18.5$ and $\chi^2_{0.75} = 14.8$.

H_o: Mathematical ability does not influence the scores in Question 6.

From the above reject H_o with a significance level of 0.75.
(The significance is nearly 0.90)

TABLE 3: NUMBER OF YEARS FORMAL STATISTICS VS SCORE IN Q1 - Q4

OBSERVED FREQUENCIES OF CORRECT RESPONSES (o_i):

Yrs Formal Stats	1	2	3	4	n
0	17	21	22	11	26
1	59	77	74	43	88
2	61	74	73	57	78
TOTAL	137	172	169	114	192

EXPECTED FREQUENCIES OF CORRECT RESPONSES (e_i):

Yrs formal stats	1	2	3	4
0	18.6	23.3	22.9	15.4
1	63.0	78.8	77.5	52.3
2	55.7	69.9	68.7	46.3

$\chi^2 = 7.27$ with 6 degrees of freedom.

From tables $\chi^2_{0.50} \angle 7.27$.

H_o: Number of years exposure to formal statistics training has no effect on the scores of Q1 to Q4.
We can reject H_o at the 0.50 level of significance.

For Question 4 ONLY: $\chi^2 = 5.58$ with 3 degrees of freedom.
H_o: Number of years exposure to formal statistics has no effect on the scores of Question 4.
Reject H_o at the 0.75 significance level.

Chapter 5 Evaluation of Episode 4 - Statistics

Introduction:

E T V material to be summatively evaluated:
The material to be summatively evaluated in this chapter is Episode 4 of the South African Broadcasting Corporation's educational television series "Statistics". This Episode was chosen for detailed evaluation because, unlike Episodes 1 through 3, it seemed designed to cause a chance in **attitude** rather than merely teaching **content** or **algorithmic methods.**

In the initial, pilot research carried out, it seemed to the researcher that this Episode received the most favourable response from the target group. It was also the considered opinion of the researcher that this was the best episode. The criteria for this judgment will become apparent in the following detailed evaluation .

Content of Episode 4: **"Point of View. (or How to Lie With Statistics.)".** The Episode presented in an often humorous manner ways in which statistics can be abused and misinterpreted. The Episode took the form of a dialogue between a "salesman" and a prospective "customer". It was lively, and held the interest of the viewers. (Unlike some of the other episodes of the Series).

The **goals** of Episode 4 are the same as those of the entire Series. (see Chapt 4)

Test Sample

The sample was increased in size over that used in the evaluation of Episode 1. The sample for the evaluation of Episode 4 consisted of a group of 130 secondary-school pupils who had **not** viewed the Episode **(Control Sample)**, and 121 who had viewed the Episode under controlled conditions. **(Test Sample).** The groups were nearly evenly divided between pupils in Standards 6 to 9. (Standard 10 was excluded from the test as the preliminary examinations were being written at the time of the evaluation). The sample is a statistically large one, and any conclusions reached may be regarded as representative of the rather non-random population (see Chapt 4). Once again the "Coloured" population group was reluctantly excluded from the evaluation due

to the "unrest" situation prevalent in the Cape at the time of the evaluation .

Test Instruments:

The data under analysis was gathered by means of a multiple-choice test, a copy of which is included in the Appendix. It will be noted that the test items were largely of an interpretive nature, requiring little mechanical, calculative ability or skills. This is consistent with the content of Episode 4, which seemed to be designed to influence a change in **attitude**, rather than teaching some process or algorithm.

Research Methodology:

The test items included tests of both the direct effect of the Episode, as well as items relating to the design and presentation of the material in general. (See Chapter 3 - Research Tools)

The test group (121) were shown the video tape of Episode 3 **before** the broadcast date, to be certain that the control group was in fact not exposed to the Episode. During the viewing, a careful note was made by the researcher of the general behaviour of the test sample, in order to assess the level of interest generated by the Episode. Post viewing interviews and discussions were carried on an informal basis.

During administration of the test material, each member of the test group was supplied with an "exam number", within which was coded the sex, assessed mathematical ability, years exposure to "formal" statistics , as well as whether or not the subject had viewed the Episode. The meaning of these codes was kept secret from the test group.

Before administration of the test material, the test group was informed of the purpose of the test. As in the case of Episode 1, the "marks" obtained were to be used in the end-of-term assessment.(See Chapt 4 for comment)

In general the Chi-Squared Test for differences in proportions was used to test for significant differences in the test scores for the different groups. (See Appendix for method). Decisions were also reached by means of more subjective methods (e.g. interviews, behaviour observation, etc) and these subjective conclusions are included in the evaluation .

INTERPRETATION OF THE DATA AND DISCUSSION

Content and Ability

Effect of assessed mathematical ability on the test scores:

Table 1: Percentage of correct responses according to assessed mathematical ability.
TEST SAMPLE (viewed Episode 4)

Math Ability	n	Q1	Q2	Q3	Q4	TOT
1	22	77,3	63,6	68,4	63,6	68,2
2	28	75,0	78,6	53,6	67,9	68,8
3	30	83,3	83,3	80,0	80,0	81,7
4	19	78,9	78,9	78,9	78,9	78,9
5	22	90,9	100	86,4	95,5	93,2
TOTALS	121	81,0	81,0	72,7	76,9	77,9

(Observed Frequencies)

The linear correlation coefficient between the total number of correct response and the assessed mathematical ability is r = 0,921.

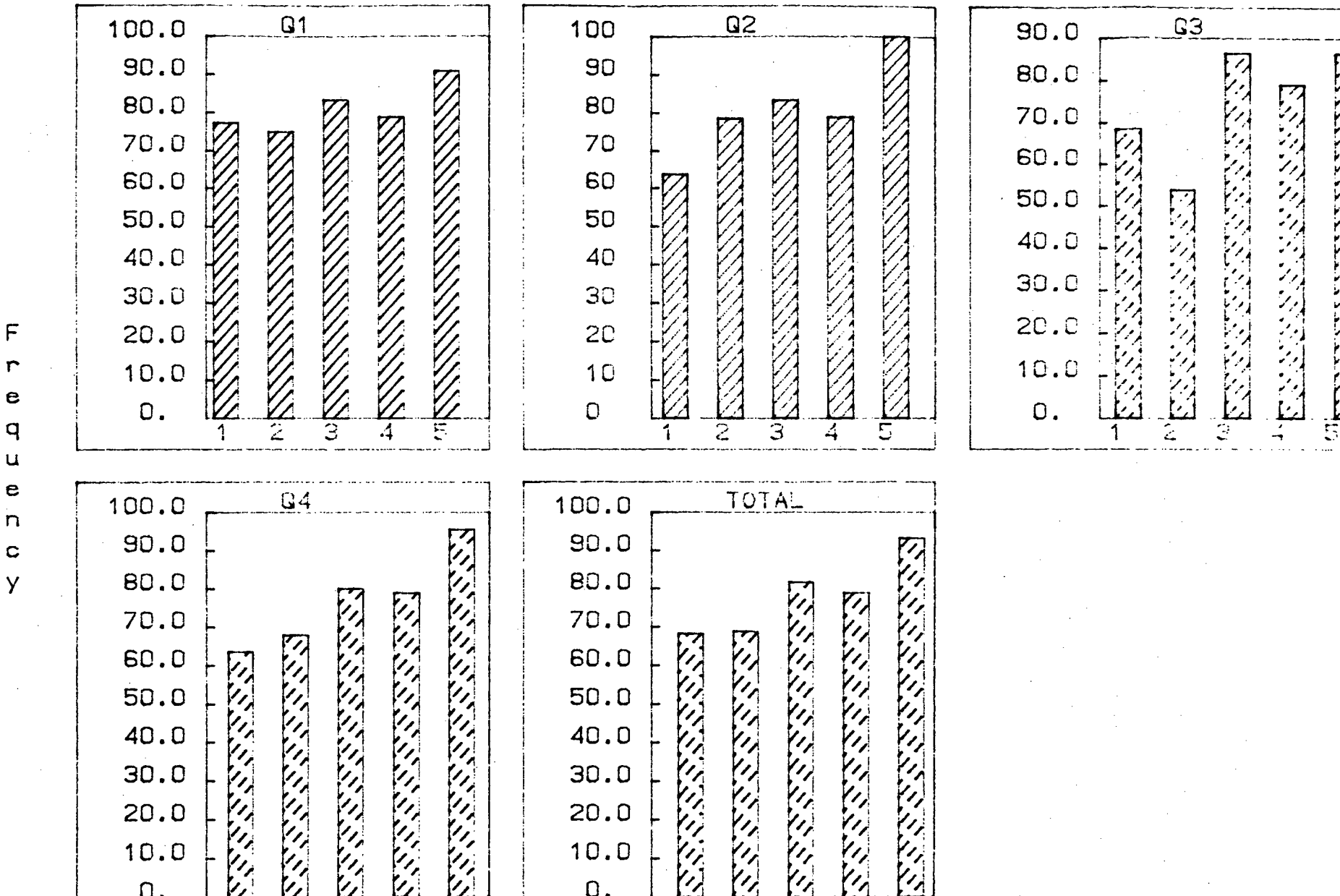
The above linear correlation coefficient is very high, but not as high as for the overall correlation observed in the evaluation of Episode 1. (r = 0,997). This slight drop in the linear correlation coefficient is, however, consistent with the test instruments, which required little "mathematical" expertise as is customarily tested in the conventional school situation. The stress was on judgmental interpretation rather than on calculating skills.

Table 1(a) Percentage of correct responses according to assessed mathematical ability.
CONTROL SAMPLE (did not view Episode 4)

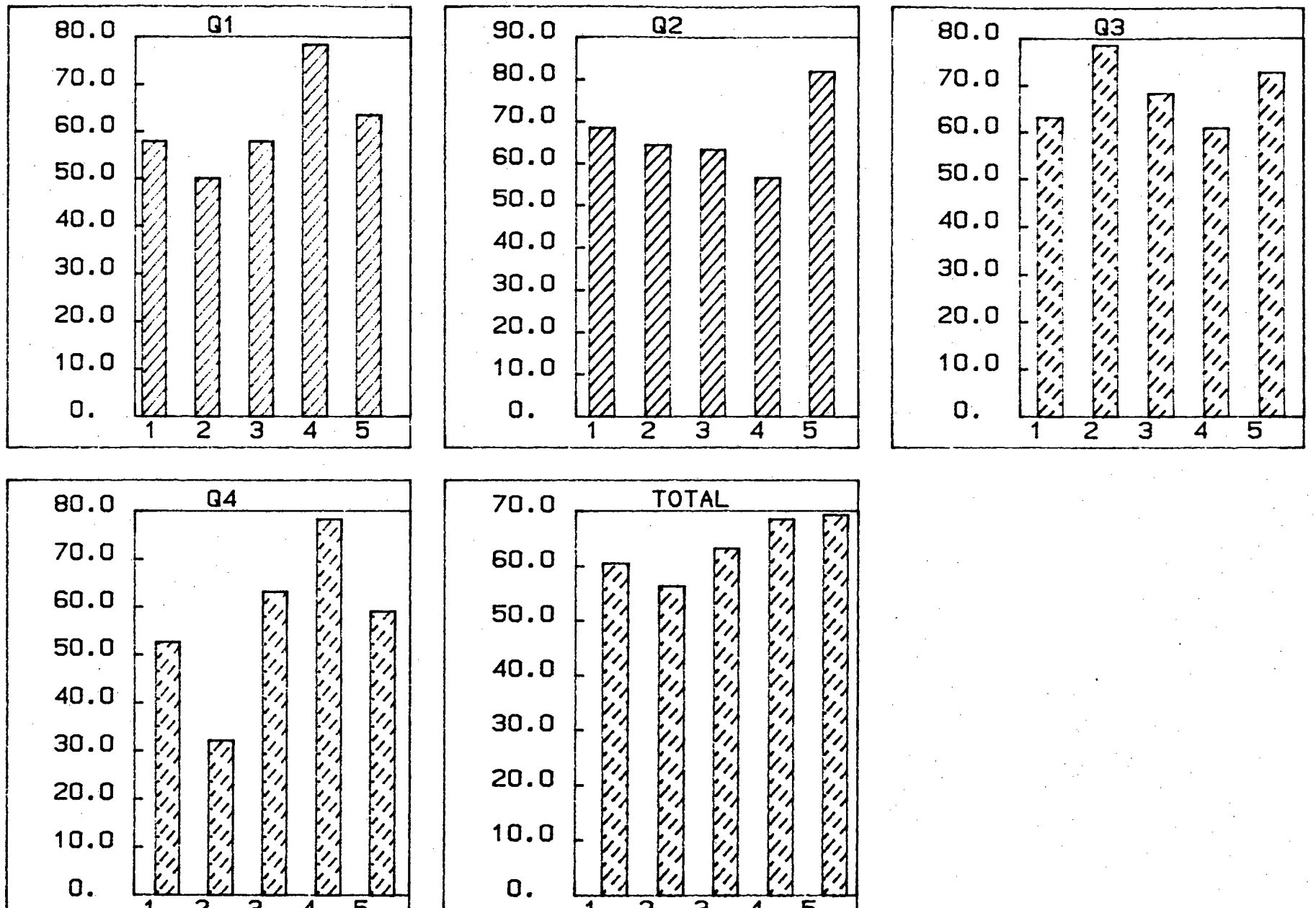
Math Ability	n	Q1	Q2	Q3	Q4	TOT
1	19	57,9	68,4	63,1	56,2	60,5
2	28	50,0	64,3	78,6	32,1	56,3
3	38	57,9	63,2	68,4	63,2	63,2
4	23	78,3	56,5	60,9	78,3	68,5
5	22	63,6	81,8	72,7	59,1	69,3
TOTALS	130	60,8	66,2	69,2	56,9	63,2

(Observed frequencies)

TEST SAMPLE-According to Maths ability



CONTROL - According to Maths Ability



Evaluation of Episode 4

The linear correlation coefficient between the number of correct responses and the assessed mathematical ability is r = 0,862 which is once again very high. This statistic must, however, not be given too much significance. It can be seen from the attached graphs that the effect of the assessed mathematical ability is not as strong as the high coefficient of correlation may suggest.

Using the respective tables of expected frequencies, the following Chi-Squared statistics were obtained:

Formulating the **null hypothesis:** "Mathematical ability has no effect on the test scores of the **test sample**"

Chi-Squared = 27,47
At the 0,01 level Chi-Squared = 26,2 (from tables)

We can therefore **reject** the null hypothesis at the 0,01 level. (In other words, we are 99% certain that we are not rejecting the null hypothesis while true)

In other words, the assessed mathematical ability of the test sample played a highly significant role in the test scores. This may have been caused due to a high correlation between general intelligence and mathematical ability. This factor requires further investigation, which is outside the scope of this thesis.

Formulating the **null hypothesis:** "Mathematical ability has no effect on the test scores of the **control group**"

Chi-Squared = 34,99
For = 0,05, Chi-Squared = 28,3

We can therefore **reject** the null hypothesis at the 0,05 level. In other words, we are 99,5% certain of not committing a type-I error. It would seem from this very high level of significance, that the control group relied almost entirely on their mathematical ability (and/or general intelligence?) to answer the test items.

COMPARISON OF TEST SCORES BETWEEN TEST AND CONTROL GROUP

Percentage of correct scores:

	n	Q1	Q2	Q3	Q4	TOTAL
TEST	121	81,0	81,0	72,7	76,9	77,9
CONTROL	130	60,8	66,2	69,2	56,9	63,2

The above table, and attached graph show clearly that (unlike the case for Episode 1) Episode 4 had a considerable effect on improving the mean frequency of correct responses achieved in the test items.

It is only in the case of Question 3 that the difference is not highly significant. This test item (see Chapt 3) could have been answered without any knowledge of statistics , it required merely a knowledge of graphical methods. Therefore it is not surprising that the difference between the test and the control groups is not significant for this item.

If we formulate the **null hypothesis:** "Test scores are not effected by the viewing of Episode 4", we can **reject** this hypothesis at the 0,10 level. We can therefore state that the Episode had a significant effect on the test scores.

EFFECT OF YEARS FORMAL SCHOOLING ON THE TEST SCORES:

TEST GROUP

STD	n	Q1	Q2	Q3	Q4	TOTAL
6	46	71,7	80,4	69,6	71,7	73,4
7	25	64,0	80,0	72,6	76,0	73,0
8	25	96,0	80,0	84,0	84,0	86,0
9	25	100,0	84,0	68,0	80,0	83,0
TOTAL	121	81,0	81,0	72,7	76,9	77,9

Referring to the above table, and to the attached graph, it would appear that the number of years exposure to "formal" statistics (ie school standard) has an effect on the test scores obtained by the test group. There is some discrepancy in the case of Question 3, where 84% of the Std 8 candidates responded correctly, whereas only 68% of the Std 9 candidates were correct. This could perhaps be explained by the fact that the more junior candidates had a more immediate familiarity with the concept of linear graphs, while the Std 9 pupils might have tended to read more into the test item than was necessary. It is a general, but lamentable fact that the concept of the linear function is largely disregarded as being trivial in Std 9 and Std 10, and is excluded in favour of the second degree functions.

Evaluation of Episode 4

As in the evaluation of Episode 1, it is not only the exposure to "formal" statistics that has influenced the test scores, but also the greater age and general mathematical "maturity" of the candidates in the higher standards. This is particularly apparent in the case for the **control group.** (see below)

CONTROL GROUP

STD	n	Q1	Q2	Q3	Q4	TOTAL
6	25	64,0	56,0	60,0	56,0	59,0
7	55	52,7	70,9	65,5	45,5	58,6
8	25	64,0	64,0	68,0	64,0	65,0
9	25	72,0	68,0	88,0	76,0	76,0

Linear correlation coefficients between years schooling and total number of correct responses:

(1) For the **test sample** r = 0,813
(2) For the **control group** r = 0,913
(3) For **both groups combined** r = 0,579

The above linear correlations are very high for the test and control groups when taken separately. The correlation for the control sample is higher than that for the test sample, which shows that those who did not view the video tape of Episode 4 relied more heavily on their mathematical experience and maturity than those who had viewed the Episode.

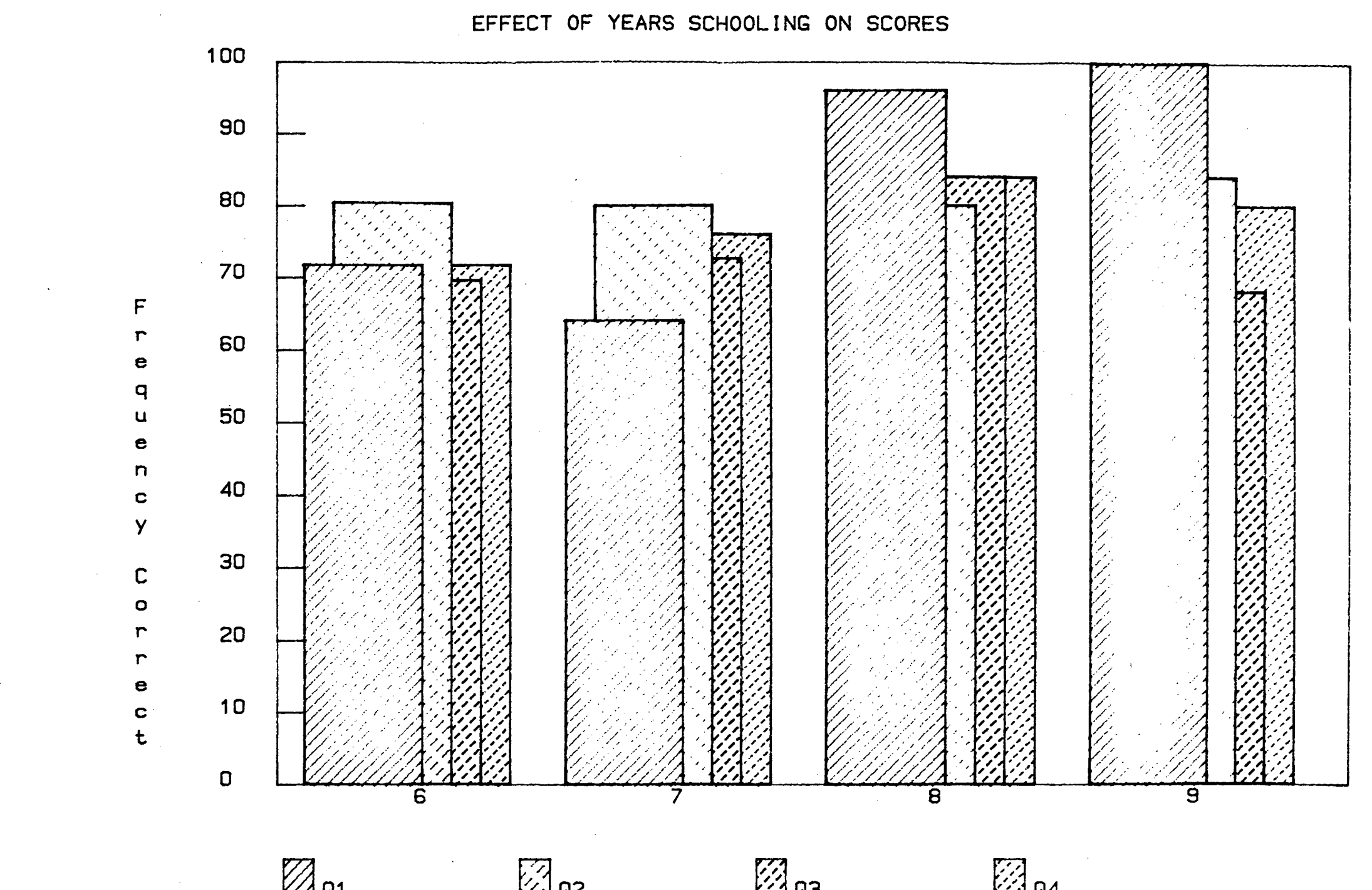
The low coefficient for the combined group is not surprising. It gives a further indication of the significant difference between the test and control groups.

Null hypothesis: "Number of years schooling has no effect on the test scores for the **test sample**"

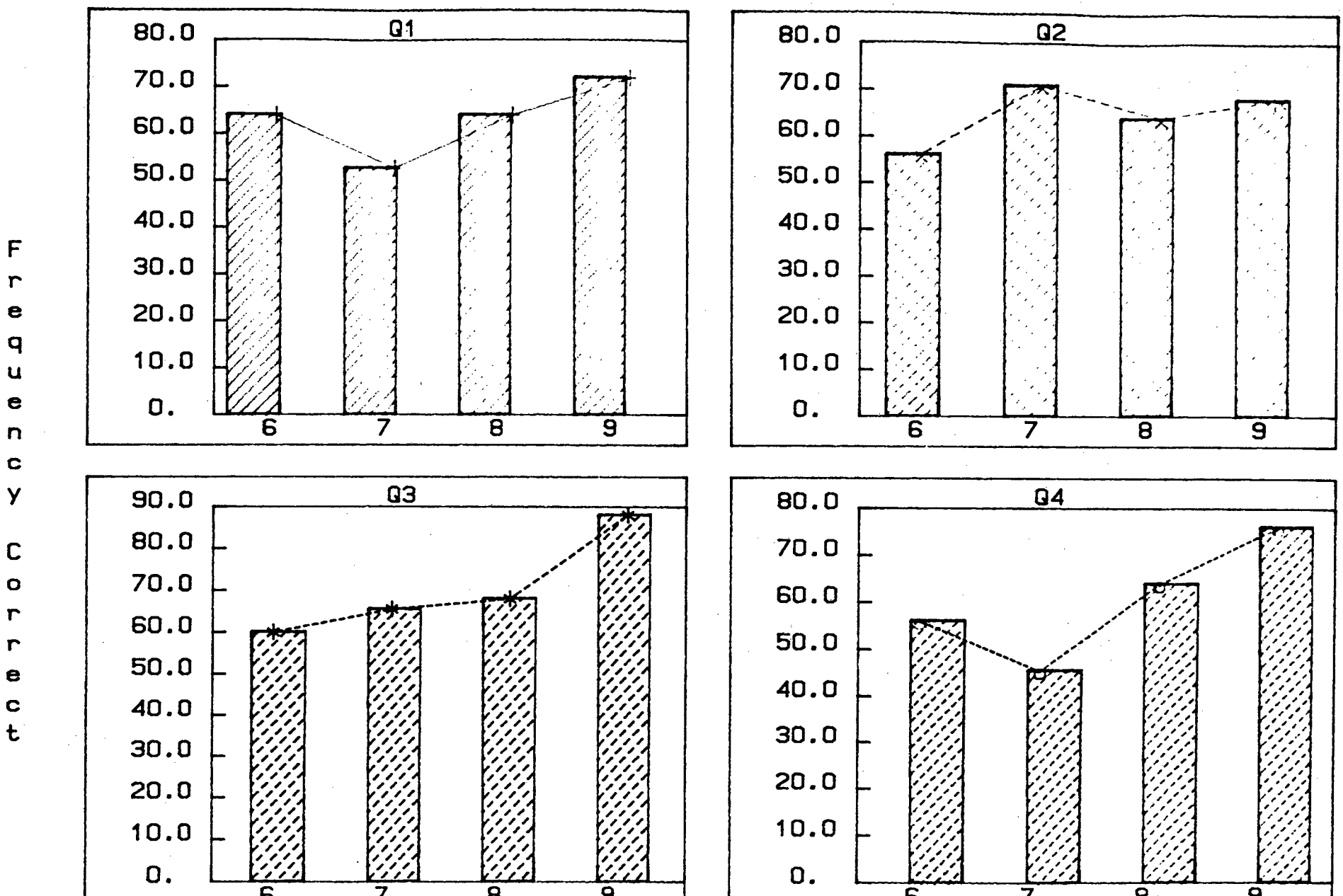
Chi-Squared = 14,88
At the 0.10 level Chi-Squared = 14,7 (from tables)

We can therefore **reject** the null hypothesis at the 0,10 level. (We are 90% certain that we are not rejecting the null hypothesis while it is true.)

The data therefore shows that the number of years of formal schooling (or school standard attained) has a significant effect on the test scores of the **test sample.**


EFFECT OF YEARS SCHOOLING ON SCORES
Frequency Correct
100
90
80
70
60
50
40
30
20
10
0
6
7
8
9
Q1
Q2
Q3
Q4

EFFECT OF YEARS SCHOOLING ON SCORES



Null hypothesis: "Number of years schooling has no effect on the test scores for the **control group**"

Chi-Squared = 21,56
At the 0,025 level Chi-Squared = 19,0 (from tables)

We can therefore **reject** the null hypothesis at the 0,025 level. (We are 97,5% sure of not rejecting the null hypothesis while true.)

As before, the higher significance level for the control group is consistent with the hypothesis that the control group had to rely more heavily on their previous knowledge and experience to succeed in the test items 1 to 4.

COMPARISON OF THE SCORES ATTAINED IN QUESTION 5 (Test / Control)

	MEAN SCORE (Q5)	
Maths Ability	Test Sample	Control Group
1	1,36	1,00
2	1,57	1,21
3	1,76	1,79
4	2,10	1,87
5	3,84	2,86

In Question 5, a score of 0 - 5 was awarded for each response, based on mathematical/statistical accuracy, originality and insight. The above table and attached graph represent the mean scores for Question 5 for each of the 5 mathematical ability levels.

It can be seen from the above tables, and from the graph, that not only does the assessed mathematical ability have a significant effect on the test scores, but that there is a significant difference in scores between the test and the control groups.

The respective **linear corellation coefficients** for the test and the control groups are given below:
(1) for **control group** r = 0,995
(2) for **test sample** r = 0,933

Both of these linear correlation are extremely high, indicating a very strong linear dependence between assessed mathematical ability, and score in Question 5. Once again, the coefficient for the control group is higher than that for the test group. This is consistent with previous reasoning.

If we formulate the **null hypothesis:** "Assessed mathematical ability has no effect on the scores obtained in Question 5" , then
(1) for the **CONTROL GROUP** Chi-Squared = 46,9
(2) for the **TEST SAMPLE** Chi-Squared = 38,9

From tables Chi-Squared =28,3 at the 99,5% level of significance.

We can therefore **reject** the null hypothesis at the 0,005 level of significance.

Results for Question 6

It was found to be of little meaning to attach a qualitative score to the responses to Question 6. The responses to this item were carefully scrutinised , and the subjective conclusion was reached that those who viewed the Episode gave responses with significantly more insight and understanding than the members of the Control Group. Assessed mathematical ability and school standard had little effect on the responses to this item - there was some correlation between both these factors and the responses, but this could probably be explained by a general factor of intelligence and maturity.

ATTITUDE TOWARD STATISTICS

The following is a summary of the responses given to Questions 7 to 14. Only the **Test Sample** responded to these items, as only they could comment on the quality and the impact of Episode 4.

1. The response to Question 10 showed a highly positive attitude toward Statistics (as was the case in the evaluation of Episode 1)

81 out of the 121 responses (66,9%) indicated that they were "keen to learn more statistics ".
17 out of 121 responses (14,0%) indicated that they "had no desire to learn more statistics", and
23 out of 121 responses (19,0%) indicated that they "do not care whether they learn more statistics or not".

It is worth comparing these statistics with those in the evaluation of Episode 1. It is apparent that Episode 4 had a more positive influence on the viewers than did Episode 1.

2. The response to **Question 9** (summarised below) shows that the Test Sample felt strongly that Episode 4 facilitated an understanding of statistics.

Frequencies of responses to Question 9:

response	frequency	
1	3	2,5%
2	14	11,6%
3	47	38,8%
4	42	34,7%
5	15	12,45

Mean score = 3,43

The above figures are not significantly different from those obtained for Episode 1. It is the author's opinion that the above mean is somewhat low in this case. It is felt that the viewers did not equate the Episode with the rather dull content of the statistics covered in the school curriculum. They may not have realised that the material presented in Episode 4 is in fact essential for the understanding and appreciation of statistics in its widest sense. This can be considered as a serious criticism of the method of teaching mathematics in typical South African schools, where all too often, the "processes", rather than the underlying concepts of the subject are stressed, at the expense of a true conceptual understanding.

3. The responses to Questions 11 and 12 - Likes and dislikes of the **PROGRAMME** (as opposed to attitude toward statistics)

Out of 121 responses:

Responses to Question 11 (LIKES)

52 (42,9%) Liked the **example** chosen to illustrate the statistics .

37 (30,6%) Enjoyed the **humour** of the situation.

23 (19,0%) Mentioned the **relevance** of the example.

17 (14,0%) Liked the general **format** and presentation of the Episode.

9 (7,4%) Specifically mentioned the use of **diagrams.**

9 (7,4%) Liked **nothing** about the Episode.

13 (10,7%) Liked miscellaneous factors, eg the "acting", "more fun than class", etc

Responses to Question 12 (DISLIKES)

Out of 121 responses:

57 (47,1%) Disliked the **presenter.** The main criticism seemed to be that he treated the viewers "like children".

42 (35,1%) Disliked **nothing** about the programme.

17 (14,0%) Found the content **too simple.**

9 (7,4) Found the the Episode was **too short.**

9 (7,4%) Felt that the explanations were **not clear.**

11 (9,1% (inter alia) Produced miscellaneous dislikes, including (a) Introduction/Titles (4) (b) Time of broadcast (3) (c) "Too much mathematics."

Evaluation of Episode 4

CONCLUSION

1. Is there a valid **need** for the Episode?

Episode 4 was most successful in achieving its goal of showing the ways in which data could be distorted and abused by the incorrect application of statistics . In modern, everyday life there is much evidence of the misuse of statistics. Episode 4 did much to make the viewers aware of the possibilities of such abuse.

2. Effect of Episode 4 on the test scores:

The Episode had a considerable positive effect on the test scores. There was no case (cf Episode 1) in which there was no significant difference between the test and the control samples. The underlying concept that one could distort the truth using statistics seemed to be a new idea for the test group, and the Episode succeeded in demonstrating this fact.

3. Effect of Episode 4 on the **attitude** towards statistics:

It is apparent from the data that Episode 4 created a positive attitude toward statistics in general. The test sample seemed to find that the humorous situations in the episode facilitated a better understanding of the subject, and consequently a more positive attitude toward the subject in general.

4: Strong and weak aspects of Episode 4:

A. **Positive** aspects of Episode 4:

About 90% of the responses to Question 11 indicated in some way that the sample approved of the example used to illustrate the main concept involved. Mention was made specifically of the **humour** used in Episode 4. The use of humour is a very powerful methodological technique, which is often neglected (or sometimes abused) by the "average" classroom teacher. This is particularly true in the "typical" mathematics lesson, where the subject is regarded by pupils and teachers alike as a "serious" one, not to be taken lightly! Another positive aspect that was specifically mentioned was the **relevance** of the example - it is a very powerful motivational factor for the facilitative teacher to relate mathematics to the real-world situation of the learner.

35% of the test sample disliked **nothing** about the programme. This is a highly significant positive evaluation if it is taken into account that the test group comprised secondary-school pupils who are notoriously over-critical of any school-teaching activity. The group was drawn from an upper middle-class environment, which would be exposed to a wide variety of television material, so would have a sound base for comparison and evaluation.

As was the case for Episode 1, a significant proportion found that the Episode was **too short.** It would therefore appear that the Episode succeeded in stimulating the interest of the viewers, creating a desire, and a motivation for further exposure to the subject.

B. **Negative** aspects of Episode 4:

As was the case in the evaluation of Episode 1, a large proportion of the viewers disliked the **presenter.** (47,1% of the respondents). It was a common criticism that the presenter tended to "talk down" to the viewers. The apparent lack of statistical knowledge was not as obvious in Episode 4 as it was in Episode 1.

The **time** of the broadcast was once again criticised , with justification. Taking into account the programmes that preceded and succeeded the "Statistics" Series, it would appear that the target audience was far younger than was originally intended by the producers of the Series. The exclusion of the Series from the Saturday re-broadcasts of "educational" programmes tended to diminish the importance and the impact of the Series to a considerable degree.

A fairly large proportion of the test group felt that the Episode was **too simple.** The author feels, unlike the case for Episode 1 where this is a valid criticism, that the subjects producing this response have been so indoctrinated into believing that statistics is nothing more than manipulating vast amounts of numerical data, that they cannot accept the fact that the underlying concepts of statistics are in fact simple. The underlying concept of Episode 4 is a subtle one, and the fact that the test sample found the Episode too simple could in fact be regarded as a highly positive criticism. It is surely one of the greatest objects of facilitative teaching to make difficult concepts appear simple.

SUBJECTIVE EVALUATION BY THE RESEARCHER

The following are the personal and subjective views of the researcher (J D C Stupart). Some of the evaluative conclusions have been based on non-quantitative research methods, such as interviews with individuals, group discussions, observation of groups during viewing, etc. These conclusions are not based on statistical methods, but may nevertheless be considered valid if considered in the domain of "action research" methodology.

Positive aspects of Episode 4:

The author feels strongly that this episode was by far the best in the series. The subtle and important concept of the possibility of "lying with statistics" was presented in a stimulating and clear manner. The example used was highly relevant, and the use of a humorous situation to illustrate the basic concept was an outstanding example of the use of this often neglected didactical tool.

On interviewing candidates who had viewed the entire series, it was Episode 4 that they recalled most vividly, and which seemed to have had the greatest positive effect, both on their knowledge of the content, and their general attitude toward statistics.

Negative aspects of Episode 4

As in the evaluation of Episode 1, it is felt that insufficient use was made of the potential of the medium, both in the location, and in the construction and the presentation of the diagrams.

The presenter was once again unsatisfactory, although his apparent lack of statistical knowledge was not as apparent as it was in the earlier episodes.

Conclusion.

The author feels that the episode under evaluation was an excellent example of the potential of educational television . As in the case of Episodes 1 to 3, the author, acting in the capacity of head of mathematics at a secondary school, insisted that the episode be used as an aid in the teaching of statistics to Std 6 and Std 7. As before, the episode can be reinforced by means of class discussion, particularly after viewing the episode. During such discussion, the learners could be encouraged to present their own examples of the misuse of statistics.

TABLE 4 VIEWED

OBSERVED

STD	TOTAL	Q1	Q2	Q3	Q4	TOTAL
6	46	33	37	32	33	135
7	25	16	20	18	19	73
8	25	24	20	21	21	86
9	25	25	21	17	20	83
TOTAL:	121	98	98	88	93	377

In order to calculate the CHI-SQUARED statistic for testing for difference between frequencies, it is necessary to calculate a table of EXPECTED FREQUENCIES. (In other words, in this case, frequencies that would be expected if the number of years schooling had NO EFFECT on the test outcomes). For example the expected response for Question 1 , for Std 6 would be (98/121) x 46 = 37.2 (etc). See Page 26 for table of expected frequencies.

TABLE 4 VIEWED

EXPECTED

STD	TOTAL	Q1	Q2	Q3	Q4	TOTAL
6	46	37.2	37.2	33.4	35.4	143.2
7	25	20.2	20.2	18.2	19.2	77.8
8	25	20.2	20.2	18.2	19.2	77.8
9	25	20.2	20.2	18.2	19.2	77.8
TOTAL:	121	97.8	97.8	88	93	376.6

If e_i = expected frequencies, and o_i = observered frequencies, then

$$\chi^2 = \sum \frac{(e_i - o_i)^2}{e_i}$$

With $(v - 1)(u - 1)$ degrees of freedom. v = number of rows,

u = number of columns.

In this case $\chi^2 = 14,88$ (with 9 degrees of freedom)

From tables $\chi^2_{0,10} = 14,7$ (see page 24)

ABLE 3 NOT VIEWED

OBSERVED

STD	TOTAL	Q1	Q2	Q3	Q4	TOTAL
6	25	16	14	15	14	59
7	55	29	39	36	25	129
8	25	16	16	17	16	65
9	25	18	17	22	19	76
TAL:	130	79	86	90	74	329

Observed frequencies of correct responses plotted against school standard.

ABLE 3 NOT VIEWED

EXPECTED

STD	TOTAL	Q1	Q2	Q3	Q4	TOTAL
6	25	15.2	16.5	17.3	14.2	63.2
7	55	33.4	36.4	38.1	31.3	139.2
8	25	15.2	16.5	17.3	14.2	63.2
9	25	15.2	16.5	17.3	14.2	63.2
TAL :	130	79	85.9	90	73.9	328.8

Frequencies expected if years schooling had no effect on test scores.

(Control group)

TABLE 2 VIEWED OBSERVED FREQUENCIES

MATH ABILITY	TOTAL	Q1	Q2	Q3	Q4	TOTAL
1	22	17	14	15	14	60
2	28	21	22	15	19	77
3	30	25	25	24	24	98
4	19	15	15	15	15	60
5	22	20	22	19	21	82
TOTAL:	121	98	98	88	93	377

Observed frequencies of correct scores plotted against assessed mathematical ability. (Test sample.)

VIEWED PROGRAMME EXPECTED FREQUENCIES

MATH ABIL	TOTAL	Q1	Q2	Q3	Q4	TOTAL
1	22	17.8	17.8	16	16.9	68.5
2	28	22.7	22.7	20.4	21.5	87.3
3	30	24.3	24.3	21.8	23.1	93.5
4	19	15.4	15.4	13.8	14.6	59.2
5	22	17.8	17.8	16	16.9	68.5
TOTAL:	121	98	98	88	93	377

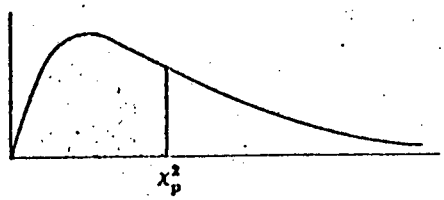
Frequencies EXPECTED in the test sample if mathematical ability had no effect on the test scores.

TABLE 1 NOT VIEWED

MATH ABILITY	TOTAL	Q1	Q2	Q3	Q4	TOTAL
1	19	11	13	12	10	46
2	28	14	13	22	9	63
3	38	22	24	26	24	96
4	23	18	13	14	13	63
5	22	14	18	16	13	61
TOTAL:	130	79	86	90	74	329

OBSERVED frequencies of correct responses by the CONTROL group plotted against assessed mathematical ability.

PERCENTILE VALUES (χ_p^2)
for
THE CHI-SQUARE DISTRIBUTION
with ν degrees of freedom
(shaded area = p)



ν	$\chi^2_{0.995}$	$\chi^2_{0.99}$	$\chi^2_{0.975}$	$\chi^2_{0.95}$	$\chi^2_{0.90}$	$\chi^2_{0.75}$	$\chi^2_{0.50}$	$\chi^2_{0.25}$	$\chi^2_{0.10}$	$\chi^2_{0.05}$	$\chi^2_{0.025}$	$\chi^2_{0.01}$	$\chi^2_{0.005}$
1	7·88	6·63	5·02	3·84	2·71	1·32	0·455	0·102	0·0158	0·0039	0·0010	0·0002	0·0000
2	10·6	9·21	7·38	5·99	4·61	2·77	1·39	0·575	0·211	0·103	0·0506	0·0201	0·0100
3	12·8	11·3	9·35	7·81	6·25	4·11	2·37	1·21	0·584	0·352	0·216	0·115	0·072
4	14·9	13·3	11·1	9·49	7·78	5·39	3·36	1·92	1·06	0·711	0·484	0·297	0·207
5	16·7	15·1	12·8	11·1	9·24	6·63	4·35	2·67	1·61	1·15	0·831	0·554	0·412
6	18·5	16·8	14·4	12·6	10·6	7·84	5·35	3·45	2·20	1·64	1·24	0·872	0·676
7	20·3	18·5	16·0	14·1	12·0	9·04	6·35	4·25	2·83	2·17	1·69	1·24	0·989
8	22·0	20·1	17·5	15·5	13·4	10·2	7·34	5·07	3·49	2·73	2·18	1·65	1·34
9	23·6	21·7	19·0	16·9	14·7	11·4	8·34	5·90	4·17	3·33	2·70	2·09	1·73
10	25·2	23·2	20·5	18·3	16·0	12·5	9·34	6·74	4·87	3·94	3·25	2·56	2·16
11	26·8	24·7	21·9	19·7	17·3	13·7	10·3	7·58	5·58	4·57	3·82	3·05	2·60
12	28·3	26·2	23·3	21·0	18·5	14·8	11·3	8·44	6·30	5·23	4·40	3·57	3·07
13	29·8	27·7	24·7	22·4	19·8	16·0	12·3	9·30	7·04	5·89	5·01	4·11	3·57
14	31·3	29·1	26·1	23·7	21·1	17·1	13·3	10·2	7·79	6·57	5·63	4·66	4·07
15	32·8	30·6	27·5	25·0	22·3	18·2	14·3	11·0	8·55	7·26	6·26	5·23	4·60
16	34·3	32·0	28·8	26·3	23·5	19·4	15·3	11·9	9·31	7·96	6·91	5·81	5·14
17	35·7	33·4	30·2	27·6	24·8	20·5	16·3	12·8	10·1	8·67	7·56	6·41	5·70
18	37·2	34·8	31·5	28·9	26·0	21·6	17·3	13·7	10·9	9·39	8·23	7·01	6·26
19	38·6	36·2	32·9	30·1	27·2	22·7	18·3	14·6	11·7	10·1	8·91	7·63	6·84
20	40 0	37·6	34·2	31·4	28·4	23·8	19·3	15·5	12·4	10·9	9·59	8·26	7·43
21	41·4	38·9	35·5	32·7	29·6	24·9	20·3	16·3	13·2	11·6	10·3	8·90	8·03
22	42·8	40·3	36·8	33·9	30·8	26·0	21·3	17·2	14·0	12·3	11·0	9·54	8·64
23	44·2	41·6	38·1	35·2	32·0	27·1	22·3	18·1	14·8	13·1	11·7	10·2	9·26
24	45·6	43·0	39·4	36·4	33·2	28·2	23·3	19·0	15·7	13·8	12·4	10·9	9·89
25	46·9	44·3	40·6	37·7	34·4	29·3	24·3	19·9	16·5	14·6	13·1	11·5	10·5
26	48·3	45·6	41·9	38·9	35·6	30·4	25·3	20·8	17·3	15·4	13·8	12·2	11·2
27	49·6	47·0	43·2	40·1	36·7	31·5	26·3	21·7	18·1	16·2	14·6	12·9	11·8
28	51·0	48·3	44·5	41·3	37·9	32·6	27·3	22·7	18·9	16·9	15·3	13·6	12·5
29	52·3	49·6	45·7	42·6	39·1	33·7	28·3	23·6	19·8	17·7	16·0	14·3	13·1
30	53·7	50·9	47·0	43·8	40·3	34·8	29·3	24·5	20·6	18·5	16·8	15·0	13·8
40	66·8	63·7	59·3	55·8	51·8	45·6	39·3	33·7	29·1	26·5	24·4	22·2	20·7
50	79·5	76·2	71·4	67·5	63·2	56·3	49·3	42·9	37·7	34·8	32·4	29·7	28·0
60	92·0	88·4	83·3	79·1	74·4	67·0	59·3	52·3	46·5	43·2	40·5	37·5	35·5
70	104·2	100·4	95·0	90·5	85·5	77·6	69·3	61·7	55·3	51·7	48·8	45·4	43·3
80	116·3	112·3	106·6	101·9	96·6	88·1	79·3	71·1	64·3	60·4	57·2	53·5	51·2
90	128·3	124·1	118·1	113·1	107·6	98·6	89·3	80·6	73·3	69·1	65·6	61·8	59·2
100	140·2	135·8	129·6	124·3	118·5	109·1	99·3	90·1	82·4	77·9	74·2	70·1	67·3

Source: Catherine M. Thompson, *Table of percentage points of the χ^2 distribution*, Biometrika, Vol. 32 (1941), by permission of the author and publisher.

Chapter 6 Comparison, Summary and Recommendations.

The following chapter gives a comparison of the evaluations of Episode 1 and Episode 4, under the headings examined in the detailed evaluations.

The chapter is concluded with a list of recommendations arising out of the evaluation.

Summary of Test Findings:

Ability in Statistics.

1. Effect of assessed mathematical ability on the test scores:

If we formulate the null hypothesis:"Mathematical ability has no effect on the test scores":

Episode 1:	**r=0,997**	**reject null hypothesis at 0,50 level of significance.**
Episode 4:	**r=0,921**	**TEST SAMPLE: reject at 0,99** **CONTROL : reject at 0,995**

It is apparent from the above that the assessed mathematical ability played a very significant part in the test scores. This is particularly noticeable in the case of Episode 4, where the control group relied almost exclusively on their mathematical ability to score in the test. It must be noted that there is a high positive correlation between mathematical ability and intelligence - it is expected that the scores in the tests would depend largely on the intelligence of the pupil in general, apart from his ability in mathematics. In the case of the control group in Episode 4, we are 99.5% certain that we are not rejecting the null hypothesis while **true.**

The slightly lower coefficient of linear correlation for Episode 4, (Episodel r=0,997; Episode4 r=0,921) is consistent with the test instruments, which did not require much mathematical expertise in Episode 4. The test items were more a test of judgmental rather than mathematical/calculating ability.

2: The effect of the ETV material on the test scores:

Episode 1

	1	2	3	4	Tot
Test	72%	90%	89%	60%	170
Control	68%	77%	86%	41%	22

Episode 4

	1	2	3	4	Tot
Test	81%	81%	73%	77%	121
Control	61%	66%	69%	57%	130

If we formulate the null hypothesis:"Viewing the ETV programme 'Statistics' had no effect on the test scores", we can **reject the null hypothesis** at the following levels of significance:
Episode 1: Reject at 0,50 level
Episode 4: Reject at 0,90 level

We can therefore be confident in stating that Episode 4, particularly, resulted in a significant change in the test scores. (improvement). The situation for Episode 1 is not so significant, although there is still a reasonable significant level for the rejection of the null hypothesis.

3: The Effect of Number of Years Formal Schooling on the Scores:

We formulate the null hypothesis: "Number of years formal schooling has no effect on the test scores"

For Episode 1: we can reject the null hypothesis at the 0,50 level of significance. This is once again a low significance level, which could suggest that the material handled in Episode 1 was largely of an intuitive nature, and that formal training in such elementary topics had little effect.

For Episode 4: For the **test sample** we can reject the null hypothesis at a significance level of 0,90. For the **control sample** we can reject the null hypothesis at a significance level of 0,975. The coefficients of linear correlation for this episode are: Test sample - r = 0,813 ; Control sample - r = 0,913 ; Combined - r = 0,579. The very high linear correlation as well as the very high significance level for the rejection of the null hypothesis indicate that the control group relied almost entirely on their experience and maturity to complete the test material. The low coefficient of correlation for the combined samples is a very powerful indicator of the highly significant difference between the scores of the test and the control groups - i.e. it is an indicator of the considerable effect of the episode on the scores.

SUMMARY OF RESULTS:

Episode 1:
The assessed mathematical ability was by far the most significant factor affecting the test scores for this episode. This is consistent with the material covered in Episode 1 - which was largely the ability to construct and to interpret graphs of various types. It is felt that perhaps it was unnecessary to devote a complete episode of the series to such elementary topics.

The effect of the number of years formal schooling, and the effect of the viewing of the episode had a very much lower significance in affecting the test scores. This is consistent with the view expressed above.

Episode 4:
Episode 4 showed a highly significant effect on the test scores. (0,90 significance level). Assessed ability in mathematics and number of years formal schooling also had a highly significant positive effect on the scores. The effect of formal schooling is probably explained by the fact that there is a direct relationship between cognitive maturity and years schooling, a factor which would affect the scores more than simply schooling in mathematics. A high degree of interpretive and subjective judgmental ability was needed to correctly respond to the test items for Episode 4. Similarly, there is a high positive correlation between intelligence and ability in mathematics, and it is probably this factor that caused the significant effect of "assessed ability in mathematics", rather than mathematical ability as such.

ATTITUDE TOWARDS STATISTICS:

The identical test items were given to the two groups under investigation (Episode 1 and Episode 4)

Question 10:	Episode 1	Episode 4	
	56%	66,9%	Keen to learn more stats.
	16%	14%	No desire to learn more stats.
	28%	19%	Did not care whether they learned more stats or not.

From the above it is apparent that Episode 4 had a more positive effect than Episode 1, but that both the episodes showed a significant positive response to the question: "Do you wish to learn more about statistics?"

Question 9: Was the episode ...1=no help at all ... 5=a great help.. in helping the understanding of statistics?

response	Episode 1 frequency	Episode 4 frequency (%)
1	3%	2.5%
2	15%	11.6%
3	42%	38.8%
4	29%	34.7%
5	10%	12.4%
MEAN	3,38	3,43

The rather low mean response could be because the two episodes in fact were little help in facilitating the ability to perform the tedious calculations required in a typical secondary-school course in statistics. This could be interpreted as a criticism of the method of teaching statistics at school, where the "processes" rather than the "products" of the subjects are drilled, often at the expense of a true conceptual understanding.

ATTITUDE TOWARDS THE PROGRAMME

LIKES: Episode 1	Episode 4
31.2%...Examples	42.9%...Examples
17.8%...Explanation	30.6%...Humour
15.9%...Relevance	19.0%...Relevance
13.4%...Format/Layout	14.0%...Format/Layout
5.7%...Use of Diagrams	7.4%...Use of diagrams
10.2%...Miscellaneous	10.7%...Miscellaneous
5.7%...Nothing	7.4%...Nothing

DISLIKES: Episode 1	Episode 4
31.8%...Presenter	47.1%...Presenter
19.9%...Too simple	14.0%...Too simple
7.3%...Too short	7.4%...Too short
3.9%...Not clear	7.4%...Not clear
6.6%...Miscellaneous	9.1%...Miscellaneous

Comparison, Summary & Recommendations

There is a very high degree of concordance between the two sets of responses to this attitudinal test item. It is noteworthy that humour scored prominently as a "like" in Episode 4 - this is certainly consistent with all accepted theories of education. More use could have been made of humourous situations throughout the series. The greatest positive feature in both the episodes was the example(s) chosen to illustrate the concepts involved. (Kruger Park in Episode 1, and the "salesman" situation in Episode 4). Both examples chosen were relevant to the experience of the learner - a crucial factor in any lesson design.

The most common "dislike" was the presenter. It appeared to both the target audience (test group) and to the researcher that the presenter was not entirely proficient in the subject that was being presented. It is an essential pre-requisite in any lesson design that the teacher be an expert in the field of study. Many of the test group felt that the presenter tended to "talk down" to the audience. This view is consistent with the other prevalent dislike, i.e. that the programme was too simple. Episode 1, in particular, seemed to devote too much time and emphasis to trivial concepts, that could be easily understood with an elementary understanding of graphs.

The criticism that the programme was "too short" could in fact be taken as a highly positive criticism. It is the hallmark of a good lesson to leave the subjects with a desire to learn more. Both Episodes seemed to have succeeded in this respect.

CONCLUSION

Need for the Programme:

In general there seems to be a serious lack of conceptual understanding of even the most basic statistical principles, even amongst those candidates with several years of "formal" exposure to the subject. Both the episodes under evaluation contributed towards such a conceptual understanding. Episode 4 in particular was most successful in making the viewers aware of the possibilities of abusing statistics.

Aims of the Programme:

1: To communicate an **awareness** of elementary statistics.
The Episodes evaluated contributed towards the creation of an awareness of statistics as it could be applied in daily life.

2: To **relate** statistics to **everyday life.**
The Episodes succeeded in showing the application of statistics to everyday life situations. The choice of examples - animal census in the Kruger Park in Episode 1, and the abuse of statistics by a salesman in Episode 4, were both very well chosen. The examples were within the real - life experience of the target audience.

3: To provide **background and reinforcement** to the introduction of statistics to the secondary school syllabus.
The episodes evaluated do contain material that is specifically mentioned in the syllabus for mathematics for the Junior Secondary course, so they do fulfill the stated aim. Episodes 5 and 6, however, are outside the syllabus, so would not necessarily meet this aim, except perhaps as a reinforcement (enrichment).

4: To indicate to the teacher ways in which statistics can be taught in a **lively and relevant** manner.

This aim could have been achieved far better if the following points were considered before production:

(a) A better, facilitative teacher should have been chosen to present the programme.

(b) Better use should have been made of the potential of the medium. e.g. it was inexcusable to manually draw charts, diagrams, etc, which were sometimes very difficult to decipher. Use should have been made of computer aided graphics, where, for example, the dynamic nature of the construction of descriptive diagrams could have been illustrated. Apart from the excellent location material from the Kruger Park, too much use was made of the studio, which in itself was unimaginative and dull.

In general, it is felt that the evaluated episodes (and in fact the entire series) **failed to achieve this aim.**
A **good, facilitative** teacher could have presented the material in a more "lively and relevant manner", using more conventional media.

Time Schedule for the Series:

The time slot allocated for the series (17h15 on a Monday) precluded the viewing by a large section of the original target audience. Not only adults, but many secondary school pupils found it impossible to view the series due to commitments at work and at school. The series was **not included in the Saturday morning broadcasts of 'educational' programs** - inclusion of the program could have overcome the above serious drawback. The 'educational programmes' that preceded and succeeded the 'Statistics' series were designed for a less academically mature audience than that envisaged for the series. Of 56 Standard 10 pupils interviewed, only 7 had realised that there was a series on statistics. The pre-broadcast advertising/publicity was almost non-existent. (cf "Siyafunda").

General:

The researcher is aware of several faults in the series, however it is felt that in general the series was successful in meeting the majority of the original aims and objectives. The ETV material has been used most successfully as an aid in the teaching of statistics to secondary-school pupils. The series is valuable when used in parallel with more 'conventional' methods of teaching. Post-viewing discussion periods were found to be exceptionally valuable. The video tape of the series has become an essential aid to the teachers of mathematics at the school at which the researcher held the position of head of mathematics. This last fact should give an indication of the general favourable attitude of the researcher.

Genevieve Jacquinot, at the 1976 Conference on Evaluation and Research into Educational Television And Radio states in her presentation:

> "...educational film 'is not only a species of cinema, but also a species of education'. What interests us is the interface, where the teaching aims (in the shape of the content) combine with a method of expression through film (the substance and manner of expression)."
>
> **"What characterizes the classical teaching film is the absence of a genuine film style**
>
> (a) Most existing materials more or less structure their message by more or less implicit reference to the linguistic mode of expression which is the basis for the whole tradition of teaching communication. It is only very rarely that one finds a genuine style of film-making (defined as 'an activity integrating diverse cinematographic and non-cinematographic principles')."

(c) There was at no stage an opportunity for student response. This is probably the single greatest weakness of "stand-alone" educational television material. (As compared with 'integrated' educational packages, which would have some feedback possibilities built in.) Barbara Searle and Patrick Suppes, in Bates & Robinson suggest that pupil response can be encouraged in educational television material, by including 'conversations' between the presenter and the audience. The audience should be asked direct questions, both in free format, and in multiple-choice format. Searle and Suppes state:

> "Characters in a radio program may talk either among themselves or directly to the listeners. We make careful distinction between these two modes. When characters are talking to each other, we expect children to listen without responding. When a character talks directly to the children, we expect and plan for the children to respond." (Bates & Robinson, p79)

The South African Broadcasting Corporation educational television programme "Siyafunda" is an excellent example of the above. The presenter creates direct eye contact with the audience, and repeatedly asks the audience to respond. I feel that much of the success of "Siyafunda" can be attributed to the approach of the presenter, who seems to be a very good facilitative teacher.

(d) **Episode** 1 had little or no story to provide continuity and viewer interest. **Episode** 4 on the other hand involved a homourous story as the vehicle for instruction, resulting in a higher degree of viewer interest. This factor relates closely to the "use of the medium".(See (b) above)

Recommendations Arising out of the Evaluation:

(1) An experienced educationalist should be included on the production team from inception of any educational television project. He should be used as a general advisor, not only on the material to be presented, but as an advisor on teaching methods.

(2) Very careful thought must be given in the appointment of the **presenter.** The presenter should be trained in general teaching and communication techniques. He/she should have a reasonable knowledge of the subject matter being presented.

(3) Full use should be made of the technology available. Educational Television is an expensive means of presentation, and can only be justified if the lesson can be presented in a manner superior to other, more "conventional" media. It is inexcusable to make use of educational technology that is even outdated and clumsy in the conventional classroom situation.

(4) When deciding on a target audience, careful consideration must be given to the **time scheduling** of the educational television series, so as not to exclude potential viewers.

(5) For any educational series, there must be a reasonable degree of pre-broadcast promotion, so as to create a desire to view the programme.

(6) After deciding on the target audience, the educational television material must be structured so that the material is relevant to the real-world of the target audience. All material must be **relevant to the experience of the learner.**

(7) A story/plot should be designed to give the series interest and continuity. The producer, educational advisor and script-writer should liase closely at the initial planning stage to implement this factor.

(8) **Formative evaluation** should be carried out at all stages of the production planning. Recommendations arising from the formative evaluation should be taken heed of, and changes implemented during the design phase of the production.

(9) **Summative Evaluation** should be given a higher degree of priority in the allocation of resources. The summative evaluation of the series "Statistics" was carried out in a very limited manner, due largely to the fact that it was performed by **one** researcher, who had to perform all the steps of the evaluation , from planning, through data collection, to final analysis and reporting.

Appendix I - TEST INSTRUMENTS

Included in this Appendix are test instruments designed to test all six Episodes of the S.A.B.C. Series "Statistics."

The test items were designed to evaluate three main factors, viz:

1. The understanding of the **content** of the material.

2. The **attitude** toward statistics of the test sample.

3. The **attitude** toward the **actual production.**

In all the tests the items were divided into the following categories:

1. **Items 1 - 4** These items were designed to test the **content** knowledge relevant to the episode under evaluation. In many cases, the test items were taken directly from the educational television script.

2. **Items 5 and 6** These two test items were in general designed to test the creativity and insight into Statistics. These items (generally) required more divergent, creative cognitive processes than was required in Items 1 - 4. It was not always possible to give a quantitative evaluation to these items.

3. **Items 7 to 10** - dealt with the evaluation of the **attitude toward statistics** of the test sample. These items were administered only to the **test-sample**, and not to the control group, as the items referred specifically to the television material. The test items were identical in **all** the tests for the different episodes.

4. **Items 10 to 14** - were designed to attempt to evaluate the **attitude** of the viewers toward **the program itself (production aspects).**

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STATISTICS Programme 1

Time 40 min

The results of this test are annonimous and are to be used to test the effect of the SABC programme "Statistics" only.

Enter your number in the space..... ☐☐☐☐☐☐ √

In questions 1 - 4 simply circle the letter corresponding to the correct answer. Marks will NOT be deducted for wrong answers, so attempt EVERY question.

A B C D

A B C D

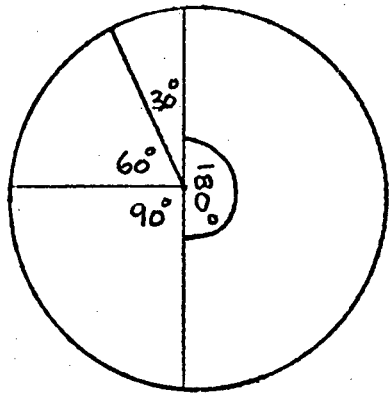
A B C D

A B C D

UNIVERSITY OF CAPE TOWN.

Evaluation of Programme 1 - STATISTICS

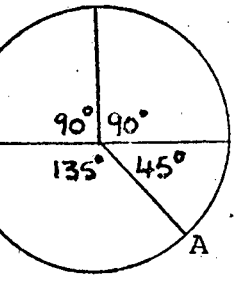
Answer ALL questions - marks will NOT be deducted for wrong answers, so please give an answer for each question. The results of this test are to be used to evaluate the effectiveness of the television programme.

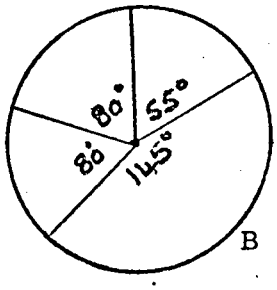


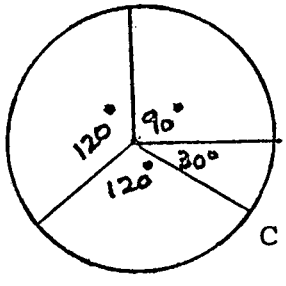
1. The pie chart alongside represents the sports played by 600 pupils at a boys' school in the Cape.
   The actual numbers playing the sports are:
   A 180 Rugby, 90 Hockey, 60 Soccer, 30 Tennis
   B 300 Rugby, 150 Hockey, 100 Soccer, 50 Tennis
   C 320 Rugby, 160 Hockey, 80 Soccer, 40 Tennis
   D Cannot be determined exactly from the pie - chart.

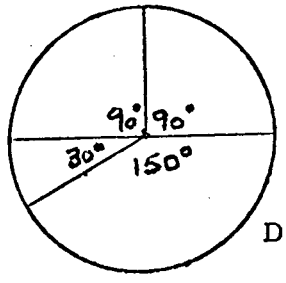
2. In a school there are 100 children with brown hair, 100 with black hair, 150 with blonde hair, and 50 have red hair.

   Which one of the four pie charts represents this information?

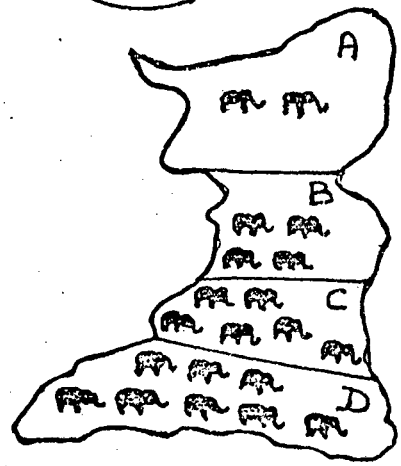






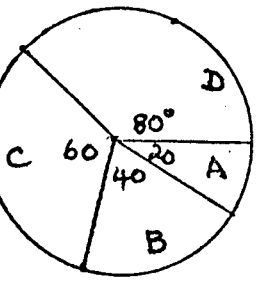


3. The figure alongside shows a map of the Kruger National Park, divided into four regions. It is estimated that there are 10 000 elephants in the Park. The approximate number of elephants in region B is therefore:

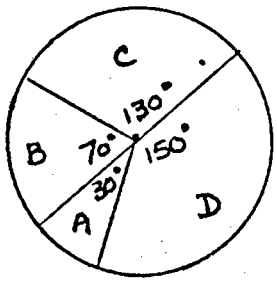


   A 400
   B 4 000
   C 2 000
   D Cannot be estimated with the given information.

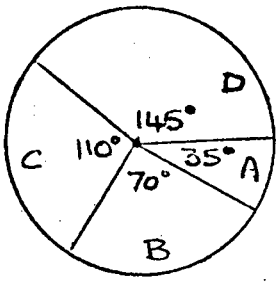
4. Which of the following pie-charts gives exactly the same information as that represented by the pictograph given in question 3?



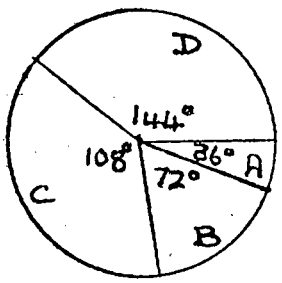
A



B



C



D

. Use a pie-chart or a pictogram to illustrate some facts about your own personal daily life. You will, of course, have to do some guessing or approximating.

. Give an example (make up your own figures) of how a pie-chart or pictogram may be used to represent data gathered about the sale of various makes of motor cars in South Africa.

You have just answered six questions that deal with statistics in general. The following questions deal with the SABC "Statistics" programme:

. - 14. SEE ANSWER SHEET.

****

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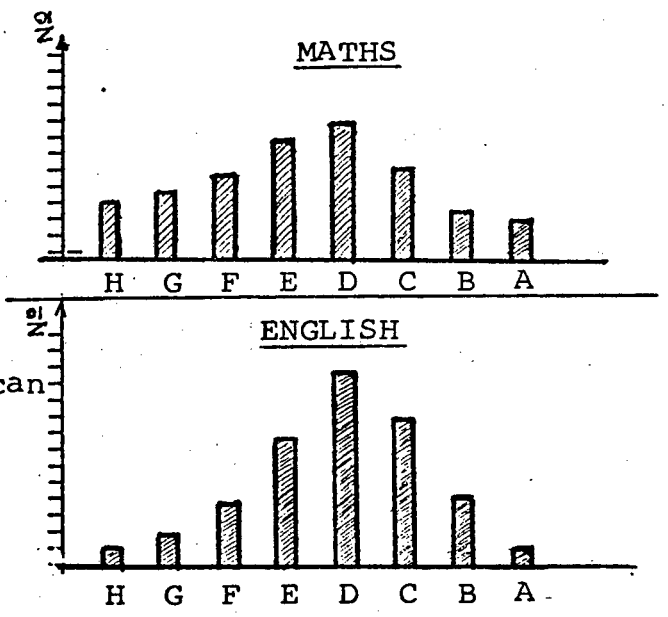
Evaluation of Programme 2 - STATISTICS

Answer ALL questions - marks will NOT be deducted for wrong answers, so please give an answer for each question. The results of the test are to be used to evaluate the effectiveness of the television programme.

1. The bar-diagrams alongside represent the symbols obtained in an examination of 100 students in Maths and English.



Mark the letter corresponding to the correct statement below that can be deduced from the given graphs:

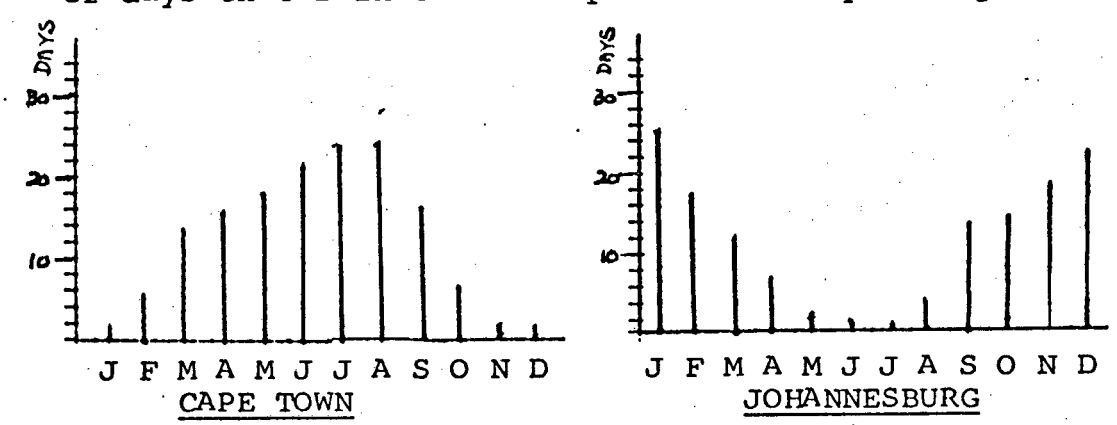
A It is easier to obtain an "A" in English than in Maths.

B It is easier to obtain an "A" in Maths, but is also easier to fail Maths than English. (Fail=G or H)

C It is easier to obtain an "A" in Maths, but is easier to fail English than Maths.

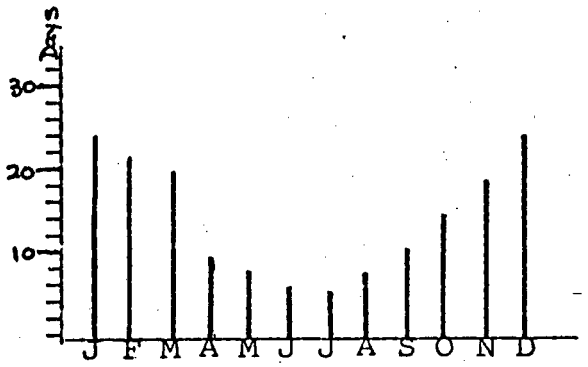
D It is easier to obtain a Fail (G or H) in Maths, and is easier to obtain an "A" in English.

2. The diagrams below represent the average number of days in which rain fell (averaged over the last five years) in the cities of Johannesburg, Cape Town and Durban. (For example, the average number of days that rain can be expected in July in Cape Town is 25)



3. (contd)

Referring to the given rainfall diagrams, which two cities have the most similar rainfall patterns?



DURBAN

A Johannesburg and Cape Town
B Johannesburg and Durban
C Cape Town and Durban
D No comparison can be made from the given diagrams.

4. If you had a rainfall gauge in your garden, how would you represent the readings that you took from day to day?

A Bar graph only
B Bar graph or pictogram
C Bar graph or broken-line graph
D Bar graph or pie-chart.

5. Give some practical example of statistics being used to predict some future happening.

6. Write down three examples from everyday life where you have seen statistical data (figures) represented by means of graphs or other diagrams.

See the answer sheet for Questions 7 - 14, which deal with the SABC Programme "Statistics" in particular.

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Evaluation of Programme 3 - Statistics

Answer ALL questions - marks will NOT be deducted for wrong answers.

1. Using the numbers: 0, 0, 0, 1, 1, 2, 4, 7, 12 :
   A The mean is 1, the mode is 0 and the median is 3
   B The mean is 3, the mode is 0, and the median is 1
   C The mean is 3, the mode is 1, and the median is 0
   D The mean is 0, the mode is 3, and the median is 1

2. You are required to send out a questionnaire to determine the most popular SABC Television programme. You would send the questionnaire to:
   A Every household in South Africa
   B Every holder of a television licence
   C About 100 people chosen randomly from the telephone book
   D The first 10 people that you meet on the street

3. The following are the ages of 9 people taken from a survey: 17, 19, 19, 20, 21,21, 21, 23, 49. Which would be the most reliable "averages" to use to represent this group?
   A The mean or the mode
   B The median or the mode
   C The median or the mean
   D Any "average"

4. Referring to the information given below (Question 5), which of the terms "mean, median or mode" would be used to indicate the most popular washing powder?
   A mean B median C mode D They are all averages, so it does not make any difference.

. The table alongside gives the responses of 118 housewives who were asked to name their favourite washing powder. (eg 17 housewives thought that "Whito" was the best)

Brand name	rated "best" by
Brighto	12
Whito	17
Sparklo	32
Surfer	14
Cold Eno	43

Represent this information using a diagram.

. Critisize this question appearing in a survey questionnaire:
"Cross the box indicating whether you are still at school or not "

YES	NO

---

ow answer Questions 7 - 14 which appear on the answer sheet. These uestions deal specifically with the SABC Television programme "Statistics"

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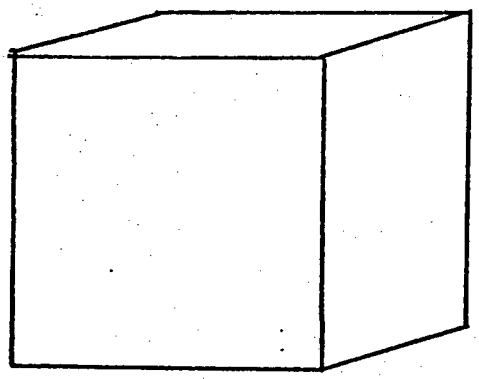
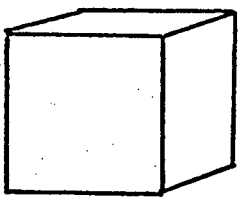
Evaluation of Programme 4 - STATISTICS

Answer ALL questions - marks will NOT be deducted for wrong answers.

1.



Company A



Company B

From the above diagram, it would appear that:

A Company A produces about twice as much as Company B

B Company A produces about four times as much as Company B

C Company A produces about eight times as much as Company B

D It is impossible to make any estimate

2.

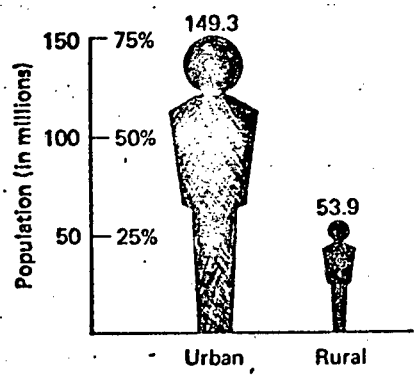


Fig 1

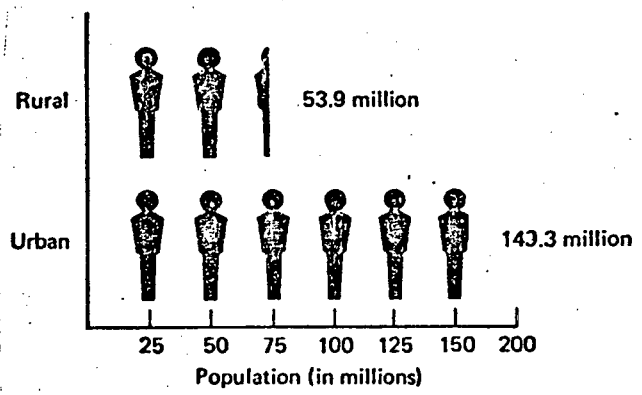


Fig 2

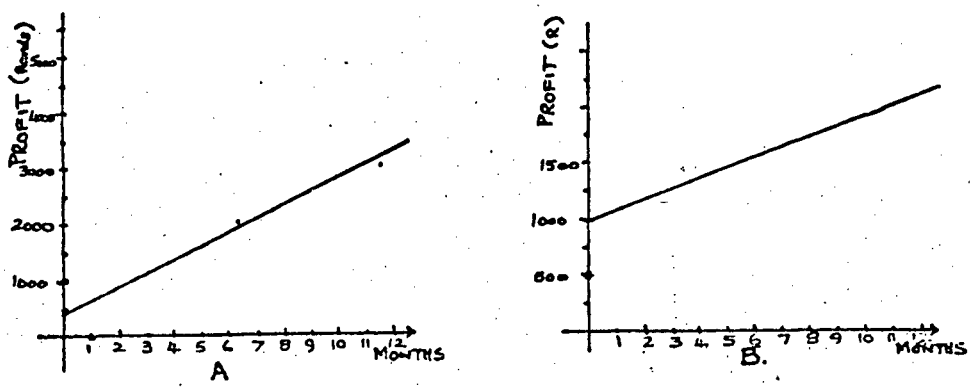
The above two diagrams represent the United States' urban and rural populations in 1970. Which figure gives the more accurate impression of the information?

A Figure 1

B Figure 2

C Both Figure 1 and Figure 2 convey the same impression

D A pictogram or pictograph is not the correct diagram to use for this type of information.



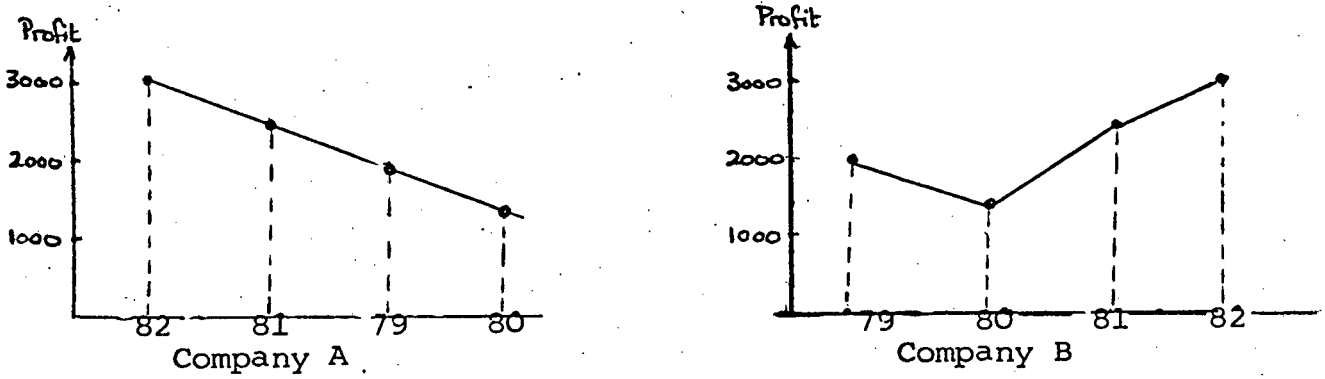
The above figures represent the profits of Company A and Company B: Use these figures to decide if

A The profits of Company A are increasing faster than the profits of Company B

B The profits of Company B are increasing faster than the profits of Company A

C The profits of both companies are increasing at about the same rate

D It is not possible to make a decision from the given diagrams. More information is required.



The above diagrams represent the annual profits of two companies. From the diagrams, decide if

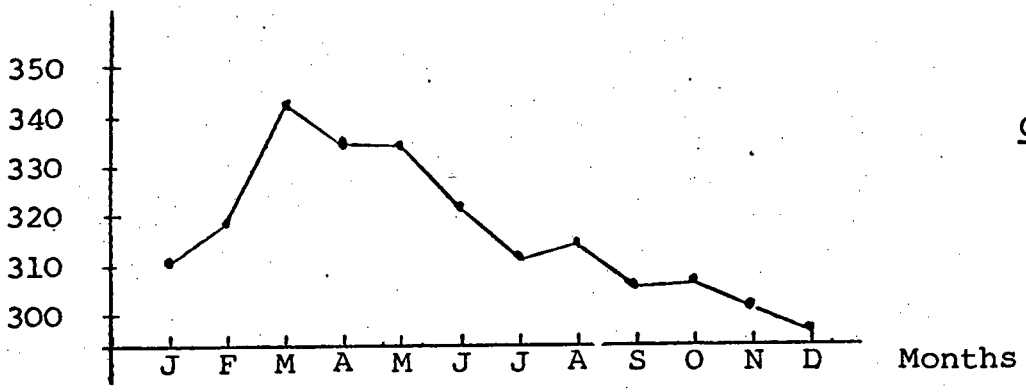
A Company A is more likely to succeed than Company B

B Company B is more likely to succeed than Company A

C Both Companies have increasing profits

D Both Companies have decreasing profits

5.



GOLD PRICE
(Rands/ounce)

The above graph represents the gold price during 1984.
Could this graph be misleading? - Explain.

6. An advertisement states: "92% of housewives interviewed choose new Hot Water Homo."
Explain why this could be classed as misleading advertising.

See the answer sheet for questions 7 - 14, which deal in particular with Episode 4 of the SABC Programme "STATISTICS".

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Evaluation of Programme 5 - Statistics

Answer ALL questions - marks will NOT be deducted for wrong answers.

1. Write down the probality of:
   A A Wednesday following directly after a Sunday
   B A dropped stone falling
   C Throwing a number 4 on one throw of an unbiased die
   D Throwing an even number on one throw of an unbiased die

2. A single coin is spun 1000 times; the number of heads that appeared is likely to be:
   A about 500
   B exactly 500
   C there is no way of telling, as there is an equal chance of any number of heads (from 1 - 1000) having occurred.
   D there is no way of telling, as one cannot fit numbers to chance events.

3. A coin is spun five times, with the following outcome:
   head, head, tail, head, head. From this you can deduce for certain:
   A either the coin is biased, or the thrower is a crook
   B the probality of throwing a head is 80%
   C heads are more likely to occur than tails
   D nothing can be deduced for certain - the coin will have to be spun many more times.

4. A gambler wins R1.00 if heads appear on the spin of a coin, and he loses R1.00 if tails appear. After 500 spins of the coin
   A he will win about R250
   B he will lose about R250
   C he will neither win nor lose anything (be about even)
   D there is no way of knowing what will happen.

5. Explain, using a relevant example, how the idea of probality can be used in everyday life.

6. An examining body has found that the probality of obtaining an "A" symbol is 2%. In 1978 5000 candidates wrote an examination, and 250 students obtained "A" symbols. Comment on the difficulty of the examination.

Questions 7 - 14, which deal specifically with Programmes 5 and 6 of the SABC series on Statistics, appear on the answer sheet.

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APPENDIX II - Results of ERIC literature search

Included in this Appendix are the full results of an on-line literature search carried out from the University of Cape Town on the ERIC databank of educational literature (Syracuse University).

I have included the complete results of the literature search for completeness. This list can be used as a valuable source of reference for future research into the summative evaluation of ETV material.

DIALOG File 1: ERIC - 66-85/Mar

EJ256710 IR509687
Education by Television in the Ivory Coast.
Valerien, Jean
Educational Media International, n4 p11-15 1981
Available from: Reprint: UMI
Language: English
Document Type: JOURNAL ARTICLE (080); NON-CLASSROOM MATERIAL (055); PROJECT DESCRIPTION (141)
Journal Announcement: CIJMAY82
The management, administration, production, and broadcasting of educational television are discussed and evaluated with respect to its use in elementary education, training of teachers, and out-of-school education in the Ivory Coast during the 1970s. (CHC)
Descriptors: Broadcast Television; *Developing Nations; Educational Administration; *Educational Television; *Elementary Education; Rural Development; *Rural Education; Summative Evaluation; *Teacher Education
Identifiers: *Distance Education; *Ivory Coast

EJ254070 IR509572
Evaluation on a Tight Budget.
Bates, Tony
Educational Broadcasting International, v14 n3 p113-16 Sep 1981
Language: English
Document Type: JOURNAL ARTICLE (080); POSITION PAPER (120)
Journal Announcement: CIJMAR82
Describes low-cost evaluation methods that many educational broadcasting organizations could use to make their programs more effective. Nine references are listed. (Author/LLS)
Descriptors: *Broadcast Television; *Costs; *Educational Television; *Evaluation Methods; Feedback; Formative Evaluation; Interviews; School Surveys; Statistical Data; Summative Evaluation

EJ244267 IR508971
The Status of Educational Technology in Brazil.
Oliveira, Joao Batista Araujo e
Programmed Learning and Educational Technology, v17 n4 p210-17 Nov 1980
Available from: Reprint: UMI
Language: English
Document Type: JOURNAL ARTICLE (080); REVIEW LITERATURE (070); EVALUATIVE REPORT (142)
Journal Announcement: CIJAUG81
Describes the development of educational technology in Brazil and analyzes examples of successful and unsuccessful projects, particularly in the field of tele-education. (Author/CHC)
Descriptors: *Developing Nations; *Educational Media; Educational Research; *Educational Technology; *Educational

EJ226959 AA531677
TV Talk: Critical Viewing Projects: A Second Look.
Potter, Rosemary Lee
Teacher, v97 n6 p32-33 Mar 1980
Available from: Reprint: UMI
Language: English
Document Type: JOURNAL ARTICLE (080); DIRECTORY (132)
Journal Announcement: CIJDEC80
Presented is an update of the special Critical Viewing Skills curriculum projects (reviewed in Teacher, April, 1979) sponsored by the U.S. Office of Education. The update provides feedback on the projects. (KC)
Descriptors: Demonstration Programs; *Educational Resources; *Educational Television; Elementary Secondary Education; Government Publications; Summative Evaluation; *Television Viewing

EJ191535 TM502723
The Nature of Inquiry and Analysis of Theoretical Progress in Instructional Television from 1950-1970.
Barbatsis, Gretchen Schoen
Review of Educational Research, v48 n3 p399-414 Sum 1978
Available from: Reprint: UMI
Language: ENGLISH
Journal Announcement: CIJMAR79
The roles of summative and formative evaluation as scientific approaches to theory building in instructional television programing for children are examined through a review of research studies. The author contends that the bias toward summative evaluation has been premature in an area of inquiry, where most of the variables are yet to be identified. (Author/JAC)
Descriptors: *Educational Television; Elementary Education; Evaluation Criteria; Formative Evaluation; *Research Design; *Research Problems; *Research Reviews (Publications); *Summative Evaluation; *Television Research

EJ139751 IR503509
Evaluation of ETV Programmes in Developing Countries
Tah Wen, Chiam
Educational Broadcasting International, 9, 1, 11-15 Mar 1976
Language: ENGLISH
Journal Announcement: CIJE1976
Descriptors: *Systems Approach; *Program Evaluation; *Evaluation Methods; *Developing Nations; Models; Educational Television; Summative Evaluation
Identifiers: Maylasia

7 EJ139259 CS703791
Sesame Street Around the World: Evaluating the Evaluators
Liebert, Robert M.
Journal of Communication, 26, 2, 165-171 Spr 1976
Language: ENGLISH
Journal Announcement: CIJE1976
Reviews the book, Sesame Street Revisited, written by Thomas Cook and associates and sums up the issues raised by the Sesame Street program and its evaluators. (MH)
Descriptors: *Book Reviews; *Educational Television; *Programing (Broadcast); Television Viewing; Summative Evaluation; Program Evaluation
Identifiers: *Sesame Street; Media Effects

8 EJ139258 CS703790
Sesame Street Around the World: The Educational Impact
Cook, Thomas D.; Conner, Ross F.
Journal of Communication, 26, 2, 155-164 Spr 1976
Language: ENGLISH
Journal Announcement: CIJE1976
Evaluates seven studies concerned with the influence of Sesame Street on the development of learning skills in preschool children and provides a balance sheet of achievements, limitations and unanswered questions. (MH)
Descriptors: *Preschool Children; *Preschool Learning; *Educational Television; *Educational Assessment; Literature Reviews; Television Viewing; Summative Evaluation
Identifiers: *Media Effects; *Sesame Street

9 EJ138418 IR503326
ITV/ETV Evaluation: What We Should Expect
Williams, Frederick; Stanford, Monty C.
Educational Technology, 16, 5, 35-38 May 1976
Language: ENGLISH
Journal Announcement: CIJE1976
A look at the accumulation of generalizations about evaluation of instructional television and what information can be expected from those evaluations currently being carried out. (HB)
Descriptors: *Educational Television; *Evaluation; *Expectation; *Media Research; Formative Evaluation; Summative Evaluation

10 EJ136438 IR503102
Spaced, Massed, and Summary Treatments as Review Strategies for ITV Production
Coldevin, Gary O.
AV Communication Review, 23, 3, 289-304 F 1975
Language: ENGLISH
three review treatments were more effective than viewing the program without review segments. (Author/HB)
Descriptors: *Educational Television; *Production Techniques; *Summative Evaluation; *Educational Improvement; *Experiments

11 EJ105506 CE501937
Developing a Strategy for Adult Education via Mass Media
McElreath, Mark P.
Adult Education, 25, 1, 23-33 F 1974
Language: ENGLISH
Journal Announcement: CIJE1975
Formative and summative evaluations of two developmental stages of a television-based multi-media system are reviewed, indicating that a strategy for adult education via mass media should include nationally known personalities and extensive advertising, and that a feedback mechanism encouraging audience participation seems to improve effectiveness. (Author/AJ)
Descriptors: *Adult Education; *Daily Living Skills; Educational Research; *Educational Television; *Evaluation Needs; Formative Evaluation; Program Effectiveness; *Program Evaluation; Summative Evaluation

12 EJ079070 EM503393
Evaluating School Radio and Television: Some Problems and Methods
Bailey, K. V.
Educational Broadcasting International, 6, 1, 22-27 Mar 1973
Language: ENGLISH
Journal Announcement: CIJEABST
Descriptors: *Educational Television; *Program Evaluation; *Evaluation Methods; Educational Radio; Evaluation Criteria; Summative Evaluation

13 EJ079066 EM503389
Evaluation: The Need for Standards
Baker, Rex
Educational Broadcasting International, 6, 1, 3-4 Mar 1973
Language: ENGLISH
Journal Announcement: CIJEABST
Author examines uniformity in broadcast teaching and suggests that an objective criteria is needed in order to deal with problems of subjective evaluations. (HB)
Descriptors: *Educational Television; *Evaluation Criteria; *Evaluation Needs; Measurement Techniques; Summative Evaluation

14 EJ069730 AA514587
Analyzing Viewer Reactions to a Preschool Television Program
Miller, George Lee
Journal of Educational Research, 66, 4, 150-2 Dec 1972
Language: ENGLISH
Journal Announcement: CIJEABST
This report describes a technique which can be used to provide both formative and summative evaluation of television programs designed to promote educational development in 3-, 4-, and 5-year-old children. (Author)
Descriptors: Data Analysis; *Educational Television; *Evaluation Methods; Formative Evaluation; *Observation; *Preschool Children; *Responses; Summative Evaluation

15 EJ059153 AA512956
An Analysis of the Relative Efficacy of Advanced Organizers, Post Organizers, Interspersed Questions, and Combinations Thereof in Facilitating Learning and Retention from a Televised Lecture
Bertou, Patrick D.; And Others
Journal of Educational Research, 65, 7, 329-33 Mar 1972
Language: ENGLISH
Journal Announcement: CIJOCT72
Descriptors: *Educational Television; Grade 9; *Instructional Materials; *Learning; Lecture Method; Multiple Choice Tests; Program Effectiveness; *Retention (Psychology); *Summative Evaluation; Tables (Data)

16 ED243448 IR011060
A Guide for Evaluation of Broadcast Radio and Television in the Delivery of Informal Education. A Graduate Project.
Smith, James A.
Mar 1982 75p.; Master of Arts, University of Alaska, Fairbanks.
EDRS Price - MF01/PC03 Plus Postage.
Language: English
Document Type: THESIS (042); NON-CLASSROOM MATERIAL (055); TEST, QUESTIONNAIRE (160)
Geographic Source: U.S.; Alaska
Journal Announcement: RIESEP84
Target Audience: Practitioners
This guide focuses on appropriate techniques for the evaluation of electronic media educational programs. Such evaluation helps to provide the educator with the feedback that is missing whenever there is no direct contact with students, and also with information on the relative worth of an educational program. The four-part publication includes: (1) a statement of purpose and a description of radio and television as educational delivery systems with emphasis on their use by the Cooperative Extension Service; (2) a brief of several evaluations of educational television; (3) a practical approach to the evaluation of electronic media delivery of extension programs with a detailed discussion of each of the phases of evaluation, plus a section on implementing the evaluation; and (4) a summary of evaluation as applied to electronic media with a checklist to serve as a guide to the evaluator. Appendices contain sample forms and examples of evaluation reports. Thirty-six references are listed.(Author/LMM)
Descriptors: Data Analysis; *Delivery Systems; *Educational Radio; *Educational Television; Evaluation Criteria; *Evaluation Methods; Formative Evaluation; Literature Reviews; *Models; Program Evaluation; Questionnaires; Summative Evaluation
Identifiers: *Cooperative Extension Service; *Informal Education

17 ED228990 IR010661
Summative Evaluation of Let Me See An ITV Science Series for Grades 1 and 2.
Webb, Norman L.
Wisconsin Educational Communications Board, Madison.
20 Jul 1982 76p.
EDRS Price - MF01/PC04 Plus Postage.
Language: English
Document Type: EVALUATIVE REPORT (142); TEST, QUESTIONNAIRE (160)
Geographic Source: U.S.; Wisconsin
Journal Announcement: RIESEP83
The Let Me See television science series for grades one and two was evaluated to assess the cumulative learning of objectives over the 12 weeks the programs were aired, as well as the effects from instructional programs that had the series as a central focus. The series of 12 15-minute programs on topics from the physical sciences, biological science, and the earth sciences was aired over the Wisconsin Educational Television Network, beginning in January of 1982. Subjects were first and second graders in 48 classes which viewed the series and 11 classes which did not. All classes were given a 20-item multiple-choice test both before and after the series was aired. Teachers of both experimental classes and control classes completed a questionnaire. Results indicated that classes at both grade levels who used the series gained significantly more than did the control classes in pre-test/post-test gain. Also related to post-test scores was time spent on supporting activities, particularly pre-activities and related activities other than discussion and learning center activities. Teachers generally found the series to be educational. This report includes 14 tables displaying study results, and appendices which provide program objectives and evaluation instruments. (LMM)
Descriptors: Childrens Television; *Educational Television;

DIALOG File 1: ERIC - 66-85/Mar

Questionnaires; *Science Education; Summative Evaluation; *Teaching Guides
Identifiers: *Let Me See (Television Series)

18 ED224006 CS006935
Summative Evaluation of Reading for a Reason: A Reading Series for Grades 7 and 8.
Webb, Norman L.
Wisconsin Educational Communications Board, Madison.
29 Sep 1982 95p.
EDRS Price - MF01/PC04 Plus Postage.
Language: English
Document Type: EVALUATIVE REPORT (142)
Geographic Source: U.S.; Wisconsin
Journal Announcement: RIEMAY83
Government: State
A summative evaluation of the instructional television series "Reading for a Reason" was conducted during the spring of 1982 as part of the premier showing of the series over the Wisconsin Educational Television Network. The series consisted of eight programs designed to teach skills for content area reading to seventh and eighth grade students. Each program presented skills and techniques that could be used to get meaning and retain information from reading textbooks and other expository materials. The study involved over 1,300 students who were given a pretest and posttest, and over 60 teachers who completed questionnaires or supplied supplementary information. A version of the Solomon Four Group Design was used because this design makes it possible to determine the effects of testing. The tests were composed of three parts--a reading style inventory, a comprehension test of the TV series elements, and a reading comprehension test. Findings from the evaluation show that (1) students at grade 7 who had used the series reported using techniques that were conducive to effective reading more frequently than did the control group; (2) students at both grade levels learned statistically more about specific skills presented in the program than did the control group; and (3) taking into consideration the pretest scores, students in grade 7 who used the series scored significantly higher on the main idea reading scale. Teachers on the whole reported being satisfied with the series and gave the series and its manual a positive overall rating. (HOD)
Descriptors: *Content Area Reading; *Educational Television; Grade 7; Grade 8; Junior High Schools; *Program Evaluation; Reading Comprehension; *Reading Improvement; *Reading Programs; Reading Skills; Summative Evaluation; Teacher Attitudes
Identifiers: *Reading for a Reason; Wisconsin

19 ED218478# CE032843
Working Together: A Study of Cooperation among Producers,
Utilization of Scientific Knowledge.
1980 220p.; For related documents see CE 032 842 and ED 170 543.
Sponsoring Agency: National Inst. of Education (DHEW), Washington, D.C. Educational Equity Group. Compensatory Education Div.
Contract No.: 400-76-0096
Report No.: ISBN-0-87944-251-4; ISR-9005
Available from: Center for Research on Utilization of Scientific Knowledge, Institute for Social Research, The University of Michigan, Ann Arbor, MI 48106 ($12.00).
Document Not Available from EDRS.
Language: English
Document Type: NON-CLASSROOM MATERIAL (055); PROJECT DESCRIPTION (141)
Geographic Source: U.S.; Michigan
Journal Announcement: RIEDEC82
This case study is one element of the summative evaluation of "Freestyle," a television series on sex-role stereotyping and career awareness. The series was developed for fourth to sixth graders viewing it at home or at school. The goal of this study was to organize the history of the project so as to present transferable lessons to the planners and managers of future projects and also to generate theoretical insights for scholars of organizations whose products affect the culture. Separate chapters describe and analyze curriculum planning, pilot production, curriculum revision, and the series design and production. The report focuses on organizational characteristics and processes rather than on individuals. The concluding chapter summarizes information on three analytic questions about power and its consequences, which guided the investigation. The questions are who had power and why, how was power brought to bear in making decisions, and the implications of the foregoing for the form and content of the products produced by the consortium. (KC)
Descriptors: *Career Awareness; Case Studies; *Childrens Television; Curriculum Development; Educational Television; Instructional Materials; Intermediate Grades; Material Development; Power Structure; *Production Techniques; *Program Development; Program Effectiveness; Program Improvement; Programing (Broadcast); *Sex Fairness; Sex Role; Sex Stereotypes; Summative Evaluation; *Telecourses; Television Research
Identifiers: *Freestyle (Television Series)

20 ED218477# CE032842
An Evaluation of FREESTYLE, A Television Series to Reduce Sex-Role Stereotypes. Research Report Series, Institute for Social Research.
Johnston, Jerome; And Others
Michigan Univ., Ann Arbor. Center for Research on Utilization of Scientific Knowledge.

DIALOG File 1: ERIC - 66-85/Mar

Sponsoring Agency: National Inst. of Education (DHEW), Washington, D.C. Educational Equity Group. Compensatory Education Div.
Contract No.: 400-76-0096
Report No.: ISBN-0-87944-256-5; ISR-9008
Available from: Center for Research on Utilization of Scientific Knowledge, Institute for Social Research, The University of Michigan, Ann Arbor, MI 48106 ($14.00).
Document Not Available from EDRS.
Language: English
Document Type: EVALUATIVE REPORT (142)
Geographic Source: U.S.; Michigan
Journal Announcement: RIEDEC82

This study is the main element of the summative evaluation of "Freestyle," a television series on sex-role stereotyping and career awareness. The series was developed for fourth to sixth graders viewing it at home or at school and contains 13 half-hour episodes. In seven test sites across the country, 268 teachers used "Freestyle" in the classroom with more than 7,000 9-12-year-olds. After one semester of experience with "Freestyle," teachers were enthusiastic. Ninety-six percent recommended its use by other teachers; only four percent had serious reservations. When implemented under conditions of heavy viewing and extensive classroom discussion, "Freestyle" showed the ability to change a large number of beliefs and attitudes regarding sex-appropriate childhood behavior and adult job and family roles. It was less successful in influencing the children's own interests in nontraditional endeavors. With the exception of girls in leadership roles, it was not effective in changing beliefs and attitudes regarding childhood behavior skills. These are apparently too complex to be dealt with in a single television series and supporting classroom activities. The report also has chapters on the development of the "Freestyle" materials, station carriage, market ratings of the program, and the impact of mere viewing without supportive discussion. (KC)

Descriptors: *Attitude Change; *Career Awareness; *Childrens Television; Curriculum Development; Educational Television; Instructional Materials; Intermediate Grades; Material Development; Nontraditional Occupations; Outcomes of Education ; Production Techniques; *Program Effectiveness; Programing (Broadcast); *Sex Fairness; Sex Role; Sex Stereotypes; Summative Evaluation; *Telecourses; Television Research
Identifiers: *Freestyle (Television Series)

21 ED212379 PS012648
Pre-Reading and Pre-Science on "Sesame Street."
Flagg, Barbara N.; And Others
Harvard Univ., Cambridge, Mass. Center for Research in Children's Television.
Sep 1978 68p.
Sponsoring Agency: Children's Television Workshop, New York,
Geographic Source: U.S.; Massachusetts
Journal Announcement: RIEJUN82

In the ninth season of the television program, "Sesame Street," new pre-reading and pre-science segments were introduced to the show. This report evaluates these segments with regard to young children's visual attention and comprehension. The intent of the evaluation was to assess the effectiveness not only of individual segments but also of the production formats designed to meet pre-reading and pre-science curriculum goals. Twenty-one 4- and 5-year-old children of low-income, ethnically mixed families viewed 30 minutes of "Sesame Street" stimulus material. While each child watched the show, the child's eye movement path across the visual presentation was recorded. The children were questioned about the content of the segments before and after viewing the program. The pre-reading formats which were most effective in attention results were ones that used the segment characters in ways to attract attention to the print and to the process of reading from left to right. The pre-reading formats that were most effective in the comprehension results were ones that clearly linked the sounds with the symbols and the symbols with meaning. The pre-science segments presented appropriate scientific content, but their format designs were not effective in teaching the material. The information was not structured enough in the presentation for the children to comprehend the message. Descriptions of "Sesame Street" pre-reading and pre-science segments and researchers' reactions prior to data collection are provided in Appendix A. A copy of the letter sent to subjects' parents, and pretest and posttest data are included in Appendices B and C respectively. (Author/MP)

Descriptors: *Attention; Childrens Television; *Comprehension; *Educational Television; Eye Movements; Material Development; Prereading Experience; *Preschool Children; Pretests Posttests; Science Instruction; Summative Evaluation; Television Research; *Television Viewing
Identifiers: Format Recognition; *Sesame Street

22 ED206274 IR009530
Using Content Analysis as a Formative Technique in a Self-Correcting Production Process.
Jochums, Brenda L.
17 Apr 1981 32p.; Paper presented at the Annual Meeting of the American Educational Research Association (Los Angeles, CA, April 17, 1981). For a related document, see ED 176 799.
EDRS Price - MF01/PC02 Plus Postage.
Language: English
Document Type: RESEARCH REPORT (143); CONFERENCE PAPER (150)
Geographic Source: U.S.; Indiana
Journal Announcement: RIEJAN82

The research reported includes a profile of all sixty ThinkAbout programs with respect to demographic balance,

DIALOG File 1: ERIC - 66-85/Mar

5-stage content analysis which was integrated with other formative evaluation techniques in the three year ThinkAbout production process. Emphasis is given to the unique contribution of the content analysis data in comparison to other formative evaluation strategies. While the traditional ThinkAbout formative strategies provided information about possible changes within a specific product unit, the ThinkAbout content analysis system was devised to provide continuity of information, and to feed information forward to the development of future program units in the series, monitoring concept, and illuminating needs for changes or improvement. A list of 12 references is included. (Author/CHC)
Descriptors: *Content Analysis; *Data Collection; *Educational Television; *Evaluation Methods; *Formative Evaluation; Intermediate Grades; Sampling; Summative Evaluation; Tables (Data)
Identifiers: *ThinkAbout (Television Series)

ED206263 IR009380
Television in the Classroom: What the Research Says.
Newman, Joan A.
Washington Office of the State Superintendent of Public Instruction, Olympia. Div. of Instructional and Professional Services.
[1 Apr 1981 18p.
EDRS Price - MF01/PC01 Plus Postage.
Language: English
Document Type: REVIEW LITERATURE (070)
Geographic Source: U.S.; Washington
Journal Announcement: RIEJAN82
Government: State
This paper reviews the findings of research on the teaching effectiveness of both instructional and open broadcast television since 1968, pointing out that the presence of a mentor who shares in the viewing and discusses what is seen with the child is a critical factor in what a child will learn. Discussion is divided into research prior to 1975; recent research thrusts; characteristics of effective instructional television programs, viewing, and planning for teaching; the research production (formative evaluation) approach; related research into teaching design; research on the effects of commercial television; and the implications of research findings for teachers. Seven case studies are presented in chart form from a series of 15 examining the cognitive and attitudinal effects on students and teachers of using the Trade-offs instructional television series to teach economics in grades five and six. A bibliography of 37 items is divided into research prior to 1975, recent research thrusts, the Research Production Approach, and related research into teaching design. (CHC)
Descriptors: *Broadcast Television; Case Studies; *Cognitive Development; *Educational Television; History; Instructional

ED195658 CE026681
"What's The Difference." Final Report.
Hazzard, Ann; And Others
American Institutes for Research in the Behavioral Sciences, Cambridge, Mass.
[1978 77p.; Some pages will not reproduce well due to small, broken print. For related documents see ED 132 284, ED 138 786, and CE 026 680.
Sponsoring Agency: Office of Career Education (DHEW/OE), Washington, D.C.
Grant No.: G007703042
EDRS Price - MF01/PC04 Plus Postage.
Language: English
Document Type: PROJECT DESCRIPTION (141); EVALUATIVE REPORT (142)
Geographic Source: U.S.; Massachusetts
Journal Announcement: RIEMAY81
This final report describes development and evaluation of Feeling Free, a series of six half-hour television programs about disabled children. The introductory chapter offers background on the project, discusses difficulties involved in integrating career-related segments to satisfy funding grants by the Bureau of Education for the Handicapped and the Office of Career Education, and shows how the first program explores four or five themes (familiarity, approach, ability, ambition) and implies the fifth (accomplishment). Chapter 2 addresses three phases of evaluation: (1) pre-production--administration of Familiarity Index and viewing of selected segments from another television series, (2) formative--children's comments on preliminary segments and testing of sequences of segments for most effective reinforcement, and (3) proposed summative. (One summative evaluation report is available in ERIC--see note.) Chapter 3 discusses distribution and promotion activities. Chapter 4 makes recommendations for future efforts in producing and evaluating programs about mainstreaming and/or disabled adults. It suggests presenting disabled as children first, as people with handicap second, and broadening "different" to include obese, adopted, and non-English speaking children. Appendixes present reports of phases 1 and 2 of a University of California at Los Angeles summative evaluation: Pilot Study and Development and Standardization of Measures. (Two finalized measures are provided.) (YLB)
Descriptors: Career Education; Childhood Attitudes; *Children; *Childrens Television; *Disabilities; Educational Media; *Educational Television; Elementary Education; Formative Evaluation; Grade 3; Grade 4; *Mainstreaming; Material Development; Production Techniques; *Programing (Broadcast); Student Attitudes; Summative Evaluation
Identifiers: Education Amendments 1974; *Feeling Free

DIALOG File 1: ERIC - 66-85/Mar

ED183874 CE024467
Khan Du A Success Model through Television for the Career Education of Handicapped Children. Final Project Performance Report.
Boyd, Charles H.
KLRN - TV, Austin, Tex.
74p.; For related documents see ED 132 284 and ED 138 786.
Sponsoring Agency: Office of Career Education (DHEW/OE), Washington, D.C.
Bureau No.:554VH80001
Grant No.: G007702397
EDRS Price - MF01/PC03 Plus Postage.
Language: English
Document Type: PROJECT DESCRIPTION (141); EVALUATIVE REPORT (142)
Geographic Source: U.S.; Texas
Journal Announcement: RIEAUG80
The KHAN DU project developed television programs and accompanying printed materials combining three elements: (1) career education objectives targeted to both handicapped and non-handicapped children, (2) visual and dramatic elements designed primarily to interest the child viewer, and (3) handicapped children playing major roles and documentary segments of adults as role models. The pilot program and three other half-hour shows and guide materials were intended to improve self-esteem regarding career potential and attitude among handicapped persons. Formative evaluation to aid in program design was accomplished in three stages: subsequent to production of the pilot program, subsequent to production of the next program, and subsequent to revision of that program. Summative evaluation involved pilot testing of the KHAN DU videotape programs in two schools in the Austin, Texas area in grades 3, 4, and 5. Students were pre- and post-tested with a project-developed scale measuring self-esteem and information learned from the film. Through data analysis it was shown that the evaluation instrument was reliable and that handicapped children increased their self-concept through exposure to the shows. (Extensive project materials and evaluation data are appended.) (YLB)
Descriptors: Attitudes; Audiovisual Aids; *Audiovisual Instruction; Bias; *Career Education; Childrens Television; *Disabilities; *Educational Television; Elementary Secondary Education; Employment Opportunities; Formative Evaluation; Guides; *Program Effectiveness; *Programing (Broadcast); Self Concept; Self Esteem; Summative Evaluation; Test Reliability; Videotape Recordings
Identifiers: Education Amendments 1974; KHAN DU Project

ED176799 IR007783
Assessing the Content of Instructional Television Programs
California, April 10, 1979)
EDRS Price - MF01/PC03 Plus Postage.
Language: English
Document Type: EVALUATIVE REPORT (142); CONFERENCE PAPER (150)
Geographic Source: U.S.
Journal Announcement: RIEFEB80
The development of content analysis instruments sensitive to the instructional, social, and value-laden content of a television series, was necessary because of formative evaluation needs to establish the congruity of the actual program content with the intended content and to assess the hidden curriculum. Because issues ranged widely, four content analysis instruments were constructed and the development of each is discussed. Four stages of content analysis methodology and use are (1) the identification of issues of concern, (2) determination of needed instrumentation, (3) construction and revision of the instruments and (4) data collection and reporting. Instrument development methodology is focused upon with an example of data and reporting for the Demographic Balance checklist. (Author)
Descriptors: Bibliographies; Checklists; *Content Analysis; Data Collection; *Educational Television; *Evaluation Methods; *Formative Evaluation; Intermediate Grades; Sampling; Summative Evaluation; Tables (Data)
Identifiers: ThinkAbout

ED162639 IR006588
Children's Television Workshop: The Electric Company. Final Report on a Television Reading Series.
Children's Television Workshop, New York, N.Y.
Jun 1978 83p.
Sponsoring Agency: Office of Education (DHEW), Washington, D.C.
Contract No.: 300-77-0027
EDRS Price - MF01/PC04 Plus Postage.
Language: English
Document Type: RESEARCH REPORT (143)
Geographic Source: U.S.; New York
Journal Announcement: RIEAPR79
The early development, prebroadcast research, early production concepts, formative research, summative research, evolution of production, and promotion and outreach activities of "The Electric Company" (TEC) are presented. Conclusions discuss (1) the uncertainty of the future of TEC despite its success and positive reception as an educational innovation; (2) some immediate questions regarding promotional activities, funding, valuable products, and teacher utilization; and (3) steps which have been taken to begin to answer these questions. A list of references is included. (CMV)
Descriptors: *Childrens Television; Educational Innovation; *Educational Television; Formative Evaluation; Outreach

DIALOG File 1: ERIC - 66-85/Mar

; *Summative Evaluation; *Television Research
Identifiers: *Electric Company

ED157033 CS004244
Summative Evaluation of Diagnostic and Prescriptive Reading Instruction, Spring, 1977 and Career Education in the Elementary School, Summer, 1977. Technical Report Number 17.
Perritt, Lea J.; Mertens, Donna M.
Appalachian Education Satellite Project, Lexington, Ky.
Nov 1977 114p.; Some parts of appendix are of marginal print quality
Sponsoring Agency: Appalachian Regional Commission, Washington, D.C.; National Inst. of Education (DHEW), Washington, D.C.
Contract No.: 76-100CO-3009A; 76-C2-0E-0226
EDRS Price - MF01/PC05 Plus Postage.
Language: ENGLISH
Document Type: RESEARCH REPORT (143)
Journal Announcement: RIEDEC78
Since 1974 the Appalachian Education Satellite Program, which is described in this report, has delivered graduate level teacher training courses in diagnostic and prescriptive reading and in career education to elementary and secondary teachers in remote areas of Appalachia. Evaluation of the courses has focused on determining how they affected participants' learning and attitudes, the effectiveness of the learning activities and methods of presentation, the reliability of the equipment, the overall course evaluations, and the way the results compare with the results of previous deliveries of the course. This report presents the results of the 1977 deliveries of the two types of courses to elementary teachers. For each course, it provides a course overview and lists topics and objectives for the individual programs in the course, discusses procedures and instruments used in the course evalaution, and presents the evaluation results. The report includes numerous tables and provides samples of such materials as attitude and background questionnaires, instructional activities rating forms, and equipment report and student satisfaction forms completed by teachers. (GW)
Descriptors: *Career Education; Course Descriptions; *Course Evaluation; *Diagnostic Teaching; *Educational Television; Elementary Secondary Education; Evaluation Methods; Higher Education; Measurement Instruments; Questionnaires; *Reading Instruction; *Teacher Education
Identifiers: *Appalachia

ED154797 IR005887
Broadcasting and the Open University Student.
Gallagher, Margaret
Open Univ., Walton, Bletchley, Bucks (England). Inst. of Educational Technology.
Journal Announcement: RIEOCT78
The purpose of this study, conducted in 1976, was to update and extend the 1974 survey entitled "Student Use of Open University Broadcasting" or the Bates Report. It was also intended to assist broadcast policy and planning decisions and to furnish individual course teams with summative evaluation data on student use of broadcasting. The report is divided into three major sections: (1) design of the survey including the sample, the questionnaire, and analysis and interpretation; (2) survey results including availability of audiovisual equipment, use of open forum broadcasts, viewing and listening on individual courses, and student views on the need for program repeats; and (3) factors affecting the use of broadcasting. Appendices are not included. (STS)
Descriptors: Educational Planning; *Educational Radio; Educational Technology; *Educational Television; *External Degree Programs; Higher Education; Mass Media; *Open Education ; Questionnaires; Student Attitudes; Summative Evaluation; *Surveys; *Use Studies
Identifiers: Open University (Great Britain)

ED148670 95 S0010548
Formative Evaluation Report on Music: A Guide to Classroom Use in Intermediate Grades.
Levine, Toby H.; And Others
Greater Washington Educational Telecommunications Association, Inc., Arlington, Va.; Levine Research Associates, Brookline, Mass.
May 1977 123p.; For a related document, see SO 010 274; Exhibits 1, 4, 14 may not reproduce clearly due to poor reproducibility of original document
Sponsoring Agency: Office of Education (DHEW), Washington, D.C.
Contract No.: 300-75-0273
EDRS Price - MF01/PC05 Plus Postage.
Language: ENGLISH
Document Type: RESEARCH REPORT (143)
Journal Announcement: RIEMAY78
The field testing project evaluated a guide to help 4th, 5th, and 6th grade teachers introduce students to musical concepts through a series of ten 30-minute television programs (see ED 143 596). The formative evaluation focused on the appropriateness of program materials for the intermediate grades, the ability of the curriculum to affect learner outcomes, and curriculum flexibility. Formal pilot testing took place in the public schools of Ann Arbor, Michigan, and Washington, D.C. Units and activities dealing with rhythm and form were preselected by researchers and time limits were imposed on teachers. The procedure involved giving a 10-minute test to students before and after exposure to the videotape lessons. Project administrators and on-site research assistants cooperated in pre- and posttesting and follow-up

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intermediate grades. Children were moderately successful to successful in understanding and distinguishing various forms and rhythms. The materials lent themselves to diverse uses. As a result of this study, the following activities are recommended: teacher training workshops, an audience awareness survey, and a summative evaluation. Included in the appendix are pre- and posttests, teacher feedback forms, and transcripts of interviews with teachers who participated in the field test. (Author/DB)

Descriptors: Behavioral Objectives; Concept Formation; Curriculum Development; *Curriculum Evaluation; Educational Television; Elementary Education; *Elementary School Curriculum; *Formative Evaluation; Grade 4; Grade 5; Grade 6; Intermediate Grades; Multimedia Instruction; *Music Activities ; Music Appreciation; *Music Education; Pretests Posttests; Tables (Data); Teacher Attitudes; Testing

ED143361 IR005138

31 **An Assessment of Parent Education and General Needs That Can Be Served by Educational Programming for Television. Executive Summary. G-98.**

Applied Management Sciences, Inc., Silver Spring, Md.

30 Apr 1977 106p.; Best copy available

Sponsoring Agency: Office of Education (DHEW), Washington, D.C. Div. of Educational Technology.

Contract No.: OE-300-76-0398

EDRS Price - MF01/PC05 Plus Postage.

Language: ENGLISH

Document Type: RESEARCH REPORT (143)

Journal Announcement: RIEJAN78

The objectives of this national survey were: (1) to order the priorities for educational programing, (2) to identify themes for the parent education television series, (3) to identify any demographic differences in perceived needs, and (4) to identify television programing preferences. Data were collected from three sources: (1) five focus group interviews with small groups in five cities, (2) 48 persons with professional viewpoints on public trends, and (3) a representative sample of 1300 American households. Recommendations based on the findings include: (1) five topics for planning educational programing (parenting and family life, economic/vocational skills and attitudes, health and nutrition, interpersonal relationships, values and morality); (2) planning should incorporate a massive promotional campaign, increased avenues for local involvement, and diverse types of people should be portrayed in normal, realistic situations; (3) decisions regarding target audiences should consider a younger, middle income group in the middle-educated range and a massive promotional campaign to attract such an audience; and (4) a survey should be conducted annually to match television programing to public needs. Demographic data, methodology, and a summary of responses to each survey

ED133079 PS009031

32 **CTW Research Bibliography. Research Papers Relating to the Children's Television Workshop and Its Experimental Educational Series: "Sesame Street" and "The Electric Company"--1968-76.**

Children's Television Workshop, New York, N.Y.

1976 23p.

Available from: Children's Television Workshop Library, One Lincoln Plaza, New York, New York 10023 ($1.00)

EDRS Price - MF01/PC01 Plus Postage.

Document Type: BIBLIOGRAPHY (131)

Journal Announcement: RIEMAY77

Target Audience: Practitioners

This selected annotated bibliography of research-related papers and reports covers major research activities in connection with the development of "Sesame Street" and "The Electric Company", the two experimental educational series produced by the Children's Television Workshop. These writings date back to the origins of CTW in 1968 and have been contributed by members of the CTW research and production staffs as well as by outside experts and institutions. References include formative and summative research studies for both series, research on the international versions of "Sesame Street", and other theoretical and scholarly discussions of research topics within the scope of media and children. (Author/SB)

Descriptors: *Annotated Bibliographies; Attention Span; *Childrens Television; Cognitive Development; *Early Childhood Education; Educational Television; Emotional Development; *Evaluation; Eye Movements; Formative Evaluation; Intelligence Quotient; Prosocial Behavior; Readiness; Research; Summative Evaluation; *Television Research

Identifiers: *Childrens Television Workshop NY; Electric Company; *Sesame Street

ED129331 IR004118

33 **Evaluation of Eight "Infinity Factory" Programs. Part II: Show-by-Show Analysis.**

Harvey, Francis A.; And Others

Education Development Center, Inc., Newton, Mass.

Jun 1976 82p.; For a related documents see IR 004 116-119

EDRS Price - MF01/PC04 Plus Postage.

Language: ENGLISH

Document Type: RESEARCH REPORT (143)

Journal Announcement: RIEFEB77

"Infinity Factory" is a television series which presents mathematics in a common-sense way to help children to understand the usefulness of mathematics in their own lives. The programs are for children ages 8 through 11, especially black and Latino children. Along with mathematics, the

eight programs and the series as a whole were evaluated. This report contains descriptions of each program and gives data on student attention, student appeal, teachers' opinions of the programs, and the number of kinds of related classroom activities. For each show the report presents: an abstract of its evaluation, a description of the show, a summary of evaluation procedures, and a discussion of the results of the evaluation. (JY)

Descriptors: Attention; Blacks; Black Students; Comprehension; *Educational Television; Elementary Education; *Elementary School Mathematics; Grade 3; Grade 4; Grade 5; Grade 6; Humanistic Education; Knowledge Level; *Mathematics Instruction; Media Research; Mexican Americans; *Minority Group Children; Motivation; Program Evaluation; Self Esteem; Spanish Americans; Spanish Culture; Student Attitudes; Summative Evaluation; Teacher Attitudes

Identifiers: *Infinity Factory; Latinos

ED129330 IR004117

31 **Evaluation of Eight "Infinity Factory" Programs; Part I: Analysis of the Eight-Show Series.**

Harvey, Francis A.; And Others

Education Development Center, Inc., Newton, Mass.

Jun 1976 61p.; For related documents see IR 004 116-119

EDRS Price - MF01/PC03 Plus Postage.

Language: ENGLISH

Document Type: RESEARCH REPORT (143)

Journal Announcement: RIEFEB77

The "Infinity Factory" television series was developed to help children ages 8 through 11 to understand the usefulness of some basic mathematics skills for everyday life. Aimed primarily at black and Latino children, the series concentrates on: the decimal number system; measurement, especially the metric system; estimation; mapping and scaling; and graphing. Throughout the series there is emphasis on creative problem solving techniques and on a positive student self-image. An evaluation of eight of the programs was conducted using 1,000 students and their teachers in 39 3rd-6th grade classes in four cities as subjects. The evaluation measured student attention, appeal of the overall programs and major segments of each program, student comprehension of story line and gains in math skills, attitudes toward math, social attitudes, and teachers' opinions of the effectiveness and usefulness of the series. This report gives a detailed analysis of the evaluation of the series taken as a whole. (JY)

Descriptors: Attention; Blacks; Black Students; Comprehension; *Educational Television; Elementary Education; *Elementary School Mathematics; Grade 3; Grade 4; Grade 5; Grade 6; Humanistic Education; Knowledge Level; *Mathematics Instruction; Media Research; Mexican Americans; *Minority Group Children; Motivation; Program Evaluation; Self Esteem;

ED129329 IR004116

35 **Evaluation of Eight "Infinity Factory" Programs. Executive Summary.**

Harvey, Francis A.; And Others

Education Development Center, Inc., Newton, Mass.

Jun 1976 18p.; For related documents, see IR 004 117-119

EDRS Price - MF01/PC01 Plus Postage.

Document Type: RESEARCH REPORT (143)

Journal Announcement: RIEFEB77

Target Audience: Practitioners

"Infinity Factory" is a television series which presents mathematics in a common-sense way to help children understand the usefulness of mathematics in their own lives. The 52-programs in the series are for children ages 8 through 11, especially black and Latino children. While covering decimal systems, measurement, estimation, mapping and scaling, graphing, and problem solving, the series also stresses positive self images for minority children and other humanistic goals. An evaluation study was conducted of eight programs, using over 1,000 students, grades 3-6, as subjects. The study examined the programs' effectiveness as a whole and individually. Results showed that the series was effective in imparting math knowledge, holding student attention, and that teachers considered the programs to be effective and useful. (JY)

Descriptors: Attention; Blacks; Black Students; Comprehension; *Educational Television; Elementary Education; *Elementary School Mathematics; Grade 3; Grade 4; Grade 5; Grade 6; Humanistic Education; Knowledge Level; *Mathematics Instruction; Media Research; Mexican Americans; *Minority Group Children; Motivation; Program Evaluation; Self Esteem; Spanish Americans; Spanish Culture; Student Attitudes; Summative Evaluation; Teacher Attitudes

Identifiers: *Infinity Factory; Latinos

ED126880 IR003793

36 **Research and Evaluation in Educational Television.**

Mielke, Keith W.

Stanford Univ., Calif. School of Education.

May 1973 49p.; Chapter 8 from "Educational Television: A Policy Critique and Guide for Developing Countries"

Sponsoring Agency: Ford Foundation, New York, N.Y.

EDRS Price - MF01/PC02 Plus Postage.

Language: ENGLISH

Document Type: BOOK (010)

Journal Announcement: RIEDEC76

A fundamental distinction is made between basic research which seeks out new, generalizable knowledge, and administrative research which provides information useful to decision makers who have a task to perform. Attention is then

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research. A concluding series of questions and comments about a hypothetical educational -television program puts the separate research branches back into their natural interrelationships. (CH)
Descriptors: Administrator Evaluation; Communications; Decision Making; *Educational Television; *Evaluation; Evaluation Methods; Formative Evaluation; Media Research; Performance Criteria; Problem Solving; Program Evaluation; Research; *Research Criteria; Research Methodology; Summative Evaluation; *Television Research
Identifiers: Administrative Research

ED123319 UD016034
37 **On Meeting Real People: An Evaluation Report on Vegetable Soup: The Effects of a Multi-Ethnic Children's Television Series on Intergroup Attitudes of Children.**
Mays, Luberta; And Others
Aug 1975 227p.; Related documents are UD 016 035-036
Sponsoring Agency: New York State Education Dept., Albany.
EDRS Price - MF01/PC10 Plus Postage.
Language: ENGLISH
Document Type: RESEARCH REPORT (143)
Journal Announcement: RIESEP76
A summative evaluation of a unique television experience for children is presented in this document. Vegetable Soup, a multi-ethnic television series, is designed to reduce the adverse effects of racial prejudice. A major focus of the program is to assist elementary school children in the development of genuine appreciation of members of all ethnic groups. The purpose of this research is to test the objectives of the program in order to determine the effect on attitudes of those children who viewed the programs compared to children who did not. A posttest-only design is used to examine the differences between the two groups. Sixteen programs are shown only to the experimental group and results are based on information gathered from spontaneous responses made by children while viewing the program and by responses to the instrument designed to test the objectives of the series. In conducting the evaluation, the focus is on four specific questions which encompass most of the stated objectives of the program. It is generally concluded that the program succeeds in affecting intergroup attitudes of children who view the show, but that this does not apply consistently over all of the racial/ethnic groups on which the study focuses. An interpretation of the results as well as a discussion of reactions to major segments of the shows and recommendations with reference to content and presentation for future T.V. productions for children, are included. (Author/AM)
Descriptors: *Affective Objectives; Attitude Change; *Childhood Attitudes; Children; Childrens Games; *Childrens Television; Cultural Awareness; Cultural Exchange; Cultural Images; Cultural Isolation; *Educational Television;
Identifiers: *Vegetable Soup Television Program

ED121385 JC760227
38 **Evaluation of Television Offerings, Fall 1975.**
Quanty, Michael
Johnson County Community Coll., Overland Park, Kans.
Mar 1976 22p.
EDRS Price - MF01/PC01 Plus Postage.
Language: ENGLISH
Document Type: RESEARCH REPORT (143)
Journal Announcement: RIEAUG76
This report summarizes results of a survey administered to Johnson County Community College (JCCC) students enrolled in two television courses, Classic Theatre, and The Ascent of Man, during fall 1975. Although questionnaires were mailed to 60 students in Classic Theatre and 121 in The Ascent of Man, usable responses were received from only 23 (38 percent) and 68 (56 percent) respectively. Females predominated in Classic Theatre (65 percent), and males in The Ascent of Man (76 percent). Classic Theatre had more students over 50 and fewer under 20 than the other course. The major source of information about the courses was a college bulletin. The two major reasons for taking the course were the three degree credits offered and general interest. Students were faithful about watching the television programs, but over 50 percent did not attend any of the seminars. Most students read the text at least once. Students responded overwhelmingly that the television presentations were effective. The consensus was that evenings are the most convenient time for television classes. Ninety percent of the students were interested in taking additional classes at JCCC. Many students (37 percent) critized the testing used in The Ascent of Man course. Survey responses are tabulated and the questionnaire is appended. (Author/NHM)
Descriptors: Community Colleges; *Educational Television; *Student Attitudes; Student Characteristics; Summative Evaluation; *Telecourses; Television Curriculum; *Two Year Colleges
Identifiers: Ascent of Man; Classic Theatre

ED120204 TM005163
39 **An Evaluation Report on Vegetable Soup: The Effects of a Multi-Ethnic Children's Television Series on Intergroup Attitudes of Children. Precis and Overview.**
Mays, Luberta; And Others
New York State Education Dept. , Albany. Bureau of Mass Communications.
Aug 1975 47p.
EDRS Price - MF01/PC02 Plus Postage.
Language: ENGLISH
Document Type: RESEARCH REPORT (143)

DIALOG File 1: ERIC - 66-85/Mar

Soup, a multi-ethnic children's television series designed to reduce and/or eliminate the adverse effects of racial isolation in elementary school students of white, black, Asian, Puerto Rican, Chicano, and Native American backgrounds. It was the purpose of the research to test the predetermined objectives of the programs in order to assess the effect of the programs in bringing about attitudinal change on the part of those children who viewed them, compared with those children who did not. Data was collected by these methods: recording verbal responses as children viewed programs, analyzing verbal responses in terms of educational gains, and administering a formal test by using an interview technique. Positive verbal responses, attainment of objectives, and significant difference in intergroup attitudes of viewers compared to non-viewers were strong indicators of program effectiveness. The series had an effect on all children who viewed it, although some of the measures showed greater gains for some children, particularly in the areas of acceptance or rejection of others. Spontaneous responses generally indicated feelings of warmth, understanding, sympathy, and empathy for children of other ethnic groups. (RC)

Descriptors: Affective Objectives; *Attitude Change; Attitude Measures; Childhood Attitudes; Comparative Analysis; Cultural Awareness; *Educational Television; Elementary Education; *Elementary School Students; Ethnic Groups; *Ethnic Relations; Intergroup Relations; Program Effectiveness; *Program Evaluation; Racial Attitudes; Summative Evaluation

Identifiers: *Vegetable Soup

ED119276 CS501264

The Nature of Inquiry and Analysis of Theoretical Progress in Instructional Television from 1950 - 1970.

Barbatsis, Gretchen Schoen

1975 41p.; Paper presented at the Annual Meeting of the Speech Communication Association (61st, Houston, December 27-30, 1975)

EDRS Price - MF01/PC02 Plus Postage.

Language: ENGLISH

Document Type: CONFERENCE PAPER (150)

Journal Announcement: RIEJUL76

The history of research concerned with the use of television for instruction has been replete with statistically non-significant and inconsistent results. Studies for almost two decades have focused on the comparative effectiveness of television with other mediums of teaching. The research focus of the Children's Television Workshop provided a contrast to the great bulk of the existing instructional television studies. This paper examines the two bodies of research from the point of view of theoretical progress achieved by two different approaches to scientific inquiry: summative and formative. Examination of the historical and research context indicates that the approach of summative research has been premature in the field of communication research regarding variables are yet to be discovered. (Author)

Descriptors: Communication (Thought Transfer); Educational Media; Educational Research; *Educational Television; *Formative Evaluation; Higher Education; Literature Reviews; *Summative Evaluation; *Television Research; *Theories

ED118141 95 IR003046

Summative Evaluation of Diagnostic and Prescriptive Reading Instruction K-6 Course, Spring, 1975. (Evaluation: DPRI 2).

Bramble, William J.; And Others

Appalachian Education Satellite Project, Lexington, Ky.

Sep 1975 135p.

Sponsoring Agency: National Inst. of Education (DHEW), Washington, D.C.

Report No.: AESP-TR-12

EDRS Price - MF01/PC06 Plus Postage.

Language: ENGLISH

Document Type: PROJECT DESCRIPTION (141)

Journal Announcement: RIEJUN76

An inservice educational television course, which offered individualized experience in diagnosing specific reading problems and in locating remedial materials, was beamed by communication satellite to 286 elementary school teachers in the Appalachian region. Course evaluation concluded that: (1) participants demonstrated a significant gain in the cognitive area; (2) participants preferred programs which balanced theory and practice; (3) participants scored a nonsignificant change in attitude; (4) site coordinators needed more training as facilitators; (5) a more efficient system of question relay and question screening should be utilized; (6) teacher-to-teacher exchange and field work were highly rated; (7) information retrieval systems would be utilized more frequently if the site coordinator possessed more training, the video program was improved, and the recommended materials were more accessible; (7) equipment performance was excellent; (8) participants considered the course experience valuable. Appendixes contain 25 tables and 4 illustrations, questionnaires, and evaluation forms. This was one of four Appalachian Education Satellite Projects. (NR)

Descriptors: Communications Satellites; Curriculum Development; Educational Media; *Educational Television; *Elementary School Teachers; Formative Evaluation; Information Needs; Information Systems; *Inservice Teacher Education; Programing (Broadcast); Questionnaires; *Reading Diagnosis; Reading Materials; *Rural Education; Teacher Education Curriculum

Identifiers: Appalachia; *Appalachian Education Satellite Project

DIALOG File 1: ERIC - 66-85/Mar

ED116690 IR002935
Quest into Matter. Final Report.
O'Bryan, K. G.; And Others
Ontario Educational Communications Authority, Toronto. Research and Planning Branch.
Dec 1975 25p.
EDRS Price - MF01/PC01 Plus Postage.
Language: ENGLISH
Document Type: PROJECT DESCRIPTION (141)
Journal Announcement: RIEMAY76
"Quest into Matter," produced by Ontario (Canada) Instructional Television, aimed to investigate the "heart of matter" at the college freshman level of chemistry. Specifically, its purpose was to demonstrate the relevance of "shape" in relation to the properties of matter from the molecular level to the galactic. Some 180 students enrolled in a first year chemistry course, and 17 freshman chemistry teachers took part in the evaluation of the program which involved responding to a set of questions after viewing the program. The students found the programs stimulating, informative, and neither boring or confusing. Most found the analogies in the program very or somewhat helpful in understanding the various properties of matter and very or somewhat relevant to their chemistry course. Teachers responded even more favorably than students. Over 90 percent found the program somewhat to very stimulating and neither boring nor confusing. Most teachers also found it very informative. Like the students, the teachers found the analogies very or somewhat helpful in understanding the various properties of matter and very or somewhat relevant to a first year chemistry course. They also preferred a combination of both the method used in the program and a conventional lecture-type method and stated they would like to see more programs of this type used in their classes. The findings suggest that programs like "Quest into Matter" would be readily welcomed as supplementary material to textbook information. (Author/HB)
Descriptors: Audiovisual Instruction; *Chemistry; *College Freshmen; Educational Media; *Educational Television; Evaluation; Higher Education; Media Research; Science Curriculum; *Science Instruction; Student Attitudes; *Summative Evaluation; Teacher Attitudes; *Telecourses
Identifiers: Canada; *Ontario Educ Communications Authority (Canada); Quest Into Matter

ED116635 95 IR002875
Summative Evaluation of Career Education in the Secondary School Course; Fall, 1974. Technical Report No. 11.
Maynard, Diane; And Others
Appalachian Education Satellite Project, Lexington, Ky.
Sep 1975 160p.
Report No.: AESP-TR-11
EDRS Price - MF01/PC07 Plus Postage.
Language: ENGLISH
Document Type: PROJECT DESCRIPTION (141)
Journal Announcement: RIEMAY76
A communication satellite was utilized as part of a 16 session career education course for secondary school teachers given at 15 sites throughout the Appalachian region. The conclusions reached were: (1) teachers preferred the sessions which presented examples of career education and were "how to do it" in format; (2) teachers preferred lab activities in which student interaction predominated; (3) teachers would use the CBRU (Computer Based Resource Units) and AIM/ARM (Abstracts of Instructional Media and Research Materials in Vocational Education) information systems if they were installed in their school systems but wanted more clarification of their usage; (4) teachers demonstrated significant gains in the cognitive area; (5) teachers indicated significant change in attitude towards career education; and (6) teachers indicated they are using more career education activities in their own classrooms. The appendixes include the names of the 35 participants, the lab activities, and various questionnaires used during the formative evaluation process. (NR)
Descriptors: Career Education; *Communications Satellites; Curriculum Development; Educational Media; *Educational Television; Experimental Programs; Formative Evaluation; Information Needs; *Inservice Teacher Education; Programing (Broadcast); Questionnaires; *Rural Education; *Secondary School Teachers; Teacher Education; Teacher Education Curriculum
Identifiers: Appalachia; *Appalachian Educational Satellite Program; Computer Based Resource Units, AIM ARM

ED115271 IR002816
Arts 100: Communications 1971-72.
Ontario Educational Communications Authority, Toronto. Research and Planning Branch.
1972 137p.; Papers and Reports Concerning Educational Communications Number 20 and 21; Not available in hard copy due to reproducibility of original document
EDRS Price - MF01 Plus Postage. PC Not Available from EDRS.
Language: ENGLISH
Document Type: PROJECT DESCRIPTION (141)
Journal Announcement: RIEAPR76
A communications course was developed as a multimedia course using supplementary learning resources, such as audiotape cassettes and a series of televised lectures. To obtain information about the appropriateness and effectiveness of the methodology of the course, the research and development branch of the Ontario Educational Communications Authority commissioned an evaluation study. Section 1 of this report presents the results of that evaluation. Section 2 of the report presents an evaluation of another followup course. The

DIALOG File 1: ERIC - 66-85/Mar

major results of the investigations conducted was to improve the courses for the following years and to recognize the need to continue the evaluation process. (HB)

Descriptors: *Communication (Thought Transfer); Communication Skills; *Course Evaluation; *Educational Television; Higher Education; *Multimedia Instruction; Summative Evaluation; Teaching Methods

Identifiers: Gordon (Donald); *Ontario Educ Communications Authority (Canada); University of Waterloo (Ontario)

ED095875 IR001057

Summative Evaluation of an Ongoing Cable Television (CATV) System in Our Fifty Elementary and Five Senior High Schools.

Cramer, R. H.

Shawnee Mission Public Schools, Kans.

May 1973 17p.

EDRS Price - MF01/PC01 Plus Postage.

Language: ENGLISH

Document Type: RESEARCH REPORT (143)

Journal Announcement: RIEJAN75

The results of evaluation of a cable television system in the Shawnee Mission Public Schools are provided in this report. The cable system is briefly described, and a breakdown by type of usage for junior high and high school courses is given. The personnel involved in the cable television system are described with an estimate of their time commitment. Finally, a teacher questionnaire and its results are presented. Many pages of this report may be difficult to read as they are hand-written. (WH)

Descriptors: *Cable Television; Dial Access Information Systems; *Educational Television; Elementary Education; Evaluation; Programing (Broadcast); *Questionnaires; Secondary Education; Summative Evaluation; Use Studies; Videotape Recordings

Identifiers: Kansas; *Shawnee Mission Public Schools KS

ED092089 88 IR000647

Carrascolendas: Evaluation of a Spanish/English Educational Television Series Within Region XIII. Final Report. Evaluation Component.

Van Wart, Geraldine

Education Service Center Region 13, Austin, Tex.

Jun 1974 234p.

Sponsoring Agency: Office of Education (DHEW), Washington, D.C.

Grant No.: OEG-0-9-530094-4239(280)

EDRS Price - MF01/PC10 Plus Postage.

Language: ENGLISH

Document Type: RESEARCH REPORT (143)

Journal Announcement: RIEOCT74

This fourth year evaluation reports the effects and usage of "Carrascolendas," a children's television series in Spanish and children; and a process evaluation of the Education Service Center Carrascolendas staff members. The field experiments consisted of viewer and nonviewer groups of Mexican-American children, grades K-3. Criterion referenced instruments designed in Spanish and English were administered which compared viewer and nonviewer scores. Combined viewers made a significant gain score increase in the Spanish areas of history, culture, and reading; and in the English areas of history, culture, and science. The content areas which had the least impact in Spanish and English were math and self-concept. Survey elicited attitudes indicate increased improvement in the use of Spanish and English by children and greater pride in the Mexican-American culture. Attitude items on which viewers made significant gains over nonviewers dealt with speaking Spanish and teacher approval of school work. The process evaluation summarizes activities and describes the services and interaction which were provided. (Author/WCM)

Descriptors: *Early Childhood Education; *Educational Television; Elementary Education; *Media Research; *Mexican Americans; Parent Attitudes; Personnel Evaluation; *Program Evaluation; Spanish Speaking; Student Attitudes; Summative Evaluation; Teacher Attitudes; Television Curriculum; Tests

Identifiers: *Carrascolendas (Television Series)

ED082536 EM011621

Decision-Oriented Research in School Television.

Mielke, Keith W.

Agency for Instructional Television, Bloomington, Ind.

27 Sep 1973 23p.

EDRS Price - MF01/PC01 Plus Postage.

Language: ENGLISH

Journal Announcement: RIEFEB74

A review of the contributions of evaluation to school television is presented, and some policy suggestions for evaluation programs are offered. The purpose is to assist the Agency for Instructional Television (AIT) in determining how to utilize evaluative research in conducting its projects and the focus is upon decision-making related to the production of television programs. Four categories of decision-oriented research are identified--background, formative, summative, and policy. Major recommendations include: 1) Each AIT activity should have a research and evaluation component; 2) AIT should focus upon decision-oriented and product-specific research and evaluation; 3) Background and in-house policy research should be an integral part of AIT; 4) Formative research should be conducted by an in-house staff and be organizationally subordinate to production; 5) Top priority for research resources should go to formative research; 6) Summative research, while necessary, is less important than formative research; 7) Utility to the decision-making process is the chief criterion by which research and evaluation is to be judged; 8) Summative research for outside consumption should be assigned to outside agencies; and 9) Original instruments

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research. (Author/PB)
Descriptors: Administrator Guides; *Decision Making; *Educational Television; *Evaluation; Formative Evaluation; Policy; *Policy Formation; Program Development; Program Evaluation; *Research Needs; Summative Evaluation
Identifiers: *Agency for Instructional Television

ED080185 PS006673
Home Start: School for Parents. Final Report.
Segal, Marilyn M.; Simco, Edward R.
Nova Univ., Fort Lauderdale, Fla.
[1972 64p.
Sponsoring Agency: Children's Bureau (DHEW), Washington, D.C.
EDRS Price - MF01/PC03 Plus Postage.
Language: ENGLISH
Journal Announcement: RIEDEC73
Home Start: School for Parents is a parent education program with three major components: a Prototype School for Parents, a pilot television series, and a Manual for Parents on the infancy period. The prototype school is evaluated in terms of its impact on parents and infants, the manual and the television shows in terms of audience response and expert opinion. The final report describes both the formative evaluation that led to the on-going program modifications, and the summative evaluation that attempted to measure the success of the program in terms of immediate objectives. The long term objective of the program - to provide children from all SES groups with a better home start - cannot as yet be assessed. (Author)
Descriptors: *Child Care; Child Rearing; Educational Television; Formative Evaluation; Guides; Infants; *Parent Education; Program Attitudes; *Program Evaluation; Questionnaires; Summative Evaluation

ED073670 EM010825
Televised Parent Training Program: Reinforcement Strategies for Mothers of Disadvantaged Children. Final Report.
Morreau, Lanny E.
Central Midwestern Regional Educational Lab., Inc., Minneapolis, Minn.
Dec 1972 79p.; See Also EM 010 826, EM 010 827, EM 010 828, EM 010 859
Sponsoring Agency: National Inst. of Education (DHEW), Washington, D.C.
Bureau No.:BR-1-0546
Grant No.: OEG-0-71-3624
EDRS Price - MF01/PC04 Plus Postage.
Language: ENGLISH
Journal Announcement: RIEJUL73
A program to train lower socio-economic parents in more effective management of their preschool children was developed [illegible] planning stage, objectives were developed and two evaluations produced and modified the prototype materials. In the final phase, the summative development and evaluation, the production and limited "field test" of the completed materials was carried out with twenty-one subjects. The results were that the programing models for the text and video-taped simulations were effective as demonstrated by the parents' successful completion of the materials, a significant increase in the parents' ability to select correct procedural statements related to behavioral management after exposure to the program, the parents' successfully written applications of the principles of behavioral management to the behaviors of their children, and the parents' receptivity to both the programed materials and their contents. (WH)
Descriptors: Behavioral Objectives; Behavior Change; *Disadvantaged Youth; Early Experience; *Educational Television; Formative Evaluation; Lower Class Parents; Mothers; Parent Child Relationship; *Parent Education; *Positive Reinforcement; Preschool Children; *Programed Instruction; Program Evaluation; Social Environment; Summative Evaluation; Training Methods; Videotape Recordings
Identifiers: Teaching Your Child

ED073178 TM002433
Reading with Television: An Evaluation of The Electric Company. A Report to the Children's Television Workshop. Volumes 1 and 2.
Ball, Samuel; And Others
Children's Television Workshop, New York, N.Y.; Educational Testing Service, Princeton, N.J.
Feb 1973 200p.
EDRS Price - MF01/PC08 Plus Postage.
Language: ENGLISH
Journal Announcement: RIEJUN73
An evaluation of the first year of "The Electric Company" is provided. Volume 1 is comprised of the following chapters: I. Introduction; II. Preparing for the Evaluation (Research Design and Sampling Procedures; Field Operations; The Treatment--the in-school viewing treatment, the at-home viewing treatment, and the content of The Electric Company--Measuring Instruments: General Considerations, tests for Children, Parent Questionnaires, Teacher Questionnaires, Observations of the Classrooms, Attendance Records, Viewing Records, and Content Analysis; III. Results--The Questions to Be Asked; Description of the Sample; Analyses of the In-School Viewing Experiments; and Analyses of the At-Home Viewing Experiments; and IV. Summary and Conclusions--Summary of Project Activities; Summary of Results; Conclusions; and Future Research. Appendixes present: Goals of the Electric Company; Description of the Electric Battery and Sample Items; Pretest Parent Questionnaire; Posttest Parent Questionnaire; Pretest Teacher Questionnaire; Posttest Teacher Questionnaire; Observation Form; Viewing Record; and Content Analysis. Seven abstracts are provided of the six viewing experiments and of

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the overview of significance levels of tests and subtests for the in-school experiments in Fresno and Youngstown. Volume 2 consists of 57 tables which provide the study data. (DB)

Descriptors: Educational Research; *Educational Television; Educational Testing; *Evaluation Methods; Grade 1; Grade 2; Grade 3; Grade 4; *Measurement Instruments; Pretesting; Pretests Posttests; *Program Evaluation; Questionnaires; *Reading Instruction; Research Methodology; Statistical Analysis; Summative Evaluation; Tables (Data); Tests

Identifiers: *Electric Company

ED062024 PS005634

Summative Evaluation of the Appalachia Preschool Education Program.

Bertram, Charles L.; And Others
Appalachia Educational Lab., Charleston, W. Va.
Dec 1971 50p.; Summary report
Bureau No.:BR-6-2909
EDRS Price - MF01/PC02 Plus Postage.
Language: ENGLISH
Journal Announcement: RIEAUG72

A report of the findings from the three-year field test of the Appalachia Preschool Education Program (APEP), an early childhood education program, is presented. The report describes the human and fiscal effort required to operate the program and the changes in the performances of children resulting from the use of the program. It also contains a description of the target population for the program. Findings include: (1) Scores on a test of cognitive objectives favored children who received the Appalachia Preschool Education Program; (2) A trend toward increased language development was observed for APEP children as opposed to children comparison groups; (3) Children who participated in the program scored significantly higher than comparison groups in psychomotor skills; (4) Children who participated in the mobile classroom activities gave indications of having developed more constructive social skills than children who received only the home visitor and television program; and (5) Children in the program reached significantly more cognitive objectives than children who received no treatment. (Author/CK)

Descriptors: Cognitive Objectives; *Comparative Analysis; *Early Childhood Education; Educational Finance; *Educational Programs; Educational Television; Field Studies; Home Visits; Individual Development; Interpersonal Competence; Kindergarten Children; Language Acquisition; Mobile Classrooms; Preschool Children; *Preschool Education; *Program Evaluation; Psychomotor Skills; Task Performance; Testing; Test Results

Identifiers: *Appalachia Preschool Education Program

ED057914 PS005219

Sesame Street Summative Research: Some Implications for Education and Child Development.

Convention of the American Psychological Association, Washington, D.C., September 7, 1971
EDRS Price - MF01/PC01 Plus Postage.
Language: ENGLISH
Journal Announcement: RIEAPR72

In an effort to evaluate the effects of "Sesame Street", 943 3-, 4- and 5-year-olds, including disadvantaged children from the inner city, advantaged suburban children, children from rural areas, and disadvantaged Spanish-speaking children, were tested by adults from the children's own neighborhoods. Results indicate that: (1) the children who watched the most learned the most; (2) the skills that received the most time and attention on the program were, with some rare exceptions, the skills that were best learned; and (3) the program did not require adult supervision for the children to learn. The children viewing at home showed gains as great as, and sometimes greater than, children who watched at school supervised by the teacher. Various disadvantaged groups made as much progress as advantaged children in learning from television. Measuring techniques developed for the study proved especially valuable when combined with the services of coordinators and testers who lived in the communities being tested. (MK)

Descriptors: *Broadcast Television; Disadvantaged Youth; *Educational Television; Ethnic Groups; Middle Class; Nursery Schools; *Preschool Children; *Preschool Learning; *Summative Evaluation; Teacher Attitudes; Television Viewing; Tests

Identifiers: Sesame Street

ED053197 TM000728

Summative Research of Sesame Street: Implications for the Study of Preschool-Aged Children.

Ball, Samuel; Bogatz, Gerry Ann
Educational Testing Service, Princeton, N.J.
1971 27p.
EDRS Price - MF01/PC02 Plus Postage.
Language: ENGLISH
Journal Announcement: RIENOV71

Sixty-six goals, mostly involving symbolic representation and cognitive processes, were evaluated to indicate those aspects of the summative research on Sesame Street that were bases for generalizing about research into the development of preschoolers. Unintended and intended outcomes were investigated as well as the program's effectiveness for various groups of preschoolers. (MS)

Descriptors: Behavioral Objectives; Child Development; *Cognitive Processes; Data Collection; *Disadvantaged Youth; Early Childhood Education; Educational Television; Interaction; Measurement; *Preschool Children; Pretesting; Pretests Posttests; Research Methodology; *Summative Evaluation; *Symbolic Learning; Testing

Identifiers: *Sesame Street

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ED041627 PS003276

Statement of the Instructional Goals for Children's Television Workshop.

Children's Television Workshop, New York, N.Y.
31 Dec 1968 11p.
EDRS Price - MF01/PC01 Plus Postage.
Language: ENGLISH
Journal Announcement: RIEDEC70

Children's Television Workshop (CTW) is an experiment in the instruction of preschool children through the medium of broadcast television. This document, which incorporates, extends, and supersedes an earlier report of a meeting to establish priorities among goals for CTW, serves six related purposes: (1) it attempts to reflect the suggestions of the many consultants to the project; (2) it provides a framework for organizing the project's goals; (3) it proposes priority objectives toward which the CTW experiment should be especially directed; (4) it provides specific operational examples of goals; (5) it serves as a common reference for the production and summative evaluation phases of the project; and (6) it communicates with the project's sponsors, advisors, and consultants, as well as the general public. The goals of the project fall into the overlapping categories of Symbolic Representation (letters, numbers, geometric forms), Reasoning and Problem Solving, and Familiarity with the Physical and Social Environment. Specific goals are extensively outlined within these categories and those which are considered the primary instructional objectives of CTW are marked with an asterisk. Evaluation of the project will be handled by Educational Testing Service. (MH)

Descriptors: Cognitive Processes; *Educational Objectives; *Educational Television; Perceptual Development; Physical Environment; *Preschool Education; Problem Solving; *Program Evaluation; Social Environment; Symbolic Learning
Identifiers: *Sesame Street

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J D C STUPART

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HOW A CHILD LEARNS MATHEMATICS: A Survey of some Theories of Educational Psychology.

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How a child learns mathematics.

Contents

Introduction

The psychology of learning, and of learning mathematics in particular, has become an important body of knowledge for the mathematics educator. "New" psychologies have arisen from the so-called "New Mathematics" curricula. (e.g. the "Discovery Method"; stress on the structure of mathematics; use of apparatus to create concepts; early readiness; intuitive thinking; etc)

Learning psychology is, however, by no means a new phenomenon - Plato and Socrates both developed theories of teaching and learning, parts of which are still relevant and applicable today. Bruner, for example, believed that it is rarely something outside the learner that is discovered; a theory consistent with the Socratic view of discovery learning.

There seems to be a great deal of controversy and irreconcileable discrepancies in the currently acceptable theories of learning. Every successfully proposed thesis seems to have its antithesis - for example, we have behaviorists vs mentalists ; connectionists vs Gestalt theorists; neo-behaviorist vs cognitive psychologists etc. It is one of the major objectives of this study to examine current learning theories, and to attempt to identify points of common agreement, as well as to point out the major differences.

A Summary of Some of the Current Learning Theories.

a: Jean Piaget

Piaget was a man of many diverse talents. He was an epistemologist, logician, biologist and developmental psychologist. He first became interested in the problems of cognitive development while analysing errors found in a series of intelligence tests, noting that there was a consistency between the age of the child being tested and the type of error.

It is important to note that Piaget has written little specifically directed at the problems of education. He repeatedly disavowed any expertise in the field of pedagogics, and yet his work, largely through

the interpretation of men such as J Bruner, has become essential reading in the field of educational psychology.

Piagetian Stages of Cognitive Development.

Piaget views the child as a developing organism passing through biologically determined cognitive stages. These stages are more or less age related although wide variations in cultures or environments will yield differences in the rate of development. Teachers must therefore always be aware of the fact that a child's understanding may be different from his, not solely due to knowing less "facts", but in a qualitatively different order of thinking.

(i) Sensory-Motor Stage of Development (Birth to 2 years)

The most important characteristic of this stage is that the child learns without the conceptual use of language. His cognitive structures (schemas/ schemata) are all dependant on his senses (sight, touch etc). The young child acts on his environment to make it understandable.

(ii) Pre-Operational Period (2 - 7 Years)

This period is usually regarded as a period of transition between the equilibrium achieved at the end of the sensory-motor period, and the higher order equilibrium achieved during the period of concrete operations. This period is characterized by the increase in internal representation of the environment through perceptual representation, through the development of language, through phantasy play and through imitation.

(iii) Period of Concrete Operations (7 - 11 Years)

During this period, a level of cognitive organisation is attained that is relatively stable. The child's ability to manipulate verbal concepts and relations remains very limited, however. The child must in fact, or in his imagination, refer his thinking to a concrete situation.

(iv) Period of Formal Operation (11 Years +)

This period ushers in the true adult mode of symbolic thinking. Thought becomes separated from the concrete, and can be carried out solely through the medium of symbols and verbal concepts.

It is important for the teacher to realise that simply because a child has reached adolescence, he is not necessarily thinking in formal-operational terms. Any learner (child or adult) may revert to concrete, or even to pre-operational modes of thinking on occasions.

There is nothing in Piaget's original theory to preclude the introduction of training procedures to accelerate the development from one stage to another. Piaget, however, adopts a conservative approach to this question, preferring to wait rather than to train. A great deal of inconclusive research has been performed in this field, and no definite conclusions have been reached. (Mermelstein 1967: Shulman p46 ; Sigel & Hooper; Smedslünd et al: Shulman p46)

Piaget's Theory of Cognitive Development

Fundamental to Piaget's theory is that cognitive development is an active process. The individual is constantly adapting to his environment. As experiences multiply, the child must organise these experiences to create some sort of order out of what is happening to him. This active organisation is in contrast to earlier behaviorist theories which primarily describe the child as being acted on by his environment.

The forces which determine cognitive development:

(i) Maturation - the development of the neural structures with age contributes to cognitive development, but alone is insufficient to explain the development of understanding.

(ii) Experience a. Random experience plays a role in the development of understanding, but the integration of the experience, the "making sense of it", remains unexplained.

b. Social transmission, both through general social intercourse and through the direct educational acts of adults is still not enough (according to Piaget) to explain the logical integration an ordered patterning of the individual's understanding of reality.

(iii) Equilibration

Some of the elements of understanding are acquired through the above factors, but these elements are unorganised, and often contradictory. This produces an uncomfortable state of cognitive conflict in the learner. Equilibration is the process whereby the learner actively re-organises his cognitive map so that logical consistency is achieved.

Piaget stresses that "facts" themselves are not the building blocks of understanding, but that the relationship between them is.

Processes of Learning:

According to Piaget, learning takes place through an active adaptation to the environment. This adaptation takes place through the processes of (i) assimilation and (ii) accommodation.

(i) Assimilation - the absorbtion and integration of a new experience into an existing schema. Sometimes several schemas have to be combined so that new experiences can be fitted in with the combination of schemas, where the new experiences could not be fitted into a single schema.

(ii) Accommodation - the process of modifying existing schemas so that they fit the realities of the new situation. Accommodation is an active process, involving exploration, questioning, experimenting and reflecting, and thus represents the core of developmental adaptation. Piaget sees cognitive growth as a series of states of cognitive disequilibrium followed by adaptation leading to new states of equilibrium. Since disequilibrium is uncomfortable, the learner seeks to accommodate to new situations through active modification of his existing schemas.

b. J S Bruner

Bruner was a faithful follower of Piaget, and was, in fact, initially the main agent in translating the general epistemological theories into a form relevant to education. The chapter in Bruner's "The Process of Education" entitled "Readiness for Learning" was ostensibly based on the works of Piaget. The largest single segment of that chapter was written by Piaget's chief collaborator, Barbel Inhelder. Great shock was therefore initiated by the opening of that chapter: "We begin by the hypothesis that any subject can be taught effectively in some intellectually honest form to any child at any stage of development." Bruner is saying that we must modify our ideas of readiness to include the subject-matter as well as the child. This is the greatest discrepancy between Piaget and Bruner. Piaget maintains that the cognitive structure is the determinant of what type and level of symbolic structure can be used. Bruner, on the other hand, maintains that the very structure of the symbolic systems are the determinants of the type and level of cognitive organisation that we can achieve.

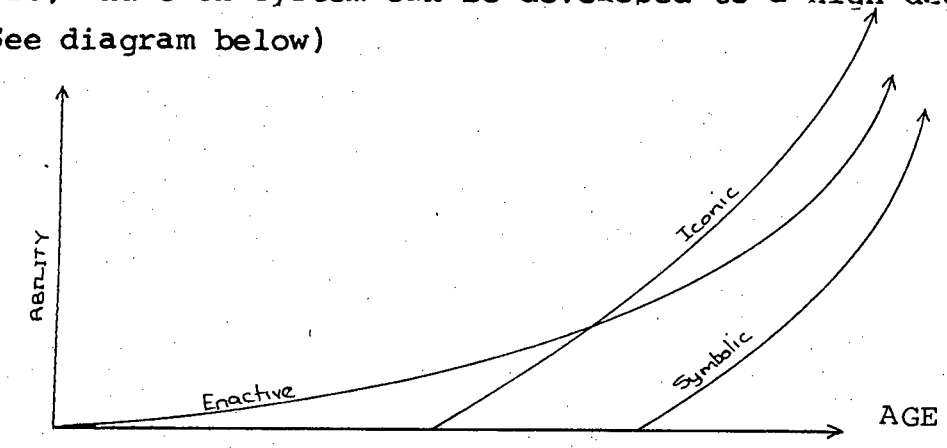
Bruner sees the following three systems as representative of all the possible ways that man can represent, condense and manipulate his environment.

(i) Enactive System - Motor action is the root of this system. Anything from using simple gestures to, for example, the motor skills of touch typing or ballet dancing. It is not a mental, but purely a motor process.

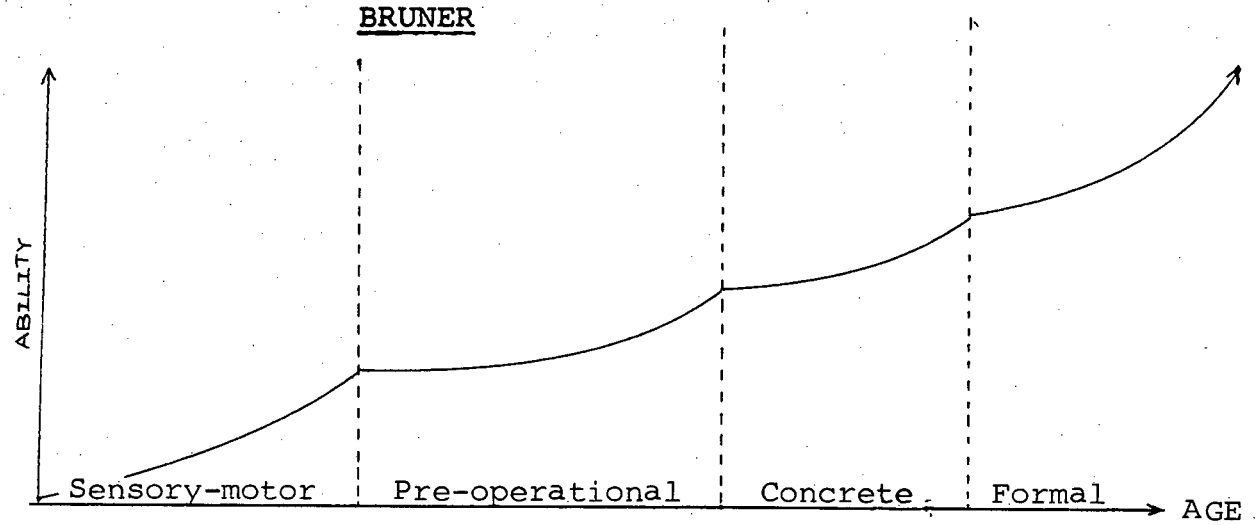
(ii) Iconic System - Perceptual images are the basis of this system. It includes anything from say, the mental image of "dog-ness" - a means of condensing or reflecting all dogs previously encountered, to creating a complex work of art. This system is a means of condensing and representing emotions and concepts through visual images, either real or imagined.

(iii) Symbolic System - Rationalized, communicable symbols are the basis of this system. Visual images are not required for understanding. Examples included in the symbolic system of understanding are the use of language, appreciation of music, understanding formal, logico-deductive mathematical systems etc.

Developmentally, the three stages appear in order in the life of the child (consistent with Piaget), but each system remains effective throughout life, and each system can be developed to a high degree of expertise. (See diagram below)



BRUNER



PIAGET

Bruner maintains that most subject matter to be learned can be represented through each of the three systems. Particular children, at their respective stage of development are going to understand more if the content is presented through the most relevant system for the particular individual.

Bruner is a strong advocate of learning by discovery. Provocative and leading questions should be used Socratically to elicit anY discovery. Bruner maintains that even if pupils are unable, initially, to find an exact "desired" solution to a problem, they will recognise certain important patterns or trends, and by so doing, desire to discover the underlying relevant rules.

Bruner almost always begins his examples on teaching with a focus on

the production and manipulation of concrete apparatus. The learner moves from the enactive through the iconic to the symbolic mode of representation of the problem.

Bruner's major work "The Process of Education", was written in 1959, after most of the mathematical innovations in education that used discovery as a core had begun. Bruner did not, therefore, initiate discovery learning. He did, however, manage to provide a theoretical foundation for discovery-based learning.

Bruner (like Piaget) stresses that the objectives of education are the kind of processes learned, rather than the subject matter products that the learner may acquire:

> The object is "to teach him (the learner) to participate in the process that makes possible the establishment of knowledge. We teach a subject not to produce little living libraries on that subject, but rather to get a student to think mathematically for himself, to consider matters as a historian does, to take part in the process of knowledge getting. Knowing is a process, not a product." (Bruner 1966,p17)

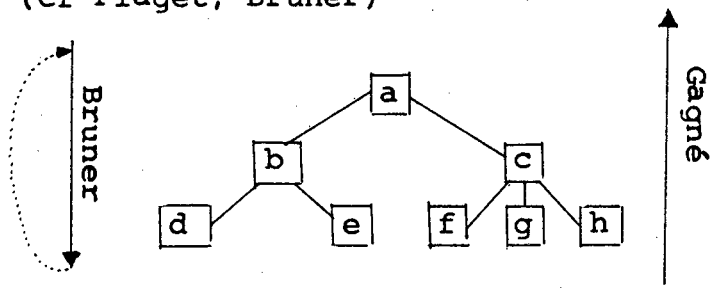
Bruner, like Piaget, believes in creating a state of "cognitive conflict" in the learner. For Bruner, the first step in discovery learning is sensed incogruity or contrast. He has always attempted to build these potential or emergent incogruities into his teaching examples. Bruner has the learner <u>begin</u> with a problem. He (the learner) is then guided back to form the necessary concepts and processes. He then derives the rules necessary for the solution of the problem. (cf Gagné, Ausubel, Polya)

c. <u>R M Gagné</u>

Gagné is in essential agreement with Bruner on the priority of processes over products as the end goal of learning mathematics. His emphasis is, however, not on teaching <u>general</u> strategies or heuristics of discovery; he is much more concerned with the teaching of rules or intellectual skills relevant to a particular domain. For Gagné, the objectives of instruction are intellectual skills or capabilities that can be specified in operational terms, can be task-analysed, and then can be taught.

Objectives must be clearly defined and stated before teaching can commence.

Gagné insists that the readiness for learning any topic in mathematics is strictly a function of the presence or absence of prerequisite learning. (cf Piaget, Bruner)



For example, in order to understand a, b and c must be understood, but to understand b, d and e must be understood, etc. For Gagné the highest level of learning involves problem-solving (a); lower levels (b,c etc) involve facts, concepts, principles, etc. For Gagné the appropriate instructional sequence is from the bottom up.

Referring to the same figure, for Bruner, the direction or sequence of instruction would be reversed. He has the learner <u>begin</u> with the problem-solving. The learner is then led back through the hierarchy to form the necessary associations and concepts, and finally is able to derive the means to solve the problem.

d. <u>D Ausubel</u>

Ausubel based his initial research on the fact that "discovery" learning had always been compared (favourably) with "rote learning".
Ausubel argued that there is a third type of learning, namely "meaningful verbal learning" which is superior to both discovery and rote learning.

Ausubel, like Gagné, emphasises the great importance of systematic, guided exposition in the learning process. The key is the careful sequencing of instructional experiences so that any unit taught is clearly related to those that precede it. It is the continuity between the learner's existing cognitive structure and the new material that makes the new material meaningful.

In sharp contrast to the views of Bruner, Ausubel sees no reason why problem-solving should precede the internalisation of new facts, concepts

or principles. Ausubel maintains that if the material can be meaningfully organised by the teacher, then the need for student discovery is removed and the process of learning is rendered far more efficient.

Ausubel's concept of the sequence of instruction reflects the positions of both Bruner and Gagné. Like Gagné, he supports a careful sequencing, a guided approach, but, like Bruner, he starts the sequence at a higher point on the hierarchy. Ausubel's introductory material is called an "advance organiser", which should be broad, and at a higher level of abstraction and generality than the new material to be learned, so that the organisers can subsume the new materials, and bridge the gap between the new material and the existing cognitive structure. Advance organisers seem to be most effective when students have little prior knowledge which can be used to organise or subsume the new materials to be learned. (Kühn and Novak, 1971) If the student has a useful conceptual structure that can be used to anchor the new material, then the advance organiser serves little purpose.

Like Gagné, Ausubel insists that readiness for learning is strictly a function of prerequisite knowledge. He states this point most succintly and unambigously in the frontispiece of his major work:

> "If I had to reduce all of educational psychology to one principle, I would say this: The most important single factor influencing learning is what the learner already knows. Ascertain this and teach him accordingly." (Ausubel,1968)

Ausubel had strong, and rather controversial views on the primary responsibilities of the school. The following two quotations follow without comment or qualitative judgement, as they appear to be quite clear in their statement of meaning and intent:

> "...We need to recognise that the primary and distinctive function of the school in our society is not to promote mental health and personality development, but to foster intellectual growth and the assimilation of knowledge... the school's role in intellectual development...is incontrovertibly primary" (Ausubel,1968,pp411,412)

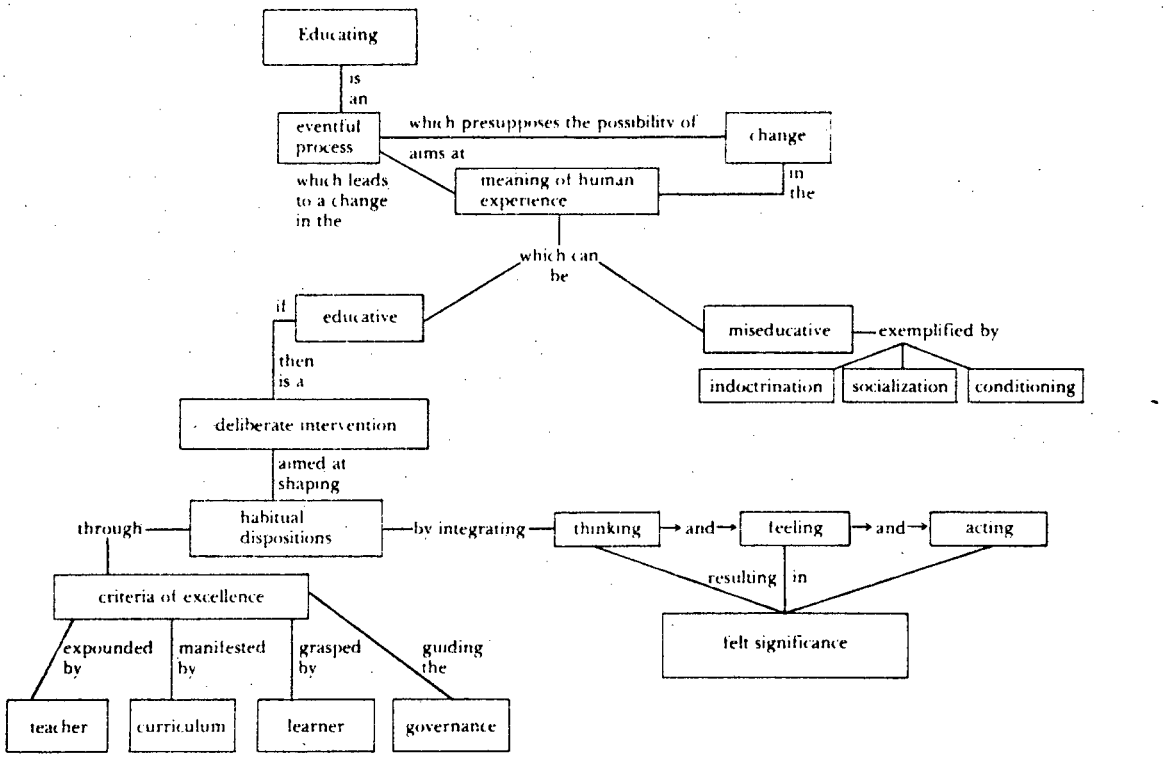
> "It may be argued with much justification, of course, that the school is also concerned with developing the student's ability to use acquired knowledge in solving particular problems, that is, with his ability to think systematically, independently and critically in various fields of enquiry. But this function of the school, although constituting a legitimate objective of education in its own right, is less central than its transmission - of - knowledge function in terms of the amount of time that can reasonably be allotted to it, in terms of the objectives of education in a democratic society, and in terms of what can reasonably be expected of most students..." (Ausubel,1968;p 23)

These views contrast sharply with those held by Bruner particularly, and in fact with the views of most current educational psychologists. Gagné, too, is opposed to this aim of education, and considers the acquisition of problem - solving ability and strategies to be the primary aim of schooling.

It is largely through the later work of researchers such as Gowan and Novak that the theories proposed by Ausubel become more powerful and complete. They identified "meaning" as the central concept in Ausubel's cognitive theory. Gowan sums up by stating that "educating is changing the meaning of human experience", and Ausubel himself amplifies this statement by adding "concepts are the vehicles of meaning."

This stress on concepts has led to the development of "concept maps" - two dimensional representations of relationships between concepts expressed simply as hierarchical arrangements of concept labels and linking words. (see the figure below - Gowan's map for "educating")

Gowan's concept map



e. R R Skemp

Like Ausubel, Skemp stresses the learning of concepts. He states the following under the heading "Principles of Learning Mathematics":

> "(1) Concepts of a higher order than those which a person already has cannot be communicated to him by a definition, but only by arranging for him to encounter a suitable collection of examples.
>
> (2) Since in mathematics these examples are almost invariably other concepts, it first must be ensured that these are already formed in the mind of the learner." (Skemp,1971;p 32)

Like Ausubel and Gagné, Skemp stresses above that the presence or absence of prerequisite learning is vital for further learning.

Like Piaget, Bruner, Bartlett, etc, Skemp sees understanding in terms of adaptation of schema : "to understand something means to assimilate it into an appropriate schema. " (Skemp,1971)

In accordance with Ausubel, Skemp is not a convinced follower of the "discovery learning" school. He states

> "Conceptual thinking confers on the user great power to adapt his behaviour to the environment, and to shape his environment to suit his own requirements...we hardly realize the enormous advantage of <u>not</u> having to do something in order to discover whether it is the best thing to do!... The power of <u>concepts</u> also comes from their ability to combine and relate many different experiences, and classes of experience. The <u>more</u> <u>abstract</u> the concepts, the greater the power to do this. ... A set of facts can be used only in the circumstances where they belong: whereas an appropriate theory enables us to explain, predict and control a great number of particular events in the classes which it relates." (Skemp,1971 p30)

The essential same sentiments are expressed for mathematics learning in particular:

> "The particular problem (but also the power) of mathematics lies in its great abstraction and generality, achieved by successive generations of particularly intelligent individuals each of whom has been abstracting from, or generalising concepts of earlier generations. The present - day learner has to process <u>not</u> raw data, but the data - processing <u>systems</u> of existing mathematics." (Skemp 1971,p 31)

Skemp considers the above to be a great advantage, because the learner can learn in years ideas which took centuries to develop. He also recognises this as a hazard, because he maintains that mathematics cannot be learned directly from the environment. At best it makes the learner dependant on his teachers, at worst a lifelong fear and dislike of mathematics can result.

It is important to note from the above quotations that Skemp, like Bruner and Gagné stresses the priority of processes over products in the learning of mathematics.

In the following quotation, in which Skemp attempts to define the responsibility of the teacher, he shows that he is in general agreement with Piagetian developmental stages, but at the same time stresses prerequisite learning as a basis for readiness.

> "the teacher of mathematics has a triple task. He must fit the mathematical material to the state of development of the learner's mathematical schemas; he must also fit his manner of presentation to the modes of thinking (intuitive and concrete thinking only, or intuitive,concrete reasoning and also formal thinking) of which his pupils are capable; and finally he must be gradually increasing their analytical abilities to the stage at which they no longer depent on him to pre - digest the material for them." (Skemp 1971, p 67)

The above is,of course,in strong agreement with Bruner's interpretation and didactical application of Piaget's general thesis.

Motivation for learning mathematics:
Skemp believes that it is no motivation for children to show "the obvious uses in the natural sciences etc" . He maintains that mathematics should be "made a pleasureable and worthwhile activity in itself, regardless of the other goals it may serve." Skemp believes that the major strides that have been made in mathematics, as well as in the other sciences, have resulted from "the quest for knowledge for its own sake." (Skemp 1971)

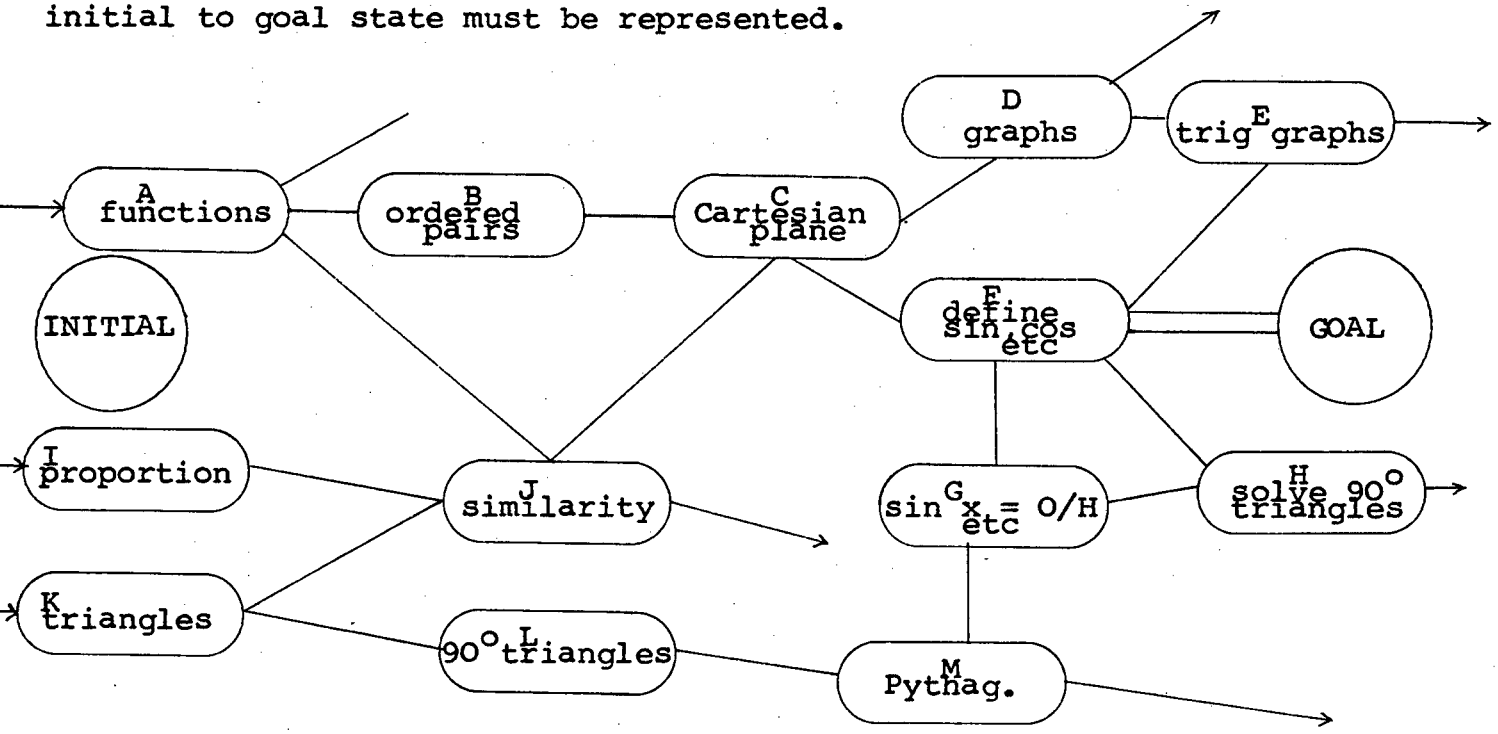
> "A tendency towards mental growth is an intrinsic quality of a schema. That we obtain pleasure from any activities which are favourable to their growth is the most powerful incentive to learning." (Skemp 1971, p 135)

The above quotation is precisely a statement of Piaget's theory, namely that the main motivation for learning in general is the creation of a state of cognitive equilibrium.

Understanding.
Skemp sees understanding exactly as does Piaget, namely that "...to understand something means to assimilate it into an appropriate schema." (Skemp 1971, p 46)
Skemp,in common with several of the preceding theorists,considers learning to be an active process. For the most part,our actions are

not random,but are systematically directed towards bringing about goal states. We are able to achieve our goals by varying our actions accordingly. Skemp calls the system for doing this a "director system."

Skemp describes learning within the framework of the following systems:
A sensor system,which takes in information about the present state of the learning. Our senses are included in this system.
The learner needs a representation of the goal state,and a comparator, which compares goal and director states.
While changing from the present to the goal states,the operand passes through a number of intermediate states. This is to say that not only the goal state and the initial state,but also a number of paths from initial to goal state must be represented.



In the above diagram,which represents Skemp's "paths" from an initial to a goal state, the "traditional" path is usually L;M;G;F,a path which is restrictive, and allows no directed progress to,for example Trig graphs (E). Another path,which could lead to a more meaningful understanding is I;J;A;B;C;F, giving the trigonometric functions a meaningful internalisation in a more generalised manner.

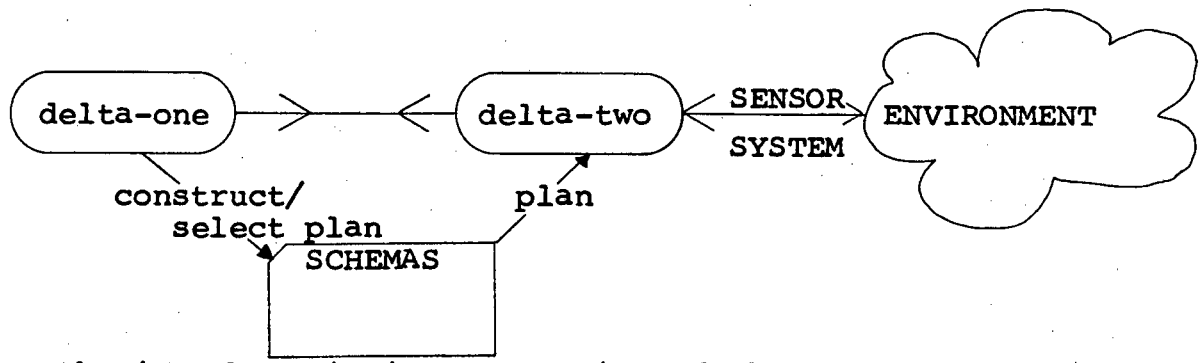
Skemp considers the director system system as being on two levels, namely: Delta-one is a director system whose operands are physical objects in the environment. Delta-two is a second-order director system which has Delta-one as its operand. Its function is to "take Delta-one to states in which Delta-one can do its job better." (Skemp 1980)

In Delta-one there has to be represented a path from the initial to the goal state. There is not,according to Skemp,much flexibility,and once off the path it is very difficult to regain it. It is therefore better to have a cognitive map,within which can be represented a variety of present and goal states,from which a great number of paths can be derived, from any present to any desired goal state,provided that both can be represented within the same map.

Skemp feels that intelligence contributes to adaptability in two way:
1. By the construction of the above cognitive maps - not just one,but a large number,for the "different kinds of job that delta - one does."
2. By deriving from these cognitive maps,particular plans appropriate to different initial and goal states. These plans can then be the basis of goal-directed action.

Skemp considers the schema (cf Piaget) as being "like a cognitive map only more so". A schema is a cognitive map in which each point (node) has "interiority" (i.e. the details are shown). Schemas provide the delta-one systems with models which are usable for many different situations, and from which a variety of plans can be derived as required. They are essential for the functioning of delta-one.

Constructing these schemas,and deriving from them plans for use in delta-one is the function of delta-two.



The author's schematic interpretation of the above.

f. C Gattegno

Gattegno begins his thesis by considering the highly complex learning carried out by a person as a young child,when there were no teachers or deliberate teaching. The "self" in that person does not change with advancing age,and Gattegno postulates that it is possible to re-create the learning potential in that person. Gattegno stresses that we (learners and teachers being one) must be aware of our "self",and indeed,must possess that most human characteristic of being "aware of our awareness".

Gattagno maintains that the accent of education should be learning,not knowledge.

> "It seems that knowledge cannot simply be entrusted to memory; everyone must produce in one's mind the equivalent of that knowledge and often replace it by a know-how." (Gattegno,1982)

"Knowing " is described as the aspect of the work of the self that leads it to the state of "owning the knowledge"."Knowing precedes knowledge and is needed to produce it." (Gattegno,1982)

By stressing knowing rather than knowledge,the individuality of the learner is recognised in its fullest sense,not by a simple re-arrangement of classroom furniture. The lesson planner is forced to examine the structure of his lessons to facilitate universal knowing.

Gattegno's theories are based on an initial activity-discovery approach. There is a very br d andgeneral guidance by the teacher,but "mistakes" are not critised or corrected - the learner must make the most of his mistakes. Mistakes should be considered as a positive part of the learning experience. There should be no feelings of guilt or failure associated with such "mistakes."

Concrete,tactile apparatus must be available,and it is from the "instruments" that the "language" could be generated.

> "...if the words and the notation come at the end of the process of becoming aware,the working mind sees as much truth in the overall involvement of the self with perception,action, virtual action,reference to experience translated into words a moment earlier,as it finds natural in all that is taking place." (Gattegno,1982)

Before designing a Gattegno-based learning encounter,it is essential for the teacher to ascertain what the learner already knows - and to facilitate education towards a mastery of "awareness".

David Wheeler, a follower of Gattegno,calls for a "humanisation" of mathematics education. "Humanising mathematics education is not to be confused with encouraging mathematics teachers to come on like warm accepting therapists." Wheeler states that "mathematics teaching often seems to generate fear and anxiety in children",and he hopes by humanising mathematics teaching (by making mathematics a part of everyday life) to eliminate the fear and anxiety. (Wheeler,1975)

Wheeler summarises some of the reasons for the need to humanise mathematics. He considers that because of the current explosion of knowledge,it is impossible to know all that is good to know. Each person must "define the boundaries of his own universe." Another reason for humanising education in general is that the schools of the world could contribute a great deal in healing the divisions between people. Finally he maintains that schooling can no longer mold children into an acceptable form, or even show children an acceptable model. This suggests that the practical "individualisation" of education is now a necessity.

Wheeler suggests three methods to facilitate the humanising of mathematics education:

1. The goal in mathematics education shoul be facilitating mathematical <u>activity</u> rather than passing on mathematical knowledge. Activity is personal,dynamic and implies involvement in one's own learning.

Rather than just any activity-based learning system,many of which have been tried and found wanting,Wheeler advocates mathematical activity which has "mathematisation" as the primary objective. We must move away from the mathematics of the past,and must stress,very strongly,the "process" over the "product." Mathematisation is,according to Wheeler "the ability to perceive relationships,to idealise them into purely mental material,and to operate on them mentally to produce new relationships." (A very similar concept to those of Piaget,Bruner,Skemp.) These processes can be derived from many,everyday,"non-mathematical" events and situations.

2. Teachers tend to present the body of knowledge of mathematics as a perfect,deductive,complete structure. Perhaps,according to Wheeler,it should be presented so that the learner sees the difficulties,dead-ends, and the frustrations of the original developers of the respective theories, who were "human" and prone to human errors and frustrations. The development of mathematics should be made a matter of everyday experience, and exposed "in the novel and the feature film rather the textbook and the documentary." (Wheeler,1975)

3. Educators must use "the lessons of awareness in order to educate children's awareness through the medium of mathematics."
Wheeler defines a definition (in mathematics) as "a formulation of an awareness." This concept would appear to be similar to the idea of a schema as proposed by Piaget,Bruner,etc.

Wheeler is in direct contrast to Skemp when he states:

> "Although it is usual to pick out generalisation as a highly significant feature of mathematical activity, it is possible to become aware that it is far less significant than the role of specialization." (Wheeler,1975)

g. G Polya

George Polya in his book "Mathematical Discovery" views the priority of school mathematics education as follows:

> "The first and foremost duty of a high school in teaching mathematics is to emphasize work in problem solving." (Polya,1962)

Polya states his "three principles of learning":
1. Active learning - Polya stresses (as do all the previous epistemologists) that learning is an active process,carried out by the learner. In learning, (problem-solving) one must add "the action of your own mind."

Polya (unlike Bruner,Skemp) is in favour of a discovery process carried out by the learner. His opinion is summed by the Eighteenth Century physicist,Lichtenburg:

> "What you have been obliged to discover by yourself leaves a path in your mind which you can use again

when the need arises."

It would seem that Skemp's "cognitive map" or the concept of a schema is not a new idea after all!

2. Best motivation - Polya's views are consistent with the views proposed by Skemp:

> "The interest of the material to be learned should be the best stimulus to learning and the pleasure of intensive mental activity should be the best reward for such activity."

3. Consecutive phases - Polya states his views using a quotation from Kant : "Thus all human cognition begins with intuitions,proceeds from them to conceptions,and ends with ideas."
Polya states: "Learning begins with action and perception,proceeds from thus to words and concepts,and should end in desirable mental habits."
This is surely not unlike the views of Gattegno/Wheeler,as well as Bruner?

Presented below are Polya's "Ten Commandments for Teaching",which could be considered a practical way of implementing many of the theoretical views expressed by the preceding authors:

1. Be interested in your subject.
2. Know your subject.
3. Know the ways of learning: The best way to learn anything is to discover it by yourself.
4. Try to read the faces of your students,try to see their expectations and difficulties,put yourself in their place.
5. Give them not only information,but 'know-how',attitudes of mind, the habit of methodical work.
6. Let them learn guessing.
7. Let them learn proving.
8. Look out for such features of a problem at hand as may be useful in solving problems to come - try to disclose the general pattern that lies behind the present concrete situation.

9. Do not give away your whole secret at once - let the students guess before you tell it - let them find out for themselves as much as is feasible.
10. Suggest it - do not force it down their throats.

The above "commandments" will now be examined in order to see which of the preceding theorists would approve of,and which would be against each "commandment".

	"FOR"	"AGAINST"
1.	All	None
2.	All	None
3.	Bruner, Gagné, Gattegno	Ausubel, (Skemp)
4.	Particularly Gattegno + all	None
5.	Gattegno, Bruner, Gagné, Skemp	Ausubel
6.	Bruner, Gattegno	?None
7.	Gagné, Bruner	Gattegno
8.	Bruner, Gagné, Skemp, Gattegno	None/?Ausubel
9.	Bruner, Gattegno	?Skemp
10.	Gattegno	?Ausubel

It is interesting to note the general agreement and concensus of the above,despite seemingly irreconcileable differences. Ausubel seems to be the furthest removed from the general concensus of the others.

/Table 1

PIAGET	BRUNER	GAGNÉ	SKEMP	AUSUBEL	GATTEGNO	POLYA
			READINESS FOR LEARNING			
Dependent on the age of the learner. His cognitive level.	Dependent on the structure of the symbolic system	A function of prerequisite learning.	Dependent on prerequisite learning & schemas.	A function of prerequisite learning.	To some extent dependent on pre-learned "know-how"	The presence of suitable problem-solving techniques.
LEARNING IS AN ACTIVE PROCESS PERFORMED BY THE LEARNER						
			METHOD OF LEARNING			
Disequililibrium-accommodation-equilibrium	Discovery - cognitive conflict-accommodation. Begin with problem-solving	Discovery - a structured hierarchy - no conflict. End goal is problem-solving	Guided discovery - creation of cognitive maps leading to goal.	No discovery - advance organiser-conflict-accommodation.	Active discovery-learning from learner, guided by teacher.	Discovery - problem-solving create methods common to other problems.
	ROTE LEARNING WILL NOT LEAD TO UNDERSTANDING					
			MOTIVATION			
A state of cognitive equilibrium	Mainly a reduction of cognitive conflict.	?	Mathematics a worthwhile activity in itself-pleasure in growth of schemas.	Ego-enhancement, genuine task-oriented interests	Seeing the pleasure in mathematical activities.	Satisfaction from "intense mental activity."
			ULTIMATE AIMS OF MATHS EDUCATION			
Not stated implicitly.	Understand processes-general strategies of discovery	Rules or intellectual skills relevant to a particular domain.	Lay a foundation of concepts on which the learner can build in any direction.	Mainly a transmission of knowledge.	"Mathematisation" aquiring "know-how", rather than knowledge.	The ability to solve problems.

Table 1

A Summary of the Various Theories.

Basic similarities and differences apparent in the preceding theories. (see Table 1)

1. Readiness for learning:

There seem to be two main schools of thought,namely that readiness is age-dependent (Piaget) and that readiness is a function of "what the learner already knows" (Gagné,Skemp,Ausubel). A third condition for readiness,unique to Bruner,is that readiness is dependant on the structure of the symbolic system to be learned.

It is felt that in fact all three theories are valid,and not mutually exclusive,and all must be considered when determining readiness for learning some new concept. It has been observed by,inter alia, K Hart,that mathematics learning is to a significant degree age-dependant. There is a need for "pure" abstract or symbolic thought modes in mathematics,which the young learner seems incapable of performing. In testing a small group of "gifted" children (Stupart 1983) aged nine and ten years,it was found that algebraic algorithmic manipulation was easily managed,but that they had no understanding of the underlying concepts (e.g. "variable"). The test group were merely treating the algebraic variables as objects - i.e. they were operating in a concrete mode.

In the South African school system,and particularly in the mathematics curriculum,there is too great an emphasis placed on abstract or "formal" mathematics at too early an age. This trend is particularly alarming in the syllabus for geometry,where in early adolescence (12 - 13) rigorous Euclidean proofs are introduced,usually with the complete exclusion of more informal,intuitive geometrical concepts. Section 6.4 of the "new" mathematics syllabus states under the heading "Euclidean Geometry":

"(i) The following must be treated as the framework of a mathematical system. Hence only axioms in logic and definitions,axioms and theorems that occur in this list may be used as reasons for statements in solving riders."

It would appear that all initiative and intuition must cease abruptly when passing to the junior secondary school!

The above,however,does not exclude the possibility of a younger learner understanding a concept such as a variable. The subject matter must be presented in such a way that the learner can operate in a concrete mode of thinking,the concrete concepts being either real or in the mind of the learner. This is precisely the theory of Bruner,who considers the structure of the symbolic system itself as being the most important factor in learning readiness.

It could be considered almost a truism that learning is dependant on what the learner already knows. Certain concepts are essential before progression to other new concepts. It would,for example be impossible to achieve an understanding of the concept "sine of an angle" without an understanding of "function","Cartesian plane","ratio",etc.
Many self-styled "educators" attempt to do this very thing,resulting in algorithmic,manipulative skill,with no real understanding of the underlying concepts.

In structuring a course in mathematics,therefore,the educator should carefully consider the following before the introduction of new concepts:

1. Are the learners capable of operating in say a purely formal mode?
2. The material should be structured to fit the most suitable mode of the learner.(e.g. Enactive,Iconic,Formal)
3. A careful analysis must be carried out into the required pre-requisite learning.

In general,therefore,the seeming discrepancies in the theories are in fact by no means mutually exclusive,and indeed,cogniscence should be made of all of them when planning the introduction of new concepts.

2. Learning is an active process:

All the preceding theorists are in agreement that learning is an active process performed by the learner,in order to make sense of his environment.

It is important to note that "active" refers to a mental,not necessarily a physical action on the learning material. Understanding is not

something "given" to the learner by the teacher. The learner actively creates his own understanding. The common "spoon feeding" techniques used by so many teachers are therefore a barrier to true conceptual understanding.

3. Method of learning (mathematics):

With the notable exception of Ausubel,and to a lesser extent Skemp, the theories agree that learning by discovery is the most desirable method of learning.

However,within the framework of discovery learning,there are variations. Bruner (based on Piaget) begins with the problem to be solved,creating a state of cognitive conflict in the learner,which he desires to reduce to a state of cognitive equilibrium. Gagné in particular,and less noticably Skemp,create no conflict situation in the learner,but present a carefully structured learning pattern,leading finally through concept-formation to the goal,viz problem-solving. Polya's views are also consistent with this model.

Gattegno and Wheeler,on the other hand,believe in a less structured method of discovery. The learner is encouraged to profit by his mistakes, and to be aware of the difficulties and pitfalls inherent in the problem. Ausubel,although opposed to discovery learning,believes in the use of his "advance organiser",which would create a state of conflict or disequilibrium in the learner. (Consistent with Piaget)

In presenting a new topic in mathematics,I would tend to use the concept of an "advance organiser",together with a discovery system similar to that proposed by Bruner. In other words,present the general problem, and let the learner discover the underlying concepts required for the solution of the problem. The language and terminology would only be introduced at a late stage in the discovery process. (Consistent with Gattegno)

For example,in teaching the graphs of the trigometric functions,the learner would begin the learning process with the general case, $f(x)=a \sin bx$ and $f(x)= a \cos bx$,and investigate the effects of the parameters a and b. The concepts "amplitude" and "period" would be assimilated into their cognitive maps,and finally the learner would understand the goal concepts,namely "waves","periodicity",and the behaviour of the trigonometric functions in general.

4. Rote learning will not lead to understanding:
The theorists under investigation are in unanimous agreement that rote learning will not lead to conceptual understanding. There is, perhaps,a place for rote-learning in "low-level" skills training; Bruner's "enactive" skills could conceivably be taught in this manner (e.g. touch typing),where little or no conceptual understanding is required. There is a place for some rote learning in school mathematics, but only after the necessary underlying concepts have been understood. (e.g. learning multiplication tables,but only after the concept of multiplication is understood,and has been assimilated.)
Unfortunately,in our school system,rote learning is often carried out almost to the exclusion of meaningful learning. On questioning several hundred high school students on their understanding of the concept "equation",it has become apparent to me that very few indeed had any understanding of the concept. They had all been taught the necessary algorithms for solving the equations,but had no idea of the meaning of their actions,or indeed of the significance of their results.

Having learnt "by heart" that the sine of an angle is "opposite over hypotneuse" etc,how can the learner fit this into the cognitive maps needed to,for example,draw the graph of $y = -7 \cos 3x$?

Possibly the worst examples of the results of rote learning in the South African are demonstrated by statements such as "two minuses make a plus" resulting in " $-5-3 = +8$",or is it the typical teacher advice: "learn your geometry theorems by tomorrow - in the exam you will get fifteen marks!" - alarming,but unfortunately common practice.

It is regrettable that the South African school learner is capable, not only of passing,but of obtaining very high marks in any external mathematics examination with little or no understanding of mathematics. By means of endless drill exercises certain algorithms are remembered, without any attempt being made by the teacher to facilitate an understanding of the relevant principles. Unfortunately this trend is also apparent at tertiary level.

It is only by freeing the system from the tyranny and threat of the external examiner,and by making the system (curriculum) more flexible, that a true understanding of mathematics may be achieved,and the anxiety attached to the subject removed.

The learner must learn to understand the "processes" not the "products" (Bruner),or,as Gattegno would say,he must gain "know-how" not "knowledge".

5. Motivation behind the learning of mathematics:
There seem to be two broad divisions in the theories behind the motivation for the learning of mathematics:
a. There is a pleasure in mental growth. Piaget and Bruner consider that the primary motivation for any learning activity is the introduction of a state of mental equilibrium following a state of "cognitive conflict". Skemp considers "the most powerful incentive to learning" to be the satisfaction of the natural tendency towards mental growth (of a schema.)

b. Mathematics is a worthwhile activity in itself:
This view is strongly expressed by Skemp,and to a lesser extent by Ausubel. Gattegno and Wheeler subscribe to this view - mathematics can be a pleasurable experience,but only if it is an integral part of human experience.

Once again,there is no dichotomy between these two motivational theories. A learner may (and I believe <u>does</u>) gain satisfaction from mental growth, which in fact leads <u>from</u> the pleasure derived from understanding the relationships and patterns in life - i.e. an understanding of mathematics for its own sake. I agree with Skemp,when he states that "it is no motivation for children to show the obvious uses in the natural sciences etc"

Punishment and reward are motivational factors,all too often used in the school situation. <u>Both</u> of these can create unhealthy levels of anxiety in the learner. These factors are extrinsic to the learner and to mathematics,and are therefore not as important as intrinsic motivation

i.e. an appreciation of mathematics for its own sake. Very often teacher response is a powerful motivational factor,but the learner soon realises that teachers can be pleased·by emitting some desired behaviour,often with little or no understanding of mathematics.

Ausubel maintains (correctly) that ego-enhancement is a powerful factor for motivation,but he does not state implicitly that in certain school societies this can be a powerful negatively motivational force. It is often the "swot" that is shunned, and the brash rugged student, who hates "maths,the teacher,the school...etc...etc" that is the leader of the school society. As Wheeler points out,what is needed is a popularisation and humanisation of mathematics (by "the novel..etc"), so that the subject becomes part of every person's reality.

In many South African schools,the motivation is supplied extrinsically by society in general,and by parents and teachers in particular. Statements such as "You can't do anything without maths" and "You need an 'A' for maths to be admitted to university" are commonplace,and are the greatest contributors to the fear and anxiety expressed by so many students. The teachers,and through them,the schools,should be less insistent on all learners attempting mathematics at its present level of formality and rigour.

6. The ultimate aims of mathematics education:
What change in the learner,or final state,does the educator desire to see after the implementation of a mathematics curriculum? This is a question of primary importance to all curriculum planners,and indeed to all teachers of mathematics.

The above theories seem to be unable to reach consensus on this point. Some of the major aims are:
a. Bruner - the learner must understand the processes not the products of mathematics. He must be aware of the general strategies of discovery. This view is shared to a large degree by Gattegno and his followers, and to a lesser degree by Skemp.
b. Gagné - rules or skills relevant to a particular domain must be learnt. This rather narrow aim would seem to be restrictive in future application to problem-solving,which Gagné considers the primary aim of

mathematics education. The ability to solve problems is,of course,the aim of Polya,who advocates the learning of general heuristic approaches to problem-solving.

c. Ausubel - sees education as a "transmission of knowledge" - a view in direct contradiction to that held by Gattegno in particular. Gattegno insists that "knowing" is more important than knowledge. The aim according to Ausubel is also contrary to the aims of Gagné and Bruner.

On close investigation of the South African mathematics curriculum, I find it very difficult to come to any conclusion as to the aim of the curriculum planners. If there is a conscious aim,it would seem to be the rote-learning of a series of algorithms to enable the learner to pass an examination. There is little or no evidence of a desire to teach an understanding of any underlying mathematical concepts or processes. The stress is at all time on the "products" of mathematics. There is certainly no attempt made to "humanise" mathematics,unless one considers the trite so-called "real-life" examples such as "if three men dig a ditch in five days...etc"

Perhaps it is time for a complete re-evaluation of our mathematics curriculum,starting with a clearly defined aim. The aim should be a worthwhile one,one which would contribute to a real,meaningful understanding of mathematics.

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A LEARNING HIERARCHY FOR THREE STANDARD TEN TOPICS

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University of Cape Town 1984

Submitted as part requirement for the Degree of
Master of Education.

Foreword

The following investigation and comment may be seen as a logical consequence of the preceeding essay "How a child learns Mathematics." The study is purely subjective, in which I have attempted to construct a practical guide for teachers, both in the Primary and Secondary schools, so that they may come to realise the essential continuity of the process of learning any topic in mathematics.

The study has also become a critique of the "new" Cape Mathematics Syllabus, which may act as a guide for future curriculum planning.

The study has been of great practical use to me (as head of a mathematics department) in planning future organisation of the teaching of the subject from Standard Six to Standard Ten. It has made me aware of the relative importance of various sections in the syllabi, and has shown that it is very often that the "key" concepts necessary for a meaningful understanding of sections that occur in Standard Ten are encountered in Standard Six or Standard Seven. This will be kept in mind when staff allocation is done in the future.

In short, I have found that the following study has become to a great extent, a summary of my personal views on the teaching of mathematics. It has been a valuable,enjoyable and rewarding experience for me.

J D C Stupart
May 1984

Contents

Introduction

> "If I had to reduce all of educational psychology to one principle, I would say this: The most important single factor influencing learning is what the learner already knows. Ascertain this and teach him accordingly." (Ausubel, 1968)

In accordance with many of the educational psychologists dealt with in the essay "How a Child Learns Mathematics" (J D C Stupart, 1984), I have attempted in the following investigation to determine the key concepts required for the understanding of three major sections of the Standard Ten mathematics syllabus. I have then attempted to trace a type of "concept map" (Gowan) back through the school years to the beginning of the Senior Primary stage.

Many teachers of high school mathematics tend to attempt to teach each section of the syllabus in isolation. I have attempted to show the complex inter-relationship between the concepts and processes learned throughout the learners' school carreer.

Another purpose of this investigation is to point out the considerable body of mathematical knowledge that a learner already has by the time he enters the secondary school. It is an unfortunate fact that very few secondary school teachers are aware of the learning carried out in the primary school.

In many schools, the less experienced, or less able teachers are very often assigned to the teaching of the junior classes (particularly Std 6 and 7). I hope to show that the mathematics learnt in these standards is fundamental to a meaningful understanding of concepts encountered in Std 10. Too many South African schools sacrifice true understanding and enjoyment of mathematics for the sake of "good" results in the final Std 10 examination.

The Standard Ten sections chosen for this study are important ones. These sections can, however, be badly taught, and hence be a cause of great anxiety and unhappiness for the learner. I have had considerable experience in teaching these topics, both at schools, and at adult level. The methods that I suggest "work" in practice.

The following investigation is, of necessity, subjective, and as far as I am aware, has not been carried out previously in this form

The syllabi from which I have extracted the information are the "new" syllabi for the Cape Province (1984). The senior secondary section of the syllabus was not yet published at the time of writing, all references being to the final draught copy, so some section references might conceivably be different in the final published version of the syllabus. I have not attempted to differentiate between material in the "core" syllabus, and that in the syllabus for the Cape Province.

Identification of the key concepts required for a meaningful understanding of differential calculus

Referring to the Cape Standard Ten mathematics syllabus, I feel that the concept to be fully understood is contained in section 6.2.2.2 i.e. Evaluation of $\lim_{h \to 0} \frac{f(x + h) - f(x)}{h}$

It is not so much an "evaluation" of this limit that is important, but an understanding of its significance.

For a meaningful understanding of the above, the following concepts must be internalised beforehand:

1. Limit

The above concept would be completely meaningless without a conceptual, meaningful understanding of the concept of a limit. Newton described the processes of calculus as the mathematics of infinitessimal changes, a concept which has to be linked with that of a limit. Without the concept of a limit, the above differential quotient would involve division by zero, which should suggest a meaningless answer to the learner.

2. Function

The concept of a function as a relationship between two variables must be meaningfully understood. The idea that one variable, the "dependent" variable changes as the other independent variable changes is fundamental. The f(x) = ... notation is required for the learner to make sense of the above quotient . It must be stressed that x and f(x) are numbers, and that a change in x causes a change in f(x).

3. Graphs on the Cartesian plane

The concept of a graph as a diagrammatical representation of all the ordered number pairs (x ; y) satisfying the requirement that a function be true is a concept that must be internalised. The idea of a gradient or slope of a graph being representive of the rate of change of the dependent variable with respect to the independent variable is the concept on which differential calculus is founded.

3. Graphs (contd)

The initial introduction to the idea of differentiation as a process for determining the slope of a graph at a given point is, of course completely meaningless without a meaningful understanding of the concept of the graph. (See fig 1)

4. Ratio

The gradient of any curve is a ratio of a change in one variable with respect to another variable. The concept of "rate" is meaningless without a full understanding of the concept of a ratio. The very notation for differentiation, viz. $\frac{dy}{dx}$ is of course a ratio between two quantities.

In the following section I have attempted to trace the formation of the above four concepts through the senior secondary, junior secondary and senior primary Cape mathematics syllabi.

An attempt has also been made to identify the concepts required in order to facilitate the understanding of the above concepts, as well as identifying the concepts necessary for an understanding and ability to carry out the required applications of differential calculus prescribed in the Standard Ten syllabus. (Higher Grade)

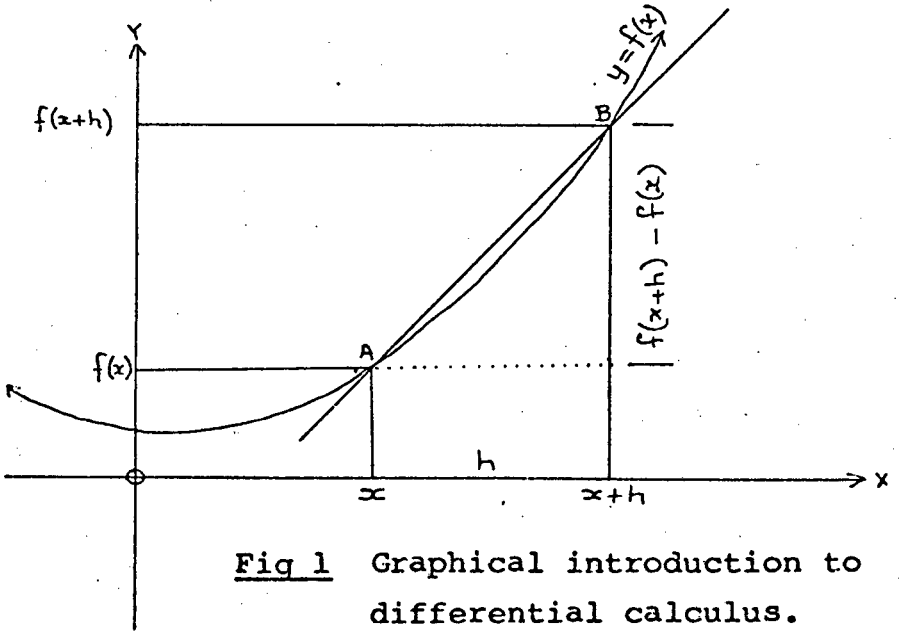


Fig 1 Graphical introduction to differential calculus.

DIFFERENTIATION

Std 2

) order of N
) Number line for N
) Operations
) fractions
II(3) graphs
II(2) money, mass, capacity, time

Std 3

3) operations on N
5) fractions
5) decimals
III(8) graphs
III(2) money, mass, capacity, time
III(4) no. sentences

Std 4

) counting Nos.
) properties of nos.
) fractions
) decimals
IV(9) graphs
IV(6) angle
IV(6) area
Iv(4) money, mass capacity, time
IV(8) no. sentences

Std 5

natural nos. (operations)
V(3) physical quantities
V(3) graphs
fractions
decimals
percentages
V(3) graph of relationship between two variables on rectangular axes
V(3) points&lines
V(3.9) angles (0°-360°)
V(3.9) triangles
V(3) no. sentences with letters
V(3) no. sentences solution by inspection

Std 6

1) factors of N
2) integers
4) exponents
3) rational nos.
5) terms
5) constant
5) variable
5) alg. expressions
VI(4.8) stats
VI(4.7) ratio
VI(4.6) linear equation solution by inspection
VI(4.6) Algebraic solution of equations

Std 7

2) factors
1) factorisation
1) alg expressions
VII(5.3) functions
VII(5.3) Cartesian plane

Std 8

.1) alg products
3) alg expressions
4.8) exponents
VIII(4.6) functions
VIII(4.6) graphs
VIII(4.4) equations

Std 9

IX(5.1) remainder theorem
IX(5.1) functions
1) real nos.
IX(5.1) inverse functions
IX(5.1) quadratic eqns

Std 10

X(6.1) series
X(6.2) limits
X(6.2) differentation

6.2 Differential Calculus

Essential pre-requisite learning for a meaningful understanding of the basic concepts of differentiation:

Standard 10

6.2.2 Limits

6.2.2.1 An intuitive approach to the concept of a limit.

It is hoped that the teachers in the secondary schools will in fact adopt an "intuitive" approach,and will not attempt to formalise this difficult concept. The concept is not a new one,as the learners should have become familiar with the basic concept while learning about infinite geometric series. (see below).

Limits should be taught,not as an end in themselves,but as a necessary tool for the introduction of the "main" concept of differentiation.

6.2.2.2 Evaluation of $\lim_{h \to 0} \frac{f(x + h) - f(x)}{h}$ ...

This is the crucial section of the syllabus for a conceptual understanding of the concept of differential calculus. The above differential quotient should be introduced in a conceptual manner by considering the average slope between two points on a curve (6.2.1), and by then considering smaller and smaller intervals (h). Creative use of an overhead projector, and computer graphics could facilitate an understanding of this basic concept.

An understanding of this section could be considered as the "goal state" of the learning process under consideration. (Skemp)

6.1.2 Sequences and Series

A meaningful understanding of this section is essential for a later understanding of the concept of a limit. Particular attention should be paid to a mathematical valid introduction to section 6.1.2.4 "Convergence of a geometric series". The correct notation (i.e. the limit notation) should be used,and not the "traditional "sum of an infinite number of terms, S_∞)

It is during the learning of this section that the pupils will (or should) form a conceptual understanding of the idea of a limit.

Standard 9

5.1.3 Functions

By this stage in their schooling,the pupils should have a meaningful understanding of the basic concept of a function. When dealing with the prescribed functions in Standard 9 (quadratic and absolute), the importance of the slopes,whether the function is increasing or decreasing,and any turning points should be emphasised. (5.1.3.2 properties of the functions in 5.1.3.1)

The idea that the value of the function changes as the value of the independent variable is fundamental to the concept of calculus.

Standard 8

4.6 Functions

It is in Standard 8 that the schema of a function must be completely and meaningfully assimilated. The basic concept is a simple one,which is unfortunately complicated by the over-stressing of endless different notations. The "formal" definition of a function only serves to create confusion and misunderstanding of the basic concept, i.e. that of one variable changing as another changes. The notation f(x) = ... should be used (not exclusively) at this stage,so that the required notation for the differential quotient can be understood in Standard 10.

In the graphical representations of the functions (4.6.3),stress must once again be laid on the idea of "change","slope",etc (see above.

Standard 7

5.3 Functions and how they are represented.

This section is probably one of the most crucial for a meaningful understanding of differential calculus. The concept of a function must be approached informally and intuitively,without undue stress on notation or definition. The idea of the change of one variable as another changes is fundamental.

It is at this level that the idea of the Cartesian plane is fully investigated, and the first graphs of functions are drawn. It is alarming that many secondary school pupils,at all levels,have little or

An understanding of such a basic concept can be facilitated by in depth questioning of the pupils understanding...e.g. "How did you find this answer?" or "You have drawn this graph,what does it mean?" etc

Standard 6

4.5.1 The concepts: Constant,variables,and the values that variables may assume.

The above concepts are fundamental in constructing any meaning to algebra in general. It is very difficult for the young adolescent learner to meaningfully construct schemas of the above concepts, which can involve operating on a purely symbolic level of thinking, which seems to contradict many of the accepted theories of the processes of learning. Attempt must be made by the teacher to introduce concrete apparatus,and to make the concepts part of the learners real world.

I consider,if it is possible,that this section is probably the most important in the whole secondary school syllabus. Incorrect concept formation at this stage can seriously jeopardise a pupils future understanding of mathematics in general,and remove mathematics from being an enjoyable and meaningful activity. It is,however,an unfortunate fact,that in many South African classrooms,the above concepts are merely "defined", and the teacher procedes almost immediately to teaching algorithms for operating in algebra (EG "Only add like terms.", "add the powers when multiplying.","subtract the bottom sign and add." etc) The pupils "taught" by such a person will probably be able to "get the right answer",but will not understand any of the underlying concepts.

4.7 Ratio

4.7.1 The concept of ratio and 4.7.3 The concept of rate are essential for an understanding of differentiation. Differential calculus is the mathematics of rates of change,expressed as ratios. This section may be considered as the introduction to the ideas of differentiation, and must be given the necessary importance of place in the division of any Standard 6 time allocation.

Standard 5

3.8 Graphical representations

3.8.3 Graphical representation of the relationship between two variables on two rectangular axes.

This is a completely incomprehensible inclusion at this level! It is inconceivable to talk about "variables" and "rectangular axes" to pupils who have yet to be exposed to the concepts. It is even more remarkable that in Standard 6 there is NO specific mention of graphs - the only graphs are in the section on elementary statistics, with no reference to a "relationship" between variables.

An intuitive and non-formal approach to graphs should be adopted at this level, with an emphasis on relevance to the real world of the child. Examples can be taken from "real" situations (eg daily temperatures, pupils' marks, height of a plant etc)

Once again, the idea of "change" should be stressed with a view to the introduction of the goal state.

3.3 Common fractions

Forming "equivalent fractions" (3.3.1) is an essential pre-requisite concept for the understanding of the concept of a ratio. The operations with fractions is, of course, fundamental to much of the school mathematics curriculum. (3.3.4.1)

3.9.1 Points and lines - the concepts: Plane, point, line, line segment, ray, horizontal lines, vertical lines, perpendicular lines and parallel lines. Nearly all these concepts are essential for an understanding of later work in graphs, and later for differentation. It should be noted that the syllabus stresses that "the approach to this section should be practical and experimental.

3.9.4 Triangles

A knowledge of the properties of triangles would be helpful in the later understanding of the Cartesian plane.

Standard 4

5 Common fractions : As above,the full understanding of equivalent fractions should be strived for,with a view to the understanding of the concept of a ratio. The idea of the relative magnitude of a fraction should be understood - i.e. that an increase in denominator results in a decrease in the magnitude of the fraction. Some intuitive ideas about the problems inherent in division by zero should be introduced at this level,and stressed more and more during the following school years. This will create a need for the ultimate introduction of the concept of "limit" in Standard 10.

9 Graphical representation : "Illustrations and graphical representation should be used where applicable." It is to be hoped that the teachers in the senior primary classes take heed of this small sentence in the syllabus, even though it would appear to be unable to be examined at this level.

Standard 3

5.2 Fractions : As above,this section must be emphasized as being vital for an understanding of all the mathematics that follows,apart from the obvious need for skills in operating fractions in very many "real - life" situations.

8 Graphical representation - see above (Std 4) for comment.

4 Operations on counting numbers : a basic proficiency in the four arithmetical operations is essential for any further algebra. It is worthy of note that the use of an electronic calculator will assist the pupil in pure arithmetical processes, but that in mathematical (algebraic) operations,he must be aware of the basic operations.

Standard 2

3. The counting numbers
3.2 Order and the number line - a fundamental concept essential to all future mathematics at school. The concept of the number line itself leads to the Cartesian plane

Standard 2 (contd)

4. Operations on the whole numbers (0 - 999)
See above (Std 3) for comment on this section.

5. Fractions
5.1 Concept formation ... - practical experiences create the concept that is essential for any further learning in mathematics. It is rather alarming to note,however,that even after four years of exposure to fractions,many Standard 6 pupils have a very weak understanding of the concept.

8. Graphical representation - see above (Std 4) for comment.

Concepts essential or helpful for <u>applications</u> of differential calculus, or concepts that would <u>assist</u> in the learning of the basic concept:

Standard 9

5.1.6 The remainder and factor theorem - a welcome re - inclusion in the syllabus. This is very useful in the sketching of third degree polynomials.

5.1.5 Quadratic equations and inequalities - essential for 6.2.5.2 the sketching of the curves of polynomials,and 6.2.5.3 applied problems in maxima and minima.

5.1.1 The real numbers - the behaviour of the real numbers is very important in the formation of the goal concept. An understanding of "real" and "imaginary" is needed for the understanding of the need for the limit concept.

Standard 8

4.2 Factors - a knowledge of factors and factorising is needed for the applications 6.2.5.2 and 6.2.5.3 mentioned above.

4.3 Algebraic expressions - a proficiency in the simplification of algebraic expressions is essential for (inter alia) the simplification of the differential quotient when differentiating "from first principles".

4.4 Equations - the solving, and more importantly, the understanding of equations is essential for most applications of differentiation covered in the syllabus.

Standard 7

5.1 Algebraic expressions & 5.2 Factorizing & 5.4 Linear equations.
See above (Std 8) for comment.

Standard 6

In this year,the following are all important for the applications of differential calculus:

4.1 Natural numbers and whole numbers
4.2 Integers
4.3 Rational numbers
4.4 Exponents
4.5 Algebraic expressions
4.6 Linear equations - solution by inspection and by algebraic method. In this section,in particular,great care must be taken to avoid the pupil losing his understanding of the basic concept of an equation by concentrating to the exclusion of all else on algorithmic methods of solution.

Standards 5,4,3 and 2

In these years I have included "number sentences" - the logical pre-requisite concepts to equations.
The sections on physical quantities (money,mass,capacity,time) have been included in order to facilitate the applications to differential problems in maxima and minima (6.2.5.3)
An understanding of decimals is particularly useful in general now that the pocket calculator is to be allowed in the schools.

Analytical Geometry of the Straight Line and Circle

Std 2

(3) order of N

(3) Number line for N

(3) Operations

(5) fractions

II(8) graphs

II(6) geom shapes

Std 3

(3) operations on N

(5) fractions

III(8) graphs

III(6) symmetry

III(6) circle

III(4) no.sentences

Std 4

2) counting Nos.

3)properties of nos.

5) fractions

3) decimals

IV(9) graphs

IV(6) angle

IV(6) pattern work (symmetry)

IV(6) circle

IV(8) no.sentences

Std 5

natural nos. (operations)

) fractions

) decimals

V(3) graphs

V(3) points&lines

V(3.9) angles (0°-360°)

V(3) graph of relationship between two variables on rectangular axes

V(3.9) drawing

V(3.9) circles

V(3) no. sentences with letters

V(3) no.sentences solution by inspection

Std 6

4.2) integers

4.3) rational nos.

4.5) constant

4.5) variable

4.5) terms

4.4) exponents

4.5) alg.expressions

VI(4.8) stats

VI(4.6) linear equation solution by inspection

VI(4.9) circle

VI(4.6) Algebraic solution of equations

Std 7

VII(5.3) functions

5.1) alg expressions

5.1) factorisation

VII(5.8)parallell lines

VII(5.3)Cartesian plane

VII(5.4)systems of equations

Std 8

(4.8)exponents

(4.3) alg expressions

(4.1) alg products

VIII(4.6) functions

VIII(4.4) equations

VIII(4.7) systems of equations

VIII(4.6)graphs

Std 9

5.1) real nos.

IX(5.1) functions

IX(5.1) inverse functions

IX(5.1) quadratic eqns

IX(5.1) systems of eqns

X(6.5) analytical geom of the str line and circle

6.5 Analytical Geometry in the Cartesian Plane

6.5.1 The distance between two points
6.5.2 The mid-point of a line segment
6.5.3 The gradient of a line
6.5.4 Comparison of a line and its sketch
6.5.5 Perpendicular and parallel lines (no proofs)
6.5.6 Colinear points and intersecting lines
6.5.7 Intercepts with the axes
6.5.8 Equations of circles with any given centre and radius
6.5.9 Intercepts of lines and circles
6.5.10 Equation of the tangent to a circle at a given point on the circle.
6.5.11 Other locusses with relevance to straight lines and circles.

The key concepts required for a meaningful understanding of the basic concepts of analytical geometry.

1. Function

The concept of a function as a relationship between two variables must be fully understood. The basically simple idea must not be complicated by an over-emphasis on notation or confusing "definitions". It is most gratifying to note that in the "new" syllabus no mention is made of "relation",or in facts of sets in general. This implies that the idea of a function as a subset of the set of ordered pairs must NOT be taught at the school level.

2. Graphs on the Cartesian plane

The welcome re-introduction of analytical geometry in the syllabus makes it absolutely essential that the pupils have a conceptual understanding of graphs - not just a process to draw the graphs of certain functions,but a meaningful understanding of what a graph is. If there is a most important single concept required for the understanding of analytical geometry,then I feel that it is this concept. It is alarming to realise just how few senior pupils have an understanding of this basic concept. A change in emphasis in the examination techniques could do much to improve this situation.

3. Point,line,circle,etc

A meaningful understanding understanding of the basic properties of geometric concepts is essential pre-requisite learning. It is questionable whether the formal axiomatic approach to this subject that is prescribed for South African schools can facilitate such a conceptual understanding. The idea of "locus" is a concept that is primary to an understanding of analytical geometry.

Analytical geometry is the combining of algebraic and geometric concepts. I feel that the "new" mathematics should have included a geometric analysis of the conic sections. This would have contributed greatly towards a more meaningful understanding of the functions covered in the algebra sections of the syllabus (parabola,hyperbola and perhaps the ellipse.)

As in the previous section on differential calculus, I will now attempt to form a type of "concept map" back to the Standard Two level.

6.5 Analytical Geometry of the Straight Line and Circle

Essential pre-requisite learning for a meaningful understanding of the basic concepts of analytical geometry:

Standard 9

5.1.3 Functions

5.1.3.2 Development of the properties of functions using their equations and graphical representations.

It is at this level that the conceptual understanding of a function, a concept that is basic to the understanding of the majority of school mathematics,must be consolidated. Teachers must beware of destroying any intuitive understanding of this simple concept by over emphasis on formal over rigorous definitions. It is imperative for teachers to note that the function must NOT be defined as a set of ordered pairs, such that ..... etc.

The important concept of the graphical method of representing a function must repeatedly be emphasized,so that the true meaning of a graph is meaningfully assimilated by the learner. Analytical geometry would be reduced to a meaningless collection of "formulae" and algorithmic methods without this understanding.

Standard 8

4.6 Functions

4.6.1 The function concept,notation and function values

See the comment on 5.1.3 (Std 9),above

4.6.3 Graphical representation of the following functions (and deduction of the properties of each from the equation and graphical representation)

4.6.3.1 $ax + by + c = 0$

4.6.3.2 $y = \sqrt{r^2 - x^2}$

4.6.3.3 $y = -\sqrt{r^2 - x^2}$

4.6.3.4 $xy = k$

4.6.3.5 $y = ax^2 + c$

This section is in fact a section on analytical geometry. The "deduction of the properties from the graphical representation" is precisely what is entailed in the study of analytical geometry. For example investigating the gradient of the straight line graph is specifically mentioned in the Std 10 syllabus (6.5.3).

The sections 4.6.3.2 and 4.6.3.3 are essential pre-requisite learning for the graph of the circle with any centre. The essential properties of the circle and straight line in general must be emphasized at this stage. Unfortunately,in the formal geometry section,the important properties of these geometric concepts are often almost ignored,all the time being spent on "proving" rather obscure and secondary properties of the circle and straight line.

The introduction of the graph of $x^2 + y^2 = r^2$ is an ideal oppurtunity to introduce the concept of fitting an algebraic equation to a purely geometric concept. It is at this stage that the basic concept of the investigation of the behaviour of a general point (x ; y) which has to fulfill certain prescribed conditions (equidistant from a fixed point), should be introduced. It is noteworthy that the relation

$x^2 + y^2 = r^2$ is not specifically mentioned in the syllabus. I feel, however, that the functions in 4.6.3.2 and 4.6.3.3 can be understood with far better understanding if the section is introduced by beginning with the circle ($x^2 + y^2 = r^2$) and then showing it to be the union of the two prescribed functions. It is certainly better to begin this way for a more meaningful concept of locus, and hence all of analytical geometry in Standard Ten.

Standard 7
5.3 Functions and how they are represented
5.3.1 Graphical representation of tabulated data.
5.3.2 Derivation of simple formulae from tabulated data.
5.3.3 Graphical representation of data obtained from fomulae
5.3.4 The concepts: Axes, origin, co-ordinates of a point.
5.3.5 The function defined by $y = mx + c$, its graphical representation in the Cartesian plane, and its properties.

The above section is probably the most important in that it is the initial formal encounter with the vital concepts of functions and their graphical representation. It must be noted, however, that although the concept of function is first mentioned specifically at this point, many learners will have a sound understanding of the concept, which they have formed from their dealings with their environment. (e.g. problems in the use of money; "the more you eat, the fatter you become" etc). The teacher must be very conscious of this intuitive understanding, and must attempt to reinforce the understanding of the concepts, rather than to destroy them by an over emphasis on formal definitions, or the presentation of certain algorithmic "short cuts" to solve "typical exam questions". An informal, intuitive approach to functions should be used for much of the Standard Six algebra.

Apart from the bewildering inclusion in the Standard Five syllabus viz. 3.8.3 "Graphical representation of the relationship between two variables on two rectangular axes" the above is the initial introduction to the key concept for analytical geometry, namely the connection between an algebraic equation and a geometric concept (the graph of the straight line). An understanding of the meaning of the process and the concepts themselves is essential pre-requisite learning for analytical geometry.

Standard 6

4.5 Algebraic expressions

4.5.1 The concepts: Constant,variables,and the values that variables may assume.

I feel that this is the single most important section for an understanding of secondary school mathematics in general. The understanding of the above basic concepts is essential for a meaningful assimilation of almost any mathematical statement,and yet many learners are taught rules,often by analogy to other non-relevant situations enabling them to "simplify" expressions etc,without any understanding of the key concepts. Many teachers express concern about the availability of time for the full understanding of the basic concepts,but I would suggest that the learning process in mathematics in particular is not a linear process. Time spent in ensuring a meaningful understanding of the basic concepts of any mathematical process will ensure an acceleration of learning (and true understanding) at a later stage. (see fig 2)

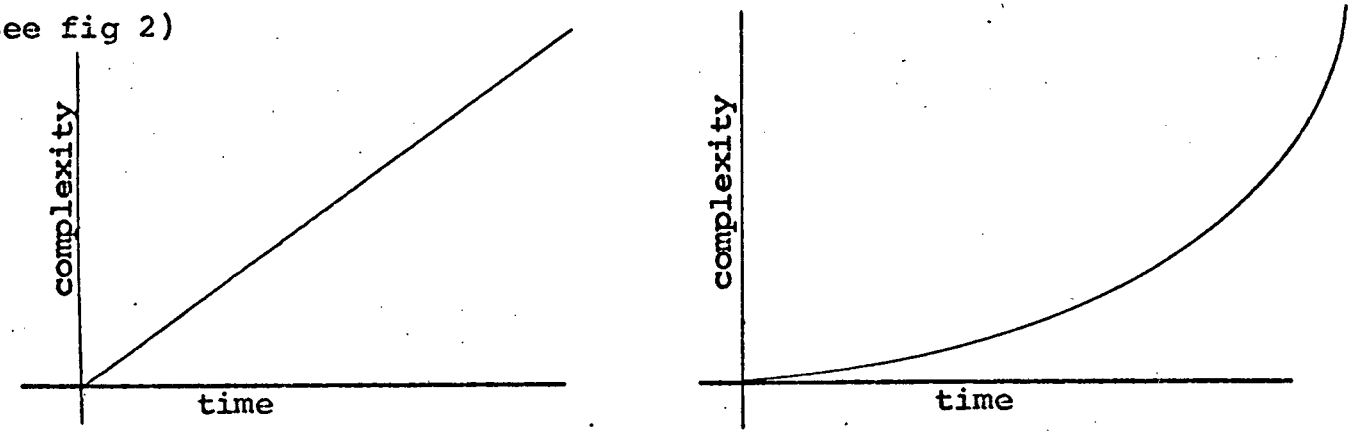


Figure 2: Time spent on basic concepts.

It is interesting to note that most of the available mathematics textbooks present endless exercises on the simplification of expressions such as $2x^3y^4 + 7y^7 + \ldots\ldots +$..etc. There is NO specific mention of the necessity for such skills in the syllabus,and it is doubtful whether such "problems" have any meaning for the learner at any stage of mathematical development. Time could surely be saved by the omission of such exercises,and used more beneficially to consolidate a meaningful understanding of the above primary concepts of mathematics.

4.9 Geometry

(Knowledge of the following should be acquired through calculations and intuitively by experimental methods.)

For the first time in the history of South African mathematics education, a method of active,discovery is sanctioned,and even encouraged by the authorities. Teachers,particularly those in the secondary school system, are often guilty of ignoring,or of discrediting the knowledge that the learner brings with him from the primary school, and even from pre-school periods. It has been found that young children have a sound intuitive idea of geometric concepts from a very early age. It has been found essential that a learner begins any study in geometry with simple,concrete experiences before he can proceed to any level of formal geometry.

4.9.2 Discovery of facts in connection with

4.9.2.1 Intersecting and parallel lines

4.9.2.2 Theorem of Pythagoras

4.9.4 The circle

An understanding of the basic properties of all the above is essential for a conceptual understanding of the concepts of analytical geometry. I would suggest that it is at this informal level that the concepts will be formed and understood,rather than later during the period of formalisation of geometry. It seems that the decision to include formal geometry at the Standard Seven level is contrary to nearly all accepted theories of learning (Piaget,Bruner in particular). I feel that it would have been far more beneficial to spend at least two years learning geometry in an informal manner. It is unreasonable to expect Std 7 learners to operate on a purely symbolic level of thought,at the second highest level of geometrical development as proposed by Van Hiele.

Standard 5

3.8 Graphical representations

(Graphs should be looked upon as a unifying concept and hence graphical representations must be used throughout the syllabus wherever applicable and suitable.)

The idea of a graph is mentioned as far back as the Standard Two syllabus. It is therefore alarming that so few learners in the secondary school have a meaningful understanding of the significance of a graph. Is this lack of understanding because of a lack of emphasis in the primary school,or is it because the secondary school teachers have destroyed the learner's intuitive understanding by an over-emphasis on the mechanical processes required in drawing graphs for the sake of drawing graphs?

3.9 Geometry

3.9.1 Points and lines

The concepts: Plane,point,line,line segment,ray,horizontal lines,vertical lines,perpendicular lines and parallel lines.

All the above concepts,which should be approached with a "practical and experimental" method,are fundamental to a later understanding of the goal concept in Standard Ten. As in Standard Six,it is important that the approach be non-formal in order to facilitate a meaningful understanding of the concepts. It has been stressed by all the epistemologists studied in the previous essay that learning is an active process,carried out by the learner,in order to make sense of his environment. The "new" syllabus for geometry in Standards Six and Five present a perfect opportunity for the introduction of true discovery learning in South African schools. It is most unfortunate that most of the textbook writers tend to be conservative,and unable to free themselves from the "traditional" methods of formal teaching. A comprehensive programme of teacher in-service training in the techniques of true discovery learning would to much to improve the current situation. It is therefore gratifying to note that in the Cape Province an honest attempt has been made to provide such training,and it is hoped that the level of conceptual understanding among the learners will improve as a result.

Standard 4

9. Graphical representation

Illustrations and graphical representation should be used where applicable.

See the section above (Std 5) for comment on this section.

6.3 The circle
This is the first formal introduction to the concept of the circle. It must be noted,however,that the learner will have an intuitive understanding of the circle,formed by his interaction with the environment. The properties of the circle should be discovered by the learner during this phase of his education,as opposed to a mere recognition of the figure from its shape.

Standard 3

8. Graphical representation
See above (Std 4 & Std 5) for comment on this section.

6.1 The circle
The drawing of the circle with the aid of string,tins,etc
Recognition of the shape of the circle should at this stage be meaningfully internalised. Using "string" to draw circles will enable the learner to discover the basic concept of the circle required for the understanding of the goal in Standard Ten,namely the property that all points on a circle are the same distance from some given,fixed point.

4. Operations on the counting numbers (0 - 9 999)
5. Fractional numbers
An understanding of the above basic concepts is essential pre-requisite learning for the whole of mathematics.

Standard 2

8. Graphical representation
This is the learner's first experience with the concept of a graph, and must be meaningfully understood in order to facilitate an understanding of a great deal of his future mathematics. (See also Std 5)

3. The counting numbers
3.2 Order and the number line
4. Operations on the whole numbers (0 - 999)
5. Fractions

A meaningful understanding of all the above is fundamental for a future understanding of mathematics in general. In particular, the section on order of the natural numbers and the number line (3.2) is a concept that is essential pre-requisite learning for a conceptual understanding of graphs on the Cartesian plane, and therefore a key concept for an understanding of analytical geometry in Standard Ten.

Concepts essential or useful in the applications of analytical geometry, or concepts that would assist in the meaningful understanding of the basic concepts.

Standard 9

5.3 Euclidean geometry

5.3.1 The Theorem of Pythagoras

An understanding of this theorem is essential for the calculation of the distance between two points (6.5.1).

5.1.5 Quadratic equations and inequalities

An understanding of the solution of quadratic equations, and the implications of the solutions is essential for the calculation of points of intersection of the straight line and circle (6.5.9). An understanding of the nature of the roots of a quadratic equation is required to enable the learner to determine the equation of a tangent to the circle at a given point on the circle (6.5.10). An understanding of the process of "completing the square" is necessary for the learner to investigate the equation of the circle in the form $x^2-ax+y^2-by = k$, and to reduce it to the form $(x - p)^2 + (y - q)^2 = r^2$.

5.1.7 Systems of equations

5.1.7.1 Solution of simultaneous equations in two unknowns with one linear and one quadratic equation.

It would be impossible to carry out the necessary operations needed to determine intercepts of lines and circles (6.5.9) or to find the equation of the tangent to the circle (6.5.10) without an understanding of the above concept of simultaneous equations.

Standard 2 to 5

The basic concepts of the operations and simple geometric concepts are applicable to all secondary school mathematics,and must therefore be meaningfully understood by the learners.

/Trigonometry

Trigonometry

Std 2

- II(3) order of N
- II(3) Number line for N
- II(3) Operations
- II(8) graphs
- II(5) fractions

Std 3

- III(5) decimals
- III(8) graphs
- III(3) operations on N
- III(4) no.sentences

Std 4

- IV(3) decimals
- IV(6) angle
- IV(5) fractions
- IV(9) graphs
- IV(2) counting Nos.
- IV(8)properties of nos.
- IV(6) rectilinear figures
- IV(6) area
- IV(6) circle
- (5) no.sentences

Std 5

- V(3) points&lines
- V(3.9) angles (0°-360)
- V(3.9) triangles
- V(3) fractions
- V(3) decimals
- V(3) graph of relationship between two variables on rectangular axes
- V(3) natural nos. (operations)
- V(3) no. sentences with letters
- V(3) no.sentences solution by inspection

Std 6

- VI(4.5) constant
- VI(4.5) variable
- VI(4.7) ratio
- VI(4.9) triangles
- VI(4.5) terms
- VI(4.3) rational nos.
- VI(4.5) alg.expressions
- VI(4.4) exponents
- VI(4.6) linear equation solution by inspection
- VI(4.6) Algebraic solution of equations

Std 7

- VII(5.8)triangles
- VII(5.3) functions
- VII(5.3)Cartesian plane
- VII(5.5) proportion
- VII(5.1) alg expressions
- VII(4.2)factors
- VII(5.1) factorisation

Std 8

- VIII(4.4) equations
- VIII(4.6) functions
- VIII(4.6)graphs
- VIII(4.8)exponents
- VIII(4.3) alg expressions
- VIII(4.10) def.of Trig functions for 0-90
- VIII(4.10)application in right angled triangles
- IX(5.1) functions
- IX(5.2) def.of Trig functions for any angle
- IX(5.1) inverse functions
- IX(5.2) formulas
- IX(5.2) trig identities
- X(5.2) graphs of sin x, cos x, tan x
- X(6.3) compound angles
- X(6.3) trig eqns.

6.3 Trigonometry

6.3.1 Function values for $-\theta$ and $(\theta + 360^{\circ}n)$ where n is an integer, expressed as function values for $\theta \in [0^{\circ} ; 90^{\circ}]$

6.3.2 The sine,cosine and tangent functions.

6.3.2.1 Description,definition,values

6.3.2.2 Maximum and minimum function values and period

6.3.2.3 Graphs of the above functions.

6.3.3 $\cos (A - B) = \cos A \cos B + \sin A \sin B$,etc

6.3.4 General and specific solutions of simple trigonometric equations.

Trigonometry is by no means a new inclusion in the South African mathematics syllabus,but I have included the topic in this study, because I feel that it is a section in which a meaningful understanding of the basic concepts is seldom achieved. With the rearrangement of the curriculum,with trigonometry being introduced at the Standard 8 level for the first time,there is a danger of even fewer learners achieving understanding of the basic concepts.

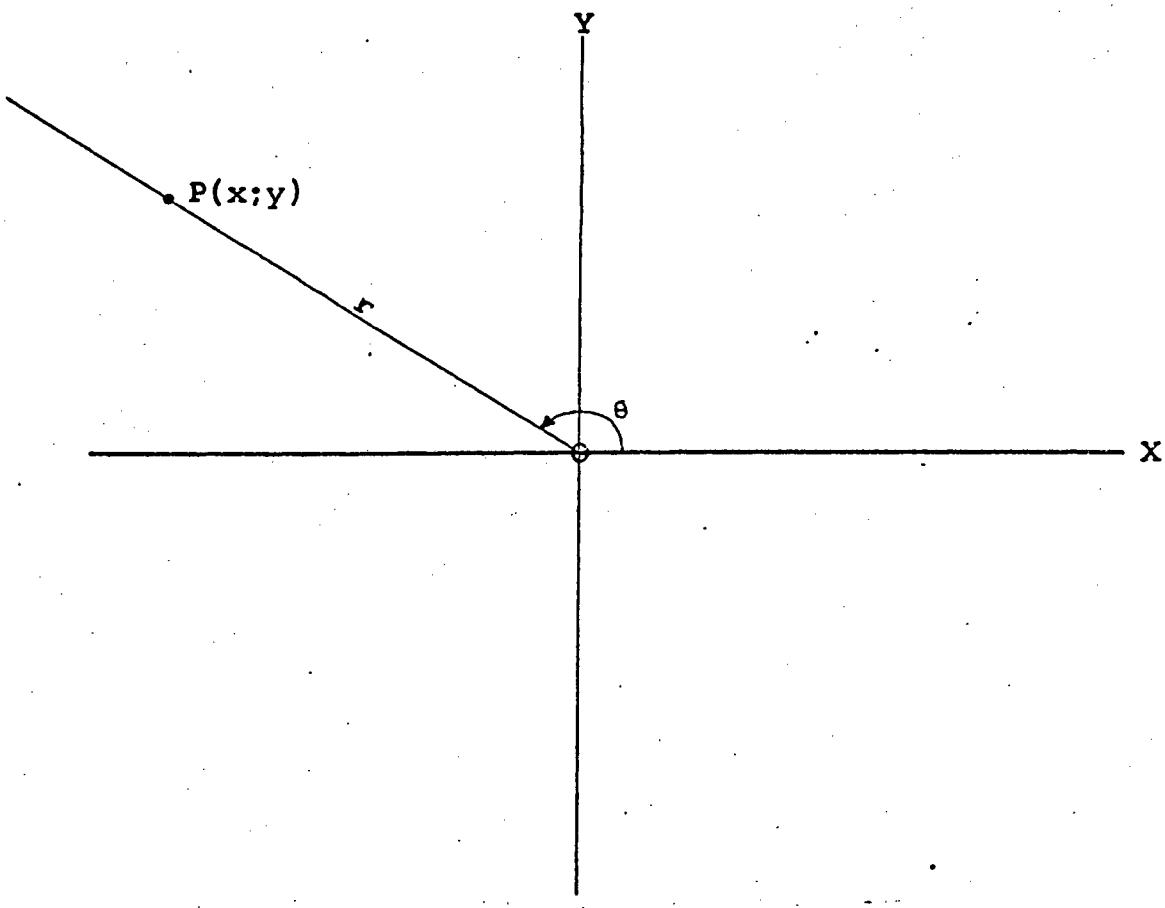
The goal concept in Standard 10 is 6.3.2,the description,behaviour and graphs of the trigonometric functions. The other main sections in Standard 10,namely 6.3.3 (compound angles) and 6.3.4 (trigonometric equations) can be considered as applications of the trigonometric functions.

The key concepts required for a meaningful understanding of the basic concepts of trigonometry:

1. Function

As in the previous two sections,this concept is vital for an understanding of trigonometry. The trigonometric functions are subtle,and unique in secondary-school mathematics. Although the trigonometric functions should be introduced in terms of points on the Cartesian plane (x ; y), the functions themselves depend on the relationship between the <u>angle</u> (θ) and the <u>ratio</u> between x and y,y and r,etc. See fig 3,below.

Figure 3: Basic illustration used to introduce the trigonometric functions



2. The representation of points on the Cartesian plane

The learners must have a meaningful (not merely mechanical) understanding of the concept of the representation of ordered number pairs (x;y) on the Cartesian plane. It is unfortunately a common practice for many teachers to give little or no time to this basic concept,but to proceed directly in presenting algorithms needed to draw the graph of the straight line. The meaning of the Cartesian plane is often ignored altogether,which results in little understanding of the basic concepts of graphs in general.

3. Ratio

This concept is,of course,a vital one for the understanding of the basic concepts of trigonometry. The concept of ratio is not mentioned

specifically after the Standard Six level,but must however be used throughout the secondary school. (See the section on differential calculus.)

Essential prerequisite learning for a meaningful understanding of the basic concepts of trigonometry:

Standard 9

5.2.1 Extension of the definitions of the six trigonometric functions for any angle in terms of the co-ordinates in the Cartesian plane.

This is the most important section of the syllabus,that must be meaningfully understood. It is imperative that the learner relate the trigonometric functions to ratios of the co-ordinates of points on a fixed line in the Cartesian plane.

The above may be considered as the goal concept for an understanding of trigonometry. I do not see the necessity for an "extension" of the "definitions" for any angle,because,if correctly introduced initially, the learner will accept the idea of any angle from the initial "definition". (see Std 8,4.10.1)

5.1.3 Functions

As before,the concept of a function is essential prerequisite learning. It must be pointed out that the trigonometric functions are in fact a description of how a ratio depends on an angle. This is conceivably the first time that the learners encounter functions whose domain and range are not simply subsets of the set of real numbers.
I feel that the section included in the Std 10 syllabus (6.3.2) in which the general behaviour of the trigonometric functions is described using graphical as well as other representation,should be introduced to the learner at a much earlier stage of the process of learning trigonometry. The early introduction of an investigation of the function $y = a \sin bx$ and $y = a \cos bx$ would act as a kind of "advance organiser" for the learner,and would facilitate a meaningful understanding of the properties of the trigonometric functions in general.

5.1.3.4 The inverses of the algebraic functions.
A meaningful understanding of the concept of inverse functions in general is essential for an understanding of such simple processes as finding the angle A if sin A = 0,5 etc. The concept of the inverse of a function can be meaningfully illustrated when studying the graphs of the trigonometric functions. (see 5.2.3,below)

5.2.3 Graphs of $y = \sin x$, $y = \cos x$, and $y = \tan x$.
The graphs of the trigonometric functions should be introduced by proceeding from the <u>general</u> ($y = a \sin bx$,etc) in order that the learners obtain an understanding of the behaviour of these functions in general. It is my opinion that the most important consequences of the trigonometric function concepts are not the applications in solving triangles,but are that the functions are periodic,with the resultant applications in all of modern physics. The understanding of the concepts of "period" and "amplitude" are fundamental for a true understanding of the general properties of the trigonometric functions.

If the graphs are introduced in the above,restricted manner as prescribed in the Std 9 syllabus,there is a danger that the basic concepts will be lost,and that the learner will merely learn an algorithmic process for drawing a meaningless curve.

Many of the properties of the trigonometric functions can be given more meaning by the learner's use of the graphs described above.
e.g 5.2.2 Function values for $(90^\circ - \theta)$.....etc. expressed as functions of θ.
Showing the sign of the function values for different domains.
Showing that $\sin \theta = \cos (90^\circ - \theta)$ etc.

In short.I would consider the above section to be <u>detrimental</u> to a meaningful understanding of the basic trigonometric concepts in the prescribed form, but that if introduced in the more general way,as suggested above,and used accordingly,this section is most important in the understanding of the goal concept.

Standard 8

I have deliberately excluded the whole of section 4.10 Trigonometry from the map of concepts for a meaningful understanding of the basic concepts of trigonometry. I consider that "defining" the trigonometric functions only for angles between 0° and 90° can lead to a formation of an incorrect schema of the trigonometric functions. The syllabus does not prescribe the "definition" required,but I feel that the restriction on the domain mentioned above would lead many teachers to "define" the functions in terms of "opposite/hypotneuse,etc",which I feel is distinctly harmful for a meaningful understanding of trigonometry. The trigonometric functions should be introduced by allowing the learner to discover the invariance of the ratio of co-ordinates in the Cartesian plane,,using any angle from the beginning. It would be difficult for a learner to change his understanding of the functions when introduced to the more general definition in Std 9,and trigonometry could become a series of meaningless process used to find the "answer" to a series of "examination questions".

The application of trigonometry to the solution of right-angled triangles must be shown to be just one of the applications of the basic concepts. I feel that the learner need never be exposed to the idea that "$\sin \theta = O/H$,etc".

There is no possibility of the learner achieving a meaningful understanding of trig. graphs,trig. identities,solving non right-angled triangles,or even the meaning of,for example,cosine 250° if he has internalised the above restrictive "definition" of the trigonometric functions.

In short,if trigonometry is to be introduced in Standard 8,then it must be introduced correctly,in order to promote a meaningful understanding of the general basic concepts.

4.6 Functions

4.6.1 The concept of a function,notation and function values

4.6.2 The definition and range of functions

The above concepts,which the learner should fully understand by this stage in the learning process,must be consolidated. Care must be taken not to destroy any meaningful,intuitive understanding by over-emphasis on rigorous definition or notations.

4.6.3 Graphical representation of various algebraic functions.
An understanding of the significance and the meaning of graphs,and the Cartesian plane in general is essential prerequisite learning for a conceptual understanding of the basics of trigonometry. As before, the learner should,by this stage have a meaningful understanding of these basic concepts,and care must be exercised not to confuse this understanding by over-formalisation.

Standard 7

5.5 Proportion
The understanding of proportion,as a logical extension of the concept of a ratio is absolutely fundamental for the understanding of the goal concept.
5.5.3 Graphical representation of direct and inverse proportion:
The graph of $y = kx$ illustrate the basic fact of trigonometry,namely that the ratio of the co-ordinates of any point on such a line remain constant. This must be one of the sections in the curriculum that is the most essential for the meaningful understanding of the basic concepts of trigonometry.

5.3 Functions and how they are represented
It is at this level that the first specific mention of a function is made. It must,however,be noted that many of the learners will have a sound,intuitive understanding of this concept. This understanding must not be destroyed or significantly changed by over formalising. There is no possibility of a meaningful understanding of the goal concept without an understanding of the function concept.

Standard 6

4.5.1 The concepts: Constant, variables, and the values that variables may assume.

As with the previous two sections (differentiation and analytical geometry), this is a concept that is fundamental to a meaningful understanding of trigonometry. (See page 17 for a detailed comment on this section)

4.7 Ratio

4.7.1 The concept of ratio

The above is one of the most important sections needed to facilitate an understanding of the goal concept. The whole of trigonometry is based on the concept of a constant ratio, and would therefore be meaningless without a meaningful understanding of the above.

Standard 5

3.8 Graphical representations

3.8.3 Graphical representation of the relationship between two variables on two rectangular axes.

The above section (3.8.3) would be a key concept if it were possible to facilitate such an understanding without the learner having formed an understanding of "variable", "axes" and the graphical representation of a function. This is of course impossible, so the teacher should concentrate in facilitating an intuitive understanding of graphs in general, so that in Standard Seven, the learner may meaningfully understand the graphical representations of a function.

3.9.1 Points and lines

3.9.2 Angles

3.9.4 Triangles

All the above geometrical concepts must be understood by the learner. The concept of angles is particularly important for the understanding of the trigonometry functions, whose domain is the set of all angles. It is surprising how many learners, even in the senior secondary school, have little true understanding of the true meaning of an angle, and no concept of the size of a "degree".

Standards 2-4

The basic properties of the whole numbers, decimals, and fractions must be fully understood. Of particular importance are the sections on equivalent fractions, which leads to the understanding of the concept of a constant ratio, and the section in Std 2 on the order of the natural numbers and the number line (3.2) , which ultimately leads to the idea of the Cartesian plane.

Concepts essential for the applications of trigonometry, or concepts that would facilitate the learning of the basic concepts:

Applications:

1. Solving triangles:

Before attempting the solution of any triangles, a sound and meaningful understanding of the general definition of the trigonometric functions must be internalised by the learner. It is important for the learner to be aware that the solution of triangles is only one of the many applications of the trigonometric functions. Many teachers have implied that the very concept of trigonometry is dependant the solution of right-angled triangles, a very narrow and restrictive view, that will result in a limited understanding of the functions in general.

The following concepts may be considered as essential prerequisite learning for the above application:

Triangles - Std 5 (3.9.4); Angles - Std 5 (3.9.2); Pythagoras - Std 6 (4.9.2.2); Applications of the six trigonometric functions in a right-angled triangle - Std 8 (4.10.2);5.2.6 Formulae -(Std 9)

2. Trigonometric equations

As above, a meaningful understanding of the trigonometric functions is fundamental prerequisite learning. The following sections are required in addition to those needed for the basic concepts:

Equations, their meaning and solution - the concept of equations is first introduced in Std 3, and is built upon from then to Std 9. The understanding of the meaning and significance of equations must be fully understood, rather than merely algorithmic methods of solution of such equations. (See the previous sections on calculus and analytical geometry)

The "new" mathematics curriculum for the Cape Province has seemingly been designed with this idea of continuity as a basic principle. (There are some exceptions, see Graphs, Std 5). This curriculum seems to place more emphasis on an active, discovery-based, intuitive type of learning, with less stress on meaningless formalism, and more applications. This change must not be seen by teachers as a swing away from the "new mathematics" of the sixties, but rather a streamlining of ideas in order to facilitate a more meaningful, conceptual understanding of the subject.

It is now up to the teachers of mathematics, and to the education departments of the tertiary institutions, to implement the sound principles behind the new curriculum. It is important that teachers do not rely too heavily on the existing textbooks, many of which give their own interpretations of the syllabus, interpretations which could negate any beneficial effects that the new approach may achieve.

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Video Techniques

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PRACTICAL CONSIDERATIONS IN THE PRODUCTION OF EDUCATIONAL VIDEO

COURSE PAPER

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PRACTICAL CONSIDERATIONS IN THE PRODUCTION OF EDUCATIONAL VIDEO

Introduction:

The following short paper is intended to serve as a guide for those who intend to design and produce video recordings for the purpose of education or instruction.

The need for such a guide arose out of the design and production of the video material "Facilitative Questioning Techniques" (T Akhurst & J D C Stupart, 1984)

During the initial planning of the above video tape, it was envisaged that the production of a 10 to 15 minute video tape on a teacher interacting with a group of pupils would be straightforward, and that it would be the accompanying "manual" that would require the most time and effort. In fact, the converse was true, even with the assistance and guidance of a profession production team.

Using the video cassette recorder as educational medium:

It would seem that the video cassette recorder can be used in the following main areas of application for education:

1. Playback of professionally pre-recorded ETV material.
2. Recordings made **by pupils** as an integrated project.
3. Recordings made **of pupils** performing various activities.
4. Use by pupils as a medium. (e.g art, camera/film club)
5. The production of ETV material for use by teachers.

1. Playback of professionally recorded material:

More and more pre-recorded (professionally produced) video recordings are becoming available for use in education. For example, the Surrey County School Council makes 80 programmes a year, and supplies 550 schools. (Foss 1982)

Educational pre-recorded video material can be roughly divided into two main categories, viz:

a. Material of a general (public) appeal, which can be suitable for educational needs.

Such video material, which is often readily accessible, includes general travelogues, art series (e.g "Civilization"), items of historical importance (e.g "World at War"),programmes of social importance (e.g "Ground Zero"), etc. It would perhaps be beneficial for educational institutions to assemble a library of such material. After proper classification, such a library would be an important source of audio-visual teaching aids. The "old" 16 mm films fulfilled a similar role, but without the ease and convenience of handling offered by the video cassette.

b. Material produced specifically for education:

ETV has been used in various countries throughout the world, with varying degrees of success. (e.g "Sesame Street", Government sponsored project in the Ivory Coast, Brazil, etc). In South Africa, ETV is relatively new, but the SABC has invested heavily in educational television, having created an educational unit, as well as having devoted several time slots to "educational" broadcasts.

> "With the help of experts or superior teachers from their own school systems, students on a one-to-one basis can be brought up to maximal response to vocal communications both in the pre-school years and in the school. Sesame Street, the well-PUBLICIZED PTV preschool video program, may provide others with guidance in this direction-less stridently and more artfully, we hope." (Gordon & Falk,1972,p141)

I feel that the outstanding example of South African educational television series is the Zulu language series, "Siyafunda".

The author has made extensive use of the video material of the SABC series "Statistics" as broadcast over SABC TV. The material proved to be a valuable aid in the teaching of junior-secondary mathematics. (See the Dissertation "Summative Evaluation of ETV Material", J D C Stupart, 1986).

Copies of all the SABC "educational" material are available on application by educational institutions. Copyright is waived for such institutions.

2. Recordings made by pupils as an integrated project:

Taking into account the fact that there is a wealth of commercially produced educational material available (over 40 000 educational films were distributed to 1 000 schools in the nine outer London boroughs - Foss,1982), it is recommended that schools do **not** attempt to make their own educational programmes such as can be professionally produced.

> "The home video camera is seen more as a learning tool which in the hands of a well-supervised pupil will not replace traditional learning skills, but will enhance them. Children will do their own exploring of subjects, investigating for themselves with the video camera. First, of course, they will have to write down what they are going to shoot, and it is felt that the involvement in video work is often beneficial to children who are backward in the basic skill of writing, as they turn to it in the context of preparing a TV show for their colleagues." (Foss, 1982, p37)

In addition to the benefits quoted above, the use of the video technology in the preparation of, say, a Biology project, would force the author of the project to investigate the **primary** sources of information, rather than paraphrasing secondary forms of information acquired from libraries.

3. Recordings made of pupils carrying out various activities:

Video tapes can be produced of (for example) school plays, debates, sporting events, etc. When viewed by the participants of such activities soon after the activity, the video material can prove to be a most valuable diagnostic aid:

> "The video tape played back while they are standing there panting helps them to see what they have done while it is still reasonably fresh in their minds." (Foss, 1982, p42)

The above quotation stresses one of the most important advantages of the video techniques over films, namely that playback can take place immediately after the completion of the event. The impact of this when used as a diagnostic aid is self evident.

Annoying, or distracting mannerisms, (e.g during an oral presentation) which may be subconscious, can be often overcome when the perpetrator is made aware of his actions on a video recording.

The video material used as above can be recorded by the teacher, or by responsible pupils.

As an example of the above category of application, Benjamin Franklin Junior High School in Ridgewood, NJ (during 1972) involved ninth grade students to produce "more than one hundred hours" of educational/instructional video material per term. (Gordon & Falk,1972). Projects included "original plays, panel discussions, gymnastic activities, mock trials in social studies classes and oral book reports in English and speech classes."

According to one teacher at the above school, "The use of school-made television programs sharpens student interest and increases motivation in addition to allowing students to see themselves as others see them." (The italics are mine) (Gordon & Falk, 1972, p85)

Another important application of "school-made" video, is the taping of teachers micro-lessons, to be used as an aid in the further education of **teachers.** Teaching techniques can be recorded, and used as a basis for the further education of the teaching staff. The teaching techniques of "master teachers" can be recorded, and stored for posterity, rather than being lost forever on the retirement or death of such a "master teacher".

Caleb Gattegno in his book Towards a Visual Culture, (1969), advocates the use of television as the new instrument of effective and impacting teaching. Gattegno believes that the child seeing for himself learns more and better than he does by means of the traditional methods of teaching in which the teacher merely tells him about something he has to learn. The above references by Gattegno are to television itself, as in 1969, the video recording industry was in its infancy. I feel sure that he would approve of the video medium, used in the above application, as well as some of the other applications.

4. The use of the VCR as medium in itself:

Students of, for example, art, graphic art, etc., could make use of the video recording equipment to produce material relevant to their field of study. The artistic and creative merits of the video medium **itself** would become the object of the study. With the (predicted) future improvements in editing facilities, as well as methods of electronic mixing/dubbing, as is now available for broadcast TV, the video medium could become an important medium in the field of artistic creation.

5. The design and production of ITV / ETV material for use by teachers:

The major part of this essay will concentrate on aspects of this application of VCR technology. If video tapes are to be produced for large-scale, public use, they must be of a sufficient professional quality and standard not to distract the learner (either consciously or subconsciously) from the object of the lesson.

THE DESIGN & PRODUCTION OF ITV/ETV MATERIAL:

The production of a video cassette recording of a sufficiently high standard for general educational application involves the following pre-determined sequenced stages:

1. Needs Analysis:

It is a worthless, and often expensive exercise to produce a video recording if in fact there is no need for such an educational aid. There are many other educational media and aids available, from the "traditional" chalk board, to the electronic computer. Each of these media have their own areas of strengths and weaknesses, and each has its own domain of application. The recording of a video cassette of a reasonably professional standard is an expensive undertaking, both in terms of time and capital investment, and should therefore not be attempted if the educational material could be presented as well by employing another educational medium.

> "There seems to me to be little point in spending our time and energies on making audio visual presentations for things that our students are already learning perfectly well by methods already in use. The value of educational resources becomes apparent when they are employed to do what we are unable to do by other methods. When we have identified a learning problem we have to further identify what is the particular learning problem with this particular topic for this particular group of learners. .... I cannot stress too strongly that we are making something for a specific purpose with a specific audience in mind. Can the audio visual presentation help to overcome their learning problems?" (McInnes,1980,p59)

It would appear that good educational productions only occur after the learning problem to be overcome has been well identified, and the best medium to overcome that problem has been carefully chosen. It is essential to bear in mind that the producer is primarily a teacher and **not** a video producer.

The video medium is essentially a **visual** one, and should therefore not be employed to record material which relies on the spoken word for its educational impact. The interview situation, with static "talking heads" is one to generally be avoided. (Unfortunately this type of situation is all too common on broadcast television)

McInnes proposes the following three essential criteria to be satisfied before actual production can commence:

* What are the needs of the subject?

* What does the medium have to offer?

* What are the learning problems of the students?

Gordon (1970) states:

"TV is best used for:

. . . courses in which teachers welcome help;
. . . subjects where the medium offers special visual advantages;
. . . course which could otherwise not be taught"
(page 87)

The first of the above criteria is worthy of note - other teachers should be consulted at the stage of the needs analysis, to determine whether or not a need for the design and production of a video cassette recording exists.

2. Production Planning:

The following section can largely be summed up by the supply of the answers to the following three questions:

* What do we want to say?

* To whom?

* For what purpose?

(McInnes,1980,p61)

> "It takes time and effort to make even a simple sequence but most of the time should be spent on **planning** what you are going to do and how you are going to do it. **I reckon 95% of my time is spent planning, researching and scripting and only 5% in shooting and editing.**" (The italics are mine, JS)
> (McInnes,1980,p61)

(James McInnes worked as an actor before turning to education. He has long experience of classroom work as a teacher of English and Drama, and has worked for the UN in Third World Countries helping to train others in the use of video in training. At the time of the writing of the above book, he was working in Britain as an advisor for Educational Resources.)

a. Content Planning:

The precise concept to be taught must be clearly understood and stated. This is a crucial aspect of production planning- each module of ITV material must have a central core concept about which to plan the actual production.

The content to be taught has an overwhelming effect on the choice of **target audience.** The choice of target audience in turn has an effect on actual production decisions, such as level of presentation, use of animation/graphics, duration of programme, etc.

Gordon has the following comment regarding target audience:

> "One point cannot be overemphasized: the lesson strategy that might be effective for one group of students (on any academic level in any subject area) may not 'work' for other quite similar students separated from the first group either by time or distance. Simply, students in one place respond differently to identical stimuli from students in another place. So do students in the same place one, two, three or four years after one another." (Gordon,1970,p136)

b. Planning of Goals:

Concise and precise **goals** must be decided upon by the producer of the material. The goals should be **specific,** aimed towards solving a particular educational problem, rather than some vague statement. These goals must be made known to all members of the production team, and all future activity should be geared towards achieving the goals. Note: the goals of a production, although closely linked to the content, should not be simply a matter of restating the content.

c. Type of Lesson:

The methodology of the production must be decided upon, **based upon educational principles, rather than TV principles.** It must be always remembered that the video recording is only an **aid** in the presentation of an activity in the field of education. The medium must not be allowed to dictate to education and educational principles. To state this colloquially, "the tail must not wag the dog"!

Gordon (1970) suggests that "all communications tend either to emphasize narrative, pictorial or dramatic ways of mediating human experience, despite the fact that nearly all communications involve all three mediums (sic) at the same time, either logically or psychologically." (page 142)

i. Narrative devices are employed in nearly all ITV lesson methodologies, for better or for worse. (See above). According to Gordon (1970) this form of device may take a number of forms, viz:

a) Pure Exposition : A gifted narrator might be successful by sheer narrative talent, but the author feels that this device would be better suited to the medium of pure audio tape recording. As was mentioned above, video is a visual medium, and it is felt that it should be employed as such.

b) Exposition plus demonstration: According to Gordon, when demonstrations are added to lectures, they are meant to "enhance and illuminate" what is said. A videotaped lesson can make use of more visual material than could be used in an actual live lesson or lecture on the same subject.

c) Exposition and/or demonstration plus reaction: Real or illusory audience reaction can be used to advantage to clarify narrative communications on ETV. General audience response is extremely difficult to record, mainly because of the limitations of the audio recording devices (see "sound",later). Reaction can, however, be simulated by including a sample class of students in the programme. Such a device was used to illustrate "facilitative questioning techniques" by Akhurst and Stupart. This technique could be employed with success in the recording of "micro-lessons" to illustrate teaching techniques to other teachers, for example.

ii. **Pictorial** emphasis is when the narrator (teacher) is reduced to a voice, and the general orientation centres upon what is seen rather than on what is said. In other words, the **visual** aspect of the medium is emphasized. This is often the method employed in the "typical" news broadcast, travelogue, etc.

Some examples of application of the above method are:

a) Skills presentations may rely entirely upon a close-up demonstration with the teacher acting as a mere explainer. Typical examples of the employment of this technique include demonstrations of surgical and dental skills, complex or costly chemical/biological/physical experiments, etc.

b) Criticism and comment may make use of the video facilities of ETV. Examples would include, for example, art appreciation, or the criticism of a student performing some activity.

iii. **Dramatic** communications are a powerful didactical tool if used correctly. The use of drama in general in education is, I feel, an aspect that is much neglected. The average school student is seldom exposed to all that both viewing and performing drama can achieve in the field of education. The use of dramatic situations may be divided into two categories:

a) Dance and theatre can be difficult to include in a video recording, but should nevertheless be considered as being a viable, potent teaching device.

b) Interviews and panel discussions may be considered as dramatic encounters. Panel members with opposing views should be led by the presenter to clash with each other. The success or failure of such productions depends largely on the choice of participants (their knowledge, sense of conviction and ability to articulate), the amount of preparation, and the skill of the moderator.

d. Allocation of resources:

The recording hardware must be made available for the duration of the production. Additional funds must be allocated for miscellaneous expenses, such as (for example) travelling to remote locations, set properties, recording tapes, etc. At this stage of the planning it is only possible to create an estimated budget - final resource planning can only be implemented after the detailed script and production schedule has been finalized.

e. Scripting:

It must be decided (see "Type of Lesson", above) whether or not the production requires a rigorous script, or a mere guideline, leaving freedom of interpretation and implementation to the narrator(s). The less rigorous type of script is often used in interview situations, or in fact in any situation requiring spontaneous reaction between the subjects of the production. If the script is to be of a free format, a list must be drawn up of the essential topics to be included in order to meet the educational goals of the production.

It must be borne in mind throughout that a series of **pictures** not **words** is being created.

> "Although video is an audio visual medium, most people are word biased. That is to say we do most of our conscious communication with words either spoken or written. Very seldom do we draw pictures to each other: we write letters. The majority of our teaching is done by talking to the students or referring them to words in books

> or on the blackboard. So beware! Do **not** write the words and then try to illustrate them. 'Write' the pictures and worry about what words you may need later. ... This transition to writing pictures first and adding words later needs a lot of conscious effort. But it is worth it." (McInnes,1980,p63)

Gordon (1970) gives the following essential contents for a "satisfactory ITV script":

1. The basic objectives of the lesson.
2. The general teaching format.
3. The main points to be covered in a given time and the amount of time (roughly) given to each.
4. The general production plan of the lesson.
5. The camera movements and the lens changes required.
6. Extent and nature of the utilization of the film chain and non-studio visuals.
7. Visuals, scenery and props required in the lesson.
8. Personnel (production and talent) required.
9. How audio is to be handled in the lesson."

(Gordon,1970,p138)

f. Choice of Presenter / Participant(s):

The choice of the main presenter(s) is a vital factor in determining the success or failure of an ETV production. (See "Summative Evaluation of ETV Material", Stupart, 1986)

The presenter(s) should have an in-depth knowledge of the content being presented. This may require further pre-production study of the material covered in the production.

> "No matter what his method of instruction, therefore, it is theoretically possible to transfer the methods of any fine teacher from classroom to TV. WHether the teacher excels at lectures, class discussions and 'Socratic' dialogues, demonstrations, or simply motivating students to do their own learning by themselves, it lies within the potential of a TV director to capture this particular quality on TV. And the physical presence (pleasing or unpleasing looks), voice, quality, nervous mannerisms and quirks of the teacher are no more relevant to the effects of his/her lesson, potentially, in a TV studio than they are in the conventional classroom." (Gordon,1970,p167)

Gordon proceeds to give the following seven criteria to be met by the "TV teacher":

1. Should be intimately familiar with his/her subject. He/she must recognize if the TV production will in any manner "threaten the integrity of his teaching".

2. Should have a clear and profound knowledge of the target audience. In other words he/she should have experience from the live classroom of instructing the same type of students as he/she is to reach by video.

3. The TV teacher should have experienced recognized professional success in a conventional classroom.

4. Should be aware of the audio or visual materials which conceivably may enhance the quality of his lesson.

5. The TV teacher should be capable of self evaluation. He should be willing to "take enlightened risks with his own talents and remain adaptable." (Gordon,1970,p169)

6. Should not be overwhelmed by the "technological tyrannies" of the video medium, but should also be curious and flexible enough to make full use of the medium.

7. Should be intelligent enough to display a receptivity to learning those techniques of a television performance relevant to his/her particular style of teaching. "Most experienced teachers are."

(Gordon,1970,p168-169)

g. Production Schedule:

A detailed timetable / sequence of future production activities made be drawn up. The recording of exterior (location) scenes, in particular, should be flexible enough to allow for vagaries in the weather. Contingency plans should be formulated to allow for unforeseen delays in production. (e.g. equipment failure)

The **shooting sequence** must be drawn up. This sequence depends largely on whether or not suitable editing facilities are available. (See "Editing", later)

h. Allocation of Tasks:

All members of the production team should be made aware of their particular responsibilities. The production manager is responsible for this delegation, and must insist on a clear understanding of this aspect of the planning, in order to avoid friction during the actual production.

THE ACTUAL RECORDING OF THE VIDEO

In accordance with the postulate that the planning should be by far the most important factor in the production of a video lesson, the following section will be brief, and limited to the inclusion of certain points which may not be obvious to the "typical" teacher who may attempt a video production. It is assumed that the basic techniques of handling the equipment are understood, and that the producer/camera operator(s) have some photographic skill.

It would seem from the literature and from the personal experience of the author, that the quality of the recording of educational video tapes is to a large extent hardware-dependent, and should be considered under two main headings, viz:

A. The "typical" school setup, in which there is one video camera, one video cassette recorder, with the resultant limited editing facilities.

B. The "studio" facilities, with multiple cameras, usually recording on the "U-matic" one inch recording tape, sound mixing facilities, video mixing equipment, full editing equipment, graphic generators, etc.

The following will concentrate on the "typical" limited school setup, and will attempt to point out the major and serious limitations of such a setup in producing video material of a technical high standard.

The following should always be borne in mind when operating under the constraints of a limited video setup:

> "You do not need to make a polished television programme. If you are foolhardy enough to present what you have shot as a television programme then your students will compare your effort with the programmes they watch every night, made on budgets of tens of thousands of pounds, and, unless you are very good, your productions will be hard put to stand the comparison. ... If you present video, not as a programme, but as some pictures and sounds that you have, then there is little risk of your students confusing your presentation with an attempt to make a television programme." (McInnes,1980,p16)

Provided that the above is always the criterion by which the video material is to be evaluated, the "single-camera" setup can be used to good advantage as an educational medium.

Editing Techniques:

I feel that the greatest restriction in the production of professional standard video material in the "one camera/one VCR" setup is the severe limitation in editing facilities. As an example, the 12 minute video tape "Facilitative Questioning Techniques" produced by Akhurst and Stupart, required the recording of over an hour of video material. The editing was performed by a team of professionals, under the direction of Akhurst and the author. Even with the use of professional, highly sophisticated editing equipment, the editing process lasted for more than twelve hours. It was felt by the producers that the production of the short video tape would have been impossible without the above facilities.

Unlike motion picture film, it is not possible to splice video tape - an odd shape would have to be cut, and the two edges of the joint would shed oxide and clog the video heads. However, it is possible to carry out a limited form of editing after shooting. The basic requirement would be two VCR's, one of which must have an "edit/start" facility, as most of the modern ones do. Using the two recorders, it is possible to play scenes off recorder number one, and pass them on to recorder number two in any order. While this is not a fully sophisticated system, it can turn out very serviceable programmes. Such an editing process would, for example, be used to assemble a sequence of shots recorded in various locations. This transfer involves a slight loss in quality, as the recording on cassette number two is obviously a copy of number one. However, this "one-generation" transfer does not produce a noticeable deterioration in quality. It is only if copies of the edited material are required that a significant drop in quality will appear: i.e. if a "third-generation" recording is required. (See Foss,1982,p104)

Sound (Audio):

The built-in microphone on most commercial video cameras is unsuitable for picking voices out of the background noise. It is a far better technique to make use of the personal clip-on microphones for each person to be recorded. A small sound mixer is an item of equipment that would be well worth considering in the basic video setup. The same argument holds, for example, for a person playing a musical instrument and singing.

> "By understanding the problems, by using more than one mike if necessary, and by having a mixer on the way from the mikes to the recording, you begin to record a much better quality of sound. Straining to listen to a poor sound recording is extremely wearisome for an audience, but there is really no need to have this problem. It is really worth the extra study, care and equipment in order to get it right." (Foss,1982,p78)

The above two factors are but two of the many problems that can arise when attempting to records educational video cassettes. They were specifically included as a result of the attempts by the author to produce such a recording. However, despite the limitations of the simple "one-camera" setup, it is felt that the potentials of the medium are great, and that video cassette recordings should feature prominently in the arsenal of teaching aids of the truly innovative and facilitative teacher.

In the future, the exciting video-disc technology, still in its infancy, coupled with the techniques of computer-aided-instruction, could well make the pure video-cassette recordings out of date. At the time of writing, however, the video medium is certainly a most powerful educational aid, and should be used as such.

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