"A STUDY OF THE AFFECTIVE DOMAIN IN SCHOOL SCIENCE"

by

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C O N T E N T S

A C K N O W L E D G E M E N T S

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A B S T R A C T

It has been found that the present science syllabuses to 'O' grade contain material which is of high social relevance. However, normal classroom teaching can take place quite satisfactorily from a certificate point of view but neglect the conscious teaching of these socially important topics. It seems that schools are successful with the cognitive domain but tend to be less successful in helping to develop desirable social attitudes and the willingness to communicate. The purpose of this study is to enable the 'O' grade pupils to develop desirable social attitudes and awareness, change existing attitudes, and as a bonus, to encourage the development of group skills such as communication, co-operation and discussion.

Four topics were chosen for the purpose of the study - "Food and Man" in the third year biology syllabus; "Water Pollution, "Air Pollution" and "Bronchitis and Cancer of the lung", all these three are in the fourth year biology syllabus.

Two different kinds of material were prepared, one for the Experimental Group and the other for the Control Group. For the Experimental Group it included -

(a) media : games, simulation games, a multimedia package and audio-visual programme;

(b) pupil tests;

(c) /

(c) teacher questionnaire;

(d) articles .

For the Control Group it included -

(a) factual articles;

(b) pupil tests;

(c) teacher questionnaire.

Six schools were chosen for the purpose of the study, and the pupils who used the material were in third and fourth year leading to 'O' grade. The general method of application was that the Experimental Group was provided with the simulation and other new materials, whereas the Control Group was provided with an article containing the same facts as appeared in the simulation, etc. Then both were given the same cognitive and affective tests.

Findings showed that the study for the Experimental Group has -

(a) provided a useful addition to the work normally carried out in the classrom;

(b) contributed to the knowledge reinforcement and recall;

(c) helped the pupils to be willing to communicate their understanding to others (through discussion, argument, presentation and reporting);

(d) provided the motivation advantage by helping the pupils to develop a high level of interest, enthusiasm and excitement;

(e) /

(e) helped the pupils to become capable of making their own decisions;

(f) encouraged the pupils to be able to work co-operatively with others;

(g) provided interaction and peer learning.

C H A P T E R 1

THE AFFECTIVE DOMAIN IN SCIENCE TEACHING

C H A P T E R 1

THE AFFECTIVE DOMAIN IN SCIENCE TEACHING

INTRODUCTION

It has been found that the present science syllabuses to 'O' grade contain material which is of high social relevance. In Biology, for example, there are many topics, such as genetics as applied to everyday life, world food problems and everyday environmental problems such as air pollution and water pollution. However, normal classroom teaching can take place quite satisfactorily from a certificate point of view but neglect the conscious teaching of these socially important topics. It seems that teachers are successful with the traditional work, i.e., the cognitive domain but tend to be less successful in helping to develop desirable social attitudes and the willingness to communicate.

The purpose of this study is to enable the 'O' grade pupils to develop desirable social attitudes and awareness, change existing attitudes, and, as a bonus, to encourage the development of group skills such as communication, co-operation, discussion .... , etc.

1.1 THE CONCEPT OF AFFECTIVE DOMAIN

It is that area which deals with feelings, emotions, reactions, interest and enjoyment, and attitudes.

Affective /

Affective objectives are treated in detail in the taxonomy of Krathwohl and his colleagues.[1] The Krathwohl taxonomy seeks to grade the levels of interest shown by a student in a subject into a hierarchy. At the lowest level of this hierarchy is simple receiving (attending to a subject). As a student becomes more interested in a subject or an activity, he exhibits a range of behaviours from simple responding (likes or dislikes the subject) to an ultimate characterization by a value or value-complex. In science, at this highest stage of the taxonomy of affective objectives, the individual is likely to have become a scientist.

1.2 THE BROAD AIMS OF SCIENCE EDUCATION

Curriculum Papers 7[2] have stated these broad aims of science education as follows:-

Pupil should acquire,

(a) some knowledge of the empirical world around him;

(b) a little of the vocabulary and grammar of science, i.e. communication skills;

(c) an ability to observe objectively;

(d) an ability to solve problem situations and think scientifically;

(e) an awareness of the culture which is science.

The objectives of the Nuffield Science Teaching Project are given in its 1964 Progress Report[3] as follows:-

Science Education should provide,

(a) /

(a) an essential ingredient in a humane education;

(b) an indispensable foundation for adult life and work in an increasingly scientific and technological age;

(c) a well-grounded understanding of science (or a branch of science), not a knowledge of disconnected facts;

(d) encouragement of children to think freely and courageously about science in the way that practising scientists do;

(e) experimental and practical inquiry for children as a means of awakening original thought.

Also, the Nuffield Science Teaching Project in 1966[4] stressed the importance of a scientific training and a critical attitude of mind, suggesting that to raise the general standard of science education, pupils should gain an understanding that lasts throughout their lives of what it means to approach a problem scientifically. This approach is compared with the limitations of the short-lived remembering of dictated information.

1.3 OBJECTIVES OF CURRENT SCIENCE SYLLABUSES

These previous aims which have been described are those statements set out for science in general. They are vague and common. Now, let us talk about the objectives of current science syllabuses, i.e., those statements which relate more specifically to the particular subject concerned.

In /

In the Nuffield Biology Teachers' Guide II, "Life and Living Processes" - published in 1966,[5] the following objectives have been stated:-

(a) To develop and encourage an attitude of curiosity and enquiry;

(b) To develop a contemporary outlook on the subject;

(c) To develop an understanding of man as a living organism and his place in nature:

(i) The usefulness and social implications of biology in relation to man's everyday needs, e.g. food and public health.

(ii) The profound influence of man's activities on other organisms.

(iii) The way in which a study of biology enables man to interpret observations that he makes in everyday life, e.g. the distribution of plants and animals.

(d) To foster a realization of the variety of life and of underlying similarities among living things;

(e) To encourage a respect and feeling for all living things;

(f) To teach the art of planning scientific investigations, the formulation of questions, and the design of experiments (particularly the use of controls);

(g) To develop a critical approach to evidence.

Curriculum Papers 7 has stated the following affective objectives to be achieved in years three and four /

four in secondary education:-

Pupils should acquire,

(a) awareness of the relationship of science to other disciplines of knowledge;

(b) awareness of the importance of science in the working, leisure and social aspects of the community and society in general;

(c) an interest and a willingness to participate in science-related leisure pursuits;

(d) willingness to conform to and an interest in propagating sensible rules for safety and good health for the sake of the community, as well as the individual;

(e) an interest in and a willingness to participate in conservation of the natural environment;

(f) an interest in gathering information about science through all the media of communication;

(g) an appreciation of man's responsibility to use science for the benefit of society;

(h) an attitude of objectivity to all decisions and assessments required of the individual.

The Report on the teaching of general science (1950)[6] of the Science Masters' Association (now the Association for Science Education) suggested (pp. 119-121) that the teaching and examining of general science should be concerned with:-

(a) acquisition of scientific information and knowledge;

(b) development of scientific modes of thought - ability /

ability to use scientific knowledge to explain facts of ordinary life;

(c) application of scientific knowledge to socially desirable ends, such as the ability to recognise situations or unsolved problems in which scientific knowledge could usefully be employed;

(d) practical powers or skills, such as the development of manual skill and dexterity; the ability to handle scientific material and apparatus, etc.

In his book, "Science for non-scientists", Goodlad (1973)[7] argues that understanding of science necessarily involves experience of science, adding that knowing about science is not enough.

1.4 THE IMPORTANCE OF AFFECTIVE DOMAIN IN SCIENCE

Relevant attitude formation must be seen as one of the essential contributions of science to the general curriculum. It is probable that success in attitude formation is more important than success in some of the specifically cognitive objectives. This view has been supported by Curriculum Papers 7 in paragraphs 59, 60, 80 and 81. Also, the papers claim that, "We consider that some attempt should be made to develop suitable attitudes to Science .... We hope that some of our Colleges of Education and University Education Departments will be prepared to take an interest in such work, so that teachers can be at least as certain of estimates in this affective domain as they already are in the cognitive." At the end of the Papers' Report, recommendations /

recommendations have been set out. The following is a summary of some of these recommendations relating to the affective domain:-

(a) There should be a reduced emphasis on the retention of factual information in science teaching, instead, the emphasis should be on interest, thinking and communication;

(b) The starting point for work in the second cycle, i.e., third and fourth year, should be that which provides the greatest motivation, essentially connecting it with the outside world;

(c) Suitable attitude assessment should be prepared for this work.

In their writings, many educators have stressed the importance of the affective domain in science. Kuslan and Stone (1968)[8] argue that instruction in science of the non-scientist must strive for goals far nobler than the mere recall of facts and understanding of scientific phenomena. They stress the importance of the affective domain in science teaching to achieve these goals. This view is also supported by Gardner (1975),[9] Ormerod (1974),[10] Rowntree (1973),[11] and Arthur and Platts (1970).[12] MacPherson (1968)[13] argues that science teaching must be attractive. He stresses the importance of interest in science teaching.

Nyholm (1964)[14] states that it is time that we brought our syllabuses up to date and gave teachers a chance to teach science as to stimulate students rather than /

than satisfy a stereotyped system.

Benita, D. (1975)[15] also stresses the importance of the affective domain, warning that if schools do not lay special emphasis on the importance of education in the affective domain then they pay for the neglect in other ways.

1.5 TO WHAT EXTENT HAS SCIENCE EDUCATION CONCERNED ITSELF WITH THE AFFECTIVE DOMAIN ?

It seems that science education has done little in the affective domain. Many educators have criticised the existing school situation in achieving its broad aims especially those objectives which consider that science education should contribute to developing desirable social attitudes.

Benita, D. (1975)[15] says that, "Schools - this still means lessons, main subjects, subsidiary subjects, home work, class work, reports, certificates, promotion .... objectives in the affective and psychomotor domain play at most a secondary role in the conscious planning. The behaviour and attitude of children are principally of interest for the school if they seem to disturb the running order of things. The ideal pupil in a school is mostly still the quiet child who moves seldom and then only quietly, listens attentively, is always prepared, answers the teacher's questions, studies independently and speaks to his neighbours only during the interval."

H.A. Thelen /

H.A. Thelen (1972)[16] and E. Reimer (1971)[17] have supported Benita's view claiming that according to the existing methods of teaching science, the pupils will forever have to be guided by someone else.

A.H. Johnstone and D.W.A. Sharp (1970)[18] reported their findings of enquiries among University students as to the factors governing giving up science subjects at school or continuing with them. They have found that difficulty with mathematics and 'boring' science courses were two popular reasons for discontinuing science as were moderate examination results which were poorer than other optional subjects.

Postman (1970)[19] has also criticised the existing school situation saying that, "At present, the only intellectual skill the schools genuinely value is memorising, and the student behaviour most demanded is answer-giving .... giving someone else's answers to someone else's questions."

Taylor (1960)[20] has also criticised the existing school situation by arguing that the usual kind of education is designed to give answers to questions which nobody asked and to inhibit the student in discovering his own truth and insight. He sees that once the skill of covering up has been acquired, the student may never be called upon to say what he really thinks or feels at any point in his education or later life.

1.6 THE NEED FOR REFORM IN SCIENCE TEACHING

Within recent years, it has been generally realised /

realised that, throughout the world, there is an urgent need for reform in the teaching of science.

It has been suggested that the new science education should be based on aims such as:-

Pupils should,

(a) possess sufficient knowledge to be able to make a reasonable prediction of the outcome of their actions;

(b) have certain skills of communication with other people;

(c) have sufficient insight into the needs and feelings of other people, and also sufficient insight into their own feelings;

(d) have the ability to form their own generalized principles of behaviour.

It has also been suggested that to achieve more progress, new science education must take into account the learners' expectations. Those learners, for example, are expected to develop inquiring minds; to be able to communicate their understanding to others; to become capable of making their own moral judgements; to be able to work co-operatively with others; to be adaptable and capable of adjusting to a changing world; and so on.

But the present situation does not bend itself to the achievement of these skills. Consequently, changes must be made to the classroom situation for these skills to be achieved. Various writers suggest areas which must /

must be looked at seriously. Among the more important are:-

(a) Attention to the development of clear, cogent and more accurate presentations (i.e., method change);

(b) Integrating and involving media, management, computer, simulation processes, game theory and other techniques as applicable to the educational process;

(c) Development of refined testing and selection methodologies to ensure better use of testing as an educational tool for diagnosis and guidance.

But despite all the efforts made to achieve this reform, the emphasis has been still on knowledge, i.e. the cognitive domain, but neglecting the affective domain.

1.7 WHY IS THE AFFECTIVE DOMAIN NEGLECTED ?

Although most educators agree that the affective domain is as important as the cognitive domain, little has been done so far. Normal classroom teaching neglects this domain. One reason for this is that, in contrast to the cognitive domain, changes in behaviour in the affective domain develop more slowly but occasionally changes may occur suddenly in an individual. Another reason for this is that to assess the individual's behavioural change is a matter of considerable technical difficulty. Johnstone (1975)[21] argues that we have a long way to go before we have a stock of valid assessment in the affective domain.

Arthur /

Arthur[12] sees that, in spite of their importance, affective objectives may be neglected or allowed to develop unsystematically for the following reasons:-

(a) difficulty in teaching;

(b) difficulty in testing or grading procedures;

(c) the tendency to concentrate on that which gives quick, observable results;

(d) the view that one's beliefs, attitudes and personality are private matters.

If we talk about the reasons for school failure in achieving the affective objectives in science teaching in some detail, we would find that there are many reasons contributing to this failure. These reasons are as follows:-

A. Problems Relating To The Formation And Change Of Attitudes

These problems can be summarised as follows:-

(a) Many attitudes are highly resistant to change. Hayman, J. and Dawson, M.[22] have noted that "attitude changes consist more often of modifications than of conversions";

(b) Modifying attitudes is a long-term affair. It has been said that the one shot programme is likely to fail for the following reasons:-

(i) Regression very often follows termination of an attitude modification programme, particularly where the target attitudes are deep seated.[23]

(ii) /

(ii) Attitudes tend to slip back to their original position, and continued efforts to modify them are therefore necessary.[22]

(iii) Recent evidence has shown that the effects of several related messages tend to summate,[24] so continually adding information through a long-range programme will result in the greatest attitude change.

(c) The same attitude formation and modification programme will have different effects on different people. Research[25] has shown that these effects differ according to the student's :-

(i) current level of knowledge;

(ii) types of past experience;

(iii) level of ability;

(iv) goals;

(v) prior attitudes.

As Browdy has noted, "Each pupil is the learner of a unique pattern of abilities, achievements, and possibilities."[26] Consequently, each will react in his own unique way to an attitude modification programme.

(d) Attitudes differ in their susceptibility to change. Change is easier, for example, when intensity rather than direction is at stake. Someone can be made more or less favourable or unfavourable than he already is with relative ease; changing him /

him from one side of an issue to the other is more difficult.

(e) Attitudes normally become more inflexible and difficult to change as age increases.(27)

(f) The resistance of an attitude to change depends on:-

(i) Intensity: i.e., its position on the certitude dimension. The further towards the commitment end the attitude is, the more deep-seated and difficult it is to change.

(ii) Direction: i.e., the extent to change which is desired if it is favourable or unfavourable.

B. Problems Relating To The Media Designed To Change Attitudes

There are some problems arising during development, application and assessment of the affective material. During the design of material, the following steps must be taken into account. (See Fig. 1.1)

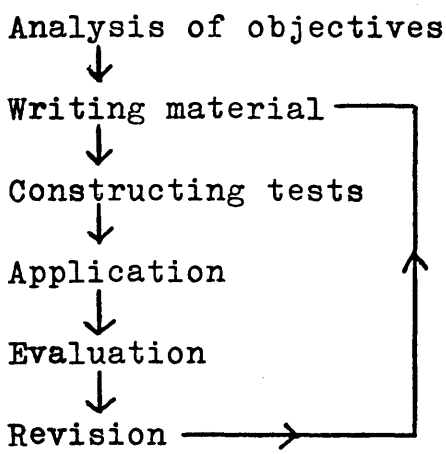


Fig. 1.1

This procedure creates problems such as:-

(a) These processes take a great deal of time;

(b) They are costly;

(c) The nature of the chosen topics. The topics must be carefully chosen to make maximum impact;

(d) It is not an easy job to define behavioural objectives;

(e) Assessment of attitudes is seldom completely successful;

(f) Many classroom management problems may arise;

(g) The techniques of preparing such media demand much skill if they can be logical and capable of changing attitudes.

C. Problems Relating To The Status Of The Person Who Originates The Material

In general, it has been found that the higher the credibility of this person, the greater will be the effectiveness of the communication in changing attitudes.(28) For example, if the pupils' own teacher originates the material, the pupils will strongly accept it. The teacher himself will be enthusiastic about his own material. But if anybody else originates the material, the pupils, and perhaps the teacher, will be less enthusiastic.

D. Problems Relating To The Individual Pupil, That Is, The One Whose Attitudes Are To Be Modified

People /

People perceive only what they wish to perceive. They read or listen to only such material as espouses or can be mis-interpreted to espouse their existing views. So, a message is likely to be effective if it is congruent with existing personality patterns or if it is in harmony with the norms of valued reference groups.

1.8 WHY AIM FOR ATTITUDE OBJECTIVES IN THE FACE OF THESE PROBLEMS ?

If we were to define education as, "What is left when the details are forgotten", what would the education of many people amount to? Many curricula are crowded with knowledge and many of the facts included in these curricula are rapidly forgotten. Weighmann and Weighmann (1973)[29] claimed that, "The knowledge explosion, in combination with an over crowded curriculum, at all levels, is causing many educators to place greater emphasis on attitude conceptualisation."

Paragraph 57 in Curriculum Papers 7 has urged educators to be interested in the affective domain, and adding, "We would see this second cycle as one during which the fundamental concepts, established however qualitatively in the first cycle, are now applied to realistic situations to deepen and broaden understanding, ... a time during which should begin to be seen the understanding, attitudes and skills which we hope our pupils will require. They can then carry away from school /

school something which is of value after much of the factual detail they have learned has been forgotten."

J.D. Halloran (1970)[30] argues that attitudes help us to supply standards or frames of reference for understanding our world.

M.E. Clark (1973), in his book, "Contemporary Biology, Concepts and Implications",[31] stresses the importance of the effectiveness of biology teaching arguing that knowledge, of itself, is neither 'good' nor 'bad' - it lies outside the domain of morality. It is, rather, the use to which knowledge is put that determines whether it brings blessings or evils.

The stress in the 1960's was upon the cognitive development, while in the 1970's, the stress by curriculum planners has been shifted from the cognitive to the affective domain. In this decade, many educators see that an effort should be made to develop the emotional part in teaching science as well as the cognitive part.

In addition to the reasons related to the knowledge explosion, and overcrowded curriculum of science at all levels, there are many reasons which urge educators to stress the importance of affective domain in science.

Favourable attitudes,

(a) help the individual learner to reinforce his previously learned skills;

(b) lead to the achievement of some important skills, such as communication, co-operation, competition .... etc.;

(c) /

(c) lead to the interaction among the learners and also between each individual learner and his teacher;

(d) help the individual learner to make his own decision;

(e) help the individual learner to reduce the inconsistency caused by introducing new information to him;

(f) help the individual learner to organise knowledge in a way which is simpler to him.

CONCLUSION

For too long, attitude formation and modification have been left to chance. While all the efforts have been stressed on the knowledge, it is likely that knowledge will disappear and attitudes remain. Can we leave attitude formation and change to chance?

C H A P T E R 2

ATTITUDES - THEIR NATURE AND MEASUREMENT

C H A P T E R 2

ATTITUDES - THEIR NATURE AND MEASUREMENT

2.1 THE CONCEPT OF ATTITUDE

The many definitions come into two main categories, A. Conceptual and B. Operational.

A. Conceptual Definitions

These definitions refer to their meanings within an abstract theoretical system. There are many of these such as Set and Readiness Views, Affect and Evaluation Definitions, Readiness/Evaluation Definitions and Definitions in terms of The Three Components of Attitudes. Let us examine each in detail.

(a) Set and Readiness Views:-

"In an early historical review of the attitude concept, Gordon Allport (1935) has used this readiness view. Of the 16 definitions that Allport cited, 13 explicitly mentioned either the words "readiness", "set", "tendency to respond", or "disposition to act". When Allport gave his own definition he also described an attitude in terms of readiness."(32)

Examples of this view:-

(i) Allport (1935) : "An attitude is a mental and neural state of <u>readiness</u> organised through experience, exerting a directive or dynamic influence upon the /

the individual's response to all objects and situations with which it is related."(33)

(ii) Newcomb (1950) : "An attitude is a readiness for motive arousal";

(iii) English and English (1958) : "Attitude refers to a predisposition to behave in a particular fashion toward a given object or class of objects and it has a directive effect upon feeling and action related to the object."(34)

Campbell (1963)(35) criticizes these readiness definitions saying that although they have adherents today, they do not differentiate attitudes from habits or other acquired behavioural dispositions.

(b) Affect and Evaluation Definitions:-

(i) Thurstone (1931) : "Attitude is an affect for or against a psychological object."

(ii) Krech and Crutchfield (1948) : "Attitude is an enduring organization of motivational, emotional, perceptual, and cognitive process with respect to some aspect of the individual's world."

(iii) Rhine (1958) : "An attitude is a concept with an evaluative dimension."

(iv) Katz and Stotland (1959) : "An attitude is a tendency or predisposition to evaluate an object or symbol of that object in a certain way."

(v) Fishbein and Raven (1962) : "An attitude is /

is an implicit evaluative response."

(c) Readiness/Evaluation Definitions:-

Schramm (1955) : "By attitudes we mean inferred states of readiness to react in an evaluative way, in support of or against a given stimulus situation."(36)

(d) Definitions in terms of The Three Components of Attitudes:-

This view sees that attitudes are frequently viewed as disposing the individual to feel, think, and act in certain ways and are inferred from these three sources.

According to this view, an attitude consists of three components -

- Cognitive (thought) component: which involves recall or recognition of knowledge, thinking, problem solving, etc.
- Affective (feeling) component: which involves feelings, emotions, reactions, appreciations, interest, enjoyment, etc.
- Behavioural (action) component: which involves the overt action by the individual perceiver.

Here are examples of this view:-

(i) Katz and Stotland (1959) : Saw an attitude as necessarily having both an affective component and a cognitive component, and behavioural component only if a person engaged in action vis-a-vis the attitude object. /

object. They also saw that cognitions without an affective component were viewed as beliefs or judgements, not attitudes.(37)

(ii) Triandis (1971) : "An attitude is an idea charged with emotion which predisposes a class of actions to a particular class of social situations."(38)

This definition suggests that attitudes have three components -

- A cognitive component, that is, the idea which is generally some category used by humans in thinking;
- An affective component, that is, the emotion which charges the idea, i.e., if person "feels good" or "feels bad";
- A behavioural component, that is, a predisposition to action.

However, there is considerable disagreement between the supporters of conceptual definition, for example:-

(a) There is disagreement about the psychological locus of attitudes. Whereas Allport stated that attitudes were "mental and neural states", Krech and Crutchfield (1948)(39) defined it as "motivational, emotional, perceptual and cognitive".

(b) There is disagreement concerning whether attitude should be defined as a response or as a readiness to respond.

(c) /

(c) There is disagreement about the degrees to which attitudes are organised.(40)

(d) There is disagreement concerning the extent to which attitudes are learned through previous experience.

(e) Also, there is disagreement about the extent to which attitudes play a directive-knowledge or a dynamic-motivational function.

B. Operational Definitions

These definitions are in terms of a set of operations as applied to a given test and its structure. The most important methods of defining attitudes through operational definitions are Thurstone's Method (1929), Likert's Method (1932), and Osgood's Method (1957). These methods will be discussed in detail in the attitude measurement.

ATTITUDES TO SCIENCE

Since we are primarily concerned with the emotional reactions of pupils towards science, it would be better for our purposes to define a person's attitude to science. Gardner (1975)(9) defined a person's attitude to science, "As a learned disposition to evaluate in certain ways objects, people, actions, situations or propositions involved in the learning of science". This will form the basis of understanding of the thinking in the remainder of this thesis.

2.2 ATTITUDE CHARACTERISTICS

According to Allport (1935), the following characteristics of attitude are evident:-

(a) An attitude is a state of readiness leading the individual to perceive things and people in certain ways;

(b) It is learned and also it can develop;

(c) It is dynamic;

(d) It leads to emotional evaluations;

(e) It is not directly observed but inferred from overt behaviour.

2.3 ATTITUDE FUNCTIONS

Katz (1960)[41] stated four functions of attitudes. Here is a summary of these functions.

(a) The instrumental, adjustive, or utilitarian function.
This function recognises that people are motivated to gain reward and minimize punishment. Attitudes serving this function are either instrumental in obtaining positive and/or preventing negative reinforcements or they are affective associations acquired in the course of satisfying other motives.

(b) The ego-defensive function.
Attitudes may be acquired and maintained to protect the person from facing threats in the external world or from becoming aware of his own /

own unacceptable impulses.

(c) The value-expressive function.

These attitudes enable the individual to give positive expression to, and an appropriate indication of, his central values and they also enable him to portray the type of person he conceives himself to be.

(d) The knowledge function.

This function recognises that attitudes help individuals to provide an understanding of and to give meaning to, what would otherwise be a not very meaningful situation.

2.4 MEASUREMENT OF ATTITUDES

I. Principles of Measurement of Attitudes

Cook and Seltiz (1964)[42] distinguished five general categories of attitude measures as follows:-

(a) Measures in which inferences are drawn from self reports of beliefs, feelings, behaviour .... etc., towards an object;

(b) Measures in which inferences are drawn from the observation of ongoing behaviour in a natural setting;

(c) Measures in which inferences are drawn from the individual's reaction to or interpretation of partially structured stimuli;

(d) Measures in which inferences are drawn from performance of "objective tasks";

(e) /

(e) Measures in which inferences are drawn from physiological reactions to the attitudinal object or representations of it.

But most studies of attitude formation and change rely on some kind of questionnaire to measure attitudes. These questionnaires usually assess attitudes through either self-reports of opinions and beliefs, self-reports of feelings or evaluations, or self-reports of behaviour or intended actions. The advantage of the self-report measure is that it is rapid, a convenient method, and the responses are highly controlled.

II. Self-Report Measures

The most important methods of attitude measurement by using the self-report techniques are Thurstone's Method (1929), Likert's Method (1932) and Osgood's Method (1957).

The following is a description of each method in some detail.

A. Thurstone's Method Of Equal-Appearing Intervals (1929)

This method is summarised as follows:-

(a) Many statements (i.e., "items") about the attitude topic are collected;

(b) These statements are then sorted by a group of judges into a series of eleven piles which are presumed /

presumed to be equally spaced on a continuum, ranging from extremely favourable to extremely unfavourable towards the topic;

(c) Ambiguous and irrelevant items are then eliminated. These are items on which the judges are not able to agree reliably on their placement along the continuum;

(d) The respondent is then asked to check the items with which he agrees;

(e) The attitude score is the mean or median of the scale values of the items that the respondent endorsed.

This method of measurement has been criticized in the following ways:-

(a) It is cumbersome and time-consuming to construct;

(b) It may be useful when applied to very general vague attitudes, but it is doubtful if such a method could easily measure precise attitude variables.

(c) Scale values are influenced by the attitudes of the judges. This criticism, however, can be eliminated by further refinements of the procedure.

(d) Identical scores may be arrived at in more than one way. Thus persons with the same attitude score may not have the same attitude.(44)

Nevertheless, this method has been used in the field of attitudes to science by Ormerod,(45) and Dutton and Stephens.(46)

B. /

B. Likert's Method Of Summated Ratings (1932)[47]

The following summarize this method:-

(a) A large number of opinion items are collected;

(b) These items are then classified by the questionnaire constructor according to whether the item is favourable or unfavourable towards the attitude object;

(c) The respondent is then asked to indicate how much he agrees or disagrees with each item of opinion on a five-point scale;

(d) The attitude score is the sum of the scores the respondent received on each item.

Although this method of measurement is much simpler than Thurstone's Method, it can be criticized as follows:-

(a) It requires an item analysis to demonstrate that all the items measure the same attitude;

(b) This method, like Thurstone's Method, may be useful when applied to very general attitudes, but it may be inappropriate as a means of measuring precise attitudes;

(c) Identical scores may be arrived at in more than one way.

Nevertheless, this method has been used in the field of attitudes to science. Brown and Davis[48] used this technique to construct five sub-scales each relating to an attitudinal objective laid down for pupils in the first two years of secondary education in /

in Scotland. Barker Lunn[49] also used this technique in measuring English school children's attitudes.

C. Osgood's Method Of Semantic Differential (1957)[50]

This method is summarized as follows:-

(a) The questionnaire constructor presents a word or phrase representing an attitude object (e.g. "Biology lessons" or "science laboratory");

(b) Then, this will be followed by several bipolar adjective scales, such as; good-bad, interesting-dull, pleasant-unpleasant, ... etc. Each pair of these adjectives is typically separated by seven intervals;

(c) The respondent marks a position on each scale for each object.

(d) Responses can be analysed in several ways. Hadden[51] lists these ways as follows:-

(i) "The overall similarity of any two concepts for an individual or group can be found by the position of the concept on all scales;

(ii) Three main factors which, it is claimed, the technique can measure, viz, "evaluative", "potency" and "activity" can be determined by separate analysis of word pairs which manifest three factors;

(iii) /

(iii) Three dimensional models can be constructed for an individual with axes reflecting responses to, e.g. "good", "active" and "weak", and points which represent where different concepts are found relative to these axes are plotted. Several concepts, when plotted give a pattern for an individual or group which, when compared with patterns developed by other individuals or groups, or at different times for the same individuals or groups, can show differences and changes in attitudes."

Although this method of measurement is very rapid in all ways, it can be criticized in that it may not be valid to add the scores from each continuum.

Nevertheless, Osgood's technique has been found to be reliable.(52) Also, it has been claimed by Brunton(53) that this technique's validity appears to be high, based on its higher correlations with scores obtained by traditional Thurstone, Likert and Guttman type of scales. However, if Thurstone, Likert and Guttman are faulty, then Osgood may also be faulty.

Over the past few years work by Johnstone, Handy and Hadden (1974)(54) has produced other measurement techniques which have tried to avoid the problems associated with summation and statistical treatment of results. This method aims to measure attitudes <u>through</u> a study rather /

rather than attitudes to the study. In this method, matched groups of students have been asked to solve a problem situation which can be tackled by different ways depending on the attitudes absorbed through the study. No arithmetical procedure hides the detailed reaction to the situation. The statistical treatment does not involve summation, but rather presenting information in graphical and tabular forms. Examples are found in Chapters 5, 6, 7 and 8 in this thesis.

2.5 THE THEORY BEHIND ATTITUDE FORMATION AND CHANGE

A great number of theories have been proposed to explain attitude formation and change. Although these theories have many limitations, they provide useful ways of thinking about the process underlying attitude change.

The following is a summary illustrating some of these theories:-

I. Cognitive Consistency Theories

In general, these theories are concerned with inconsistencies that arise between related beliefs, bits of knowledge, and evaluations about an object or an issue. These theories include, A. Balance Theory, B. Congruity Theory, C. Affective-Cognitive Consistency Theory, and D. Dissonance Theory. The following is a summary of each.

A. /

A. Balance Theory

The basic model of this theory was set up by Heider (1946)[55] (1958).[56] The theory is concerned mainly with the relationships among three elements:- the perceiver P; the other person O; and object X.

The Theory Assumptions

(a) Two generic types of relationships were considered to exist between elements; liking relationship (L) including all forms of affect (e.g., liking, loving, approving, admiring .... etc.), and unit relationship (U) which expresses the fact that two elements are perceived as belonging together (e.g., similar, close to, part of, belongs, possesses, ... etc.);

(b) Both relationships, i.e. liking relationship and unit relationship can be positive (+L or +U) or negative (-L or -U);

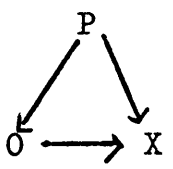
(c) Balance exists if all three relations are positive or if two relations are negative and one is positive;

(d) Imbalance exists if all three relations are negative or if two relations are positive and one is negative.

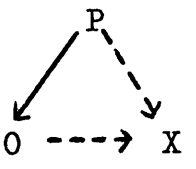
The following figures show the four possible balanced configurations, and the four possible imbalanced configurations. A full line indicates liking or ownership and the dotted lines indicate disliking or does not possess.

The /

The balanced configurations



(a)



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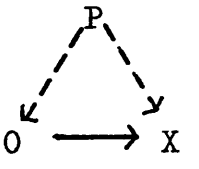

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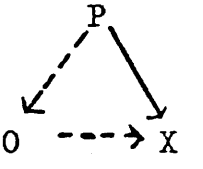
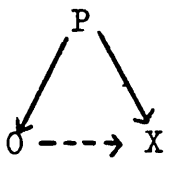
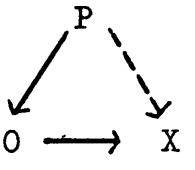


(d)

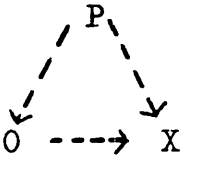
The imbalanced configurations



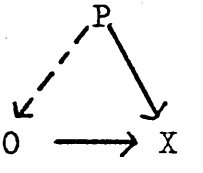
(e)



(f)



(g)



(h)

(e) Balanced states are stable, whereas imbalanced states are unstable, which consequently leads to a psychological tension by the perceiver leading him to restore balance cognitively by changing the relations. For example, in triad (f) the balance can be achieved in several ways: by change in P's attitude towards X; by change in P's attitude towards O; or by change in the relationship between O and X.

<u>The Theory Predictions</u>

(a) A person's attitude towards an issue depends on his attitude towards a source (the other person - O) who is linked with the issue;

(b) An individual will be attracted to or feel positively towards people whom he perceives to feel as he does about objects and issues, and will feel negatively towards people whom he perceives as disagreeing with him.

<u>The</u> /

The Theory Deficiencies

Osgood (1960)[57] and Zajonc (1960)[58] have noted a number of deficiencies in Heider's balance model. The following summarise some of these deficiencies:-

(a) The theory does not consider the degree of liking or unit relationship which consequently leads to no degrees of balance and imbalance;

(b) It is not possible to make quantitative predictions about the degree of change;

(c) The theory did not consider systems that have more than three elements;

(d) There is a problem with the negative unit relationship; is it to be interpreted as the absence of a positive relationship or as the opposite of a positive relationship?

(e) The theory does not make specific predictions about which relationship will be changed to restore balance.

B. Congruity Theory

This theory was proposed by Osgood and Tannenbaum (1955)[59]. The theory is similar to Heider's theory but deals specifically with the problem of the acceptance of communication. The theory is only concerned with predicting the person's evaluation of the source and of the concept. In this special situation, there is a person P, another person or source S, and a concept, object or matter O.

The Theory Assumptions /

The Theory Assumptions

(a) Congruity exists when a source S and concept O that are positively associated, have exactly the same evaluation by the person P, and when a source S and concept O that are negatively associated, have exactly the opposite evaluations by a person P;

(b) In tests of the congruity models, the source S and the concept O are each evaluated on a semantic differential scale, as has been explained before, on which scores range from +3 to -3. The theory suggests that if the source is related to the concept by positive assertion, the congruity exists if the evaluation of the two is exactly the same (e.g., a +3 source and a +3 concept). If the source is related to the concept by a negative assertion, congruity exists if the evaluation of the two is exactly the same but opposite in sign (e.g., a +3 source and a -3 concept).

The Theory Predictions

(a) When incongruity exists, the person's attitudes towards both the source and concept will change;

(b) When incongruity exists, the more extreme the person's attitude is towards one of the "objects", the less will that attitude change.

The Theory Evaluation

Congruity theory is more specific in its predictions /

predictions about changes in evaluation than balance theory. A study by Tannenbaum (1966) supports the general aspects of congruity theory. This study shows that if two concepts are linked by either positive or negative assertions to a single source, attitude change towards one of the concepts produces a change in source evaluation, which then produces a change towards the second concept.

C. Affective-Cognitive Consistency Theory

This theory was proposed by Rosenberg (1956)[61] (1960).[62] In this theory, Rosenberg has been concerned with the consistency between a person's overall attitude or affect towards an object or issue and his beliefs about its relationship to his more general values.

The Theory Assumptions

(a) A person's affect towards or evaluation of the attitude object tends to be consistent with his cognitive structural component;

(b) When there is inconsistency between the two beyond a certain level of tolerance, the individual is motivated to reduce the inconsistency and thereby to change one or both components to make them more consistent.

The Theory Predictions

(a) Changes in the cognitive component through persuasive communications produce changes in the /

the affective component;

(b) Changes in the affective component produce changes in the cognitive component in order to bring about consistency between the two.

The Theory Deficiency

(a) There has been little concern with the content of the communication, and also with degrees of kinds of reactions to sources of communication;

(b) The theory has not produced much subsequent research.

D. Dissonance Theory

This theory was proposed by Festinger (1957).[63] The theory is concerned with the relations among "cognitive elements" and the consequences when elements are inconsistent with one another. According to this theory, cognitive elements are defined as bits of knowledge or opinions or beliefs about oneself, about one's behaviour, and about one's surroundings in the environment.

The Theory Assumptions

(a) The theory suggests three possible relationships among elements:

(i) They may be irrelevant to one another. (The knowledge that I smoke heavily, and the knowledge that it is raining in South Africa.);

(ii) They may be relevant and consistent (referred to as consonant) with one another/

another. (The knowledge that I smoke heavily, and the knowledge that smokers are regarded as more masculine.);

(iii) They may be relevant but inconsistent (referred to as dissonant) with one another. (The knowledge that I smoke heavily, and the knowledge that smoking causes lung cancer.);

(b) Dissonance is a state of psychological tension that motivates the organism to reduce dissonance;

(c) Dissonance may be reduced -

(i) by changing elements (or the behaviour related to element);

(ii) by changing the importance of elements;

(iii) by adding contrast elements;

(iv) by making dissonant elements irrelevant to each other;

(d) In addition to attempting to reduce dissonance, the organism avoids information that would increase dissonance.

The Theory Predictions

(a) A person experiences dissonance when he engages in behaviour contrary to his attitude;

(b) The less the amount of justification (e.g., reward promised for engaging in the behaviour), the more the dissonance aroused. If all avenues of dissonance reduction, other than attitude change, are /

are closed off, the theory predicts that a person changes his attitude to make it more consonant with his behaviour;

(c) The amount of attitude change depends on the amount of dissonance aroused;

(d) Maximum attitude change is achieved by giving a person the amount of justification just barely sufficient to induce him to engage in the counterattitudinal act;

(e) The individual seeks consonant information and avoids dissonant information. Furthermore, the greater the amount of dissonance a person is experiencing at the moment, the greater is his tendency to seek supportive and avoid non-supportive information;

(f) Dissonance and decision making: according to this theory, when a person has to choose among a number of alternatives, he experiences conflict before the decision, and dissonance after the decision.

The Theory Deficiencies

Kiesler, Collins and Miller (1969)[40] have stated criticisms to this theory.

The following is a summary of some of their views;-

(a) It is extremely difficult, if not impossible, to make precise quantitative measurements of the degree of dissonance;

(b) The theory has not mentioned how dissonance may be reduced /

reduced in practical concern as well as theoretical interest;

(c) Precise predictions are impeded by the difficulty in measuring a cognitive element's resistance to change;

(d) How do we measure the importance of an element? This term is vague;

(e) Several critics have claimed that dissonance theory is disproven because of the vagueness of some terms.

Nevertheless,[40] the theory has been an extraordinary useful tool for the study of attitude and cognitive change.

II. Social Judgement Theory

It was proposed by Sherif and Hovland (1961).[64] The theory is concerned with assimilation affects as well as contrast affects.

The Theory Assumptions

(a) A person's initial attitude serves as an anchor for the judgement of attitudinally related stimuli and provides a point of reference against which he evaluates other opinions;

(b) The other views on the issue could be ordered on the attitudinal continuum and that the dimension could be considered as comprised of categories or latitudes;

(c) /

(c) According to Sherif and Hovland (1961),[64] Sherif, Sherif and Nebergall (1965),[65] when introducing other opinions -

(i) the latitude of acceptance, which is the range of opinions the individual finds acceptable, encompasses the opinion that best characterizes his own stand;

(ii) the latitude of rejection, which is the range of opinions the individual finds objectionable, encompasses the opinion that he finds most objectionable;

(iii) the latitude of non-commitment is the range of opinions that the person finds neither acceptable nor unacceptable;

(d) The widths of a person's latitudes and the location of his preferred position on an issue determine how he judges and evaluates a communication:

(i) If a communication falls within his latitude of acceptance, he assimilates it (i.e., views it as clear to his own stand) and evaluates it as fair and unbiased;

(ii) If a communication falls within his latitude of rejection, he contrasts it (i.e., views it as further away from his own stand) and evaluates it as relatively unfair and biased.

The Theory Predictions

(a) With respect to attitude change, the theory predicts that: /

that:

(i) Communications that are judged to be within the latitude of acceptance produce change towards the message. The greater the discrepancy between the initial position of the recipient and the position advocated in the message, the greater the attitude change;

(ii) For communications that fall within the latitude of rejection, the greater the discrepancy, the less the change;

(b) The theory argues that the latitude widths are affected by factors such as the degree of the respondent's self-involvement and the communicator credibility.

The theory Deficiencies

There are a number of ambiguities in the theory, such as:-

(a) There is no clear-cut evidence that differences in latitude width mediate involvement's effect on attitude change;

(b) It is difficult to test the communicator credibility, because the communicator and message are presented together;

(c) The theory is vague in specifying the exact relationship between judgemental displacements and attitude change.

III. /

III. Functional Theory

It was proposed by Katz (1960),[41] and Katz and Stotland (1959).[37] This theory is concerned with the relationship between attitudes and other facets of human behaviour.

The Theory Assumptions

Four functions that attitudes may serve for an individual are defined. These functions have been discussed in another place in this chapter - under the heading "Attitude Functions".

The Theory Deficiency

This theory has not stimulated much research, except for the work on changing ego-defensive attitudes, for the following reasons:-

(a) There are problems associating with identifying which function a specific attitude serves for a given individual;

(b) The framework specifies the conditions for attitude arousal and change only at a very global level.

CONCLUSION

For the purposes of the research work, some of these theories have been found to build the theoretical basis in developing, applying, and evaluating the material as follows:-

(a) Congruity Theory has contributed to the material assessment, i.e. the Semantic Differential Method. However, /

However, the problems associated with summation and statistical treatment of results, have been avoided by depending on the measurement techniques which have been produced by Johnstone, Handy and Hadden (1974)[54] as it has been mentioned before;

(b) Affective-Cognitive Consistency Theory has been found useful in the material structure and application - the relationship between cognitive component and affective component and also the role of persuasive communications;

(c) Dissonance Theory has been found useful in the material structure and application in general, and particularly, the material of "Cigarette Smoking";

(d) Social Judgement Theory has been found useful in the material application, especially the role of communication in changing attitudes.

C H A P T E R 3

EDUCATIONAL MEDIA AND ATTITUDE CHANGE

C H A P T E R 3

EDUCATIONAL MEDIA AND ATTITUDE CHANGE

3.1 THE CONCEPT OF EDUCATIONAL MEDIUM

Educational medium is the vehicle which carries the message. It is this technique which assists students to acquire, retain and transfer responses.

Dewey[66] defined the concept of medium as:-

> "Medium signifies first of all an intermediary. The import of the word "means" is the same. They are the middle, the intervening things through which something now remote is brought to pass. Yet not all means are media. ..... A medium as distinct from raw material is always a mode of language and thus of expression and communication. Pigments, marble and bronze, sounds, are not media of themselves. They enter into the formation of a medium only when they interact with the mind and skill of an individual."

Dewey's definition of media was aimed at clarifying its usage in art. However, it can be generalized to the educational field.

From Dewey's definition, we can conclude the following characteristics of media:-

(a) They are not everything seen, heard, read, talked about, etc.;

(b) /

(b) They cannot be defined on the basis of mechanical considerations, television, motion, pictures, radio, ... etc.;

(c) They form a particular mode of language and consequently of communication.

3.2 MEDIA FUNCTIONS

I. General Functions

In general, it has been said that media can be used for:-

(a) Motivation;

(b) Recalling earlier learning;

(c) Providing new stimuli and new instructional situations;

(d) Activating the student's response;

(e) Getting feedback about pupil's learning;

II. Specific Functions for Attitude Change

One possible use of media in education is the development and modification of attitudes. This view is supported by Hayman and Dawson (1970).[22] Educational technologists see that pupils' attitudes may be modified or changed by developing suitable media or programmes. Then these media or programmes should be put in a school situation so that evaluation takes place.

Research /

Research[24] has shown that :-

(a) when suitable media are well developed, applied and assessed, they can lead to attitude change;

(b) continually adding information through a long-range programme will result in the greatest attitude change.

3.3 THE NEED FOR USING MEDIA

Paragraphs 92 and 95 in the Curriculum Papers 7 have mentioned the importance of using media in the classroom urging teachers to use them. The following statements are quoted:-

> "Teachers, headmasters and local authorities all must reassess their attitudes to visual and other aids. The teacher should integrate them with his normal lessons so that the best use can be made of material which would be quite impossible to obtain in the classroom."
> - Paragraph 92.
>
> "At the time of rapid growth in technology in education, announcements are made, almost daily, of new devices or new techniques for use in the classroom. It is clear that we are only at the beginning of what is likely to be a revolution in teaching methods." - Paragraph 95.

3.4 THE SUITABLE MEDIA FOR THE AFFECTIVE DOMAIN

Now, we proceed to an important question:- What kind /

kind of media are likely to be the most suitable for changing attitudes? Educational technologists see that their kind of media can help pupils to develop inquiring minds, to be willing to communicate their understanding to others, to become capable of making their own decisions, to be able to work co-operatively with others and to be adaptable and capable of adjusting to a changing world. Educators agree that games, simulations, case studies, role playing and audio-visual programmes are some of these media, which if they are well prepared, applied and evaluated, can lead to attitude change.

For the purpose of this study, the stress was made on games and simulations. One of the reasons is that many educators see that games and simulations can play a major part in changing attitudes. In his book "Games for Growth", Gordon (1972)[67] has claimed that games and simulations can be used to change attitudes; to improve participant's attitudes towards learning; and to increase the student's feeling of effectiveness in his environment.

Now, let us talk, in some detail, about games and simulations as suitable media for the affective domain.

I. What Games and Simulations Are

Tansey and Unwin (1969)[68] defined simulation as:- "the representation of a situation or environment by some analogue, usually of less complexity and greater convenience /

convenience and often with a compressed time scale".

Twelker (1971)[69] has defined simulation as follows:-

"Simulation = (real life) - (task - irrelevant elements)"

Daniels (1975)[70] has defined games as those techniques which involve a real element of competition governed by rules which themselves may be of a dynamic nature.

Bloomer (1973)[71] has defined simulation, game and simulation game as follows:-

A simulation : is an ongoing representation of reality; it may be an abstracted, simplified or accelerated model of the process.

A game : is played when one or more players compete for pay-offs, according to an agreed set of rules.

A simulation game : is therefore something which combines the features of a game (competition, rules, players) with those of a simulation (incorporation of critical features of reality).

Taylor and Walford (1972)[72] have defined simulation saying that:-

"What happens in any simulation .... is that :

1. Players take on roles which are representative of the real world, and then make decisions in response to their assessment of the setting in which they find themselves.

2. /

2. They experience simulated consequences which relate to their decisions and their general performance.
3. They monitor the results of their actions, and are brought to reflect upon the relationship between their own decisions and the resultant consequences."

II. Why Games and Simulations Should Be Played In The Classroom

Educators agree that the object of the game is to involve the student in the types of situation, motives, practical constraints and decisions that are the subject of study, not the specific details. The student should emerge from the game with a better understanding of what it was all about, what was possible and what was not, and why.

There are many advantages achieved from using games and simulations in the classroom. The following are some of these advantages.

A. Games and Simulations for Motivation

Games and simulations can achieve the motivation advantage for many reasons:-

(a) They require active participation. Players can negotiate, bargain, debate, discuss, argue, etc.;

(b) They help the players to make their own decisions. Players /

Players can take decisions and then observe their consequences;

(c) They help the players to gain a feeling of control over their environment;

(d) They provide the players with quick feedback. Participants know immediately what they have done and the reasons for their success or failure. Educators agree that quick feedback is a valuable reinforcement of learning;

(e) They develop a high level of interest, enthusiasm and excitement;

(f) They introduce real-life situations into the classroom;

(g) They provide interaction and peer learning. Almost all educational games call for interaction among players. As a result, they help the participants to develop the willingness to communicate their ideas with each other;

(h) They develop competition and co-operation. All games are competitive to some extent. Also players in one team co-operate among themselves to compete with other teams.

For all these reasons, some educators see that if educational games did nothing more than motivate students, that would be sufficient justification for playing them.

B. Games And Simulations For Learning And Growth

It has been found that games and simulations have an /

an important role in learning and growth in several ways:-

(a) They are usually concerned with developing problem-solving abilities and with cultivating an understanding of the processes.
Because they emphasize decision making, players utilize what they know - facts and concepts - and apply it to the problem at hand.
Schild (1971)[73] has done a study on the influence of games in the school achievement of five hundred children. The study has shown significant improvement in the learning of some facts and concepts, but not all.
A study by Gordon (1968)[74] has shown that a number of simulations appear to have been useful with both gifted and slow learners at the same time.

(b) They may help the players to deepen their comprehension. When the participant plays a game or simulation, he must understand his function in a situation. As a result, comprehension of his function in relation to others is deepened;

(c) They may help the participant to analyse and synthesize the relationships among different facts;

(d) They may help the participants to make judgements. In playing a game, students implicitly evaluate their own actions and those of other players continuously. When a game depends heavily on negobiation /

negociation, the participant must evaluate the deals or promises offered by other players in terms of how well these satisfy his own interests.

C. Games And Simulations For Developing And Changing Attitudes

Although many educators claim that games and simulations can develop and change attitudes, there is no clear-cut evidence so far supporting this opinion. However, research has shown that there is no complete success in developing and changing attitudes through games and simulations because there are many problems relating to attitude change. These problems were discussed before in the previous chapter. This present study, which includes preparation, application and evaluation of media designed to develop and change attitudes and to engender communication skills in science at 'O' grade, will show to what extent games and simulations can achieve this. Educators agree that despite the incomplete success of games and simulations in attitude change, if well developed, applied and evaluated, they should be able to serve many functions in the classroom; see Fig. 3.1.

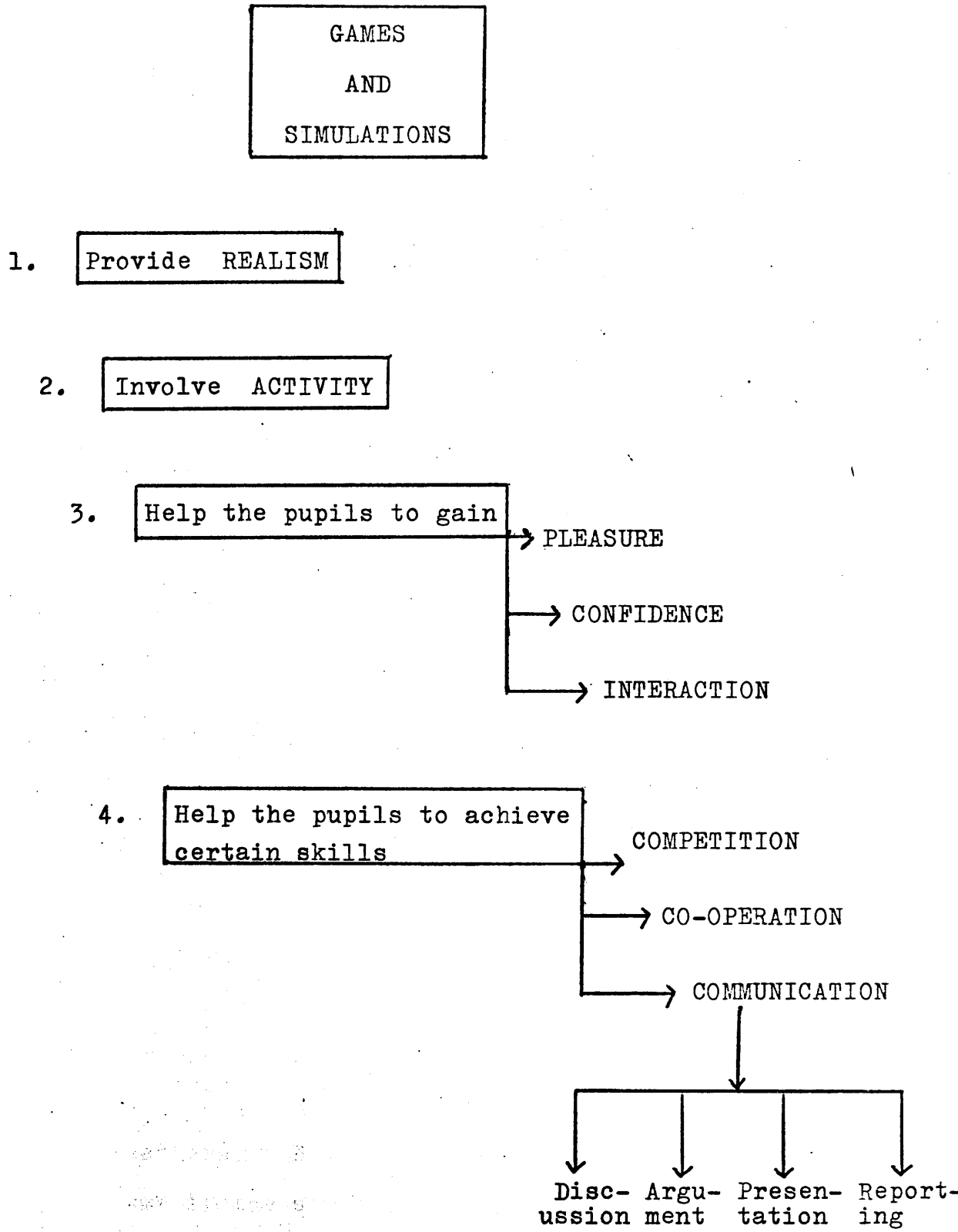

GAMES
AND
SIMULATIONS
1. Provide REALISM
2. Involve ACTIVITY
3. Help the pupils to gain
PLEASURE
CONFIDENCE
INTERACTION
4. Help the pupils to achieve certain skills
COMPETITION
CO-OPERATION
COMMUNICATION
Discussion
Argument
Presentation
Reporting

Figure 3.1

III. Some Problems associated with Games and Simulations

There are some reservations about the use of simulations and games in the classroom situation:-

(a) There are classroom management problems. These can be overcome by careful planning at the preparation stage;

(b) Games and simulations are time-consuming. It is a frequent cry of the classroom teacher, that the introduction of games and simulations in the classroom is seriously hampered by the lack of time available and also because of examination demands. This problem can also be overcome at the preparation stage. The units devised for this present study last for one hour only;

(c) The cost of the most commonly used simulation is rather high. Nevertheless, once made, they can be used for many years. They may be as cost effective as any other medium such as films and television;

(d) Their use in the classroom may be unfamiliar not only to the students themselves, but also to the teachers. However, this problem can be overcome if the structure of the unit is simple and the instructions are straightforward;

(e) The teachers' attitudes may affect their use. This problem can be overcome; one possibility is that they should be given a role in the game or /

or simulation and become deeply involved. Also, well developed games and simulations may encourage teachers to be convinced of their value.

In conclusion, it should be stated quite clearly that we are not trying to prove that games and simulations are better than the more conventional forms of teaching and learning. To quote from Tansey and Unwin (1969)[68],

> "The whole of simulation is merely a means to an end. It is an alternative strategy. If the lecture .... or any other method works there is no need for simulation. If, on the other hand, these methods are not achieving the results that are desired, then it is as well to have an alternative method of presentation. Simulation is merely this method of presentation."

Nevertheless, since other forms of learning rarely make provision for group learning and decision making, we feel that there will be an increasing demand for simulation exercise. Tribe and Peacock (1973)[75] support this view.

3.5 FACTORS INFLUENCING THE EFFICIENCY OF THE MEDIA DESIGNED TO CHANGE ATTITUDES

Special attention must be given to the matter of reaching the audience. This can be achieved by the following means:-

(a) The pupils' attention must be gained and held;

(b) The material presented to them must be understandable;

(c) /

(c) It must be presented in such an attractive way as to encourage them to participate.

After the message reaches its intended audience, however, its efficacy still depends on a number of factors. These factors are:-

A. Characteristics of the message;

B. Characteristics of the person sending it;

C. Characteristics of the pupils for whom it is intended.

Let us talk about each of these factors in some detail.

A. Characteristics of the Message

(a) The message should not arouse much fear;(76)

(b) The material should contain new information which has not been known before. This new information should be strong enough to make an impact on the pupil;

(c) The material must be relevant to the pupils' ages and intelligence;

(d) Real life situations are more acceptable than others;

(e) The media structure must be logical, i.e. each idea should lead to or imply another relevant one;

(f) The information must be relevant to help the learners to achieve specific skills, such as competition, co-operation, discussion, argument etc.

The /

The most suitable media which are capable of achieving these skills are those ones which include diagrams, maps, colour slides, drawings, graphs, charts, etc. By using these aids, the impact is frequently faster and more lasting.

B. Characteristics of the Person sending the Message

It has been found that the higher the credibility of the person sending the communication, the greater will be the effectiveness of the communication in changing attitudes. The communicator can be credible in a number of ways:-

(a) He may be seen as impartial and trustworthy;

(b) He may be considered an expert in the area under consideration;

(c) He may be perceived as intending only to inform his audience and not to manipulate them in any way;

(d) He may be similar to the receiver in some way;

(e) He may be personally liked.

Whatever the source of his credibility, however, it assists him in modifying the attitudes of the audience.

C. Characteristics of the Pupils whose Attitudes are to be modified

Generally, one can say that a message is more likely to be effective if it is congruent with existing personality /

personality patterns or if it is in harmony with the norms of valued reference groups.(77) Thus, it is better in most cases to begin with where a person is and work changes gradually.

Susceptibility to change depends also on a set of personality factors which might be referred to as self-dependence or self-sufficiency. Edwards (1964)(78) and Goldstein (1953)(79) have mentioned these factors.

The following is a summary of this view:-

(a) The person who is self-sufficient is difficult to change;

(b) Those who tend to be rigid in respect for and obedience to authority, are more likely to be changed through persuasive communication;

(c) Those who are other-directed, i.e. who depend on relationships with other people, are more susceptible to change than those who tend to be inner-directed;

(d) Those who are affected less by social isolation are likely to be affected less by communications designed to change attitudes;

(e) A person's reference groups, and the extent of his dependence on them, affect his changeability.

3.6 LIMITATIONS OF MEDIA

The following are some specific observations which may be made concerning the use of media in attitude formation /

formation and modification:-

(a) There are no clear-cut formulae to be applied willy-nilly in using media. Certain value judgements are necessary;

(b) It is preferable to utilize a variety of media, i.e. multi media rather than depending on one medium;

(c) It has been found that sound-motion pictures, tape-slides sequence and television are the most suitable, because they can easily reach the level of non verbal and subconscious behaviour.

However, planning of a course or series of courses in which a major purpose is to develop or modify attitudes is a difficult task which requires understanding and care. It can be done, however.

C H A P T E R 4

THE EXPERIMENTAL STUDY - GENERAL INTRODUCTION

C H A P T E R 4

THE EXPERIMENTAL STUDY - GENERAL INTRODUCTION

4.1 PURPOSE OF THE STUDY

The study aims to enable '0' grade pupils to:-

(a) develop desirable social attitudes and awareness;

(b) change existing attitudes;

(c) and as a bonus, to encourage the development of group skills such as communication, co-operation, competition, etc.

4.2 SCOPE OF THE STUDY

(a) Six schools were selected for the study. These schools were:-

North Kelvinside Secondary School, Glasgow
Woodside Secondary School, Glasgow
Johnstone High School, Johnstone
John Neilson High School, Paisley
Hamilton Grammar School, Hamilton
Lenzie Academy, Lenzie

(b) The pupils who used the material were in third and fourth years leading to '0' grade.

4.3 PREPARATION FOR THE STUDY

A. The biology syllabuses at '0' grade were carefully examined to identify areas which would be capable of:-

(a) /

(a) developing desirable social attitudes and awareness;

(b) affording material which would enable pupils to be willing to communicate their ideas to each other.

The following topics were chosen:-

(a) FOOD : "Food and Man", in the third year biology syllabus;

(b) MAN IN HIS ECOSYSTEM :

(i) "Water Pollution" in the fourth year biology syllabus;

(ii) "Air Pollution" in the fourth year biology syllabus.

(c) EXCHANGE OF GASES : "Bronchitis and Cancer of the Lung" in the fourth year biology syllabus.

B. A number of science advisers and biology teachers in the six schools mentioned before were consulted -

(a) to see if they agreed or disagreed with the chosen topics;

(b) to check if these areas were already being used by them for this purpose.

All of them agreed with the choice, and also claimed that these areas were not already being used by them for this purpose.

C. To study the pupils' existing attitudes to science in general, to be in contact with teachers and pupils, and to make sure that these areas were not used by teachers /

teachers for the purpose of the study, the researcher:-

(a) visited all the schools which were selected for his research work;

(b) attended many lessons in biology and chemistry as well - one day every week for three months - in one of these schools, North Kelvinside Secondary School.

D. Material Preparation

In the light of A, B and C above, the material was prepared. This material will be discussed in some detail in the following chapters, but, in general, two different kinds of material were prepared, one for the Control Group and the other for the Experimental Group.

Material for the Experimental Group

This material will be discussed in detail in the following chapters, but in general it was made up of the following components:-

(a) Media

(i) Games : "FOOD GAMES" (FOOD TRICKS GAME and FOOD RUMMY GAME);

(ii) Simulation Games : "STRATHCLYDE PARK GAME" and "AIR POLLUTION GAME";

(iii) A multimedia package : "CIGARETTE SMOKING";

(iv) Audio-visual Programme : "FOOD IS A WORLD PROBLEM".

(b) /

(b) Pupil Tests : Cognitive; Affective.

(c) Teacher Questionnaires, including a list of educational objectives which it was hoped to be achieved by means of each medium;

(d) Articles :

"RIVER POLLUTION IN SCOTLAND" and

"AIR POLLUTION AND HEALTH".

Material for the Control Group

(a) Factual articles on :-

"NUTRITION AND FOOD";

"RIVER POLLUTION IN SCOTLAND" (the same article as for the Experimental Group);

"AIR POLLUTION AND HEALTH" (different from that used by the Experimental Group);

"SMOKING AND HEALTH";

(b) Pupil Tests : the same cognitive and affective tests as used with the Experimental Group;

(c) Teacher Questionnaires : the same questionnaires as used with the Experimental Group;

E. Material Application

The design of application will be discussed in detail in the following chapters, but the general method of application was as follows:-

Group 1 /

Group 1	Group 2
Experimental Group	Control Group
(a) Provided with the simulation and other new materials. (b) Tests : cognitive and affective.	(a) Provided with an article containing the same facts as appeared in the simulation, etc. (b) Same tests as Experimental Group

F. Material Assessment

Again, the techniques of assessment for each medium will be discussed in detail in the following chapters, but the general techniques of assessment were:-

(a) Likert's Method of Summated Ratings (1932);

(b) Osgood's Method of Semantic Differential (1957);

(c) The Method designed by Johnstone, Hadden and Handy (1973/4).

C H A P T E R 5

THE FIRST UNIT : "FOOD AND MAN"

C H A P T E R 5

THE FIRST UNIT : "FOOD AND MAN"

This unit was applied in two consecutive years, thus allowing the final edition to be modified in the light of comments received on the trial edition.

5.1 THE TRIAL EDITION OF THE UNIT

A. The Design Of The Unit

(a) The educational objectives of the unit were defined;

(b) The material preparation: This material included:

(i) A set of cards, along with rules, for playing the following games -

FOOD TRICKS GAME

FOOD RUMMY GAME

CAMP SUPPLIES GAME

(ii) A set of colour slides and a cassette for an audio-visual programme on the theme, "FOOD IS A WORLD PROBLEM".

(c) The material application: It was applied in 1974-75 to third year S.C.E. biology pupils in the six selected schools. It was also tried by twenty science teachers who attended a one-day conference in Kirkcaldy, Scotland.

(d) The unit assessment: The assessment tools were:

(i) Pupil Tests - Cognitive Test and Affective Test were prepared to be given after using the /

the material;

(ii) Teacher Questionnaire.

Let us examine each part in some detail.

B. The Educational Objectives Of The Unit

(a) Food Games. By using the "Food Games", the pupils should be able to:-

(i) Show an interest and enjoyment in the study of food;

(ii) Communicate with each other;

(iii) Compete with each other;

(iv) Choose a suitable diet for the needs of their age group;

(v) Strike a balance between food value and some variables, such as cost, advertising and quantity, (i.e. to handle a multivariate situation);

(vi) Recognise kinds of food which contain the most food value;

(vii) Apply their knowledge about food to real life situations (to daily life).

(b) Programme - Food Is A World Problem. By using the "Food Programme", the pupils should be able to:-

(i) Show an interest and enjoyment in the study of food;

(ii) Exhibit some sympathy towards countries suffering hunger and malnutrition;

(iii) Deepen their understanding of some specific terms /

terms related to food, such as malnutrition, hunger and starvation.

C. Sources Of Material

To get the ideas for the unit, the researcher was in contact with Oxfam and World Food Organisations. Also, the available references in this field were read. These will be listed in the Bibliography.

D. The Material Structure

(a) Food Games.

A set of cards, along with rules, for the playing of three different games, i.e. FOOD TRICKS, FOOD RUMMY and CAMP SUPPLIES, was devised. This set consisted of sixty cards. Each card represented a foodstuff which the pupils knew well. On one side of each card, there was a drawing representing the foodstuff, its quantity and its price. On the other side, there was a list of the food elements which this foodstuff contained, and also the quantity of each. These quantities were calculated according to the available reference.(80)

(b) Food Programme.

It consisted of colour slides (fifteen) and tape recording which were shown in sequence to the whole class at the same time, using a projector and cassette player.

E. /

E. How The Material Was Applied

The following plan of application was adopted. The teacher should have two groups of pupils (called Group 1 and Group 2) matched as far as possible according to their ability in biology.

GROUP 1 (Experimental Group)	GROUP 2 (Control Group)
(a) To be provided with the Food Games and The Food Programme; (approx. 1½ hours)	(a) No new material.
(b) To be given the tests (Cognitive and Affective). (30 minutes)	(b) To be given the same tests.

F. The Assessment Of The Unit

(a) Pupil Tests

(i) Cognitive Test. It was an objective multiple choice test consisting of forty items in two parts. The first part (twenty-two items) was about the "Food Value of some Foodstuffs", the second (eighteen items) was about "Food as a World Problem".

(ii) Affective Test. Two different techniques were included in this test, Osgood's Method /

Method and Johnstone et al.

(b) Teacher Questionnaire.

It included a list of educational objectives which it was hoped would be achieved. The teacher was asked to indicate how successful in his opinion the material was in helping pupils to achieve these objectives.

G. Results

Although some significant differences in favour of the Experimental Group were obtained, the material, i.e., the Food Games and the Food Programme, did not really succeed in enabling the pupils to achieve the defined objectives in general. Also the teachers' responses and comments supported the pupils' results. Those teachers saw that although the material provided a useful addition to the work normally carried out in the classroom, it required far more time than recommended.

They also saw that the "CAMP SUPPLIES GAME" and the "Food Programme" were too difficult to sustain the complete attention of the pupils. The same comments were said by the Science Principal Teachers who attended the conference in Kirkcaldy.

In the light of the pupils' results, Principal Teachers' responses to the Teacher Questionnaire and their comments, and also the comments of those teachers who attended the conference in Kirkcaldy, more significant modifications were found necessary to be introduced to the unit.

5.2 THE FINAL EDITION OF THE UNIT

A. The Design Of The Unit

(a) The educational objectives of the unit were modified, especially those regarding the Food Programme;

(b) The Food Games were reduced to two games instead of three. These two games were:-

FOOD TRICKS GAME

FOOD RUMMY GAME

(c) The Food Programme was modified;

(d) The design of the application was modified;

(e) The Cognitive Test was shortened and modified;

(f) Many changes were introduced to the Affective Test;

(g) The Teacher Questionnaire was modified.

Let us consider these modifications in some detail.

B. The Educational Objectives Of The Unit

(a) Food Games. By using the "FOOD GAMES", the pupils should be able to:-

(i) Enjoy the study of food;

(ii) Compete with each other;

(iii) Communicate their ideas to others on the food value of some items;

(iv) Recognise kinds of food which contain the greatest food value;

(v) Choose a suitable diet for the needs of their age group.

(b) /

(b) Programme - Food Is A World Problem. By using the "FOOD PROGRAMME", the pupils should be able to:-

(i) Take an interest in the problems associated with lack of one or more food items;

(ii) Show some sympathy towards countries suffering hunger and malnutrition;

(iii) Appreciate the responsibilities of advanced countries in dealing with problems of malnutrition, hunger and starvation in underdeveloped countries;

(iv) Understand individual responsibility in advanced countries for helping people in poorer and less developed countries suffering hunger and malnutrition;

(v) Understand some specific terms related to food, such as malnutrition, hunger and starvation;

(vi) Make an accurate comparison between British children and some African children regarding -

- the quantity of food which each of them eats in one day,
- the average annual number of deaths per thousand babies under one year old;

(vii) State the countries which do not have enough food to make an adequate diet;

(viii) State the reasons for the higher death rate in children /

in children under one year old and the lower life expectancy in poorer and less developed countries.

C. The Material Structure

(a) Food Games.

These were reduced to two games:- FOOD TRICKS GAME and FOOD RUMMY GAME. Appendix 5.2(a) shows the set of cards. The aims and rules of the two games appear in Appendix 5.2(b).

(b) Food Programme.

This programme was shortened and modified. Also new up-to-date colour slides were added to make the programme more effective.

Details of the script and pictures of the programme appear in Appendix 5.2(c).

D. How The Material Was Applied

The design of application was modified as follows:-

(a) The time of applying and evaluating the material was reduced to ONE HOUR for application and 20 minutes for assessment;

(b) Clearer instructions for teachers were introduced to reduce the management problems;

(c) A suggested time-tabling for the one hour period of application was introduced.

The covering letter which was sent to Principal Teachers /

Teachers of biology appears in Appendix 5.2(d). Also, the Teacher's Instructions appear in Appendix 5.2(e).

(d) A factual article titled, "NUTRITION AND FOOD" was prepared for the Control Group. The aim of this article was to minimize the cognitive variables among different selected schools as far as possible. Here is a summary of the article content:-

- What foods are
- The balanced diet
- Diseases attributable to malnutrition
- Social effects of malnutrition
- Food is a world problem

This article appears in Appendix 5.2(f).

E. The Assessment Of The Unit

(a) Pupil Tests

- Cognitive Test - it was reduced to twenty-eight items.
- Affective Test. Many modifications were introduced to the preliminary test. The following is a summary of these modifications:-
  - (i) The instructions were simplified;
  - (ii) The vagueness of how the pupils respond was overcome;
  - (iii) A new assessment technique, Likert's Method of Summated Ratings, was introduced;
  - (iv) /

(iv) A new situation was introduced instead of the two situations included in the preliminary test.

Both tests appear in Appendix 5.2(g).

(b) Teacher Questionnaire.

It was altered in the light of the modifications introduced to the educational objectives.

This questionnaire appears in Appendix 5.2(h).

F. Results

I. An Evaluation of the Individual Pupil's Performance

- Cognitive Test

Details of the test results of both Experimental Group and Control Group appear in Appendix 5.2(i). Also, two graphs appear in Appendix 5.2(j,i) and 5.2(J,ii), illustrating the results.

Here is a summary of the results.

(a) There was a significant difference in favour of the Experimental Group in items 3, 7, 9, 10, 12, 15, 16, 18, 20, [illegible], 22, 26, 27 and 28.

(b) Some differences, but not significant, were found in items number 5, 6, 11, 17, 19, 23, 24 and 25 (eight items).

(c) Two items (2 and 14) were significantly different in favour of the Control Group.

(d) Five items (1, 4, 8, 13 and 21) showed slight differences in favour of the Control Group.

(e) /

(e) A few items showed negative discrimination. This happened in item 5 - the Experimental Group; and items 10, 20, 22, 26 and 28 - the Control Group.

Discussion

(a) If we look at the fourteen items which showed significant differences in favour of the Experimental Group, we would find that the majority of them (eight) were from Part 2, i.e. the part of Food as a World Problem. This means that the programme presented the facts in a more effective way than the article for the Control Group did.

(b) From the differences, some of them were significant, which were found between both groups regarding Part 1, i.e. the part of Food Value, we can conclude that the Food Games were successful in enabling the pupils to :-

(i) reinforce some of their previous knowledge about the food value of some foodstuffs - items 3, 5, 6, 7, 9, 10, 11 and 12;

(ii) recognise kinds of food which contain the greatest food value - items 3, 5, 6, 9, 10, 11 and 12;

(iii) choose a suitable diet for the needs of their age group - item 7.

(c) By analysing the data obtained from both groups regarding Part 2, i.e. the part of Food as a World Problem - from item 13 to item 28 - we can conclude /

conclude that the programme was successful in enabling the pupils to:-

(i) Understand some specific terms related to food, such as malnutrition, hunger and starvation - items 15, 16 and 17;

(ii) Make an accurate comparison between British children and some African children regarding the quantity of food which each of them eats in one day - item 18;

(iii) State the countries which do not have enough food to make an adequate diet - items 19, 26 and 27;

(iv) State the reasons for the higher death rate in children under one year old and the lower life expectancy in poorer and less developed countries - items 22, 23, 24, 27 and 28.

(d) Some items showed reverse results, i.e. in favour of the Control Group, for the following reasons:-

(i) Some of them included information which was not directly manipulated in the material - items 1 and 8;

(ii) The Food Games did not add much regarding some knowledge which the pupils had already known before - items 2 and 4.

(e) A few items (5, 10, 20, 22 and 28) showed negative discrimination but this was so small (maximum - 0.11) that it could have occured by chance and so was ignored.

• Affective Test

To explain how the results were calculated, the following specimen is shown:-

	A	B	C	D	E	
Interesting	☐	☐	☐	☐	☐	Boring
Exciting	☐	☐	☐	☐	☐	Dull

(a) Frequencies in the first two boxes, A and B, were added to show the agreement with the item, or the statement;

(b) Frequencies in the third box, C, showed that the respondent was neutral regarding the item or the statement;

(c) Frequencies in the fourth and fifth boxes, D and E, were added to show the disagreement with the item, or the statement;

As a result, three categories for each item or statement were obtained.

(d) The percentages of the frequencies in all three categories regarding each item or statement were calculated;

(e) These percentages were compared in both experimental and control groups to look for significant differences;

(f) Also, χ^2 was calculated for each part of the test to give a general picture about the significance of each part as a whole. These results appear in /

in Appendix 5.2(k).

(g) Moreover, graphs were drawn illustrating the comparison of the Experimental Group with the Control Group. Each graph illustrated the results of each part. These graphs appear in Appendix 5.2(£,i), 5.2(£,ii) and 5.2(£,iii).

Here is a summary of the results and discussions:-

A. Part 1(a)

In this part, they were asked to give their general impression about the material they had studied. The following were found:-

(a) A significant difference regarding all the items in this part was found in favour of the Experimental Group. This group found the material more interesting, exciting, enjoyable to study, easy to understand and helpful than the Control Group who read an article including the same content;

(b) By using χ^2 for this part as a whole, a significant difference at 1% was obtained in favour of the Experimental Group.

Discussion

We can conclude that the material, i.e. the Food Games and the Food Programme, was very successful in encouraging the pupils in the Experimental Group to develop an interest and enjoyment in the study of food compared with the pupils in the Control Group who read /

read a factual article.

Part 1(b)

In this part, they were asked to give their general impression of the subject of "Food Values". For the Experimental Group, this meant what they had learned in their normal classroom in addition to the material, i.e., the Food Games and Food Programme, but for the Control Group, this meant what they had learned in their normal classroom in addition to the article they read. The following were found:-

(a) A significant difference was found in favour of the Experimental Group. This group showed that the subject of "Food Value" was more interesting, exciting, easy to understand and helpful than the Control Group;

(b) By using χ^2 for this part as a whole, no significant difference was obtained.

Discussion

From these results, we can conclude that the material, i.e. the Food Games and the Food Programme, was successful in changing the pupils' attitude of interest to the subject of Food Value.

Part 1(c)

In this part, they were asked to give their general impression of the subject of "Food as a World Problem". The following was found:-

A significant /

A significant difference was found in favour of the Experimental Group. This group showed that the subject of "Food as a World Problem" was more exciting, enjoyable to study and easy to understand than the Control Group.

Discussion

From these results we can conclude that the material was successful in changing their attitude of enjoyment to the subject of "Food as a World Problem".

B. Part 2

In this part they were given some statements and asked to indicate their opinion. The following was found:-

(a) A significant difference was found in favour of the Experimental Group regarding item 4;

(b) A significant difference but in the reverse direction, i.e. in favour of the Control Group was found in item 2.

The discussion for this part is included in the discussion in part 3.

C. Part 3

In this part, they were given a situation followed by some statements and asked about their opinion. The following were found:-

(a) A significant difference was found in favour of the Experimental /

Experimental Group regarding statements 4 and 6;

(b) No significant difference was found in statements 1, 2, 3 and 5.

Discussion

From the results in parts 2 and 3, we can conclude the following:-

(a) The materials, i.e. the Food Games and the Food Programme, were successful in enabling the pupils to:-

(i) take an interest in the problems associated with lack of one or more food items;

(ii) show some sympathy towards countries suffering hunger and malnutrition;

(iii) appreciate the responsibilities of advanced countries in dealing with problems of malnutrition, hunger and starvation in under-developed countries.

(b) The material was not really successful in enabling the pupils to understand the individual responsibility in advanced countries for helping people in poorer and less developed countries suffering hunger and malnutrition.

II. An Evaluation of the Principal Teachers' Responses and Comments

• Teachers' Responses

Details of these responses appear in Appendix 5.2(m). Also, there is a graph shown in Appendix 5.2(n) illustrating these responses. However, the following summarise /

summarise these responses:-

(a) All of them, except two responses, agreed that the material was successful in achieving all the defined objectives except one;

(b) They differed about the objective of enabling the pupils to understand individual responsibility in advanced countries for helping people in poorer and less developed countries suffering hunger and malnutrition.

Note: The same result was obtained from the Pupil Questionnaire.

• Teachers' Comments

All of them agreed that :-

(a) The material provided a useful addition to the work normally carried out in the classroom;

(b) The pupils enjoyed the Food Games;

(c) The programme of "Food as a World Problem" was much improved and more effective;

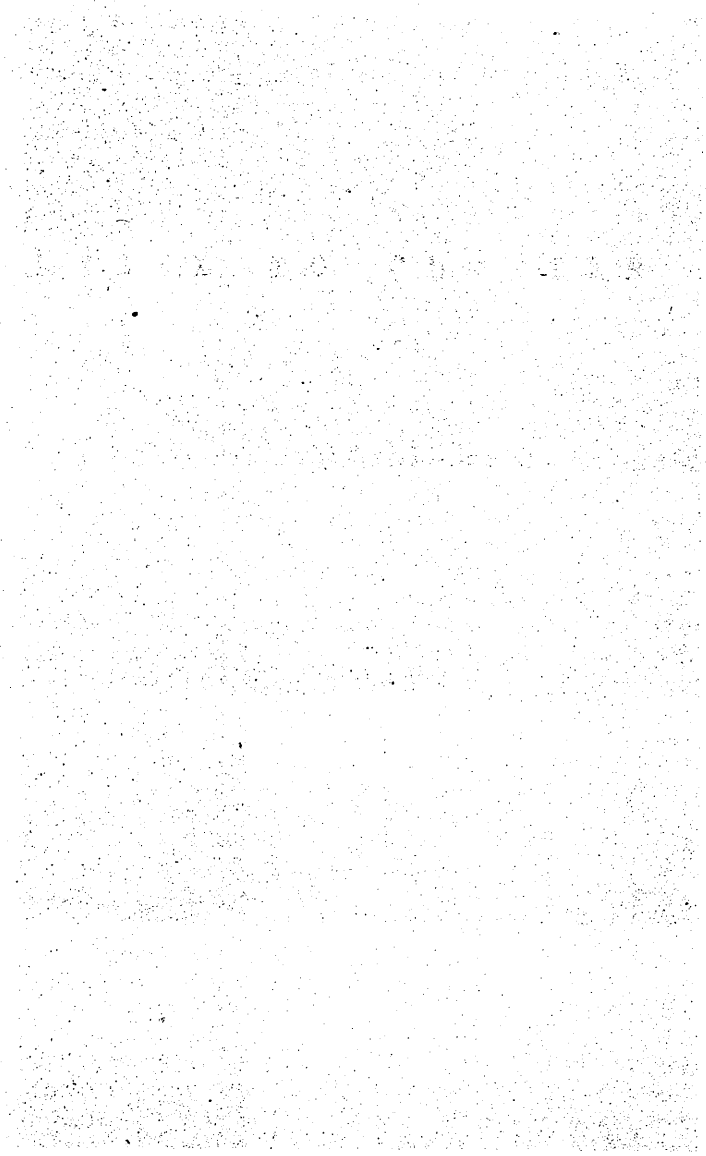
(d) The project as a whole was interesting, enjoyable and instructive.

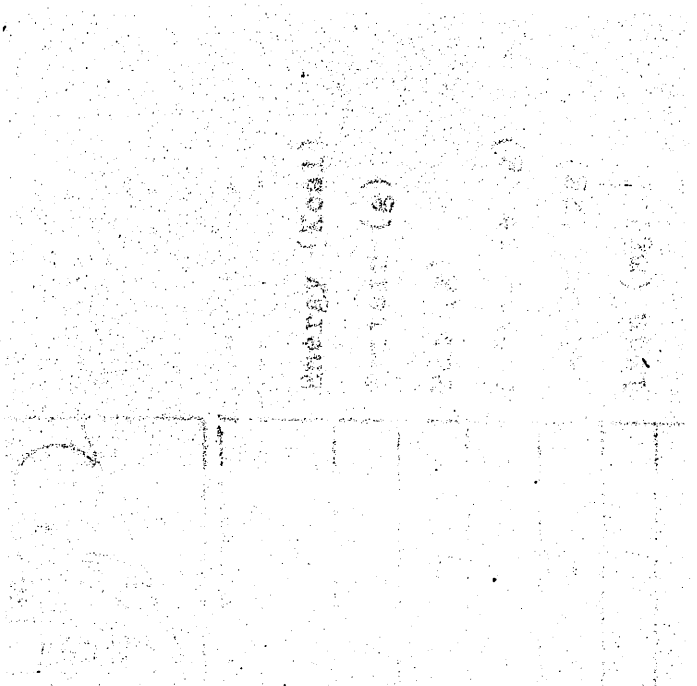
Conclusion

From the results of this study it can be claimed that material of this kind is more effective than normal classroom teaching in encouraging pupils in their enjoyment of the subject, in stimulating interest, in encouraging /

encouraging communication, co-operation, competition, interpersonal reaction and personal decision making.

In addition, there is evidence that the material encourages positive attitudinal changes towards science.





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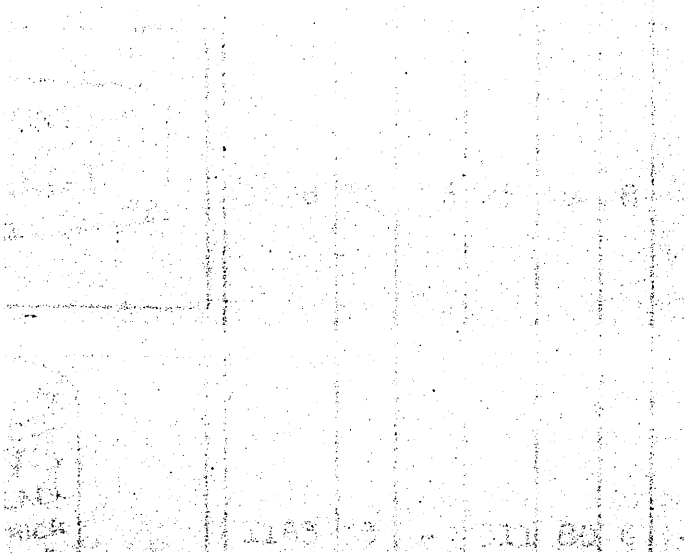
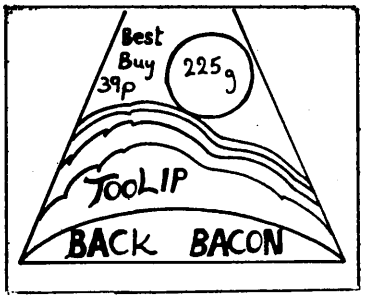
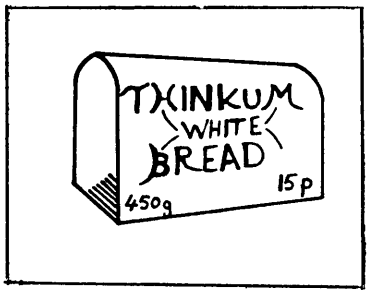
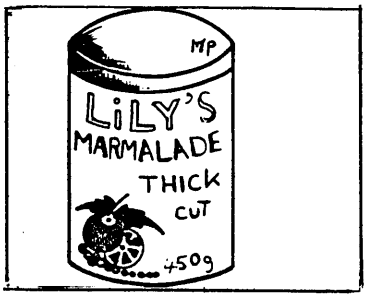
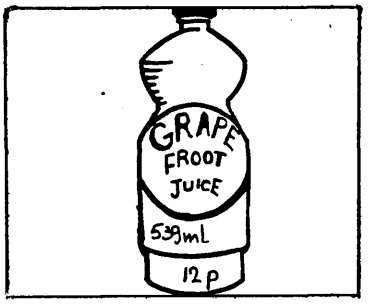
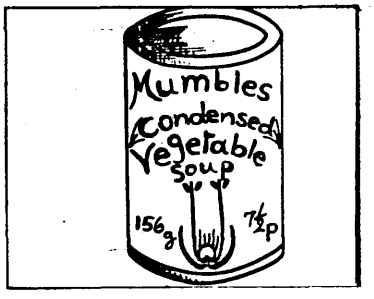
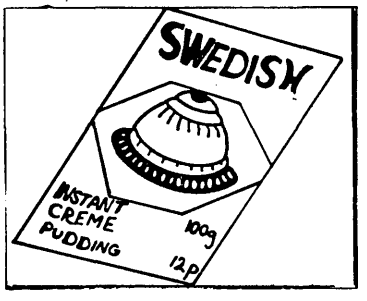
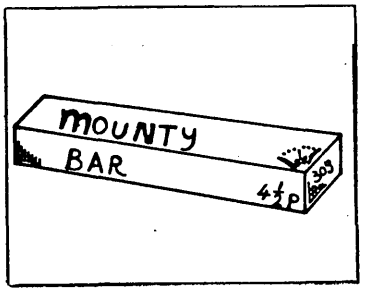
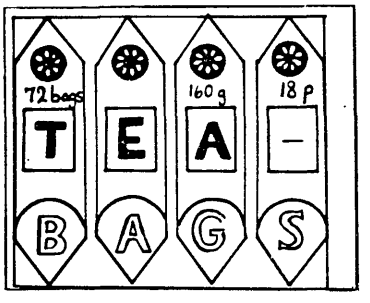
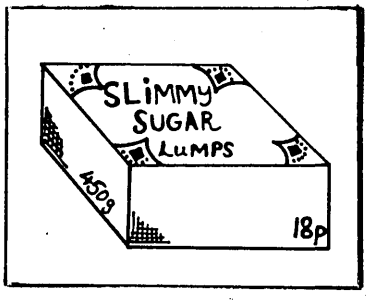
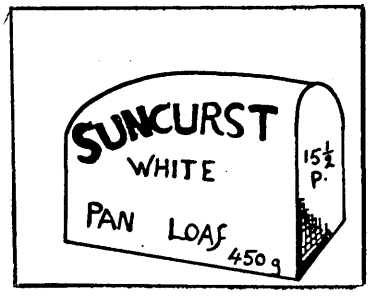
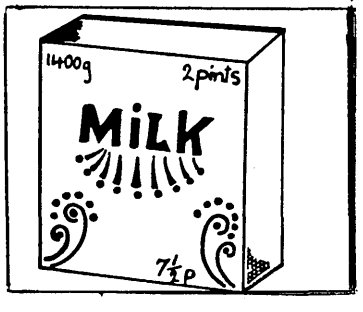


A P P E N D I X 5.2(a)

THE FOOD CARDS

	Energy (Kcal)	Protein (g)	Fat (g)	C'Hydrate (g)	Calcium (mg)	Iron (mg)	Vit. A (I.U.)	Vit. C (mg)	Vit. D (I.U.)
	940	27	90	-	24	3	-	-	-
	92	3	40	9	30	1	250	2	-
	1098	35	6	237	414	8	-	-	-
	1183	3	-	311	80	6	-	48	-

	Energy (Kcal)	Protein (g)	Fat (g)	C'Hydrate (g)	Calcium (mg)	Iron (mg)	Vit. A (I.V.)	Vit. C (mg)	Vit. D (I.V.)
	190	4	-	46	229	2	383	267	-
	64	3	2	6	7	1	248	12	-
	149	2	3	29	90	-	105	1	1
	165	2	11	16	7	1	21	-	-
	-	-	-	-	-	-	-	-	-

	Energy (Kcal)	Protein (g)	Fat (g)	C'Hydrate (g)	Calcium (mg)	Iron (mg)	Vit. A (I.V.)	Vit. C (mg)	Vit. D (I.V.)
	1793	1	192	-	3	-	7875	-	88
	1782	-	-	450	-	-	-	-	-
	1793	1	192	-	3	-	6080	-	640
	1098	35	6	137	414	8	-	-	-
	760	36	44	56	1364	-	1602	24	16

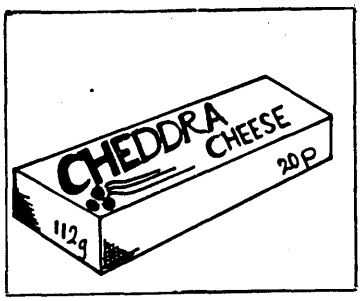
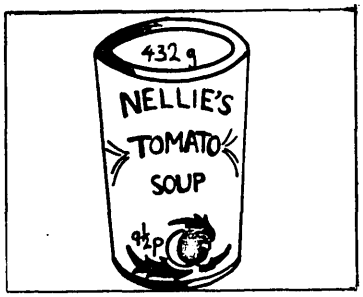
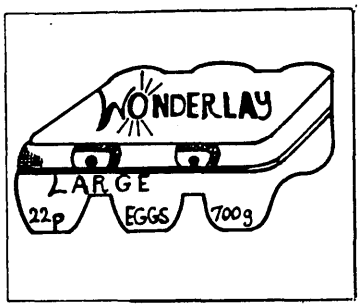
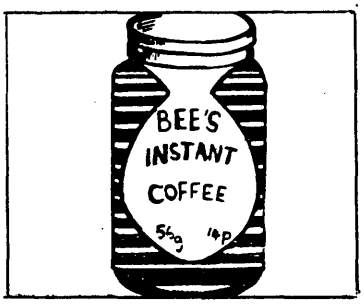
	MEAT BALLS IN GRAVY	Bovis 'BROON' BREAD	"BAKED" BEANS
Energy (Kcal)	1391	732	131
Protein (g)	64	23	9
Fat (g)	120	4	1
C'Hydrate (g)	-	158	25
Calcium (mg)	46	276	85
Iron (mg)	17	5	3
Vit. A (I.V.)	-	-	703
Vit. C (mg)	-	-	5
Vit. D (I.V.)	-	-	-

	Break Flakes
Energy (Kcal)	1251
Protein (g)	23
Fat (g)	2
C'Hydrate (g)	303
Calcium (mg)	24
Iron (mg)	10
Vit. A (I.V.)	-
Vit. B_1 (mg)	4
Vit. B_2 (mg)	5

Energy (Kcal)	Protein (g)	Fat (g)	C'Hydrate (g)	Calcium (mg)	Iron (mg)	Vit. A (I.V.)	Vit. C (mg)	Vit. D (I.V.)
1991	19	105	227	288	4	-	-	-

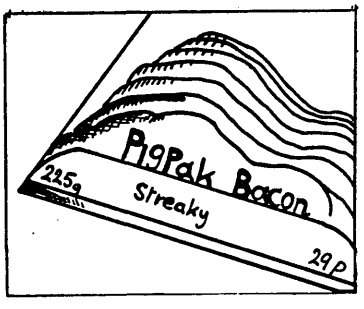
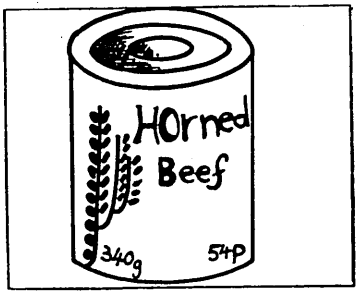
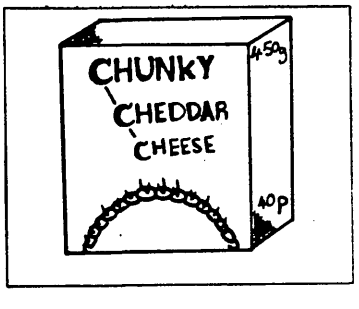
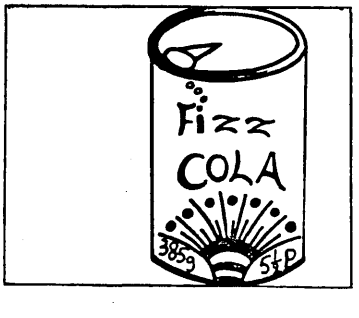
Energy (Kcal)	Protein (g)	Fat (g)	C'Hydrate (g)	Calcium (mg)	Iron (mg)	Vit. A (I.V.)	Vit. B_1 (mg)	Vit. B_2 (mg)
1440	27	3	312	28	23	-	3	4

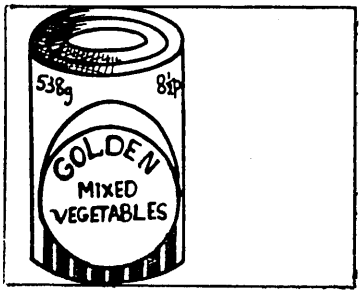
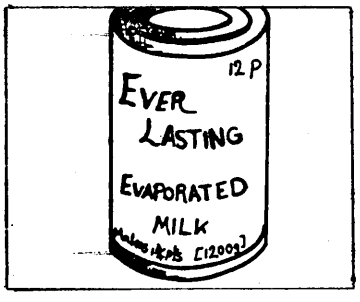
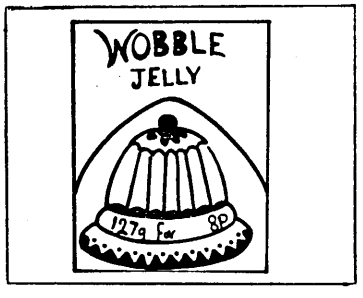
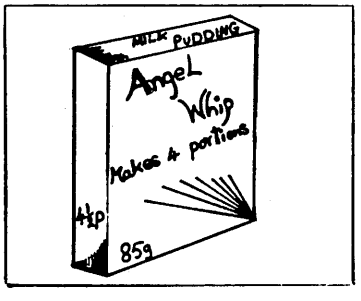
Energy (Kcal)	Protein (g)	Fat (g)	C'Hydrate (g)	Calcium (mg)	Iron (mg)	Vit. A (I.V.)	Vit. C (mg)	Vit. D (I.V.)
774	13	9	163	332	2	282	4	3

	Energy (Kcal)	Protein (g)	Fat (g)	C'Hydrate (g)	Calcium (mg)	Iron (mg)	Vit. A (I.V.)	Vit. C (mg)	Vit. D (I.V.)
	475	28	39	-	909	1	1581	-	16
	120	6	-	16	70	2	740	90	-
	1134	84	87	-	396	18	6930	-	1190
	-	-	-	-	-	-	-	-	-

Energy (Kcal)	Protein (g)	Fat (g)	C'Hydrate (g)	Calcium (mg)	Iron (mg)	Vit. A (I.V.)	Vit. B_1 (mg)	Vit. B_2 (mg)
1454	27	3	352	28	11	-	4	6

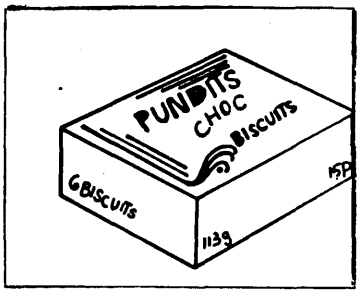
Energy (Kcal)	Protein (g)	Fat (g)	C'Hydrate (g)	Calcium (mg)	Iron (mg)	Vit. A (I.V.)	Vit. C (mg)	Vit. D (I.V.)
1912	25	208	-	22	3	7875	-	88
405	15	16	52	97	4	-	-	-
972	72	74	-	339	15	5940	-	1020

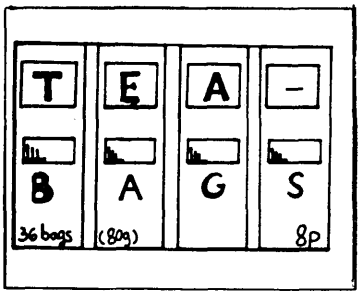
	Energy (Kcal)	Protein (g)	Fat (g)	C'Hydrate (g)	Calcium (mg)	Iron (mg)	Vit. A (I.V.)	Vit. C (mg)	Cit. D (I.V.)
	1980	2	384	-	6	-	7900	-	174
	1772	51	170	-	45	5	-	-	-
	1095	50	95	-	36	13	-	-	-
	1908	114	156	-	3654	3	6354	-	64
	594	2	-	150	80	-	-	-	-

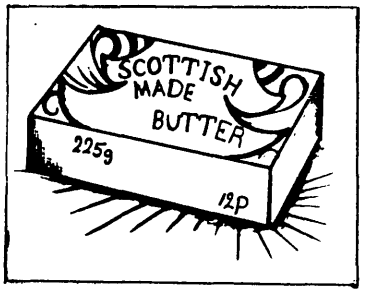
	Energy (Kcal)	Protein (g)	Fat (g)	C'Hydrate (g)	Calcium (mg)	Iron (mg)	Vit. A (I.V.)	Vit. C (mg)	Vit. D (I.V.)
	264	26	-	53	70	9	5475	121	-
	670	32	39	49	1200	-	1410	21	14
	1793	1	192	-	3	-	6080	-	640
	324	1	-	88	22	2	-	13	1
	91	2	3	25	30	-	105	2	1

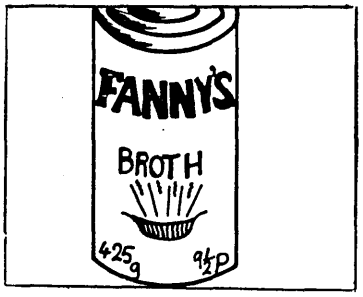
Energy (Kcal)	469	328
Protein (g)	22	15
Fat (g)	27	16
C'Hydrate (g)	34	30
Calcium (mg)	840	176
Iron (mg)	-	3
Vit. A (I.V.)	987	1131
Vit. C (mg)	15	2
Vit. D (I.V.)	10	171

Energy (Kcal)	1440
Protein (g)	27
Fat (g)	3
C'Hydrate (g)	312
Calcium (mg)	28
Iron (mg)	23
Vit. A (I.V.)	-
Vit. B_1 (mg)	3
Vit. B_2 (mg)	4

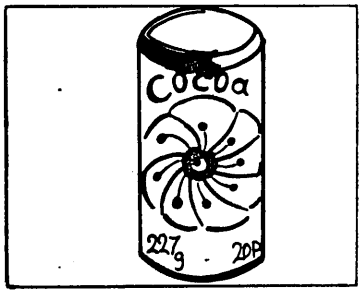
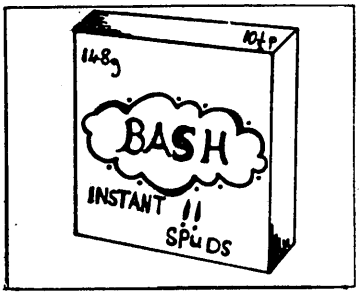
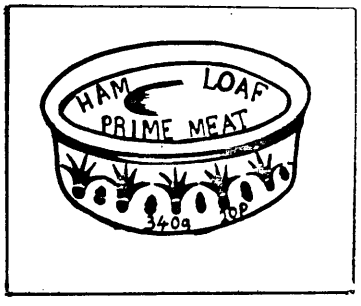
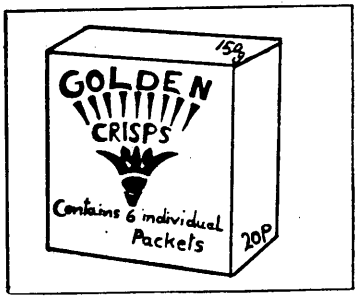
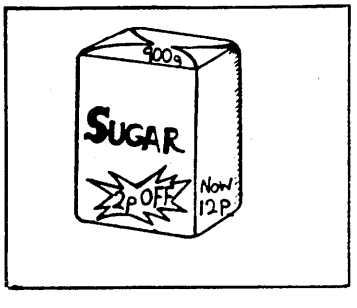


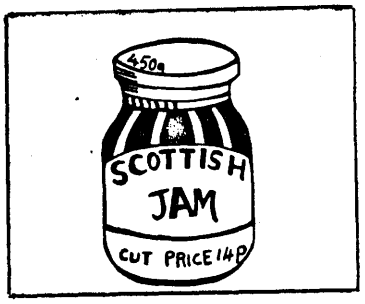
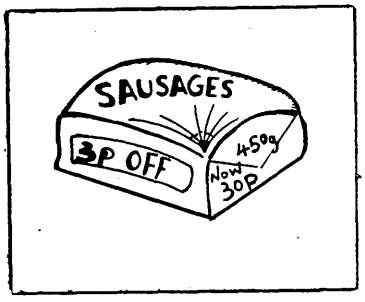
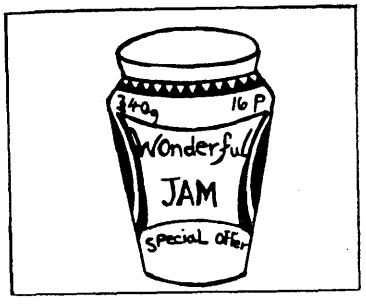
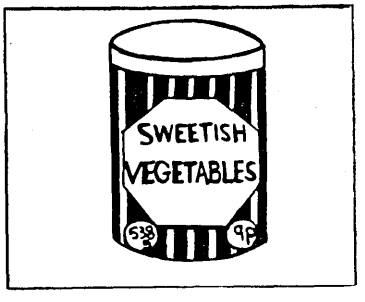






	Energy (Kcal)	Protein (g)	Fat (g)	C'Hydrate (g)	Calcium (mg)	Iron (mg)	Vit. A (I.V.)	Vit. C (mg)	Vit. D (I.V.)
	611	6	35	69	75	2	21	-	-
	-	-	-	-	-	-	-	-	-
	1793	1	192	-	3	-	7875	-	88
	160	7	24	-	6	21	-	-	-
	578	25	19	80	550	4	700	-	7

	Energy (Kcal)	Protein (g)	Fat (g)	C'Hydrate (f)	Calcium (mg)	Iron (mg)	Vit. A (I.V.)	Vit. C (mg)	Vit. D (I.V.)
	1026	47	53	79	120	33	161	-	-
	366	12	2	80	138	3	-	-	-
	1251	36	120	-	32	3	-	-	-
	562	12	3	135	11	4	-	-	-
	3564	-	-	900	-	-	-	-	-

	Energy (Kcal)	Protein (g)	Fat (g)	C'Hydrate (g)	Calcium (mg)	Iron (mg)	Vit. A (I.V.)	Vit. C (mg)	Vit. D (I.V.)
	1183	3	-	311	80	6	-	48	-
	1449	67	126	-	48	18	-	-	-
	49	2	-	12	111	3	1113	135	-
	894	2	-	235	60	5	-	36	-
	215	27	-	38	81	54	2663	97	-

	Energy (Kcal)	Protein (g)	Fat (g)	C'Hydrate (g)	Calcium (mg)	Iron (mg)	Vit. A (I.V.)	Vit. C (mg)	Vit. D (I.V.)
	288	26	-	48	63	8	2100	111	-
	1190	4	-	302	76	6	-	52	-
	414	27	2	78	270	10	2228	16	-

A P P E N D I X 5.2(b)

FOOD TRICKS GAME

For 2 - 6 players

The Aim of the Game

To recognise food classes and relative amounts of each class

The Rules of the Game

1. At the start of the game the dealer shuffles the cards;
2. Each player receives 7 cards face up and must not look at the back of each card;
3. The player to the left of the dealer begins by specifying a food class and playing a card which is high in that particular class;
4. Each of the other players plays a card in the same class;
5. The cards are then turned over and the player who has played the highest food value in that class is the winner of the trick;
6. The winner of the trick then recommences the game by playing a card and specifying the food class;
7. The game proceeds in this way until all cards have been played;
8. The winner of the game is the player who wins most tricks.

FOOD RUMMY GAME /

FOOD RUMMY GAME

For 2 - 6 players

The Aim of the Game

To collect a set of 5 cards, each one representing a high content of one class of food.

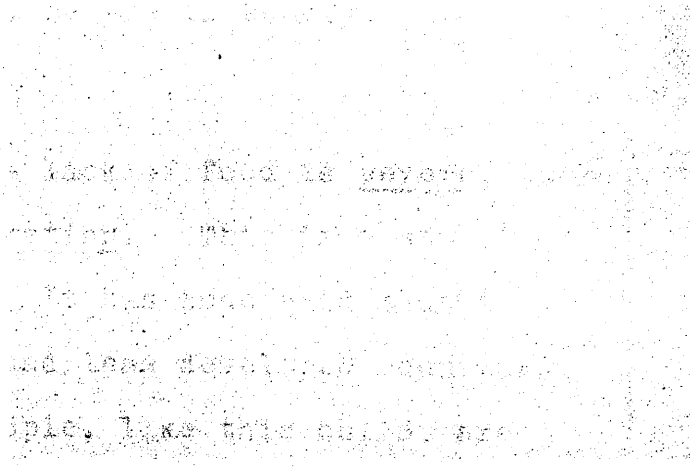
The Rules of the Game

1. At the start of the game the dealer shuffles the cards;
2. The dealer gives each player 5 cards face up and the players must not look at the back of each card;
3. The remainder of the pack is placed face up in the middle of the table and the top card is placed face up alongside the rest of the pack;
4. The player to the left of the dealer starts;
5. He can choose either of the cards he sees to add to his hand and then reject one from his hand. He can reject both, but if he rejects both, he must lift the top card from the pack and place it on the card alongside the pack before the next player can play.

   N.B. A player must have exactly 5 cards in his hand after each turn.
6. The game proceeds in this way until one player claims to have a set of cards consisting of - a high Energy /

a high Energy	(more than 1000 K cal)
a high Protein	(more than 30 g)
a high Fat	(more than 120 g)
a high Carbohydrate	(more than 160 g)
a high Vitamin C	(more than 50 mg)

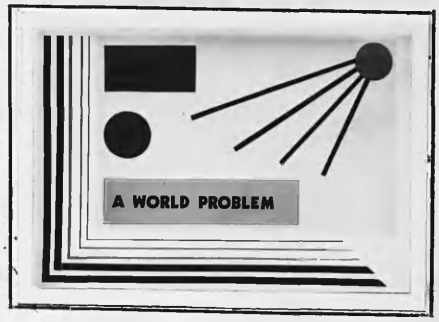
7. To check a player's claim, he states what each card represents and then checks he is above the limiting value by looking at the back of the card. E.G. If Beetawix represents a food which is 'high' in carbohydrate, then this claim will be accepted if the carbohydrate content is greater than 160 g, which it is - 312 g.;
8. If a player claims to have a complete set, but his claims fall below the limits set in rule 6, the game will continue without him;
9. A player wins a game if all his claims are correct.



A P P E N D I X 5.2(c)

PROGRAMME : FOOD IS A WORLD PROBLEM

Many people in the world do not get enough to eat and they suffer accordingly.



They tend to be unhealthy due to a sheer lack of food; this is hunger.

This woman and her child, like many other women and children in poorer and less developed countries, are both hungry. She cannot nurse him because she is hungry.

Where this lack of food is severe, there is starvation. This is a starving child. It has been said that in poorer and less developed countries, more people, like this child, are going to die from starvation than from wars.

In addition to hunger and starvation, there is malnutrition. It is caused by the lack of one or more vitamins, lack of protein ... etc. Malnutrition contributes to what are called deficiency diseases. These are due to imbalance in one's diet.

Here is a malnourished child. He is too weak to stand on his feet. This child, like many other children from poorer and less developed countries, suffers from an inadequate diet, and therefore his body tissues and muscles waste away - he is lifeless and weak and is very prone to disease and is possibly mentally retarded.

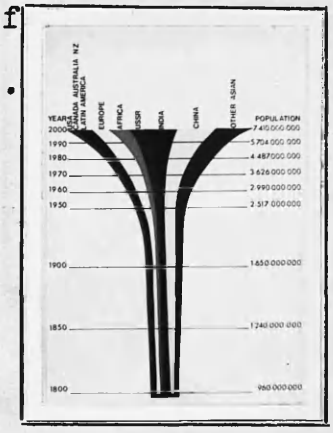
These two children are the same age. The healthy one is British and the other is African. Clearly the British child has developed more rapidly. Notice the amount of food that each child eats each day.

Let us look at the pattern of world food supply. Here is a map showing world-wide distribution of food resources in 1970. Notice that only the areas marked in red /

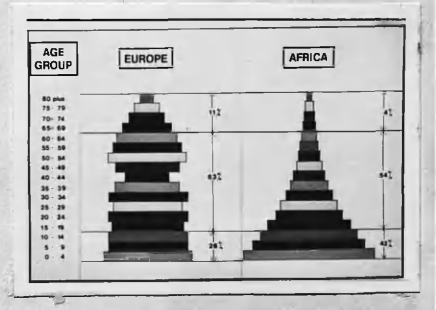
red have adequate food supplies. Approximately two-thirds of the population is undernourished or starving. Which areas do not have enough food to make an adequate diet? Some parts of Africa, India, China and the Far East, Mexico, Central and South America.

Now let us consider the world population distribution.

This diagram shows how the populations of various areas of the world are growing. Look at today's population in Europe and Africa. Which is larger? The answer is Europe. It has more than twice the population of Africa. Now look at the estimated populations in Europe and Africa in the year 2000, which area has the greater increase? You should see that it is Africa. Note also the very rapid increase in the Asian populations.



This diagram shows the relation between the numbers of people in different age groups in Europe and Africa. In Africa 42% of the population is under 15 years of age; whereas in Europe 26% of the population is under 15 years of age. In Africa 4% of the population is 65 years or more; whereas in Europe /



Europe this figure is 11%. You can also see from this diagram that percentage figures for age groups decrease quicker for Africans than for Europeans. Does this mean that Africans have longer or shorter lives than Europeans? They have much shorter lives than Europeans. One reason for this has already been explained - inadequate diet and lack of food - but just how bad is this?

Notice that Africa does not have its fair share of food, but Europe has more than its fair share. Which area of the world receives the best share of food per head of population? The U.S.A. and Canada. Which country has the smallest share in world food supplies? The answer is the Far East.

Here there is a comparison between the Europeans, like yourself, and Africans.

I like to drink coke. I have never heard of it.
I have a family doctor. I have not.
I like to eat sweets. I have never heard of them.
I usually eat fruit. I would like to.
I am in good health. I suffer from T.B.
I drink clean water./

I drink clean water. I drink dirty water.

I am used to drinking milk. I would like to drink milk.

I am used to eating cakes. I eat only bread.

I have a choice of food. I have no choice.

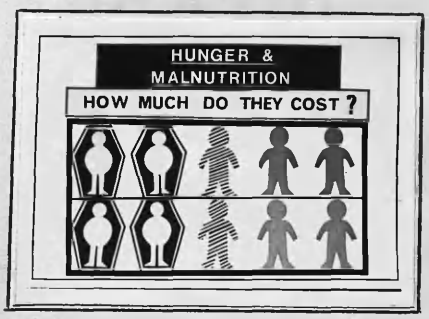
I am well fed. I am underfed.

I shall probably live until I am 70 years old. I probably shall die before I am 50 years old.

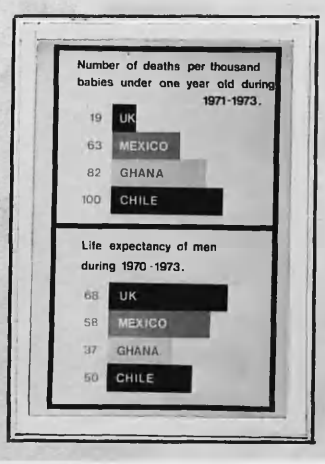
I have money to buy luxuries. I have not enough money even for essentials.

Now we know that <u>real</u> differences exist between children in Europe and in Africa and that many in Africa will die in middle age because of malnutrition, but just how many people in families are affected?

Here is a typical African family with 10 children - 4 die before they reach 5 years of age, and 2 are seriously affected by malnutrition. How does this pattern compare with other countries?

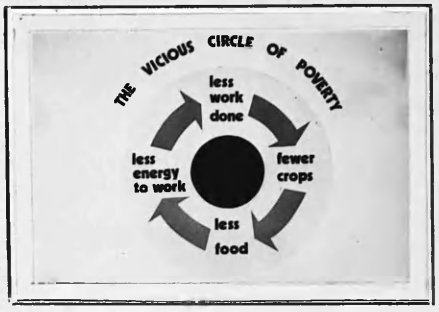


This shows the average annual number of deaths per thousand babies under one year old over the past three years, and the life expectancy of men in the same countries. Which country, of those /

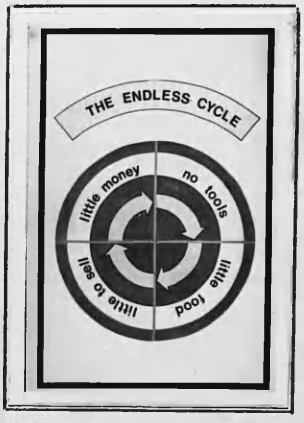


those shown, has the best standard of life? The United Kingdom. Look at the figures for the poorer countries, why do more babies die? Why is the life expectancy lower? Malnutrition and hunger, and even starvation; poor housing as well; poor medical care; inadequate production of food because of lack of development and ignorance in agricultural methods.

Let us look at the problems of these poorer countries. Notice the Vicious Circle of Poverty and malnutrition. We know what food people require, and we know how to produce it, but there is more to it than that.

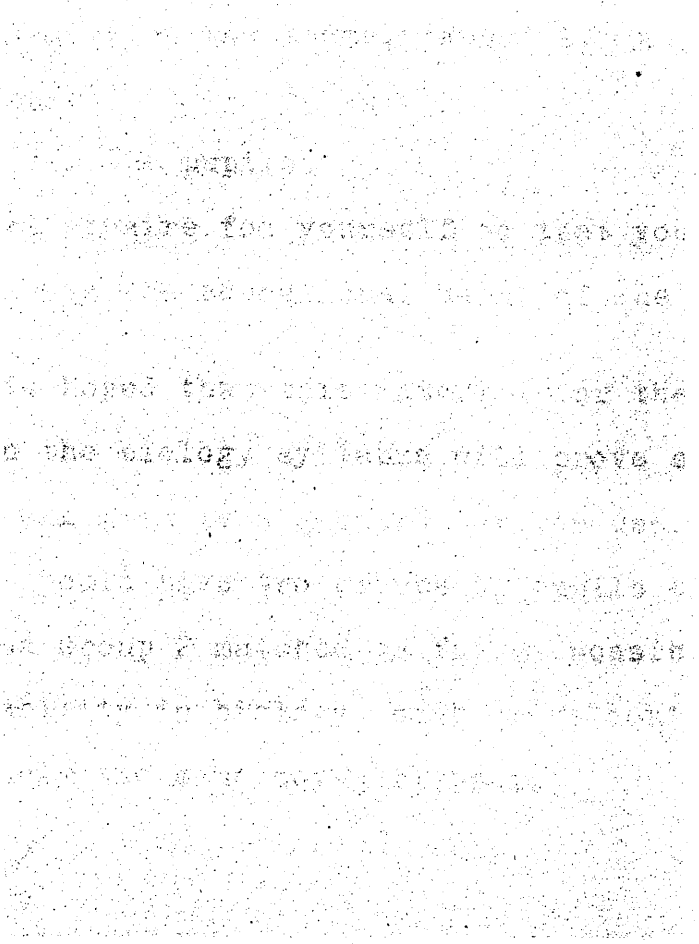


This shows the endless cycle which is related to the Vicious Circle. Suggest at which point we should try to break this Endless Cycle. We should try to provide more money, so that more food can be produced, so that dirt and consequent infection can be eliminated in poor homes, and hopefully so that malnutrition can be wiped out. The answer, however, is not straightforward. Along with a family income increase, we must offer education to the people involved. Many must be told what, in terms /



terms of vitamins and proteins and other necessary food components, they require if they are to live a healthy life. We must also help them to change their attitudes to bad customs relating to eating. There is a wise saying which runs as follows:-

> Give a man a fish, and you feed him for a day. But teach a man to fish and you feed him for a life time.



A P P E N D I X 5.2(d)

Dear Mr.

RESEARCH IN SCIENCE EDUCATION

Thank you very much for your co-operation and help in my research work. I now enclose the necessary material, and I wonder if you would restrict this material to third year pupils.

1. Four sets of cards, along with rules, for playing two different food games, "FOOD TRICKS" and "FOOD RUMMY".
2. A set of slides and a cassette for an audio visual programme on the theme, "FOOD IS A WORLD PROBLEM".
3. Tests for the pupils.
4. A questionnaire for yourself so that you can indicate the educational value of the material.

It is hoped that this material for the section on food in the biology syllabus will prove effective and the following plan is suggested for its use.

You should have two groups of pupils called Group 1 and Group 2 matched as far as possible according to their ability in biology, each group containing approximately the same boy-girl ratio.

Group 1 /

Group 1 (Experimental)	Group 2 (Control)
(a) Provide the Food Games + the Food Programme (approx. 1 hour)	(a) Provide the article on "NUTRITION AND FOOD" (approx. 20 minutes)
(b) Give tests	(b) Give the same tests

Please ask the pupils to indicate clearly on answer sheets which group they belong to, and also ask them to give only ONE correct answer for each question.

INSTRUCTIONS FOR USE OF AUDIO-VISUAL MATERIAL

1. Slides and tape should be shown in sequence to the whole class at the same time, using a projector and cassette player.
2. When a question is posed during the programme, switch off the player and discuss the answer with the pupils, then switch on again and you will be given the answer.
3. You will find it an advantage to run through the programme before using it with your pupils.

I should be grateful if you could return all the material to me along with completed answer sheets for tests and for the questionnaire.

Your school will be provided with a copy of the results of the research, and I hope the results will be of use to you.

Thank you for your co-operation.

Yours faithfully,

A P P E N D I X 5.2(e)

A STUDY IN FOOD

(FOOD GAMES AND FOOD PROGRAMME)

Teachers' Instructions

1. Plan of Application.

The following plan of application has been designed. You should have two groups of pupils (called Group 1 and Group 2) matched as far as possible according to their ability in biology; each group containing the same boy-girl ratio.

Group 1 (Experimental)	Group 2 (Control)
(a) Provide the supplementary material	(a) Provide the article "NUTRITION AND FOOD"
(b) Give the tests (20 minutes)	(b) Give the same tests

Please ask the pupils to indicate clearly when they fill in the required information of the tests which group they belong to, also ask them to give only one answer.

2. The exercise is planned to last about ONE HOUR with 3rd year S.C.E. biology pupils.

3. To organise the exercise, the following is given:-

(a) Please divide the experimental group into small groups - it is suggested that four to six pupils /

pupils could be in each group, and allowed to sit around a table, bench or desk to facilitate playing the games.

(b) Provide each group with:-

(i) A set of cards;

(ii) Rules for playing two different food games - FOOD TRICKS GAME, and FOOD RUMMY GAME.

(c) Give them time (45 minutes) to finish the two games.

(d) Use the Audio-Visual Programme on the theme, "FOOD IS A WORLD PROBLEM". (It lasts about 15 minutes.)

4. The suggested time-tabling of the one hour period is:-

0	FOOD TRICKS GAME	(25 mins.)
25 mins.	FOOD RUMMY GAME	(20 mins.)
45 mins.	AUDIO-VISUAL PROGRAMME	(15 mins.)
1 hour	End.	

INSTRUCTIONS FOR USE OF AUDIO-VISUAL MATERIAL

1. Slides and tape should be shown in sequence to the whole experimental group at the same time, using a projector and cassette player.

2. When a question is posed during the programme, switch off the player and discuss the answer with the pupils, then switch on again and you will be given the answer.

3. /

3. You will find it advantageous to run through the programme before using it with your pupils.

A P P E N D I X 5.2(f)

Glasgow University - Research in Science Education

NUTRITION AND FOOD

Control Group

WHAT FOODS ARE

Foods contain a wide range of chemical substances. Many foods, after digestion and absorption, are capable of renewing the body tissues, allowing for growth and repair, and providing protection against injury and disease; others often taken in much smaller quantities, are required to provide the delicate balance of controls needed for the maintenance of life.

THE BALANCED DIET

A balanced diet should include seven essential constituents. These are:-

1. Proteins They are essential constituent of all animal and vegetable cells. They are used in the body for growth and for repair of tissues, and are therefore of particular importance to the growing child. They are also a source of energy.

   They are found in meat, fish, milk, cheese, eggs and cereals.

2. Carbohydrates They are used in the body to supply heat and energy usually rapidly and also for storage. They can be converted into fats.

   Carbohydrates are often referred to as "sugars" and /

and include substances like glucose, fructose, sucrose (cane sugar), maltose, cellulose and starch.

Starch is a major constituent of foods like flour, bread, potatoes and rice, and is broken down by the digestive process first into maltose and then into glucose which, on absorption, provides energy and heat required for life.

3. Fats They are used in the body to supply heat and energy. They are found in all animal fats, such as meat fat, butter fat and oils. They are an important source of energy and heat. In animals, fat may be formed from carbohydrate. The chief sources of animal fats are butter, cream, the fat of meat and, to a lesser extent, cheese and egg yolk.

Vegetable fats are present in olive oil, nuts and margarine.

4. Vitamins They are chemical substances which protect the body against certain diseases and bacterial invasions, and are necessary for the use of calcium. They are essential to life and to health although they are found in very small amounts in natural foods. Vitamins are needed only in small amounts; if an adequate amount of any particular vitamin is available in the diet, no benefit will be reaped by taking more.

The following are some kinds of vitamins:-

(i) /

(i) Vitamin A This is necessary in the body for growth, it is concerned in the perception of light, and it protects skin and mucous surfaces of the body from infection.

It is formed in the body from a substance known as carotene, whichwas first found in the yellow pigment of carrots, hence its name.

The following are the sources of Vitamin A, beginning with the most potent source and ending with the least:-

- Animal : halibut liver oil, cod-liver oil, ox-liver, butter, margarine, cheese, eggs, sardine, herring, etc.
- Vegetable : carrot, spinach, apricot, tomatoes, peaches, etc.

(ii) Vitamin D This is the anti-rachitic vitamin (stops development of rickets, a disease of the bone). It is concerned with the laying down of calcium and phosphorus in bone, it is therefore of particular importance during periods of rapid growth. It may be obtained from food, or it may be formed in the skin by the action of sunlight.

It is contained in cod-liver oil, sardines, herring, tinned salmon, margarine, eggs and butter.

(iii) /

(iii) Vitamin B Group All members of the group are widely distributed in foodstuffs, and are often found together.

The group is necessary for growth, health of the skin and in treatment of pernicious anaemia (shortage of the number of red blood cells causing severe illness).

The members of the Vitamin B group are found together in bread, meat extract, cheese, eggs, malt and milk.

(iv) Vitamin C (Ascorbic Acid) This is the vitamin which stops the disease - scurvy. Scurvy causes breakdown of some parts of Luma tissue. It is the most unstable of the vitamins.

This vitamin is found mainly in fruit and vegetables, is easily destroyed by cooking and tends to deteriorate if food is stored. Ascorbic acid exists in high concentration in rapidly growing vegetables; new potatoes contain more of it than old potatoes.

It occurs in black-currants, sprouts, cauliflower, cabbage, orange, lemon, grapefruit, potato.

5. Mineral Salts Minerals are important in the formation of bones and teeth (especially calcium, phosphorus and magnesium), as constituents of body cells, and as soluble salts in tissue fluids. Most of these /

these minerals are needed only in very small amounts; they are widely distributed in nature.

The most important mineral substances required by the body are sodium, potassium, calcium, iron, copper, phosphorus, sulphur and iodine.

The following are some of these minerals and their uses:-

(i) Sodium and Potassium Sodium is needed by every cell and tissue of the body, in order to assist in the production of glandular secretions and to maintain the slight alkalinity of the blood.

Potassium is needed for cell building, especially of red blood cells, and for muscle contraction.

(ii) Calcium Salts These are necessary for the hardening of bones and teeth, the coagulation of blood, the normal working of the heart, and prevention of excessive excitability in nerve cells.

They are present in organic form in milk, cheese, eggs, green vegetables, fruit, cereals, sardines and almonds; and as inorganic salts in ordinary drinking water.

(iii) Iron This mineral is necessary in order that the haemoglobin of the red cells can combine readily with oxygen.

It is /

It is present in a complex organic form in red meat, and also in liver, egg yolk, nuts, brown bread, spinach, all fruits and green vegetables that are rich in chlorophyll.

(iv) Iodine The main use of iodine in the body is related to the secretion of the thyroid gland - thyroxin. Very small quantities are needed. The main sources of iodine are sea foods especially shell fish, and drinking water.

6. Water Water forms about 65% of the bodyweight in human beings. At least 1½ pints of fluid should be drunk daily by an adult. Water takes food to the body cells. It also assists in the dilution and removal of toxins and other waste substances, and in the regulation of body temperature and the density of body fluids.

7. Roughage This consists, chiefly, of the indigestible cellulose of fruits, vegetables and wholemeal. It has no food value, but its bulk in the intestines stimulates the activity of the intestines and so assists in the elimination of waste products from the large intestine.

DISEASES ATTRIBUTABLE TO MALNUTRITION

To be healthy, one must eat a balanced diet. To obtain a balanced diet, it is necessary to eat the seven essential nutrients mentioned before, i.e. proteins, carbohydrates /

carbohydrates, fats, vitamins, mineral salts, water and roughage. As you [illegible] know, each one contains different nutrients which perform different functions in the body. A shortage of any of these can cause various deficiency diseases.

A group of disorders known as 'deficiency diseases' is now known to be due to the absence or lack of these substances, and an insufficient supply of them is responsible for many vague conditions of ill-health.

These deficiency diseases can be divided into two main groups:-

1. Protein - Calorie Deficiency

   Kwashiorkor It is found in large parts of S.E. Asia and throughout Africa, particularly West Africa where it gets its name. It is caused by lack of protein and is common among young children who are weaned straight on to an adult starchy diet. The young child becomes apathetic, the stomach distends because of oedema (swollen tissues caused by fluid retention), muscles are wasted and skin discolours and sometimes peels off. Diarrhoea and anaemia are also symptoms. Over a period, this disease retards growth and lowers resistance to other diseases. Early treatment with special high protein fluid feeding is essential; if untreated, death frequently results.

2. Vitamin Deficiency

   (i) /

(i) A vitaminosis or lack of Vitamin A It can lead to blindness, and it affects many children between 6 months and 3 or 4 years in parts of Asia and Latin America.

(ii) Rickets Rickets in children is caused by a shortage of Vitamin D which prevents the proper absorption of calcium and phosphorus, needed for the growth and maintenance of normal teeth and bones. In a baby with rickets the bones do not become sufficiently hardened during the first year of life, and as soon as he begins to walk, the soft bones of the legs bend under the weight of his body. His teeth are late in erupting and are prone to decay. If the diet of an expectant mother is deficient in Vitamin D or in lime and phosphorus, the child's bones will not harden correctly and the teeth will not be well formed. The mother herself will suffer from dental decay or worse. The cure is a diet rich in calcium enriched with Vitamin D; milk and cod-liver oil are good sources, and frequent exposure of the skin to sunlight helps too.

(iii) Beri-beri It is due to lack of Vitamin B, particularly the thiamine component, and is common in Asian countries with a staple diet /

diet of polished rice. It is prevalent in children and expectant and nursing mothers. It causes wasting and paralysis of the limbs, and in its acute form may lead to heart failure and signs of nervous disorder.

The cure is foods with a high content of thiamine.

(iv) Pellagra It is another Vitamin B deficiency disease, due to lack of niacin, and is common among maize eating people.

The cure is a well-balanced diet with plenty of meat and green vegetables.

(v) Nutritional Anaemia It is due to lack of Vitamin C. It particularly affects expectant mothers and young children, and is one of the main causes of death in childbirth.

Meat, liver and foods containing iron are the cure.

In addition to these specific diseases, underfeeding and malnutrition can cause weakness to all infections, and vastly increase the death rate from diseases such as pneumonia and measles.

SOCIAL EFFECTS OF MALNUTRITION

The social effects of malnutrition are enormous. To quote an official report; "The entire mode of life is organised around the fact of an insufficiency of calories /

calories in the diet, and the results of this are socially deplorable. There is a lack of energy and initiative, a refusal to face physical or intellectual effort. At school, underfed children cannot pay attention for long and are very soon inclined to fall asleep .... These secondary effects are immeasurable, and only a revolution in dietary standards will correct all these deficiencies."

FOOD IS A WORLD PROBLEM

There are a number of people in the world, who live in poor countries, and do not have enough to eat. These people are more likely to be ill than those in rich countries like our country. There are many reasons for that. Those people who live in poor countries suffer hunger or even starvation. Some of them suffer malnutrition. Many of them lack essential foods such as protein and vitamins. Children are particularly badly hit. They need more body-building food than adults because they are growing fast. When they do not get it they are liable to catch all kinds of diseases and to suffer very seriously from them. However, it is true to say that many children from poorer and less developed countries (e.g. some parts of Africa, Central and South America) suffer from an inadequate diet or even lack of food and therefore their body tissues and muscles waste away - they are lifeless and weak and are very prone to disease.

If we look at the pattern of world food supply, we /

we would find a huge gap between rich and poor countries. It is estimated that up to 1966 there was enough food to supply everyone alive with enough calories and proteins, but now a large proportion of the world's population is either under-nourished or malnourished. So one big problem we face is unequal distribution of food supplies along with spoilage and wastage. One of the contributing factors is that the rate of increase in population in these poorer and less developed countries is growing faster than in rich countries.

Poor countries also do not have their fair share of food, meanwhile, the developed countries have more than their fair share. As a result, real differences exist between children in developed countries and less developed countries and many in less developed countries will die in middle age for the following reasons:-

(a) Malnutrition and hunger, and even starvation;

(b) Poor housing;

(c) Poor medical care;

(d) Inadequate production of food because of lack of development and ignorance in agricultural methods.

As a result of these factors, children in poor countries, and all people as well, live an endless cycle of poverty. Those people cannot have the food they need as long as there is a shortage of money and lack of tools or agricultural equipment to develop better techniques in food production. In addition, there is the ignorance of what they need in terms of chemical composition and amount of vitamins and proteins.

A P P E N D I X 5.2(g)

Glasgow University - Research in Science Education

ANSWER SHEET (FOOD)

(1) Please fill in the following:-

Girl ☐

Boy ☐

Group No. _____

Name of School : _ _ _ _ _ _ _

Your full name : _ _ _ _ _ _ _

School Year : _ _ _ _ _ _ _

Date of Birth : _ _ _ _ _ _ _

Today's Date : _ _ _ _ _ _ _

(2) Please indicate by a tick which of the following most nearly fits your course:-

(a) Studying for an 'O' grade in three sciences.

(b) " " " " " " two sciences.

(c) " " " " " " one science only.

(3) Please turn over to indicate your answers.

Thank you for your co-operation

Please give your answer to each question on this sheet of paper.

IMPORTANT (1) Be sure you answer all the questions, do not omit any.

(2) There is only one correct answer for each question and this must be given in the form A, B, C, D.

Question Number	Answer	Question Number	Answer	Question Number	Answer
1.		11.		21.	
2.		12.		22.	
3.		13.		23.	
4.		14.		24.	
5.		15.		25.	
6.		16.		26.	
7.		17.		27.	
8.		18.		28.	
9.		19.			
10.		20.			

PUPIL TEST (FOOD)

(Please indicate your answer on the separate sheet provided)

Part 1

1. The approximate amount of energy expended by you per day is -
   A. 30 Kilocalories
   B. 300 "
   C. 3000 "
   D. 30000 "

2. If you have 100 g. of each of the following foodstuffs which of them is the richest source of energy?
   A. Milk
   B. Butter
   C. Cheese
   D. Chocolate

3. If you have 100 g of each of the following foodstuffs which of them is the richest source of Protein?
   A. Jam
   B. Milk
   C. Butter
   D. Cheese

4. If your doctor told you to eat a foodstuff rich in Vit. D, which one of the following would give you most Vit. D per 100 g.?
   A. Eggs
   B. Milk
   C. Butter
   D. Cheese

5. Which of the following has the best food value - a cup of -
   A. Tea
   B. Coke
   C. Cocoa
   D. Coffee

6. If you have 100 g. of each of the following foodstuffs which of them is the richest source of Vit. C ?
   A. Jam
   B. Carrot
   C. Tinned peas
   D. Grapefruit juice

7. /

7.	How many grams of protein, on average, do you require per day?	A. 25 g. B. 45 g. C. 65 g. D. 85 g.
8.	How many grams of Calcium, on average, do you require per day?	A. 0.08 g. B. 0.80 g. C. 8.00 g. D. 80.00 g.
9.	If a player before a match has to choose a foodstuff to supply him with the maximum amount of energy, which of the following does he choose if he has 200 g. of each available?	A. Milk B. Biscuits C. Orange juice D. Roasted peanuts

---

Write the letter of the substance in Column 2 which is the best example of the nutrient in Column 1. For example -

Column 1	Column 2
carbohydrate	A. sugar B. orange C. cabbage D. milk

The answer is given by writing 'A' in the answer sheet. This means that although each of the substances contains carbohydrate, sugar is the best example of that nutrient.

Column 1	Column 2
10. protein	A. Milk
11. fat	B. Cornflakes
12. carbohydrate	C. Liver D. Butter

Part 2 /

Part 2

Write the letter of the word in Column B which best matches the phrase in Column A. Each word in Column B may be used once, more than once, or not at all.

Column A	Column B
13. Imbalance in the correct amount of nutrients;	A. Hunger B. Obesity C. Malnutrition D. Starvation
14. Inadequate total amount of nutrients;	
15. Eating insufficient protein in diet;	
16. Severe lack of total amount of nutrients;	
17. An excess consumption of carbohydrate, etc.	
18. An average British child eats in one day more than an average African child eats in one day. Is this excess -	A. Less than twice B. Exactly twice C. More than twice D. More than three times
19. From the countries listed, which one does not have enough food supplied to make an adequate diet?	A. Canada B. Mexico C. France D. Belgium
20. The fraction of the world's population who have an inadequate diet is -	A. 1/6 B. $\frac{1}{3}$ C. $\frac{1}{2}$ D. $\frac{2}{3}$

21. /

21. The estimated population of the world today in thousand millions is -

A. $1\frac{1}{2}$
B. $2\frac{1}{2}$
C. $3\frac{1}{2}$
D. $4\frac{1}{2}$

22. If we compared Africa's population today with Europe's today, we would find that -

A. Africa has a bigger population than Europe.
B. Africa has a smaller population than Europe.
C. Both have the same number of people.
D. Don't know

23. If we compared Africa with Europe, regarding their rate of increase in population, what would we find?

A. Africa has a bigger rate of increase than Europe.
B. Africa has a lower rate of increase than Europe.
C. Both have the same increase.
D. Don't know.

24. If we compared the life expectancy of men in Europe with those in Africa we would find that -

A. Europeans have a longer life expectancy than Africans.
B. Europeans have a shorter life expectancy than Africans.
C. Both Europeans and Africans have the same life expectancy.
D. Don't know

25. Which country given has the most adequate food supply for an adequate diet?

A. Chile
B. Ghana
C. Mexico
D. Britain

26. /

26. Which country given has the smallest share in world food supplies?

A. Africa
B. Canada
C. Far East
D. South America

27. If you arranged in order the following countries regarding their share of the world food supplies, with the one having the highest share first, and the one having the lowest share last, what arrangement would be the correct one?

A. Europe, U.S.A., South America, Africa.
B. U.S.A., Europe, Africa, S. America.
C. Europe, U.S.A., Africa, S. America.
D. U.S.A., Europe, S. America, Africa.

28. If we compared the number of children in Africa under fifteen years' of age with the number in Europe, would you say that there are -

A. The same number.
B. Twice as many in Africa as in Europe.
C. Half the number in Africa compared with the number in Europe.
D. Twice as many in Europe as in Africa.

PUPIL QUESTIONNAIRE

(1) The aim of this questionnaire is to get your reaction to a list of statements regarding 'FOOD'. You are asked to read each statement carefully then indicate your answer, which represents your serious opinion.

(2) There are no 'right' or 'wrong' answers.

Part 1

Please put a tick (✓) in the appropriate box which fits your true opinion of the material you have just studied.

Here is how you are to use these boxes:-

If you place your check-mark in the first box close to 'Good'

Good ☑ ☐ ☐ ☐ ☐ Bad

this means that the material is very good

If you place your check-mark in the second box near to 'Good'

Good ☐ ☑ ☐ ☐ ☐ Bad

this means that the material is fairly good.

If you place your check-mark in the third box (in the middle)

Good ☐ ☐ ☑ ☐ ☐ Bad

this means that your impression on the material is neutral, i.e. not good not bad.

If you place your check-mark in the fourth box to 'Good' i.e. the second box to 'Bad'

Good ☐ ☐ ☐ ☑ ☐ Bad

this /

this means that the material is fairly bad.

If you place your check-mark in the fifth box to 'Good', i.e. the first box close to 'Bad'

Good ☐ ☐ ☐ ☐ ☑ Bad

this means that the material is very bad.

Here is an example of describing something, for example, a particular flower -

Small	☐	☐	☑	☐	☐	Large
Beautiful	☑	☐	☐	☐	☐	Ugly
Bad smelling	☐	☐	☐	☑	☐	Good smelling

This means that the flower is of medium size and very beautiful, but it has a fairly good smell.

By using the same method of ticking please give your general impression about the material you have just studied.

IMPORTANT (1) Be sure you answer all the questions, do not omit any;

(2) Never put more than one check-mark on a single scale.

The material you have just studied is:-

Interesting	☐	☐	☐	☐	☐	Boring
Exciting	☐	☐	☐	☐	☐	Dull
Not enjoyable to study	☐	☐	☐	☐	☐	Enjoyable to study
Easy to understand	☐	☐	☐	☐	☐	Difficult to understand
Unhelpful	☐	☐	☐	☐	☐	Helpful

By using /

By using the same method of ticking, please give your general impression about THE SUBJECT OF FOOD VALUES.

The subject of food values is -

Interesting						Boring
Exciting						Dull
Not enjoyable to study						Enjoyable to study
Easy to understand						Difficult to understand
Unhelpful						Helpful

Again, by using the same method of ticking, please give your general impression about THE SUBJECT OF FOOD AS A WORLD PROBLEM.

The subject of food as a world problem is -

Interesting						Boring
Exciting						Dull
Not enjoyable to study						Enjoyable to study
Easy to understand						Difficult to understand
Unhelpful						Helpful

Part 2

Please indicate your opinion by putting a tick in the appropriate column against each statement:-

	Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
1. I should like to do something to help those children who are undernourished, hungry and starving in poor countries.					
2. We must just accept that some people in poorer and less developed countries have to be hungry and malnourished.					
3. I should like to make a donation in order to save malnourished, hungry and starving people in poorer countries.					
4. Since the problem of lack of food does not exist in our country, we do not bother about it.					
5. All of us in Britain have our responsibility to help those in other countries suffering a severe lack of food.					

Part 3 /

Part 3

Suppose that you have read the following news in your local newspaper:-

"THE GREATEST TRAGEDY OF THE 20th CENTURY

Every week, about 3,000 people, including hundreds of little children, in poorer and less developed countries are hungry, undernourished and starving. Please rush us your emergency contribution so that we can immediately purchase food for those victims."

	Certainly, yes	Probably, yes	Uncertain	Probably, no	Definitely, no
1. Would you agree to make a donation?					
2. Would you ask the members of your family to give what they could for saving those starving children?					
3. If you are asked to urge your friends to make a donation, would you be willing to do so?					
4. Do you see that every individual in rich countries, like your country, is responsible for helping those hungry people?					

5. /

	Certainly, yes	Probably, yes	Uncertain	Probably, no	Definitely, no
5. Britain, as a rich country, has a responsibility to help people in poor countries suffering from hunger.					
6. Some people in rich countries say: "Since those starving people live in other countries, and not in our country, then let them starve!" - do you agree with them?					

A P P E N D I X 5.2(h)

Glasgow University - Research in Science Education

TEACHER QUESTIONNAIRE (FOOD)

This is a list of educational objectives which may, in part, have been achieved by using the food games and tape slide sequence.

After your pupils have finished this material, please fill in the following questionnaire yourself (as teacher using the material), indicating with a tick how successful you think the material has been in helping pupils to achieve these objectives.

FOOD GAMES

How successful have these games been in enabling the pupils to:-

	Very successful	Fairly successful	Unsuccessful
1. Enjoy the study of food;			
2. Compete with each other in winning;			
3. Communicate their ideas to others on the food value of some items;			
4. Recognise kinds of food which contain the greatest food value;			
5. Choose a suitable diet for the needs of their age group.			

Programme /

Programme - FOOD AS A WORLD PROBLEM

	Very successful	Fairly successful	Unsuccessful
1. Take an interest in the problems associated with lack of one or more food items;			
2. Show some sympathy towards countries suffering hunger and malnutrition;			
3. Appreciate the responsibilities of advanced countries in dealing with problems of malnutrition, hunger and starvation in under-developed countries;			
4. Understand individual responsibility in advanced countries for helping people in poorer and less developed countries suffering hunger and malnutrition;			
5. Understand some specific terms related to food, such as malnutrition, hunger and starvation.			
6. Make an accurate comparison between British children and some African children regarding -			
(a) the quantity of food which each of them eats in one day;			
(b) /			

	Very successful	Fairly successful	Unsuccessful
(b) the average annual number of deaths per thousand babies under one year old;			
7. State the countries which do not have enough food to make an adequate diet;			
8. State the reasons for the higher death rate in children under one year old and the lower life expectancy in poorer and less developed countries.			

Please list:-

(a) Any other objectives which you think have been achieved by using this material;

(b) Any comments about the material, including criticism.

(A) Other objectives which have been achieved by using "FOOD GAMES"

(B) Other objectives which have been achieved by using the programme, "FOOD AS A WORLD PROBLEM".

(C) Comments

To be completed by Principal Teacher.

Name of Principal Teacher: _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

Name of School: _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

Number of pupils who attempted this material:

Total _____

Boys _____

Girls _____

Date(s) of use _____

Today's date _____

THANK YOU FOR YOUR CO-OPERATION

A P P E N D I X 5.2(i)

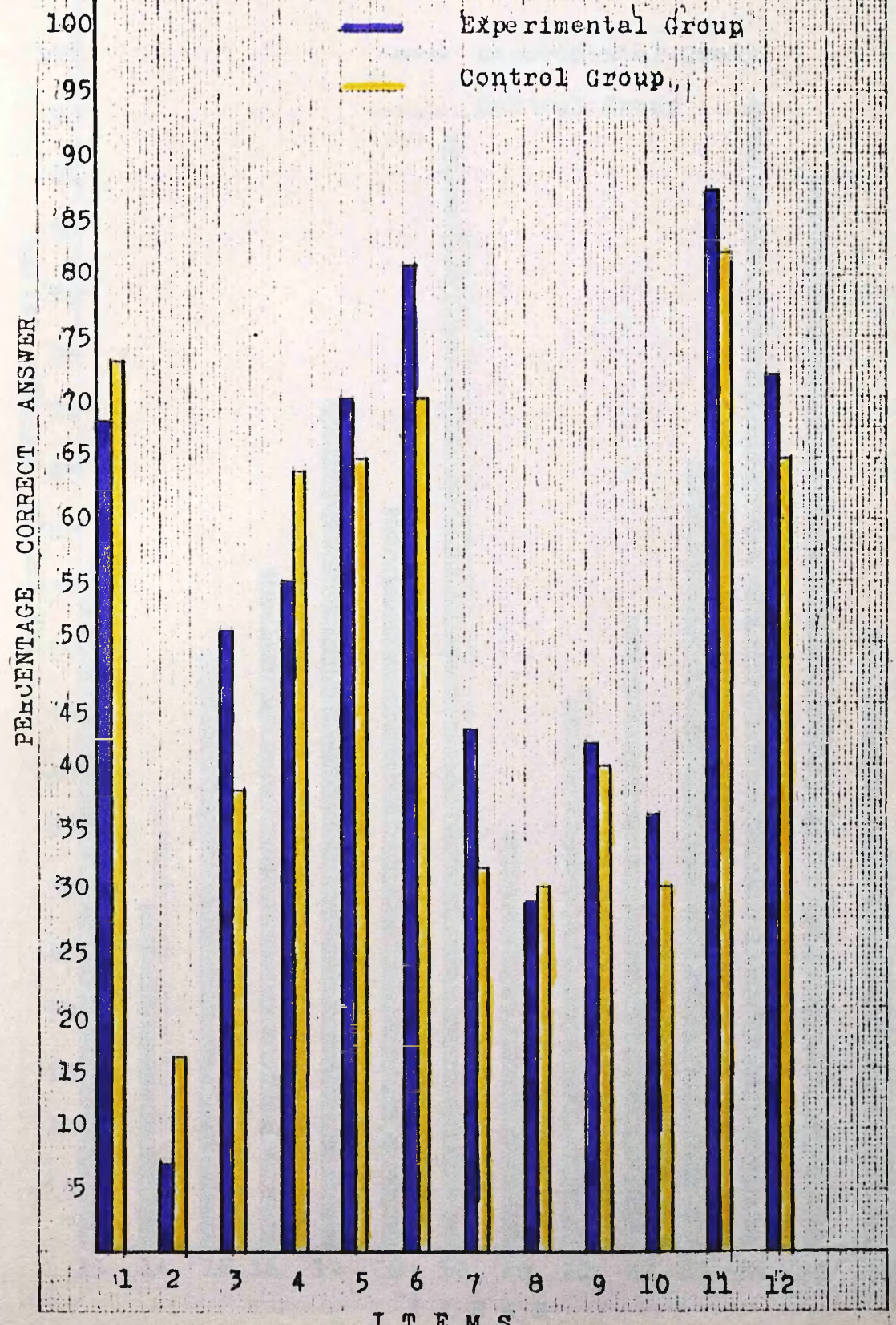
ANALYSING OF THE PUPIL TEST (COGNITIVE TEST)

Question Number	Experimental Group		Control Group		Sig.
	% age Correct Answer	Discri-mination	% age Correct Answer	Discri-mination	
1.	67.26	0.26	72.73	0.23	-
2.	6.67	0.11	16.16	0.33	-
3.	51.43	0.30	38.38	0.17	*1%
4.	55.24	0.08	63.64	0.10	-
5.	69.52	-0.02	64.65	0.21	-
6.	80.95	0.17	69.70	0.37	-
7.	42.86	0.10	32.32	0.00	*1%
8.	28.57	0.17	30.30	0.00	-
9.	41.90	0.12	40.40	0.21	*1%
10.	36.19	0.20	30.30	-0.04	*1%
11.	86.67	0.20	81.82	0.29	-
12.	72.38	0.34	64.65	0.46	*5%
13.	56.19	0.25	57.58	0.35	-
14.	28.57	0.38	38.38	0.25	-
15.	50.48	0.21	42.42	0.33	*1%
16.	61.90	0.41	51.52	0.30	*5%
17.	71.43	0.27	64.65	0.42	-
18.	61.90	0.29	40.40	0.12	*1%
19.	93.33	0.23	84.85	0.17	-
20.	35.24	0.10	27.27	-0.11	*1%
21.	45.71	0.19	47.47	0.10	-
22.	53.33	0.23	29.29	-0.11	*1%
23.	65.71	0.26	57.58	0.43	-
24.	96.19	0.05	77.78	0.36	-
25.	90.48	0.23	81.82	0.29	-
26.	52.38	0.25	33.33	-0.06	*1%
27.	54.29	0.33	47.47	0.18	*1%
28.	12.38	0.20	1.01	-0.10	*1%

APPENDIX 5.2(j.1)

COGNITIVE TEST

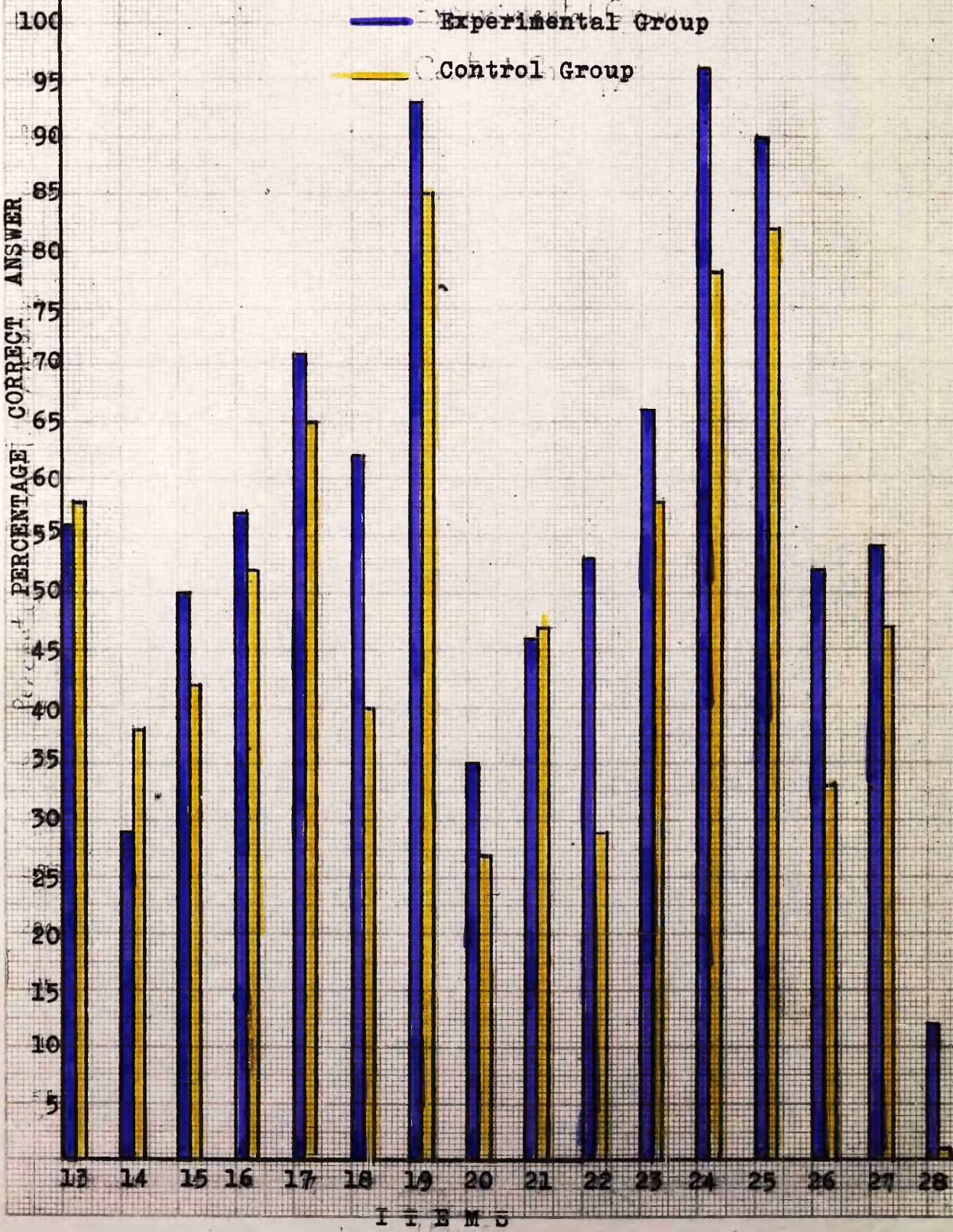
Part 1 : FOOD VALUE



A P P E N D I X 5.2(i,ii)

COGNITIVE TEST

Part 2 : FOOD IS A WORLD PROBLEM



A P P E N D I X 5.2(k)

ANALYSING OF THE PUPIL QUESTIONNAIRE

(THE AFFECTIVE TEST)

PART	Ques. No.	A and B					C					D and E				
		Exp.		Cont.		Sig.	Exp.		Cont.		Sig.	Exp.		Cont.		Sig.
		F.	%	F.	%		F.	%	F.	%		F.	%	F.	%	
1 (a)	1.	85	83	27	28	*1%	13	13	25	26	*1%	4	4	44	46	*1%
	2.	54	53	8	9	*1%	37	36	33	35	*1%	11	11	53	56	*1%
	3.	14	14	41	44	*1%	15	15	27	29	*1%	74	72	26	28	*1%
	4.	74	73	34	36	*1%	16	16	29	31	*1%	11	11	31	33	*1%
	5.	7	7	11	12	*1%	14	14	16	17	*1%	78	79	66	71	-
		234		121			95		130			178		220		

Total of Exp. Group responses = 234 + 95 + 178 = 507

" " Cont. " = 121 + 130 + 220 = 471

	507	471	507	471
	234	121	95	130	178	220
Fe	130		140		237	
Fo	234		95		178	

$$\chi^2 = \frac{(104)^2}{130} + \frac{(45)^2}{140} + \frac{(59)^2}{237}$$

$$= 83.20 + 14.46 + 14.68 = 112.34 \ *1\%$$

Degrees of freedom (V) = 2

PART	Ques. No.	A and B					C					D and E				
		Exp.		Cont.			Exp.		Cont.			Exp.		Cont.		
		F.	%	F.	%	Sig.	F.	%	F.	%	Sig.	F.	%	F.	%	Sig.
1 (b)	1.	50	49	36	38	*1%	17	17	21	22	*1%	35	34	39	41	*1%
	2.	24	24	16	17	*1%	37	37	31	34	*1%	40	40	45	49	*1%
	3.	34	34	31	33	*1%	32	32	35	37	*1%	34	34	29	31	*1%
	4.	48	48	36	38	*1%	31	31	31	33	-	22	22	28	29	*1%
	5.	8	8	13	14	*1%	16	16	16	17	-	77	76	64	69	*1%
		164		132			133		134			208		205		

Total of Exp. Group responses = 164 + 133 + 208 = 505

" " Cont. " " = 132 + 134 + 205 = 471

	505	471	505	471	505	471	
	164	132	133	134	208	205	
Fe	167		144		220		
Fo	164		133		208		

$$\chi^2 = \frac{(3)^2}{167} + \frac{(11)^2}{144} + \frac{(12)^2}{220}$$

$$= 0.05 + 0.84 + 0.65 = 1.54 \quad \text{No sig.}$$

Degrees of freedom (V) = 2

PART	Ques. No.	A and B					C					D and E				
		Exp.		Cont.			Exp.		Cont.			Exp.		Cont.		
		F.	%	F.	%	Sig.	F.	%	F.	%	Sig.	F.	%	F.	%	Sig.
1 (c)	1.	67	64	50	53	-	12	11	9	9	*1%	27	26	36	38	*1%
	2.	32	31	27	28	*1%	42	41	30	32	*1%	28	27	38	40	*1%
	3.	30	29	36	38	*1%	23	22	19	20	*1%	52	50	41	43	*1%
	4.	54	52	37	40	*1%	21	20	33	35	*1%	29	28	24	26	*1%
	5.	16	15	13	14	*1%	16	15	25	26	*1%	74	70	57	60	-
		199		163			114		116			210		196		

Total of Exp. Group responses = 199 + 114 + 210 = 523

" " Cont. " " = 163 + 116 + 196 = 475

	523	475		523	475		523	475
	199	163		114	116		210	196
Fe	179			128			216	
Fo	199			114			210	

$$\chi^2 = \frac{(20)^2}{179} + \frac{(14)^2}{128} + \frac{(6)^2}{216}$$

$$= 2.23 + 1.53 + 0.16 = 3.92 \quad \text{No sig.}$$

Degrees of freedom (V) = 2

PART	Ques. No.	A and B					C					D and E				
		Exp.		Cont.			Exp.		Cont.			Exp.		Cont.		
		F.	%	F.	%	Sig.	F.	%	F.	%	Sig.	F.	%	F.	%	Sig.
2	1.	84	81	72	79	-	15	14	11	12	*1%	5	5	8	9	*1%
	2.	20	19	15	16	*1%	14	14	11	12	*1%	69	67	66	72	-
	3.	80	77	64	69	-	17	16	21	23	*1%	7	7	8	9	-
	4.	27	26	31	37	*1%	10	10	10	12	-	67	64	42	51	*1%
	5.	70	67	49	53	-	20	19	21	23	-	14	13	23	25	*1%
		281		231			76		74			162		147		

Total of Exp. Group responses = 281 + 76 + 162 = 519

" " Cont. " " = 231 + 74 + 147 = 452

	519	452	519	452	519	452	
	281	231	76	74	162	147	
Fe	265		85		147		
Fo	281		76		162		

$$\chi^2 = \frac{(16)^2}{265} + \frac{(9)^2}{85} + \frac{(15)^2}{147}$$

$$= 0.96 + 0.95 + 1.53 = 3.44 \quad \text{No sig.}$$

Degrees of freedom (V) = 2

PART	Ques. No.	A and B					C					D and E				
		Exp.		Cont.			Exp.		Cont.			Exp.		Cont.		
		F.	%	F.	%	Sig.	F.	%	F.	%	Sig.	F.	%	F.	%	Sig.
3	1.	82	81	74	80	-	14	14	17	18	*1%	5	5	2	2	*1%
	2.	70	69	64	68	-	15	15	17	18	*1%	16	16	13	14	*1%
	3.	59	60	62	67	-	21	21	21	23	-	18	18	10	11	*1%
	4.	62	61	42	45	*1%	23	23	25	27	-	16	16	26	28	*1%
	5.	75	74	53	57	-	15	15	24	26	*1%	12	12	16	17	*1%
	6.	9	9	11	12	1%	8	8	7	8	-	84	83	75	81	-
		357		306			96		111			151		142		

Total of Exp. Group responses = 357 + 69 + 151 = 577

" " Cont. " " = 306 + 111 + 142 = 659

	577	577	577
	659	659	659
	357	96	151
	306	111	142
Fe	268	97	124
Fo	357	96	151

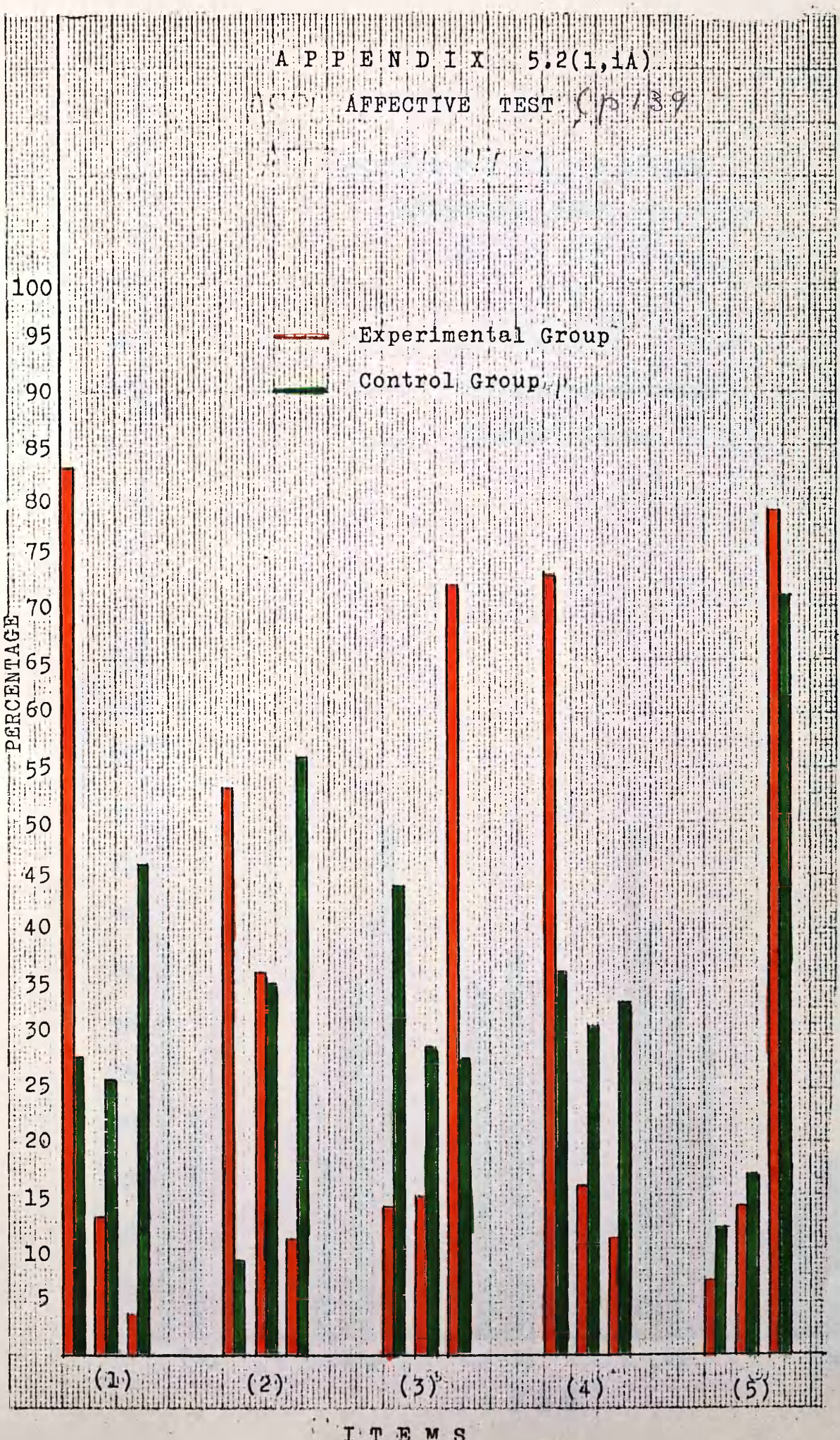
$$\chi^2 = \frac{(89)^2}{268} + \frac{(1)^2}{97} + \frac{(27)^2}{124}$$

$$= 29.55 + 0.01 + 5.87 = 35.43 \quad *1\%$$

Degrees of freedom (V) = 2

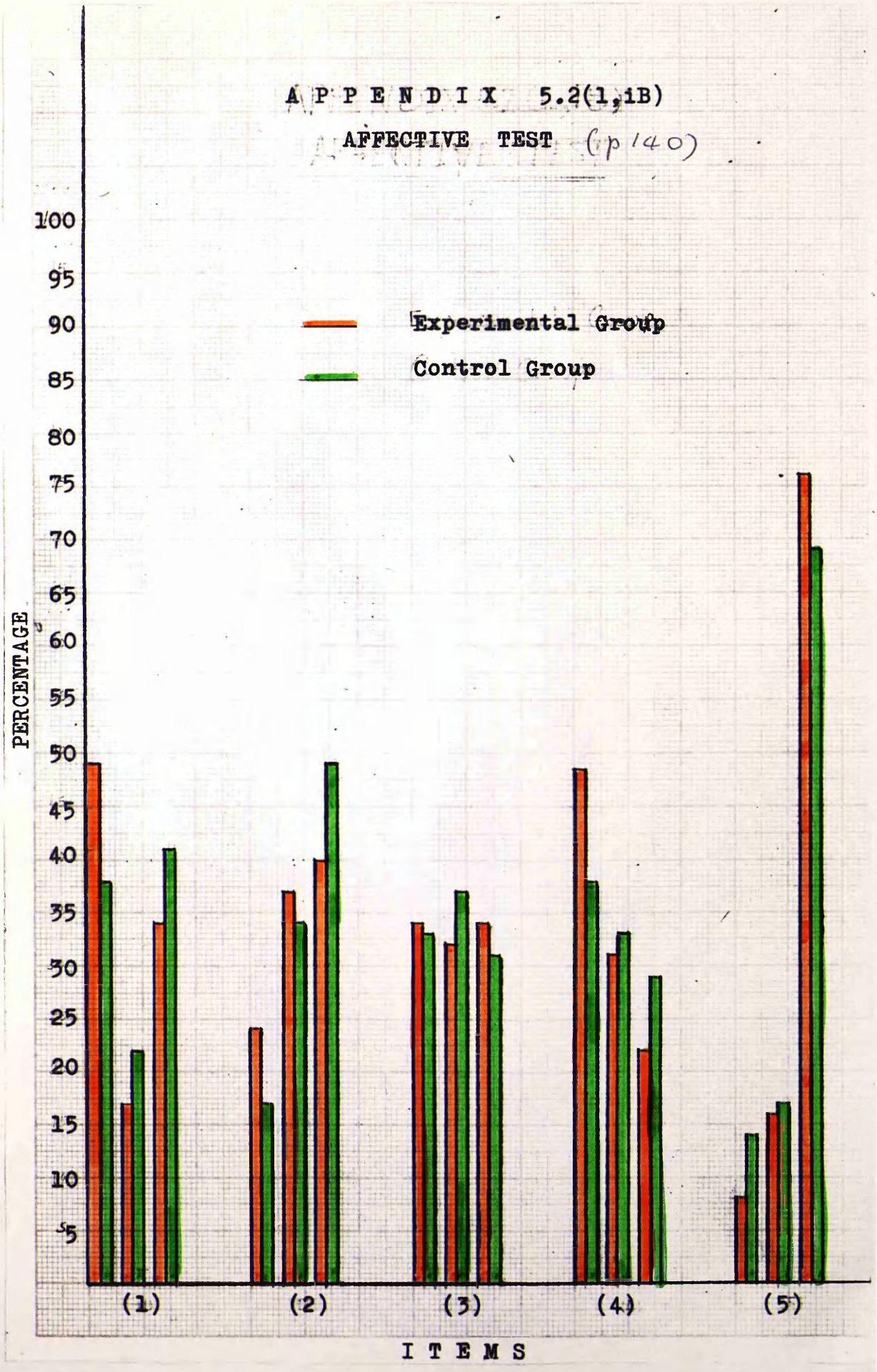
A P P E N D I X 5.2(1,iA).

AFFECTIVE TEST (p. 139)



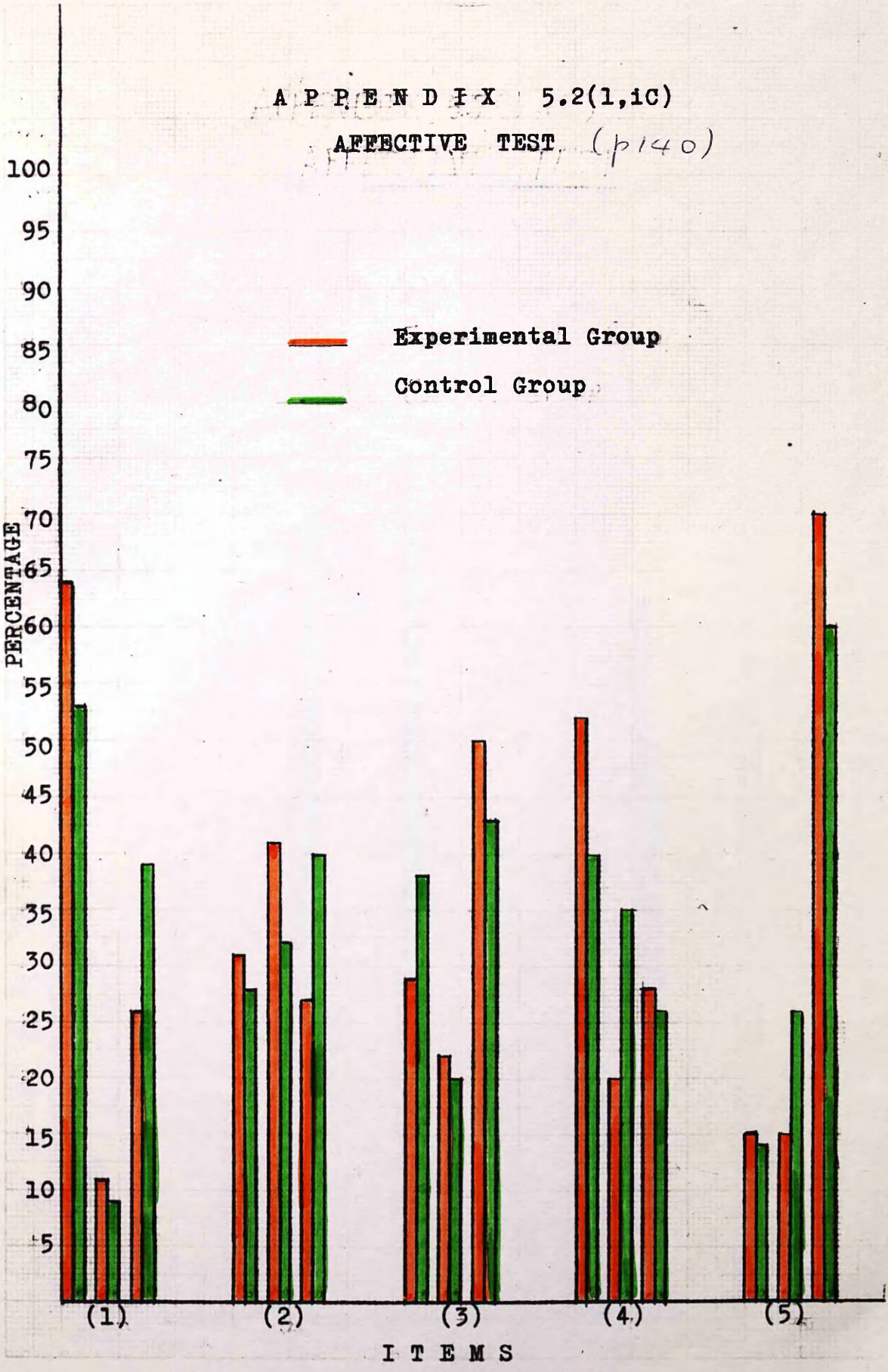
A P P E N D I X 5.2(1,iB)

AFFECTIVE TEST (p 140)



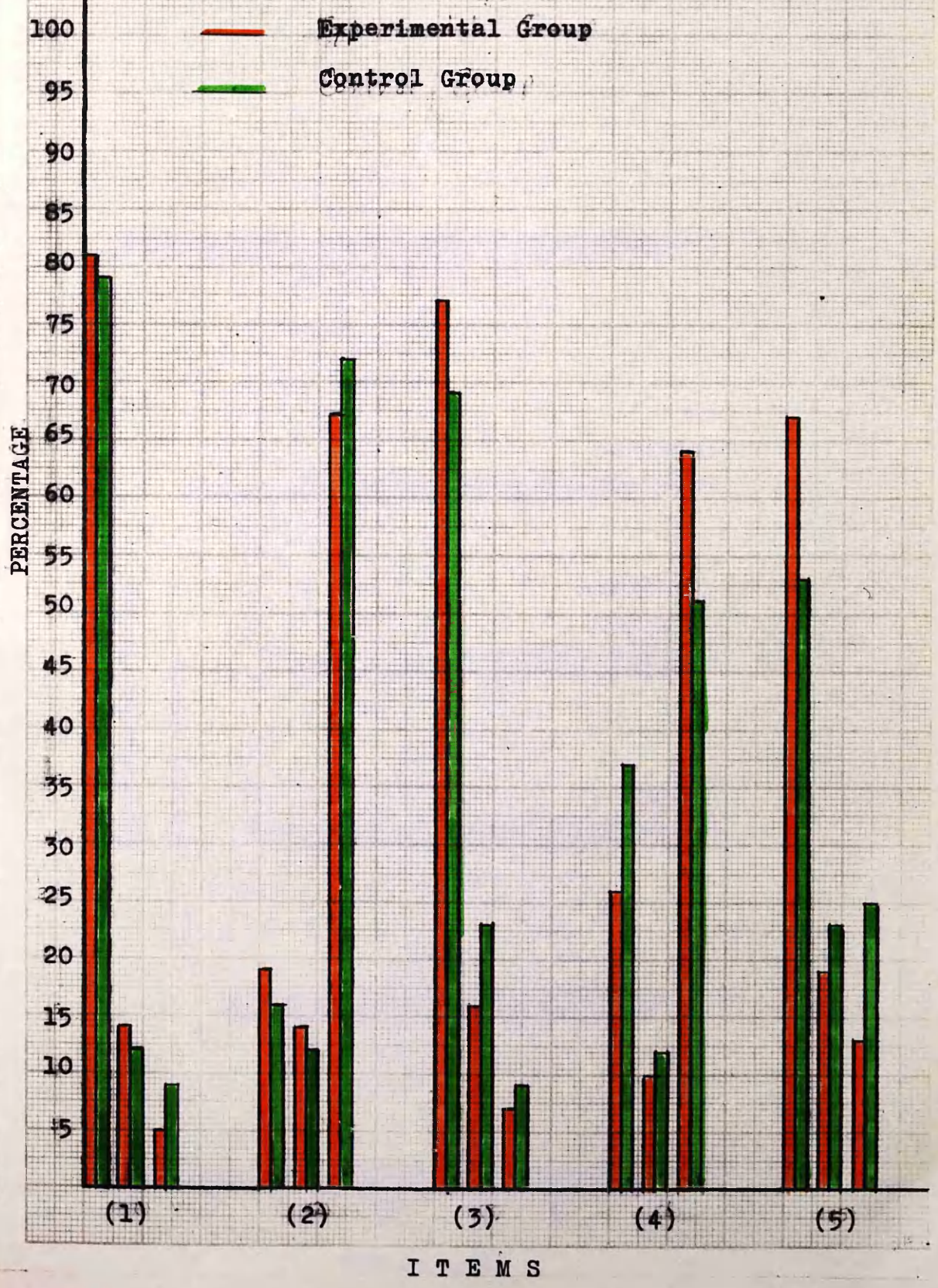
A P P E N D I X 5.2(1,iC)

AFFECTIVE TEST (p140)



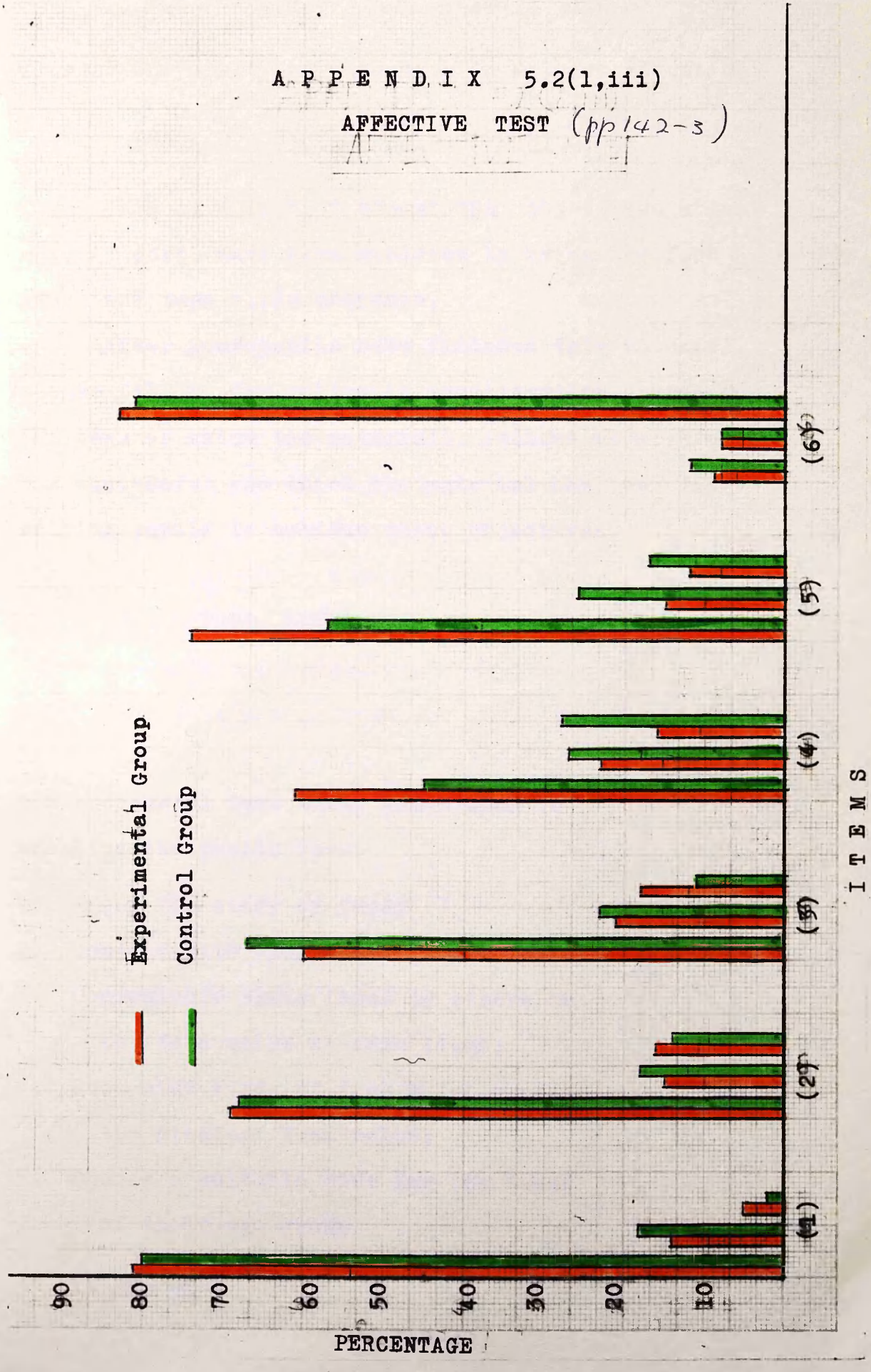
A P P E N D I X 5.2(i,ii)

AFFECTIVE TEST (p141)



A P P E N D I X 5.2(1,iii)

AFFECTIVE TEST (pp 142-3)



A P P E N D I X 5.2(m)

Glasgow University - Research in Science Education

TEACHER QUESTIONNAIRE (FOOD)

This is a list of educational objectives which may, in part, have been achieved by using the food games and tape slide sequence.

After your pupils have finished this material, please fill in the following questionnaire yourself (as teacher using the material), indicating with a tick how successful you think the material has been in helping pupils to achieve these objectives.

FOOD GAMES

How successful have these games been in enabling the pupils to:-

	Very successful	Fairly successful	Unsuccessful
1. Enjoy the study of food;	5	-	-
2. Compete with each other in winning;	3	2	-
3. Communicate their ideas to others on the food value of some items;	2	3	-
4. Recognise kinds of food which contain the greatest food value;	4	1	-
5. Choose a suitable diet for the needs of their age group.	-	2	1

Programme /

Programme - FOOD AS A WORLD PROBLEM

	Very successful	Fairly successful	Unsuccessful
1. Take an interest in the problems associated with lack of one or more food items;	1	2	1
2. Show some sympathy towards countries suffering hunger and malnutrition;	3	1	-
3. Appreciate the responsibilities of advanced countries in dealing with problems of malnutrition, hunger and starvation in under-developed countries;	1	3	-
4. Understand individual responsibility in advanced countries for helping people in poorer and less developed countries suffering hunger and malnutrition;	-	2	2
5. Understand some specific terms related to food, such as malnutrition, hunger and starvation;	4	1	-
6. Make an accurate comparison between British children and some African children regarding -			
(a) the quantity of food which each of them eats in one day;	4	1	-

(b) /

	Very successful	Fairly successful	Unsuccessful
(b) the average annual number of deaths per thousand babies under one year old;	4	1	-
7. State the countries which do not have enough food to make an adequate diet;	2	3	-
8. State the reasons for the higher death rate in children under one year old and the lower life expectancy in poorer and less developed countries.	2	3	-

Please list:-

(a) Any other objectives which you think have been achieved by using this material;

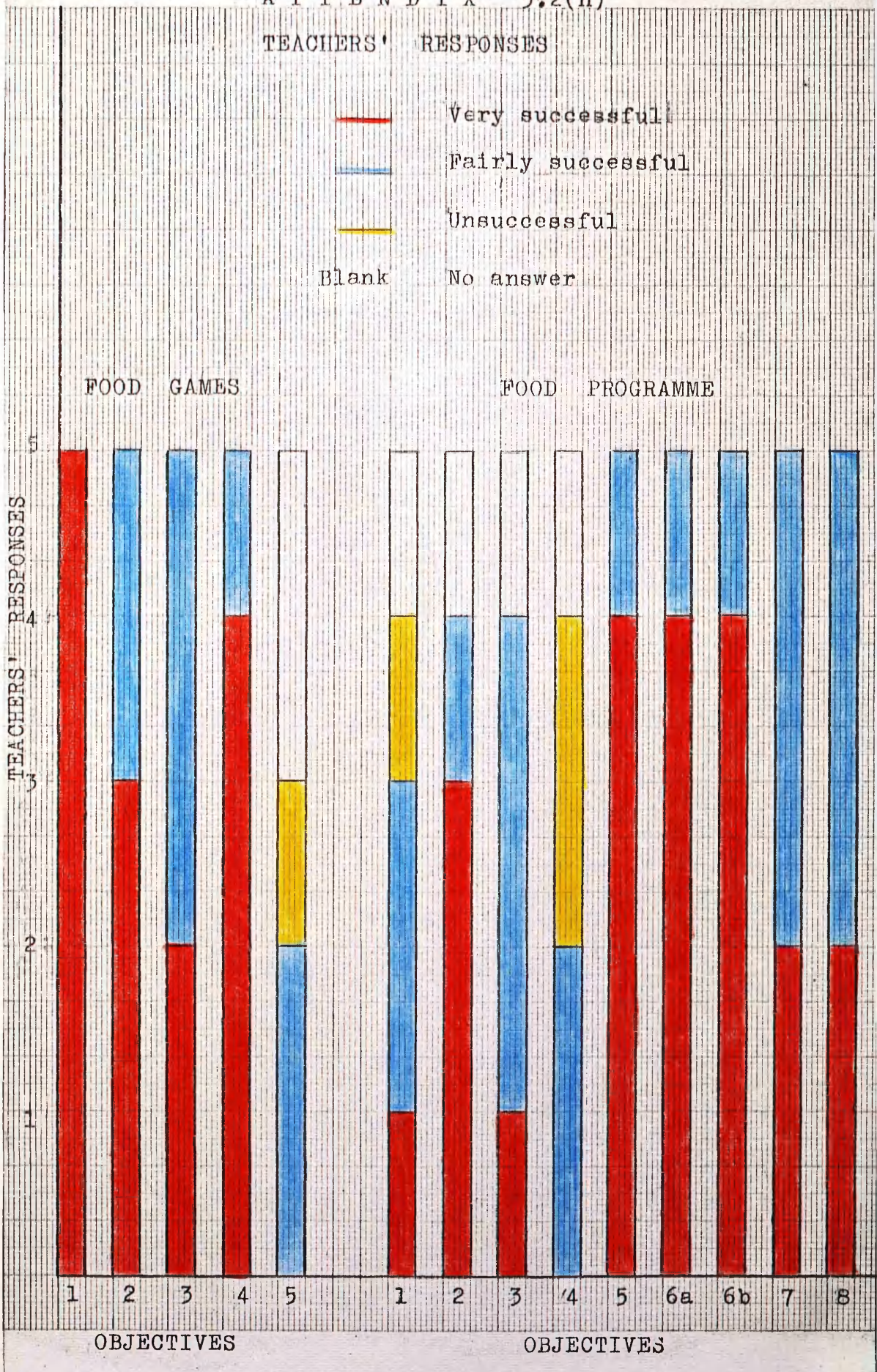
(b) Any comments about the material, including criticism.

(A) Other objectives which have been achieved by using "FOOD GAMES"

(B) Other objectives which have been achieved by using the programme, "FOOD AS A WORLD PROBLEM"

(C) Comments

A P P E N D I X 5.2(n)



C H A P T E R 6

THE SECOND UNIT : "RIVER POLLUTION"

C H A P T E R 6

THE SECOND UNIT : "RIVER POLLUTION"

This unit was applied in two consecutive years, thus allowing the final edition to be modified in the light of comments received on the trial edition.

6.1 THE TRIAL EDITION OF THE UNIT

A. The Design Of The Unit

(a) The educational objectives of the unit were defined.

(b) The material preparation:- A study in river pollution called "STRATHCLYDE PARK GAME" was devised.

(c) The material application:- It was applied in 1974-75 to fourth year S.C.E. biology pupils in Grangemouth High School, and Howell's School, Clwyd, Wales. It was also tried by a group of science teachers who attended a one-day conference in Kirkcaldy, Scotland.

(d) The unit assessment:- The assessment tools were -

(i) Pupil Tests: Cognitive Test and Affective Test were prepared to be given after using the material;

(ii) Teacher Questionnaire.

Let us examine each part in some detail.

B. /

B. The Educational Objectives Of The Unit

By using the "STRATHCLYDE PARK GAME" , the pupils should be able to:-

(a) understand some of the -

(i) factors causing water pollution;

(ii) results arising from water pollution;

(b) take an intelligent interest in the problems associated with water pollution;

(c) appreciate the responsibilities of various authorities (e.g. Purification Boards, Local Authorities) in dealing with water pollution problems;

(d) understand individual responsibility for -

(i) causing water pollution;

(ii) financing its reduction;

(e) communicate their ideas to others on the subject of water pollution.

C. Sources Of Material

To get the ideas for the unit -

(a) The researcher was in contact with the Authorities of the Clyde River Purification Board (East Kilbride), the Strathclyde Park Joint Committee (Bothwell), and the Chemist's and City Analyst's Department (Glasgow);

(b) The Strathclyde Park, South Calder River and Ravenscraig Steel Works were visited. These were /

were photographed to provide the colour slides used in the study and for historical interest.

D. The Material Structure

Since the changes between the trial and final edition of the unit were so slight, their discussion will be postponed until the modified version is described.

E. How The Material Was Applied

Teachers were provided with the plan of application, the exercise organisation, the suggested timetabling of the one hour period, and guides to parts 3 and 5 which required their active participation.

F. The Assessment Of The Unit

(a) Pupil Tests

(i) Cognitive Test. In this test, they were asked to name two factors causing water pollution, and two results arising from water pollution;

(ii) Affective Test. Three different techniques were included in this test. The first was Osgood's Method. In the second, they were given opinion statements and asked to put them in order. The third was that of Johnstone et al.

(b) /

(b) Teacher Questionnaire It included a list of educational objectives which it was hoped would be achieved. The teacher was asked to indicate how successful the material was in helping pupils to achieve these objectives.

G. Results

Although some significant differences in favour of the Experimental Group were obtained, the material did not really succeed in enabling the pupils to achieve the defined objectives in general. Also, the teachers' responses and comments supported the pupils' results. Those teachers saw that the structure of some items in the Pupil Questionnaire was vague. This resulted in misunderstanding by some pupils. Nevertheless, they saw that the material structure was very good and logical. The same comments were made by the Science Principal Teachers who attended the conference in Kirkcaldy. However, more significant modifications were introduced to the Pupil Questionnaire and the defined objectives. Slight modifications were introduced to the material structure.

6.2 THE FINAL EDITION OF THE UNIT

A. The Design Of The Unit

(a) The educational objectives of the unit were modified;

(b) /

(b) Very slight modifications were introduced to the material structure;

(c) The design of the application was modified;

(d) The Cognitive Test was enlarged;

(e) Some changes were introduced to the Affective Test;

(f) The Teacher Questionnaire was modified.

Let us consider these modifications in some detail.

B. The Educational Objectives Of The Unit

By using the "STRATHCLYDE PARK GAME", the pupils should be able to -

(a) understand some of the -

(i) factors causing water pollution;

(ii) results arising from water pollution;

(b) state the kinds of the pollutants of water;

(c) understand the ways used to assess the water quality of rivers;

(d) know

(i) the action already taken by local authorities;

(ii) the approximate costs associated with such action;

(e) take an interest in the problems associated with water pollution;

(f) appreciate the responsibilities of various authorities (e.g. Purification Boards, Local Authorities) in dealing with water pollution problems;

(g) /

(g) understand individual responsibility for -

(i) causing water pollution;

(ii) financing its reduction;

(h) communicate their ideas to others on the subject of water pollution.

C. The Material Structure

As mentioned before, the material structure would be discussed here. It was divided into five parts of which parts 3 and 5 required the teacher's active participation in class discussion. The remainder was carried out in pupil groups.

Here is a summary of the material structure.

Part 1 : The pupils were asked to establish a recreational park including an artificial loch. They were given the conditions to be taken into account when constructing the park, the facilities and activities included, and a map (Map A) including four possible areas which might be suitable for establishing this park. An ordnance survey map covering the same area was also given to the pupils, and is enclosed in the thesis. Then they were asked, as a group, to agree which was the most suitable location.

Part 2 : They were informed that the decision had already been taken by establishing a new park called "STRATHCLYDE PARK" in June 1973 which was centred in /

in the Hamilton-Motherwell area. They were provided with the reasons for choosing this area, and a map (Map B) illustrating the plan of the Park and its artificial loch.

Part 3 : They were told that the South Calder River was to be the feeder for this loch, and shown a map (Map C) illustrating the river condition. Then they were given another map (Map D) illustrating the activities along the river stretch, and more information about Sewage Works and Steel Works which pollute the river.

Part 4 : They were told about the efforts of the Local Authorities and by the Clyde River Purification Board to reduce toxic contaminants discharging into the South Calder Water.

Part 5 : They were told about the cost of improving Sewage Works and reducing discharges from Steel Works as estimated in 1972. Then they were asked in class discussion to complete a table of revision questions which was projected on a screen. At the end, to give a touch of realism, colour slides illustrating the Park, its artificial loch in the building and the industrial discharges were also shown.

The study appears in full in Appendix 6.2(a)

D. How The Material Was Applied

The design of the application was modified as follows:-

(a) /

(a) Clearer instructions for teachers were introduced. The plan, along with teachers' instructions, appears in Appendix 6.2(b).

(b) An article entitled "RIVER POLLUTION IN SCOTLAND" was prepared, for both the Control Group and Experimental Group. Its aim for the Control Group was to minimise the cognitive variables among different selected schools, whereas for the Experimental Group it was to provide the pupils with a background about the subject of water pollution before playing the game.

Here is a summary of the article content:-

- What is meant by "clean" water?
- What is meant by pollution?
- What are the pollutants in water?
- What are the effects of pollutants on water courses?
- How can water quality be assessed?
- What has been done in Scotland to control discharges to rivers?

This article appears in Appendix 6.2(c).

E. The Assessment Of The Unit

(a) <u>Pupil Tests</u>

(i) Cognitive Test - It was enlarged as a result of the new information included in the article;

(ii) Affective Test - Modifications were introduced to the preliminary test. The following /

The following is a summary of these modifications:-

- The instructions were simplified;
- The opinion statements in which the pupils were asked to put them in order, were replaced by Likert's Method.

Both tests appear in Appendix 6.2(d)

(b) Teacher Questionnaire It was altered in the light of the modifications introduced to the list of educational objectives. This questionnaire appears in Appendix 6.2(e).

F. Results

I. An evaluation of the individual pupils' performance.

- Cognitive Test

Details of the test results appear in Appendix 6.2(f). Also, a graph appears in Appendix 6.2(g), illustrating the results.

Here is a summary of the results:- From the frequency distribution of both Experimental Group and Control Group, the following were found -

(a) The mode for the Experimental Group was at mark 7, whereas it was at mark 6 for the Control Group;

(b) The mean for the Experimental Group was 6.96, whereas it was 5.77 for the Control Group.

Discussion /

Discussion

From these results, we can conclude the following:-

(a) The Experimental Group did better in the Cognitive Test in general than the Control Group, i.e., the material contributed to the knowledge reinforcement and recall.

(b) The material was successful in enabling the pupils to -

(i) understand some of the -

- factors causing water pollution,
- results arising from water pollution;

(ii) understand the ways used to assess the water quality of rivers.

• Affective Test

The results of this test appear in Appendix 6.2(h). Also, graphs were drawn illustrating the results - Appendix 6.2(i-1A), 6.2(i-1B), 6.2(i-2) and 6.2(i-3).

Here is a summary of the results and discussions.

Section 1

A. In the first part of this section, they were asked to give their general impression about the material they had studied.

(a) A significant difference regarding all the items in this test was found in favour of the Experimental Group. This group found the material more interesting, exciting, enjoyable to study, easy to understand and helpful than the Control Group.

(b) /

(b) By using a χ^2 test for this part, as a whole, a significant difference at the 1% level was obtained in favour of the Experimental Group.

Discussion

We can conclude that the material, i.e., the "STRATHCLYDE PARK GAME" was very successful in encouraging the pupils in the Experimental Group to develop an interest and enjoyment in the study of "River Pollution", compared with the pupils in the Control Group who read a factual article.

B. In the second part of this section, they were asked to give their general impression of the subject of "River Pollution". For the Experimental Group, this meant what they had learned in their normal classroom, the factual article on "River Pollution in Scotland" and the "Strathclyde Park Game". For the Control Group, this meant what they had learned in their normal classroom in addition to the factual article, i.e. the same factual article read by the Experimental Group.

The following was found:- A significant difference was found in favour of the Experimental Group. This group showed that the subject of "River Pollution" was more interesting, exciting, enjoyable to study, easy to understand and helpful than the Control Group.

Discussion

From /

From these results, we can conclude that the "Strathclyde Park Game" was successful in changing the pupils' attitude of interest and enjoyment to the subject of River Pollution.

Section 2

In this section, they were given some statements and asked to indicate their opinion.

(a) A significant difference was found in favour of the Experimental Group regarding items 2 and 3;

(b) Differences, but not significant, were found in favour of the Experimental Group regarding items 1, 4 and 5;

(c) A significant difference but in the reverse direction, i.e. in favour of the Control Group, was found in item 6;

(d) By using a χ^2 test for this section as a whole, significance near to 10% level was obtained.

The discussion for this section is included in the discussion in Section 3.

Section 3

In this section, they were given a situation followed by some statements and asked about their opinion.

(a) A significant difference at the 1% level was found in favour of the Experimental Group regarding items 3, 4, 5 and 6;

(b) /

(b) Differences, but not significant, were found in favour of the Experimental Group regarding items 1 and 2;

(c) By using a χ^2 test for this section as a whole, significance at the 1% level was obtained.

Discussion

From the results, in Sections 2 and 3, we can conclude the following -

The material, *ie.* the "Strathclyde Park Game", was successful in enabling the pupils to -

(a) appreciate the responsibilities of various authorities (e.g. Purification Boards, Local Authorities) in dealing with water pollution problems;

(b) understand individual responsibility for -

- causing water pollution,
- financing its reduction.

II. An evaluation of the Principal Teachers' responses and comments

- Teachers' Responses

Details of these responses appear in Appendix 6.2(j). Also, there is a graph shown in Appendix 6.2(k) illustrating these responses.

Summary -

(a) All of them agreed that the material was successful in achieving objectives 1(a), 4(a), 6 and 7(b);

(b) /

(b) The majority of them, 5 out of 6 responses, agreed that the material was successful in achieving objectives 1(b), 2, 3, 5, 7(a) and 8;

(c) They differed about the objective 4(b), i.e. knowing the approximate costs associated with the action already taken by local authorities.

• Teachers' Comments

(a) All of them agreed that -

(i) the material provided a useful addition to the work normally carried out in the classroom;

(ii) the material encouraged the pupils to communicate their ideas to others, to co-operate, to make their own decisions and to be involved in the problems raised in the study and the ways of tackling such problems;

(iii) the project as a whole was interesting, enjoyable and instructive.

(b) Some of them claimed that -

(i) the material needed to be co-ordinated with an actual visit to the site of the park and to the pollution sources on the South Calder;

(ii) the amount of material was far too great for the one hour allowed, so the pupils did not have the complete chance to grasp the importance of the many factors involved.

Conclusion /

Conclusion

From the results obtained, we can conclude that using well developed games and simulations in the classroom can achieve the motivation advantage by helping the participants to make their own decisions, to develop a high level of interest, enthusiasm and excitement, to deal with real-life situations, to provide interaction and peer learning, and to develop co-operation. Moreover, they can contribute to the knowledge reinforcement and recall.

APPENDIX TO CHAPTER 6

A P P E N D I X 6.2(a)

A STUDY IN RIVER POLLUTION

Part 1

Suppose that you have been given a job in the Scottish Development Department. Your task is to establish a very large recreational park. It should be placed within reasonable reach of major centres of population and should be between 5 km^2 and 7.5 km^2 in area. It is intended that a central feature of the park will be an artificial loch. Some of the essential activities of the park are:-

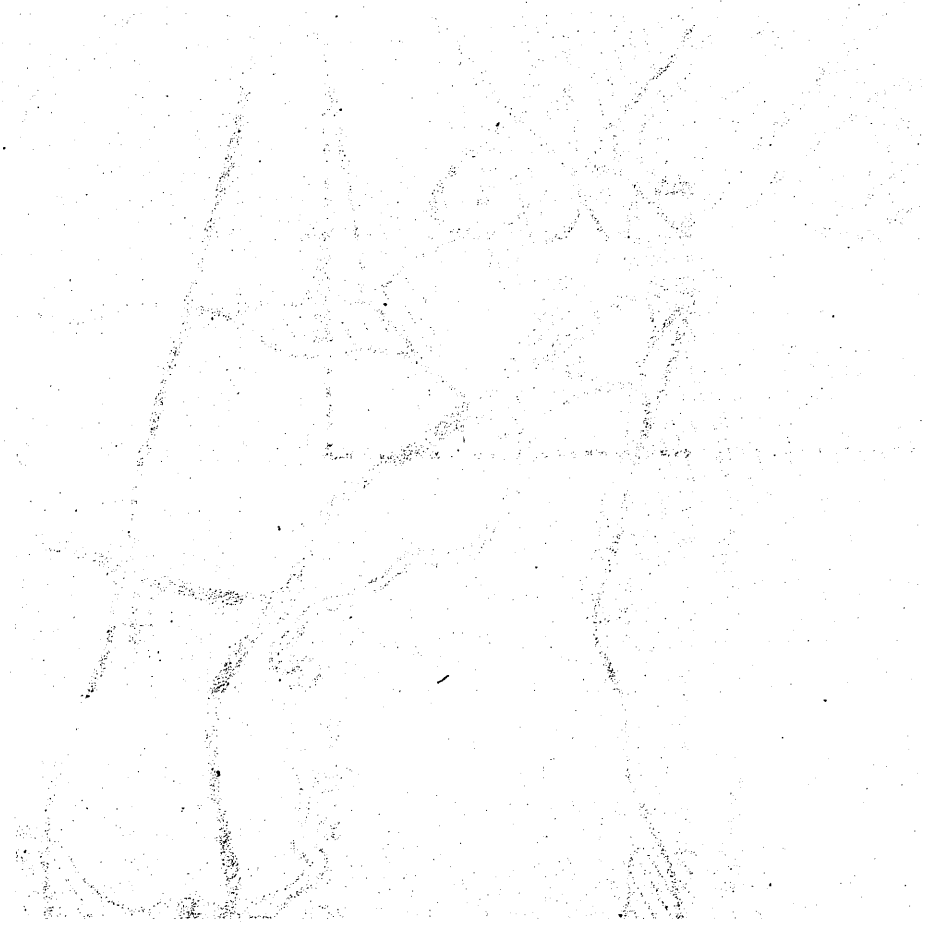
1. The loch should contain a straight length of about 2 km in order to provide facilities for competitive rowing.
2. The park must provide scope for the following -
   (i) areas suitable for picnics;
   (ii) open space including a golf course and facilities for soccer, cricket and athletics (track and stadium);
   (iii) other facilities such as a camping site and a caravan site.
3. Adequate provision must be made for rowing, canoeing, dinghy sailing and angling.
4. The Clyde cannot be used as a source of water supply for the loch, because of sedimentation problems.

Look at map A; you will find that there are four possible /

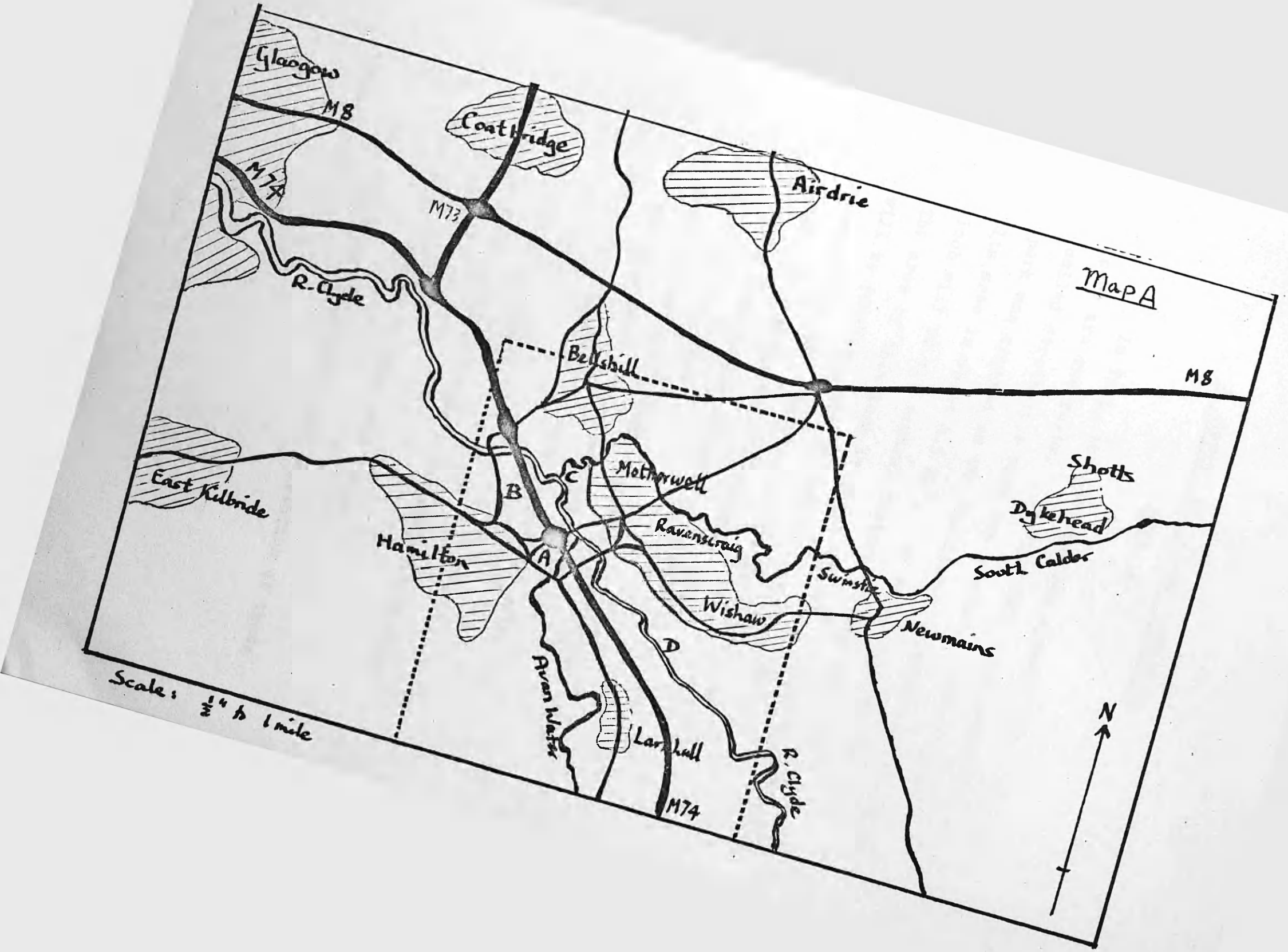
possible areas which might be suitable. These are marked A, B, C and D.

Discuss the following questions with members of your group:-

1. List the factors which you must take into account when choosing a position for the park.
2. What are the advantages and disadvantages of choosing each of A, B, C or D?
3. As a group, try to agree on which area is the most suitable.



Map A


Glasgow
M8
Coatbridge
Airdrie
M73
M74
R. Clyde
Bellshill
M8
East Kilbride
Motherwell
Shotts
Dykehead
Hamilton
A
B
C
D
Ravenscraig
South Calder
Wishaw
Newmains
Avon Water
Larkhall
M74
R. Clyde
Scale: 1/4 inch 1 mile
N

A STUDY IN RIVER POLLUTION

Part 2

In fact, the decision has already been taken and here are the facts. In June 1973 a new regional park called Strathclyde Park was started. This regional park was centred on the Hamilton-Motherwell area (area C). Its area is about 6.5 km^2. An artificial recreational loch will be the central feature of this new park. The area of this loch is about 0.8 km^2. Some excavation will be required, and the river Clyde will have to be straightened out; because of the flat nature of the ground, this presents no problems.

The reasons for choosing this area to be the new park are as follows:-

1. Golf and racing (already established) are very close, making a compact recreational area.
2. The South Calder River will supply the water for the loch.
3. The ground in this area is flat.
4. There is a sufficient length for competitive water sports.
5. This area is near to many main towns.

The following table shows the population of these towns in 1973.

City /

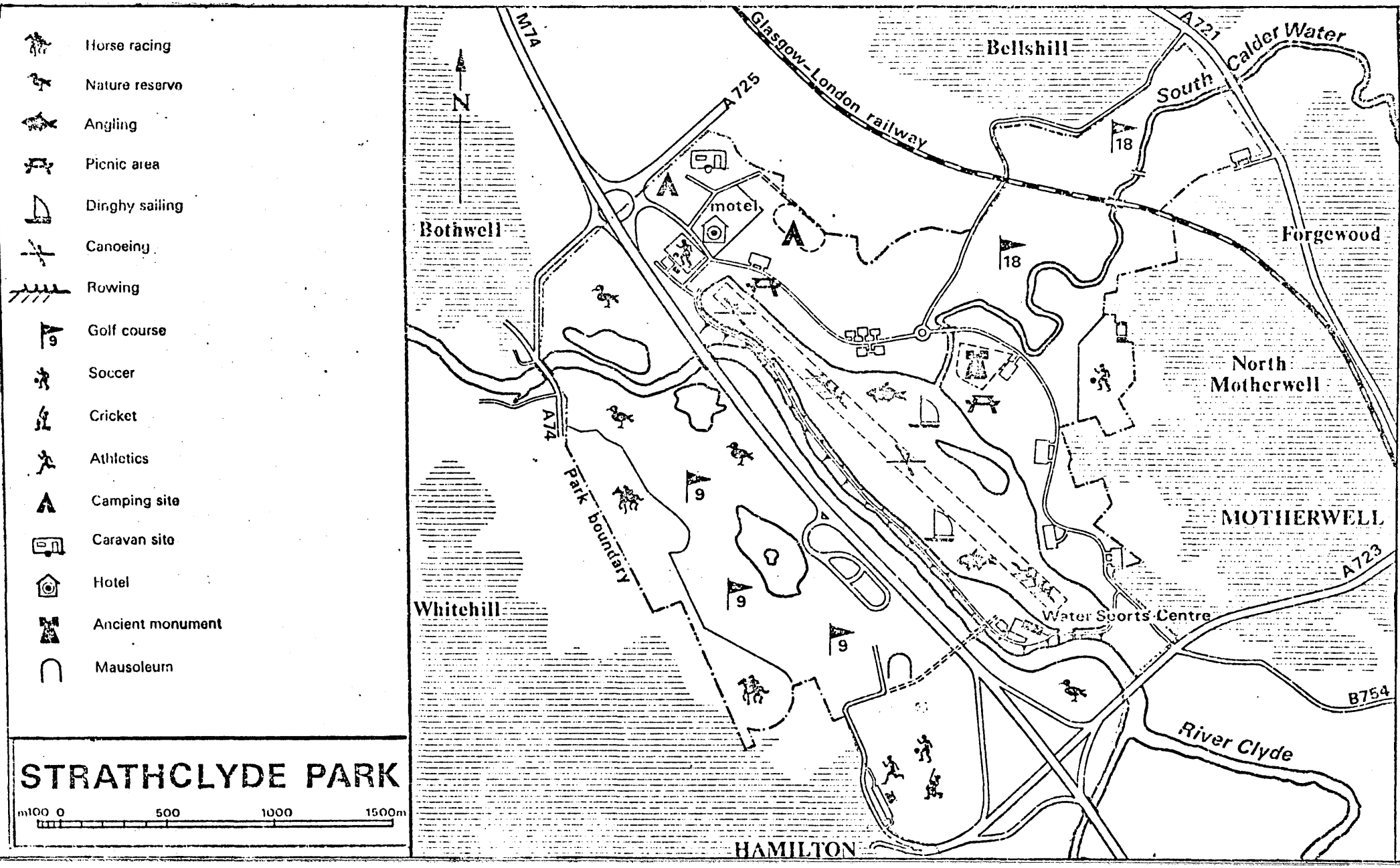
City	Population (in thousands)
Motherwell	77.1
Hamilton	52.0
Coatbridge	50.7
Airdrie	35.0
Bothwell	20.0
Larkhall	13.0
Shotts and Dykehead	12.0
Lanark	8.0

The population within the area is shown in the following table.

Distance from the centre of the park	Population
3 miles	about 215,000
10 miles	about 1,000,000
20 miles	about 2,200,000
50 miles (less than 1½hrs. drive)	about 4,000,000 (about 80% of the population of Scotland)

Look carefully at map B which illustrates this new park and its artificial loch. Discuss the following questions:-

1. Look at the list of activities in Part 1. Are all these activities on the proposed map?
2. What is the maximum possible length of the loch, and also its maximum and minimum widths? Give your answer and the reasons.


Horse racing
Nature reserve
Angling
Picnic area
Dinghy sailing
Canoeing
Rowing
Golf course
Soccer
Cricket
Athletics
Camping site
Caravan site
Hotel
Ancient monument
Mausoleum
STRATHCLYDE PARK
m100 0 500 1000 1500m
N
M74
A725
Glasgow–London railway
A721
Calder Water
Bellshill
South
Bothwell
motel
Forgewood
North Motherwell
MOTHERWELL
A74
Park boundary
Whitehill
A723
Water Sports Centre
B754
River Clyde
HAMILTON

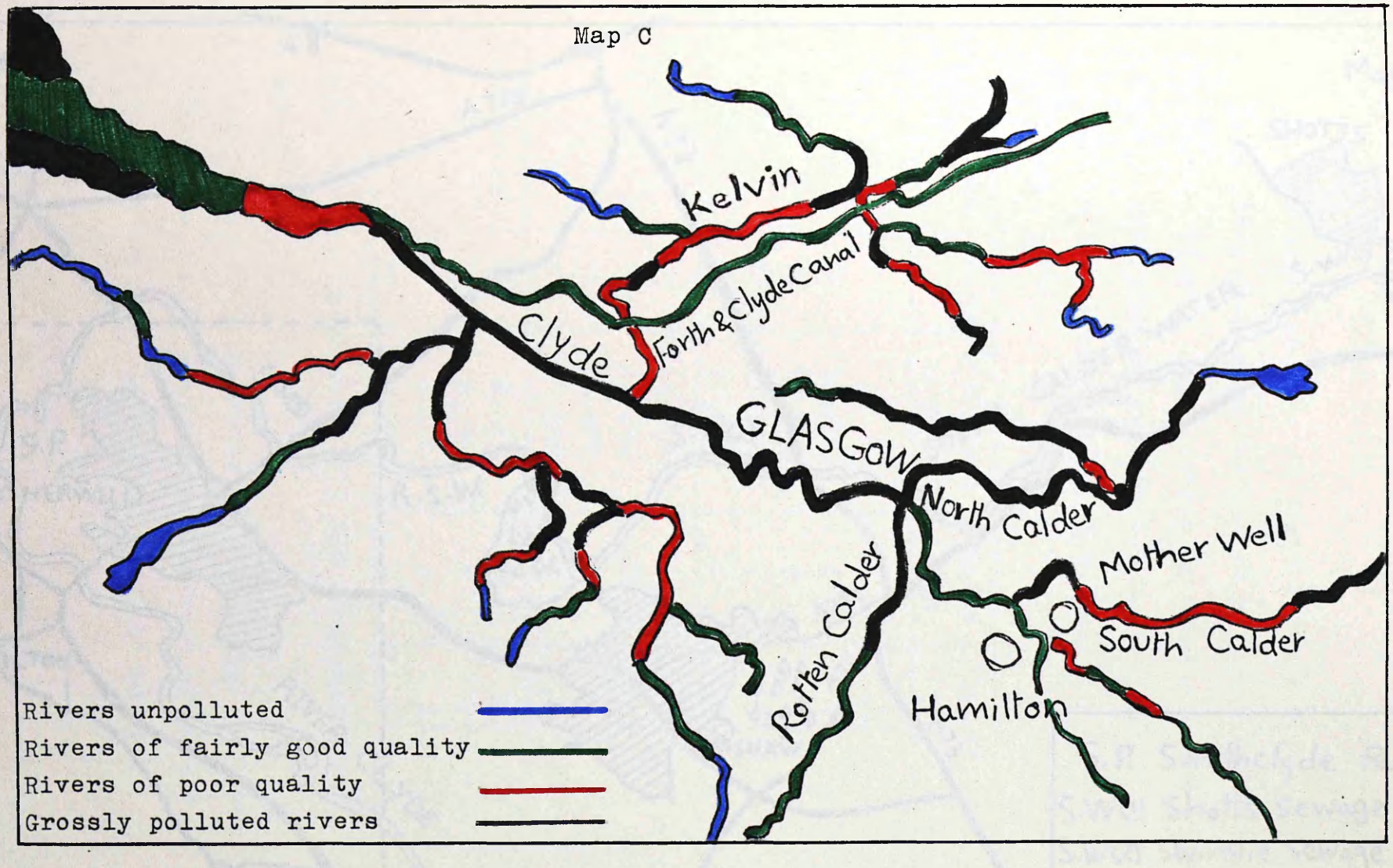
A STUDY IN RIVER POLLUTION

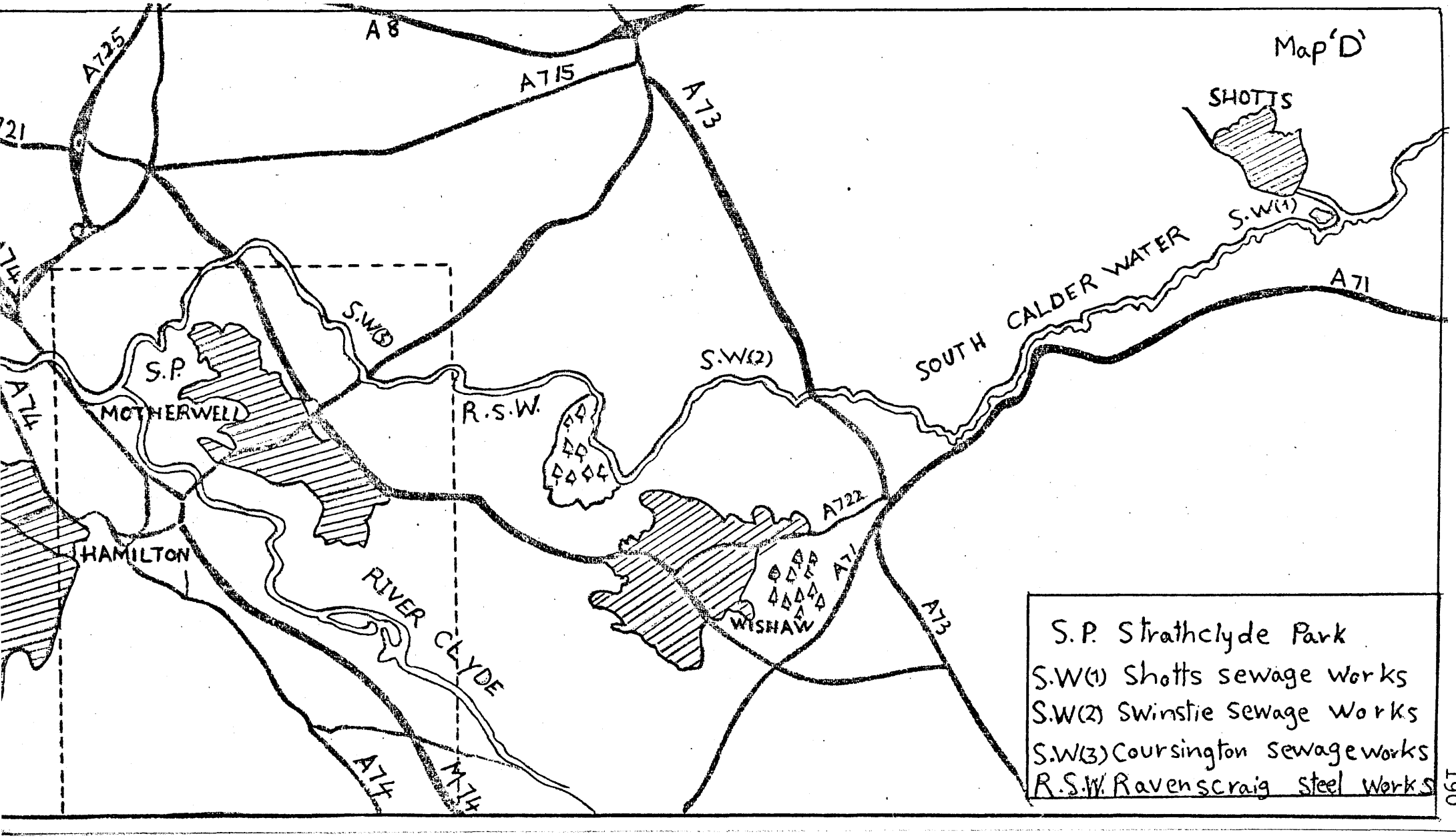
Part 3

The South Calder Water will be the feeder for this loch. Now, let us see the condition of the South Calder Water. River Purification Boards, who have overall responsibilities for the monitoring and control of river pollution, classify rivers as four types. Such a map is on the screen. (Map C).

Now let us see the activities along the stretch of the South Calder Water in some detail. Map D shows these activities.

Now let us consider the efficiency of Sewage Works and Steel Works.


Map C
Kelvin
Forth&ClydeCanal
Clyde
GLASGOW
North Calder
Mother Well
Rotten Calder
South Calder
Hamilton
Rivers unpolluted
Rivers of fairly good quality
Rivers of poor quality
Grossly polluted rivers


Map 'D'
A8
A725
A715
A73
SHOTTS
S.W(1)
SOUTH CALDER WATER
A71
S.W(3)
S.W(2)
S.P.
MOTHERWELL
R.S.W.
A74
A722
HAMILTON
RIVER CLYDE
WISHAW
A73
A74
M74
S.P. Strathclyde Park
S.W(1) Shotts sewage works
S.W(2) Swinstie Sewage Works
S.W(3) Coursington Sewageworks
R.S.W. Ravenscraig steel works

I. Sewage Works

To identify the rate of their efficiency, samples are taken every year from each works by the Clyde River Purification Board. Each sample is then analysed and classified according to the pollution level.

The following table shows the results of analyses from 1970 to 1973.

Sewage Works	Year	Population served	Samples taken	Classification		
				S	B	U
Shotts and Dykehead	70	11,300	4	3	-	1
	71	12,000	4	1	-	3
	72	12,000	4	-	-	4
	73	12,000	4	3	-	1
Swinstie	70	14,000	4	-	1	3
	71	15,000	3	1	-	2
	72	15,000	4	-	-	4
	73	15,000	4	2	-	2
Coursington	70	8,130	4	4	-	-
	71	8,130	5	5	-	-
	72	8,130	4	3	-	1
	73	8,130	4	4	-	-

S Satisfactory in treating all the sewage effluent

B Borderline

U Unsatisfactory in treating all the sewage effluent. This results in continuous discharge of poorly treated effluent to the South Calder Water.

II. Steel Works

The following table shows the description of these works.

Steel Works /

Steel Works	Description
Ravenscraig, Motherwell	Despite action taken to reduce the incidence of oil pollution to the South Calder Water, oil has been discharging into the surface water. Toxic contaminants have also been discharging.
Clydesdale, Bellshill	Although modifications to the works' drainage system were carried out to eliminate continuous overflows to the South Calder Water, significant quantities of emulsified oil are still present in the discharge.

Refer to maps A, B, C (on screen) and D, and the two preceding tables.

1. Which of the sewage works is most efficient in treating all the sewage effluent over the period 1970-73 ?
2. Which of these sewage works is still unable to treat all the sewage effluent?
3. Which of these works has been changed in 1973 to be more efficient than in 1972?

A STUDY IN RIVER POLLUTION

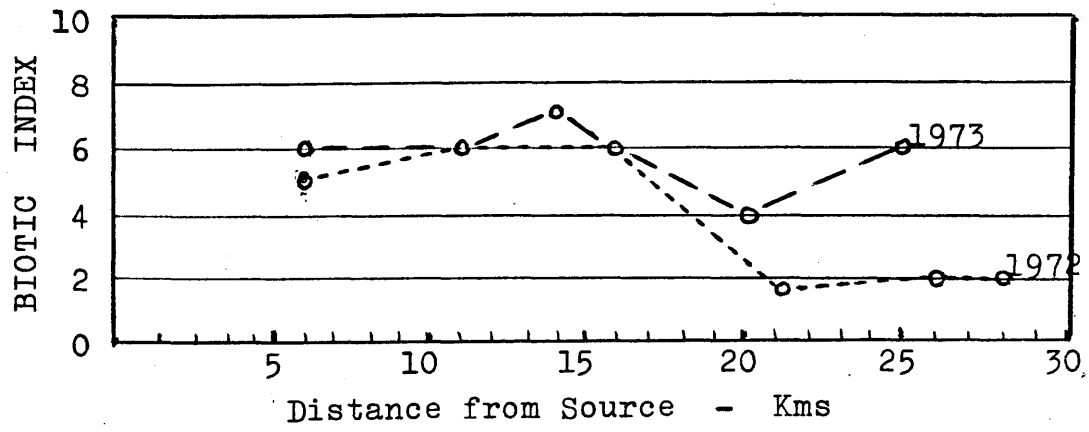
Part 4

To reduce toxic contaminants (e.g. oil and badly treated sewage) in the South Calder Water, action has been taken by the Local Authorities and by the Clyde River Purification Board. To identify the effects of action on improving the quality of water, the Board take samples of stream animals (invertebrates); this assesses the river quality in biological terms. A scale is used where "0" represents extremely polluted conditions and "10" is appropriate to a completely unpolluted highland stream.

The following key helps you to understand this biotic index.

K E Y	10	CLEAN : TROUT ABUNDANT
	8	MODERATELY POLLUTED : TROUT AND COARSE FISH
	6	POLLUTED : TROUT RARE
	4	HEAVILY POLLUTED : COARSE FISH RARE
	2	GROSSLY POLLUTED : FISHLESS
	0	

Here is data for 1972 and 1973:-



1. /

1. (a) Where might trout be found on the South Calder in 1972? In practice, is finding trout very likely? Why?

   (b) What accounts for the low biotic index at 20 km?

2. (a) At about 20 kms from the source (just above the park) steel works are located. Suggest what might have caused the change to the new condition.

   (b) Where on the river has the improvement been most marked?

A STUDY IN RIVER POLLUTION

Part 5

It will be costly to reduce water pollution in the South Calder Water, and subsequently in the Strathclyde Park loch. Money would have to be spent to increase the efficiency of sewage works to a satisfactory level. Also the money will have to be spent reducing the discharge of oil pollution and toxic contaminants by steel works.

1. The following table shows the cost for improving SEWAGE WORKS as it was estimated in 1972.

Sewage Works	Sort of Improvement	Cost (£)	Whether or not this has been done since 1972
Shotts	a. Sewage Works extension	400,000	No
	b. Sewer rebuilding	100,000	No
Swinstie	a. Sewage Works extension	350,000	No
	b. Sewers	215,000	Yes

2. The following table shows the cost for reducing discharges from STEEL WORKS as it was estimated in 1972.

Steel Works /

Steel Works	Sort of Improvement	Cost (£)	Whether or not this has been done since 1972
Ravenscraig	a. Oil pollution prevention measures	120,000	Yes
	b. Diversion and treatment of the coke oven liquor	1,000,000	No
Clydesdale	Recycling the discharges	500,000	Yes

But if the work were to be put in hand now, of course, there would be a considerable increase in the price (probably by 100%).

Discuss the following questions:-

1. What is the total cost for improving SEWAGE WORKS as it was estimated in 1972?
2. What is the total cost for reducing discharges from STEEL WORKS as it was estimated in 1972?
3. Which improvements are most important in reducing overall pollution?

A P P E N D I X 6.2(b)

A STUDY IN RIVER POLLUTION

Teachers' Instructions

1. Plan of application

The following plan of application has been designed. You should have two groups of pupils, called Group 1 and Group 2, matched as far as possible according to their abilities in Biology, each group containing the same boy-girl ratio.

Group 1 (Experimental Group)	Group 2 (Control Group)
A. On the day before the application of the study Issue the article: (RIVER POLLUTION IN SCOTLAND)	No material
B. On the day of application of the study i. Provide the case study ii. Give the test (15 mins)	i. Provide the article: (RIVER POLLUTION IN SCOTLAND) ii. Give the same test

Please ask the pupils to indicate clearly when they fill in the required information of the test which group they belong to, also ask them to give only ONE answer for each question.

2. The exercise is planned to last about one hour with fourth year S.C.E. biology pupils.

3. It is divided into five parts of which parts 3 and 5 require your active participation in class discussion.

4. /

4. The remainder will be carried out in pupil groups - it is suggested that four to six pupils could be in each group, and allowed to sit around a table, bench or desk to facilitate discussion.

5. To organise the exercise, the following guide is given:

(a) Divide the class into groups. Issue a little scrap paper. Issue Part 1 to each pupil and map A to each group. Allow time for discussion.

(b) Issue Part 2 to each pupil and map B (plan of recreational area) to each pupil. Allow time for discussion.

(c) Issue Part 3 to each pupil. Put up Map C (River Purification) on overhead or slide projector. Issue Map D to each group. Discuss with the class as a whole the details of the map, perhaps using the questions supplied overleaf. Allow the small groups to complete Part 3.

(d) Issue Part 4 to each pupil. Allow time for discussion.

(e) Issue Part 5 to each pupil. Allow a few minutes for discussion then discuss with the whole class the completion of the overhead or slide projection table - see details provided overleaf. Then show the colour slides which illustrate the activities in the park.

6. The suggested timetabling of the one hour period is :

0	Part 1	(10 mins)
10 mins	Part 2	(10 mins)
20 mins	Part 3	(15 mins)
35 mins	Part 4	(10 mins)
45 mins	Part 5	(15 mins)
1 hour	End	

NOTE: It is preferable to run through the study before using it with your pupils.

TEACHERS' GUIDE TO PART 3

Most rivers are most clean at their sources, becoming polluted as effluents are added downstream. The South Calder, however, is most polluted near its source (due to Shotts and Dykehead Sewage), becoming slightly improved as it winds its way through wooded country, and then returning to a state of gross pollution as it takes effluents from other sewage works (Swinstie and Coursington) and steel works (Ravenscraig and Clydesdale).

Discuss the general picture with the whole class, allowing them to deduce the main sources of pollution on the South Calder. Some suggested questions are:-

1. What is the condition of the South Calder as it goes from source to the Clyde?
2. If the South Calder Water is used to supply the Strathclyde Park loch, what might the loch be like?
3. What would you expect the fish life in this loch to be?
4. How will the water quality of the loch affect the various proposed activities for the loch?

TEACHERS' GUIDE TO PART 5

The following are some of the "expected answers" to complete the table:-

Best /

Best site of the Park	A	B	C ✓	D
Essential water cleaning	Shotts	Swinstie	Ravens craig ✓	
Helpful water cleaning	Shotts ✓	Swinstie	Ravens craig	
The fraction of the total cost which has been spent in cleaning the river over the total cost	less than $\frac{1}{2}$ ✓	$\frac{1}{2}$	more than $\frac{1}{2}$	
What are the reasons for choosing Hamilton-Motherwell area to be the location of the new Park?	1. Population distribution and transport. 2. Sufficient flat ground and water supply. 3. Nearness of other amenities.			
The percentage of the population within 50 miles of the centre of the park to the total population of Scotland	60%	70%	80% ✓	90%
Who have the overall responsibilities for the monitoring and control of river pollution?	R.P.B. ✓	L.A.	R.P.B. + L.A.	None of these
Who pays the price of reducing air pollution?	(You and I)			
Is it worth it to have a clean loch?	Definitely Yes	Probably Yes	Uncertain	Probably No / Definitely No
If you are asked to pay more money to reduce water pollution in this park, would you agree?	Definitely, yes	Probably, yes	Uncertain	Probably, no / Definitely

THANK YOU FOR YOUR CO-OPERATION

A P P E N D I X 6.2(c)

Glasgow University - Research in Science Education

RIVER POLLUTION IN SCOTLAND

Experimental and Control Groups

What is meant by "clean" water?

It is water which is normally well-oxygenated and contains a large and varied number of life forms, including protozoa, bacteria and aquatic plants and animals, forming a complex system and keeping the stream in a healthy condition.

What is meant by pollution?

Pollution of a water course may be defined as the destroying or modifying of life in such waters and/or the reducing of the purity of such waters so rendering them foul or filthy.

In other words, water courses may be polluted by anything discharged into them that causes damage to their ecology.

What are the pollutants of water?

Pollutants are of three general kinds:-

1. Substances which remove the dissolved oxygen from a stream.

Water courses are very complex and finely balanced systems of flora and fauna and the presence in the water of dissolved oxygen is absolutely essential for the systems to be able to sustain the life that they should. The green aquatic plants require dissolved oxygen for growth /

growth and nearly all forms of water fauna, and particularly fish, require dissolved oxygen for their life to be sustained. Migratory fish, particularly the salmon, also require adequate dissolved oxygen. Unfortunately, oxygen is almost insoluble in water; at saturation at normal temperatures it is soluble to the extent of only ten parts of a million and it is upon this ten parts of a million of dissolved oxygen that the whole life of a stream depends.

By far the most important of the oxygen-removing substances is untreated sewage which may be defined as "the liquid wastes (domestic and industrial) from a community". Micro-organisms present in the stream oxidise the sewage and thereby remove the dissolved oxygen from solution. Such pollution, however, may be reversed since there is an exchange of oxygen between the atmosphere and the water surface and a river can thus recover in time. A film of oil on the surface will, however, prevent this vital pick-up of oxygen.

2. Substances which are directly toxic to fish or to human life

These substances include the salts of the heavy metals, e.g. lead, zinc, cadmium metals, cyanides, and a number of organic compounds.

3. Substances which reduce the water's clearness

These are finely divided solid matter that can cause the water to interfere with normal processes of life. Pollution of water by these suspended solids occurs from such processes as washeries, china-clay workings and the like.

What are the effects of pollutants on watercourses?

Pollutants can harmfully affect watercourses as follows:-

1. They may damage fish and shellfish important for human food;
2. They may cause ecological changes and so alter the productivity of the seas;
3. They may foul beaches and otherwise damage amenities;
4. They may interfere with fishing gear or shipping, and hamper other uses of the sea or wastes.

How can water quality be assessed?

Water quality can be readily and quantitatively assessed, either by chemical analysis or by tests involving fish, or both. In general terms, however, the existence of a wide range of fauna usually indicates unpolluted conditions. When a river begins to become polluted, the more sensitive species disappear, but although fewer species are present those remaining are represented in greater numbers. But where both chemical and biological data are available, sometimes the results conflict.

For example, the distribution of fish within a river system may be affected by factors other than the degree of pollution. Of these, rate of water flow is perhaps the most important.

A. Chemical Analysis

In Scotland River Purification Boards exist. Their job is to reduce water pollution. Each of these boards /

boards has set points for monthly chemical sampling with an average of one river per day undergoing a full analysis. In addition, purification boards also analyse trade and sewage works' effluents as well as river water, checking for suspended solids, dissolved oxygen, pH BOD (Biology Oxygen Demand), Phosphate and nitrogen compounds. Where their presence is suspected, they also look for toxic metals, phenols, detergents and cyanides.

B. Biological Analysis

Purification boards also examine insects and fish as a blanket test of a river's health, acting on the assumption that water supporting a good mixture of bottom fauna and fish is also suitable for most human purposes short of direct public water supply.

What has been done in Scotland to control discharges to rivers?

In 1951, an Act was passed. This act gave river purification authorities control over new discharges of sewage and trade effluent to rivers. This Act was followed by the Rivers (Prevention of Pollution) (Scotland) Act, 1965 (the 1965 Act), which extended control powers to cover existing discharges to rivers and new discharges to certain areas of tidal waters. The importance of the 1965 Act was that it stimulated the action necessary to improve the quality of many unsatisfactory existing discharges.

Since 1951, considerable effort taken by the Scottish /

Scottish Purification Authorities has controlled discharges, particularly those from industrial sources which are classified as follows:-

(a) Effluents from food and drink manufacture; (farming, soft drinks (brewing and distilling), food processing, and manufacture (e.g. milk, vegetables, meat, poultry etc.)).

(b) Other organic effluents; (textile manufacture, paper and board making, leather tanning etc.).

(c) Effluents from engineering industry (engineering, iron and steel making, plating and metal finishing etc.).

(d) Chemical effluents; (chemical and allied industries, petroleum refining, petrochemicals and plastics, hospitals, laboratories and research establishments, gas and coke making).

(e) Miscellaneous; (laundry and dry cleaning, coal mining, brick making and quarrying, electricity generation and others).

All these industrial sources discharge effluents to Scottish Surface Waters.

It has been estimated that 166 million gallons per day are discharged from trade effluents to the Scottish Rivers, 116 million gallons into the Inland Waters and 50 million gallons into the Tidal Waters. Efforts have taken place by the Scottish Local Authorities to reduce these discharges by -

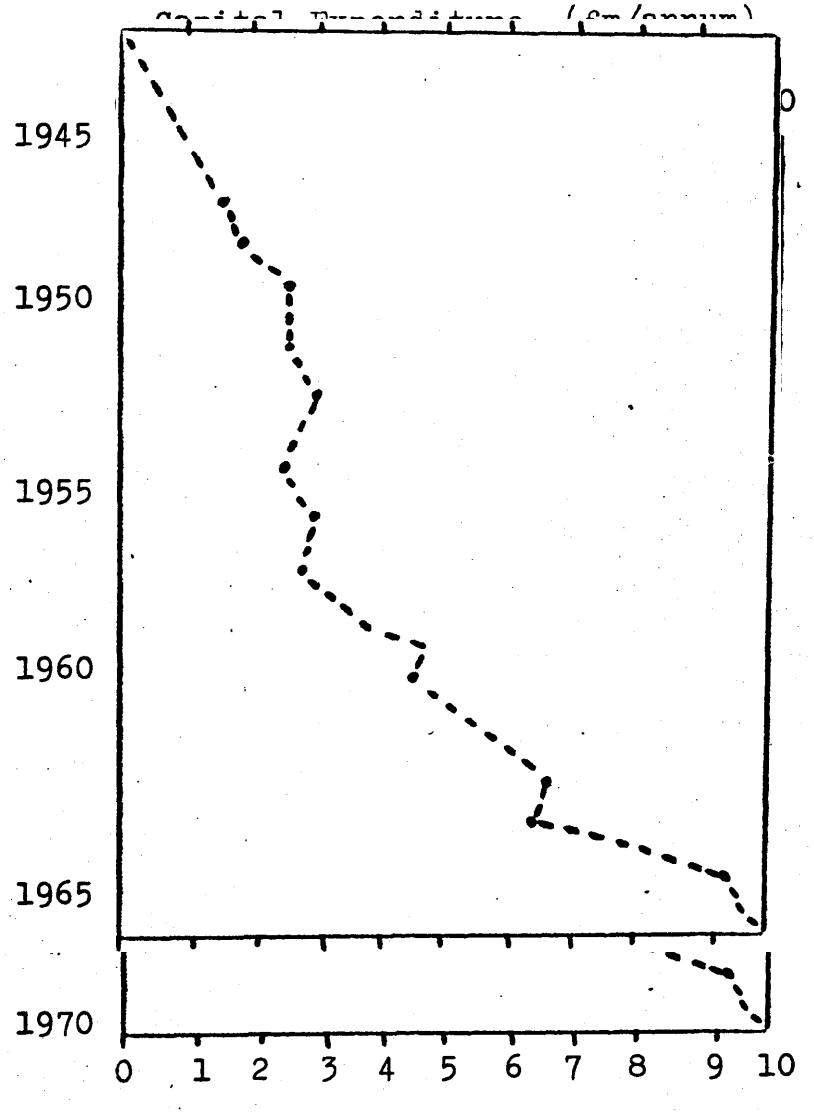
(a) treatment of domestic sewage by constructing sewage works,

(b) /

(b) controlling the discharged substances of industries.

But to do so, money is needed. 91.2 million pounds were spent on sewerage (systems of sewers) and on sewage treatment and disposal from year 1945 to year 1970.

The following diagram shows the annual capital investment by the Scottish Local Authorities on schemes of sewerage and sewage disposal in this period (1945-70).



A P P E N D I X 6.2(d)

Glasgow University - Research in Science Education

RIVER POLLUTION

1. Please fill in the following: Name of School:_____
   Your full name:_____
   School Year: _____
   Date of Birth: _____
   Today's Date: _____

   Girl ☐
   Boy ☐

   Group No _____

2. Please indicate by a tick which of the following most nearly fits your course:-

   (a) Studying for an 'O' Grade in three sciences

   (b) " " " " " " two sciences.

   (c) " " " " " " one science only.

THANK YOU FOR YOUR CO-OPERATION

Part 1

PUPIL TEST

Please answer the following questions:-

A. Name two factors causing water pollution.

   1.

   2.

B. Name two results arising from water pollution.

   1.

   2.

C. State two kinds of the pollutants of water.

   1.

   2.

D. State two ways used to assess the water quality of rivers.

   1.

Part 2

PUPIL QUESTIONNAIRE

1. The aim of this questionnaire is to get your reaction to a list of statements regarding WATER POLLUTION. You are asked to read each statement carefully then indicate your answer, which represents your serious opinion.

2. There are no 'right' or 'wrong' answers.

Section 1

Please put a tick (✓) in the appropriate box which fits your true opinion of the material you have just studied.

Here is how you are to use these boxes:-

If you place your check-mark in the first box closing to 'Good'

Good ☑ ☐ ☐ ☐ ☐ Bad

this means that the material is very good.

If you place your check-mark in the second box near to 'Good'

Good ☐ ☑ ☐ ☐ ☐ Bad

this means that the material is fairly good.

If you place your check-mark in the third box (in the middle)

Good ☐ ☐ ☑ ☐ ☐ Bad

this means that the material is neutral,

i.e. not good not bad.

If you place your check-mark in the fourth box to 'Good', i.e. the second box closing to 'Bad',

Good ☐ ☐ ☐ ☑ ☐ Bad

This means that the material is fairly bad.

If you place your check-mark in the fifth box to 'Good', i.e. the first box closing to 'Bad'

Good ☐ ☐ ☐ ☐ ☑ Bad

this means that the material is very bad.

Here is an example of describing something, for example, a particular flower -

Small			✓			Large
Beautiful	✓					Ugly
Bad smelling				✓		Good smelling

This means that the flower is of medium size, and very beautiful, but it has a fairly good smell.

By using the same method of ticking, please give your general impression about:-

The material you have just studied

IMPORTANT (1) Be sure you answer all the questions; do not omit any.

(2) Never put more than one check-mark on a single scale.

The material you have just studied is -

Interesting						Boring
Exciting						Dull
Not enjoyable to study						Enjoyable to study
Easy to understand						Difficult to understand
Unhelpful						Helpful

Again, by using the same method of ticking, please give your general impression about:-

The /

The subject of water pollution

The subject of water pollution is:-

Interesting						Boring
Exciting						Dull
Not enjoyable to study						Enjoyable to study
Easy to understand						Difficult to understand
Unhelpful						Helpful

Section 2

Please indicate your opinion by putting a tick in the appropriate column against each statement.

	Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
1. We must make industries clean up their own pollution.					
2. We must just accept that river pollution is an unfortunate result of modern day living.					
3. Each one of us is the cause of pollution.					
4. We must instruct Local Authorities to build adequate sewage works.					
5. In the end, each one of us has to pay in order to overcome pollution.					
6. We cannot afford to take the necessary action to reduce river pollution to a reasonable level.					

Section 3

Please indicate your opinion by putting a tick in the appropriate column against each statement.

Suppose that you live in a district near to the River Clyde. You note that some people often throw domestic rubbish into the river. You have read in your local newspaper that some people have complained to the Local Authority and the Clyde River Purification Board urging them to solve the problem because of the health hazard which may arise.

	Definetely Yes	Probably Yes	Uncertain	Probably No	Definitely No
1. Do you consider that throwing domestic rubbish into the river contributes to a health hazard?					
2. Would you sign a petition protesting against the dumping of domestic rubbish into a river?					
3. Do you think there is more scope for documentary T.V. programmes concerned with the causes and effects of water pollution?					
4. Do you think that more money should be spent in discouraging rubbish dumping through advertising in local press and radio?					
5. Would you agree to pay increased rates in order to finance cleaning up the river?					
6. Should the Government increase the penalties against those who dump rubbish?					

A P P E N D I X 6.2(e)

University of Glasgow - Research in Science Education

Teacher Questionnaire (RIVER POLLUTION)

This is a list of educational objectives which may, in part, have been achieved by using this case study.

After your pupils have finished the study, please fill in the following questionnaire yourself (as teacher using the material) indicating with a tick how successful you think the material has been in enabling pupils to achieve these objectives.

How successful has this material been in enabling the pupils to:-	Very successful	Fairly successful	Unsuccessful
1. Understand some of the - (a) factors causing water pollution;			
(b) results arising from water pollution.			
2. State the kinds of the pollutants of water.			
3. Understand the ways used to assess the water quality of rivers.			
4. Know (a) the action already taken by local authorities;			
(b) the approximate costs associated with such action.			
5. Take an interest in the problems associated with water pollution.			

6. /

	Very successful	Fairly successful	Unsuccessful
6. Appreciate the responsibilities of various authorities (e.g. Purification Boards, Local Authorities) in dealing with water pollution problems.			
7. Understand individual responsibility for (a) causing water pollution; (b) financing its reduction.			
8. Communicate their ideas to others on the subject of water pollution.			

Please list here any other objectives which you think have been achieved by using this material.

Please list here any comments about the material, including criticism.

To be completed by Principal Teacher:-

Name of Principal Teacher:_____

Name of School:_____

Number of pupils who attempted the case study: _____ (Boys _____ Girls_____)

Date of use:_____

Today's date:_____

THANK YOU FOR YOUR CO-OPERATION

ANALYSIS OF THE PUPIL TEST (Cognitive Test)

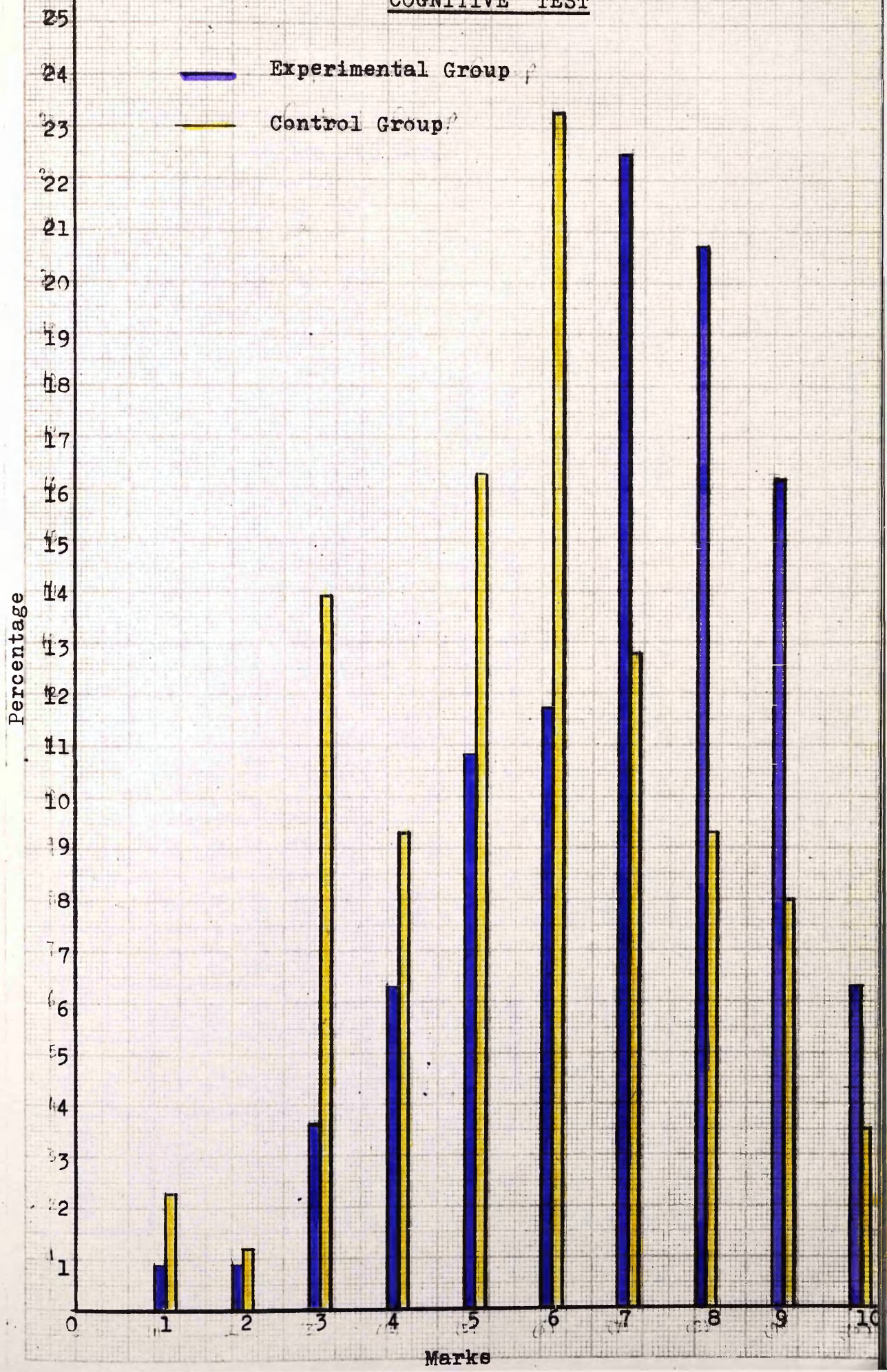
Experimental Group				Control Group				Sig.
Mark (M.)	Frequency (F.)	Percentage Frequency	M. x F.	Mark (M.)	Frequency (F.)	Percentage Frequency	M. x F.	
1	1	0.9	1	1	2	2.3	2	* 1%
2	1	0.9	2	2	1	1.2	2	-
3	4	3.6	12	3	12	13.9	36	* 1%
4	7	6.3	28	4	8	9.3	32	* 1%
5	12	10.8	60	5	14	16.3	70	* 1%
6	13	11.7	78	6	20	23.3	120	* 1%
7	25	22.5	175	7	11	12.8	77	* 1%
8	23	20.7	184	8	8	9.3	64	* 1%
9	18	16.2	162	9	7	8.0	63	* 1%
10	7	6.3	70	10	3	3.5	30	* 1%
	111		772		86		496	

μ (for the Experimental Group) = 772 ÷ 111 = 6.96

μ (for the Control Group) = 496 ÷ 86 = 5.77

A P P E N D I X 6.2(g)

COGNITIVE TEST



A P P E N D I X 6.2(h)

ANALYSING OF THE PUPIL QUESTIONNAIRE

(Affective Test)

SECTION	Ques. No.	A and B				Sig.	C				Sig.	D and E				Sig.
		Exp.		Cont.			Exp.		Cont.			Exp.		Cont.		
		F.	%	F.	%		F.	%	F.	%		F.	%	F.	%	
1 (a)	1.	53	50	31	36	* 1%	30	29	14	16	* 1%	22	21	40	47	* 1%
	2.	28	27	18	21	* 1%	39	38	27	32	* 1%	36	35	39	46	* 1%
	3.	25	23	39	45	* 1%	35	33	25	29	* 1%	47	44	22	26	* 1%
	4.	55	52	24	29	* 1%	34	32	21	25	* 1%	16	15	39	46	* 1%
	5.	12	11	14	16	* 1%	20	19	25	29	* 1%	75	70	46	54	* 1%
		173		126			158		112			196		186		

Total of Experimental Group responses = 173 + 158 + 196 = 527

" " Control " " = 126 + 112 + 186 = 424

	527	424		527	424		527	424
	173	126		158	112		196	186
Fe	157			139			231	
Fo	173			158			196	
χ^2	$= \frac{(16)^2}{157}$		$+ \frac{(19)^2}{139}$			$+ \frac{(35)^2}{231}$		
	= 1.63		+ 2.60			+ 6.25 = 10.48 * 1%		

Degrees of freedom (V) = 2

SECTION	Ques. No.	A and B					C					D and E				
		Exp.		Cont.		Sig.	Exp.		Cont.		Sig.	Exp.		Cont.		Sig.
		F.	%	F.	%		F.	%	F.	%		F.	%	F.	%	
1 (b)	1.	47	47	36	42	* 1%	23	23	17	20	* 1%	31	31	33	38	* 1%
	2.	22	21	11	13	* 1%	41	39	33	38	* 1%	43	41	42	49	* 1%
	3.	31	29	36	42	* 1%	38	36	32	38	* 1%	37	35	17	20	* 1%
	4.	43	41	30	35	* 1%	34	33	19	22	* 1%	27	26	37	43	* 1%
	5.	16	15	12	14	* 1%	20	19	19	22	* 1%	69	66	55	64	-
		159		125			156		120			207		184		

Total of Experimental Group responses = 159 + 156 + 207 = 522

" " Control " " = 125 + 120 + 184 = 429

	522	429		522	429		522	429
	159	125		156	120		207	184
Fe	152			146			224	
Fo	159			156			207	

$$\chi^2 = \frac{(7)^2}{152} + \frac{(10)^2}{146} + \frac{(17)^2}{224}$$

$$= 0.32 + 0.69 + 1.29 = 2.30 \quad \text{No sig.}$$

SECTION	Ques. No.	A and B					C					D and E				
		Exp.		Cont.		Sig.	Exp.		Cont.		Sig.	Exp.		Cont.		Sig.
		F.	%	F.	%		F.	%	F.	%		F.	%	F.	%	
2	1.	97	90	76	89	-	9	8	1	1	* 1%	2	2	8	9	* 1%
	2.	7	6	11	13	* 1%	10	9	4	5	* 1%	91	84	71	83	-
	3.	58	54	47	55	* 5%	30	28	25	29	* 1%	20	19	13	15	* 1%
	4.	93	87	66	78	-	9	8	10	12	* 1%	5	5	9	11	* 1%
	5.	89	82	58	67	-	15	14	20	23	* 1%	4	4	8	9	* 1%
	6.	16	15	8	9	* 1%	27	25	23	27	* 1%	63	59	54	64	-
		360		266			100		83			185		163		

Total of Experimental Group responses = 360 + 100 + 185 = 645

" " Control " " = 266 + 83 + 163 = 512

	645	512	645	512	645	512		
	360	266	100	83	185	163		
Fe	335		105		205			
Fo	360		100		185			

$$\chi^2 = \frac{(25)^2}{335} + \frac{(5)^2}{105} + \frac{(20)^2}{205}$$

$$= 1.87 + 0.24 + 1.95 = 4.06 \quad * \text{near to } 10\%$$

Degrees of freedom (V) = 2

SECTION	Ques. No.	A and B					C					D and E				
		Exp.		Cont.		Sig.	Exp.		Cont.		Sig.	Exp.		Cont.		Sig.
		F.	%	F.	%		F.	%	F.	%		F.	%	F.	%	
3	1.	100	93	83	96	-	3	3	1	1	* 1%	4	4	2	2	* 1%
	2.	98	90	77	90		7	6	7	8	-	4	4	2	2	* 1%
	3.	63	58	52	61	* 5%	36	33	25	29	* 1%	10	9	8	9	* 1%
	4.	73	68	49	57	* 5%	28	26	26	30	* 1%	7	6	11	13	* 1%
	5.	79	72	46	53	* 5%	15	14	21	24	* 1%	15	14	19	22	* 1%
	6.	88	81	58	67	* 5%	10	9	18	21	* 1%	10	9	10	12	-
		501		365			99		98			50		52		

Total of Experimental Group responses = 501 + 99 + 50 = 650

" " Control " " = 365 + 98 + 52 = 515

	650 515	650 515	650 515
	501 365	99 98	50 52
Fe	461	124	66
Fo	501	99	50

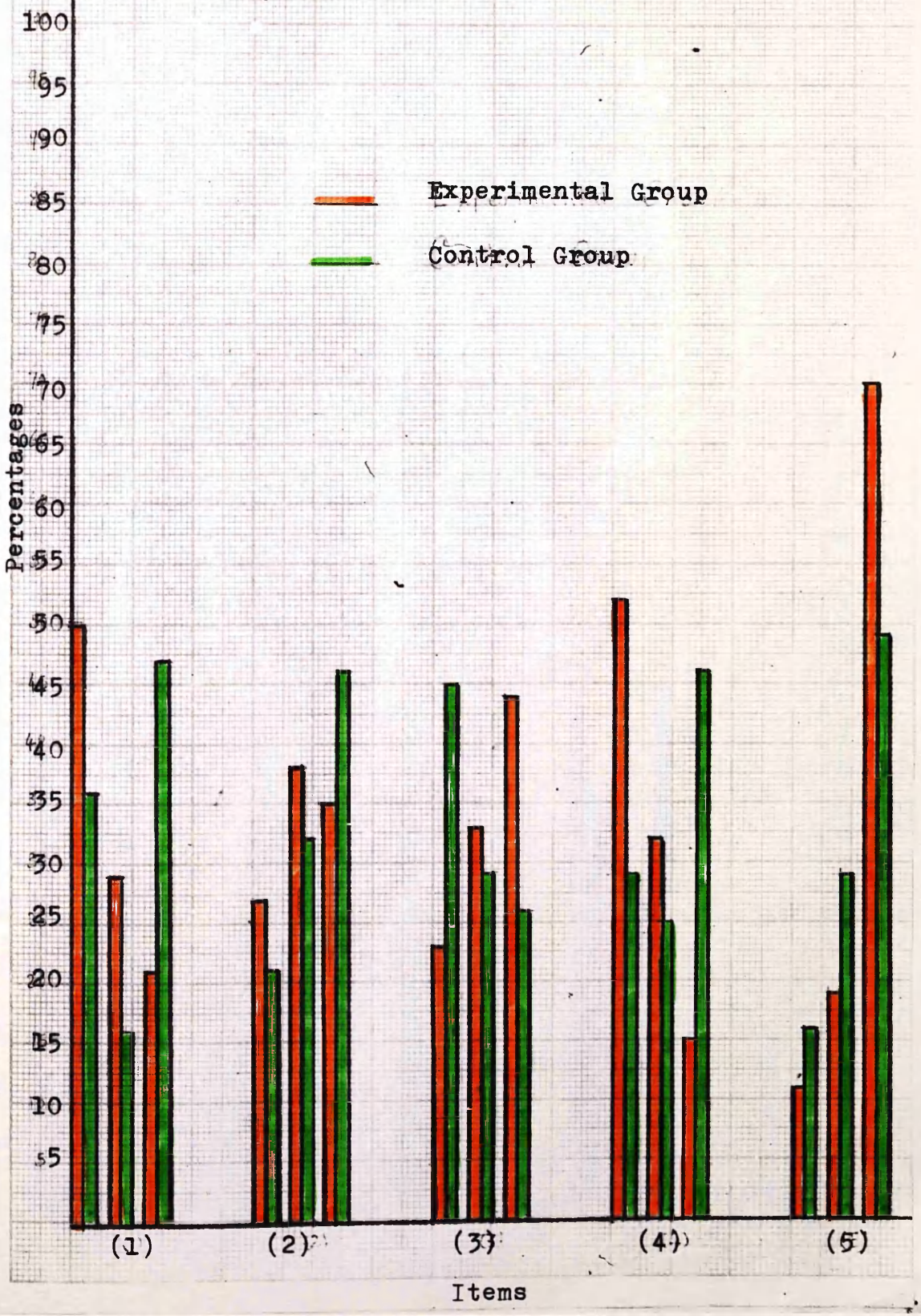
$$\chi^2 = \frac{(40)^2}{461} + \frac{(25)^2}{124} + \frac{(16)^2}{66}$$

$$= 3.47 + 5.04 + 3.88 = 12.39 \quad * 1\%$$

Degrees of freedom (V) = 2

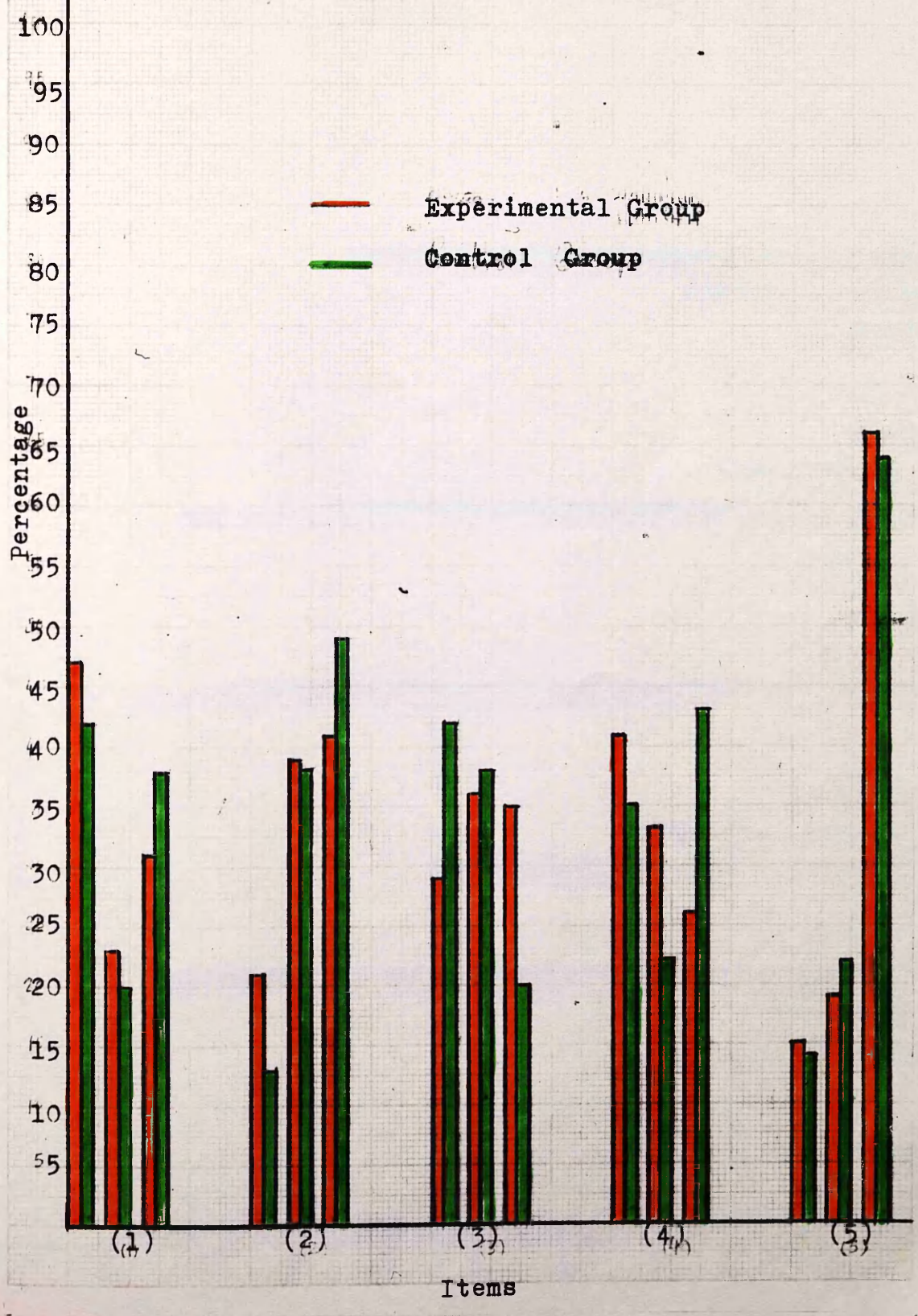
A P P E N D I X 6.2(i-1A)

AFFECTIVE TEST (p209)



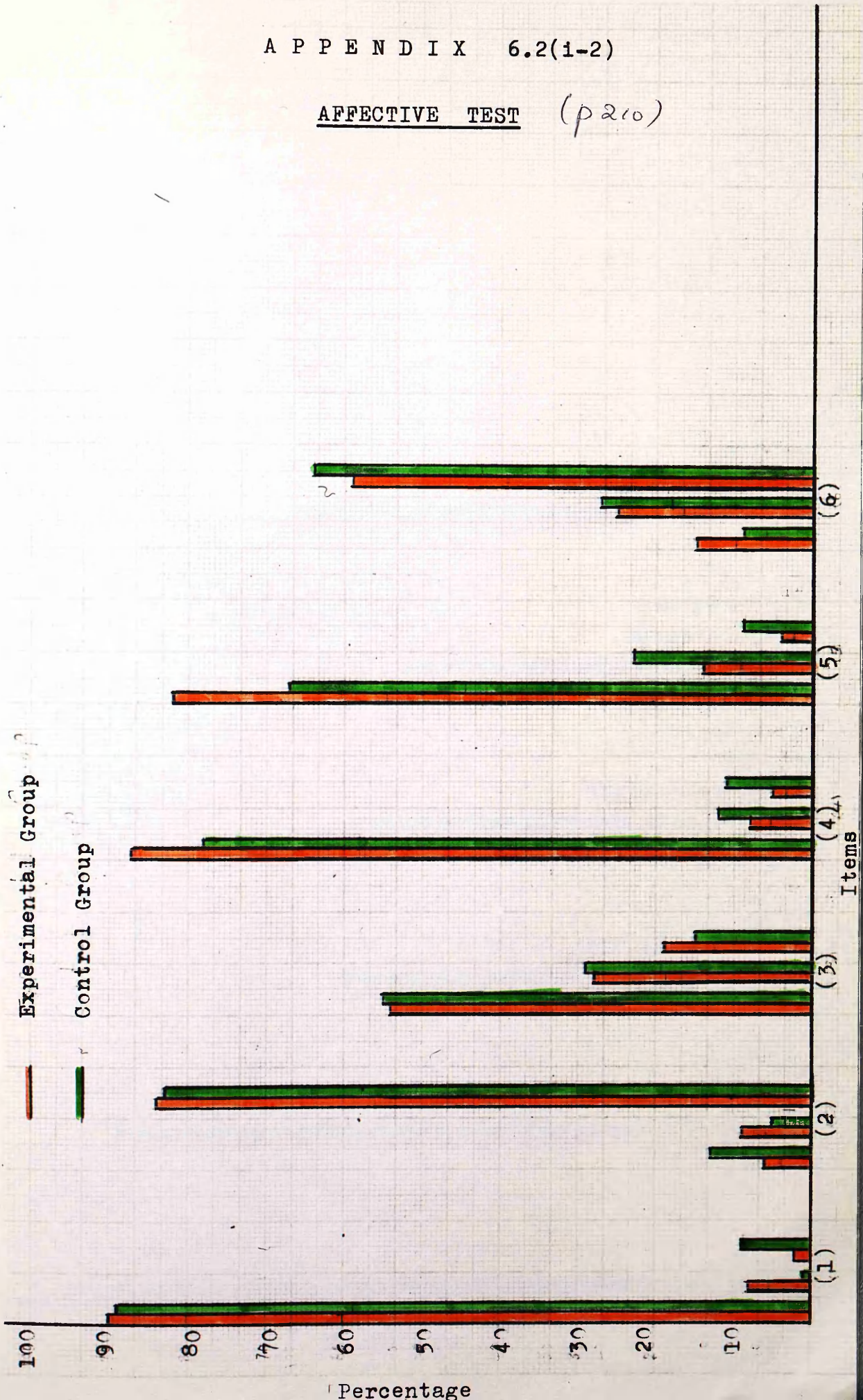
A P P E N D I X 6.2(i-1B)

AFFECTIVE TEST (p 210)



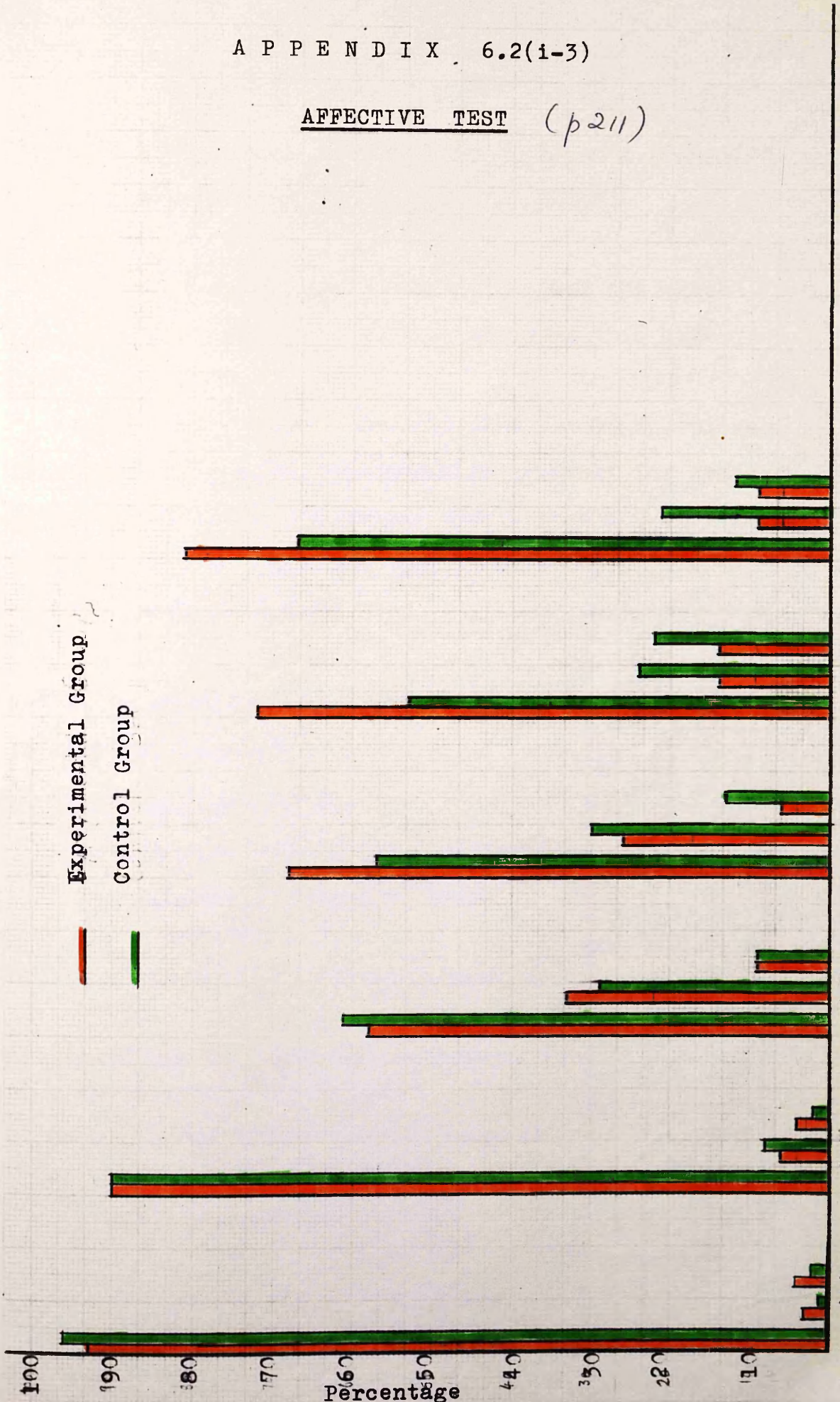
A P P E N D I X 6.2(i-2)

AFFECTIVE TEST (p 210)



A P P E N D I X 6.2(i-3)

AFFECTIVE TEST (p211)



A P P E N D I X 6.2(j)

University of Glasgow - Research in Science Education

Teacher Questionnaire (RIVER POLLUTION)

This is a list of educational objectives which may, in part, have been achieved by using this case study.

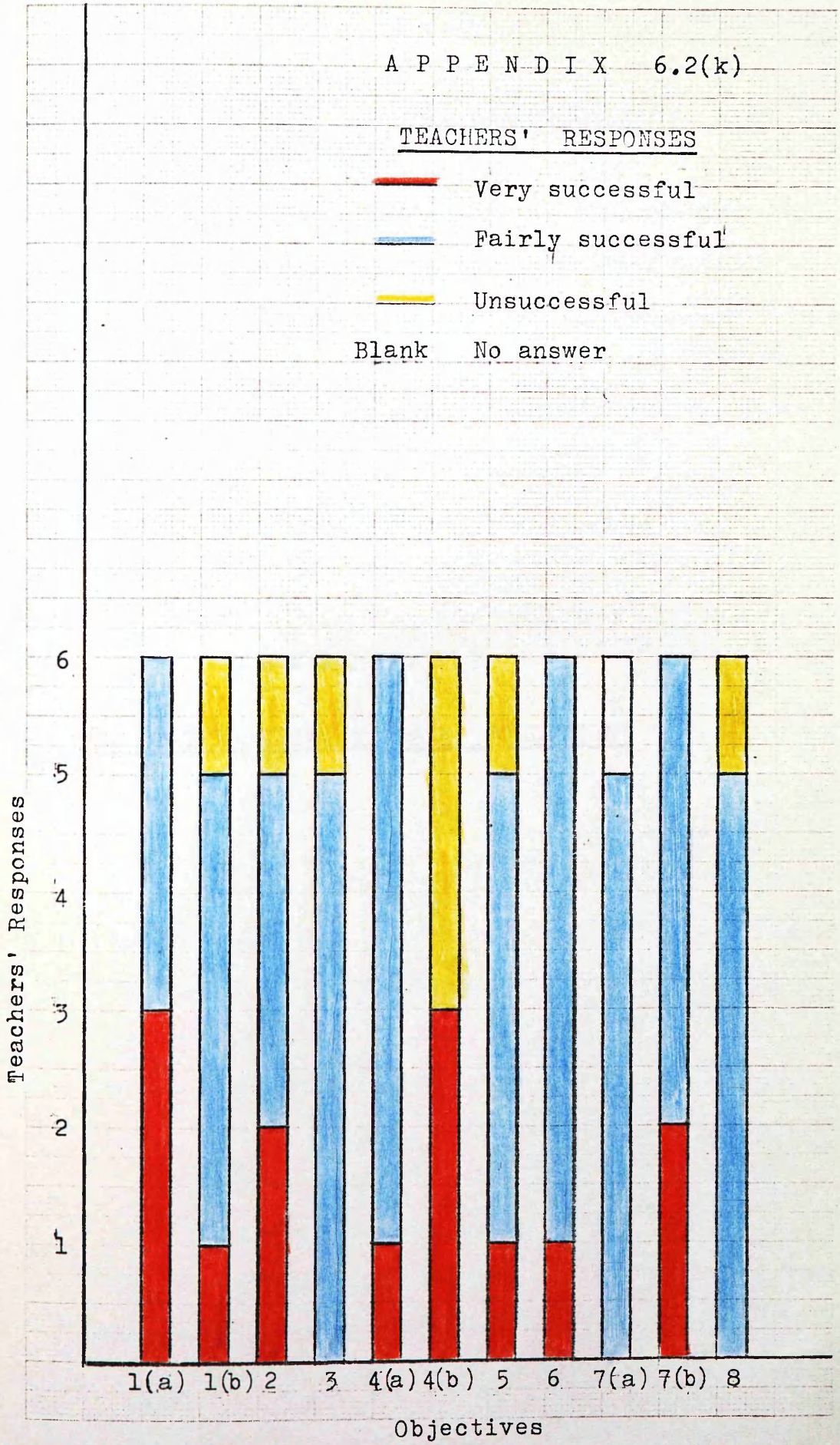
After your pupils have finished the study, please fill in the following questionnaire yourself (as teacher using the material) indicating with a tick how successful you think the material has been in enabling pupils to achieve these objectives.

How successful has this material been in enabling the pupils to:-	Very successful	Fairly successful	Unsuccessful
1. Understand some of the - (a) factors causing water pollution;	3	3	-
(b) results arising from water pollution.	1	4	1
2. State the kinds of the pollutants of water.	2	3	1
3. Understand the ways used to assess the water quality of rivers.	-	5	1
4. Know (a) the action already taken by local authorities;	1	5	-
(b) the approximate costs associated with such action.	3	-	3
5. Take an interest in the problems associated with water pollution.	1	4	1

6. /

	Very successful	Fairly successful	Unsuccessful
6. Appreciate the responsibilities of various authorities (e.g. Purification Boards, Local Authorities) in dealing with water pollution problems.	1	5	-
7. Understand individual responsibility for (a) causing water pollution; (b) financing its reduction.	-	5	-
	2	4	-
8. Communicate their ideas to others on the subject of water pollution.	-	5	1

A P P E N D I X 6.2(k)



C H A P T E R 7

THE THIRD UNIT : "AIR POLLUTION"

C H A P T E R 7

THE THIRD UNIT : "AIR POLLUTION"

Very slight modifications were introduced to the material structure after it was tried by a group of science teachers who attended a one-day conference in Kirkcaldy, Scotland. No modifications were introduced to the pupil tests, cognitive and affective, and also to the teacher questionnaire.

7.1 THE DESIGN OF THE UNIT

(a) The educational objectives of the unit were defined;

(b) The material preparation: a study in air pollution called "AIR POLLUTION GAME" was devised;

(c) The material application: it was tried in 1974-75 by a group of science teachers who attended a one-day conference in Kirkcaldy. It was also applied to the pupils in the selected schools in 1975-76;

(d) The unit assessment: the assessment tools were -

(i) pupil tests : Cognitive Test and Affective Test were prepared to be given after using the material;

(ii) Teacher Questionnaire.

Let us examine each part in some detail.

7.2 /

7.2 THE EDUCATIONAL OBJECTIVES OF THIS UNIT

By using the "AIR POLLUTION GAME", the pupils should be able to:-

(a) Understand some specific terms related to air pollution, such as smoke, and grit and dust;

(b) State the types of pollutants of the atmosphere;

(c) Understand some of the -

(i) sources of air pollution;

(ii) air pollution effects on our health;

(d) Realise the extent of the annual cost of air pollution

(i) in Britain as it was estimated in 1972;

(ii) in Glasgow from 1959 to 1974;

(e) See the importance of air pollution as a problem today;

(f) Appreciate the responsibilities of householders, industrial authorities and road transport authorities in dealing with air pollution problems;

(g) Understand individual responsibility for -

(i) causing air pollution;

(ii) financing its reduction;

(h) Communicate their ideas to others on the subject of air pollution.

7.3 SOURCES OF MATERIAL

To get the ideas for the unit, the researcher was in contact with the Authorities of the Environmental Health Department (Glasgow), and the Chemist's and City Analyst's /

Analyst's Department (Glasgow). Also, information was obtained from the National Society for Clean Air (N.S.C.A.) Publications (Brighton); National Environment Research Council (London); Associated Octel Company - Engine Lab. (London); Department of the Environment (London); Warren Spring Laboratory (East Kilbride Branch).

7.4 THE MATERIAL STRUCTURE

In this game, the teacher, as well as the Experimental Group, has a role. The game proceeds as follows:-

"A 60 year old lady called Mrs. Isabella Macdonald, has been found dead in her house at 61 Pinkerton Drive, Creswell, on 2nd December, 1974."

She was a non-smoker; the area around her house had not yet become a smoke control area; she had stayed in a highly polluted area; the post-mortem indicated that the cause of death was bronchitis, apparently aggravated by local conditions of severe air pollution occurring at the time.

Then they were given a sketch map of Creswell, the imaginary Scottish town, and a drawing which showed the area in which this old lady has stayed illustrating the circumstances surrounding her death. Now, let us talk, in some detail, about the role of the Teacher, and Experimental Group.

A. The Role Of The Teacher

He was told that he was the Chairman of the Inquiry which /

which had been set up with the three groups who were thought to have the overall responsibilities for polluting the air - Society for Consumer Protection; Industrial Agency and Road Transport Association. Then he was informed about his task in the Inquiry. He was also provided with instructions to direct the game and some questions which may help him in his Inquiry.

Details of the role of the teacher appear in Appendix 7(a).

B. The Role Of The Experimental Group

They were divided into three groups. Each group represented the body which was thought to have a part in polluting the air, and consequently in the death of Mrs. Macdonald. The material appears in full in Appendix 7(b). Let us talk about the role of each body in some detail.

(1) Society for Consumer Protection

This group was asked to draw up a brief report presenting evidence supporting its view that domestic air pollution (mainly from coal fires) was not a major factor in the death of Mrs. Macdonald. The group was provided with relevant information, such as comparison of pollutant quantities produced by domestic sources with other sources; the health hazards associated with various pollutants from domestic sources; the vast scale of action already taken, both nationally and locally, to reduce the pollutants from domestic sources; the achievements in reducing air pollution in the Scottish /

Scottish town, Creswell.

(2) Industrial Agency - Research Group

This group was asked to draw up a brief report presenting evidence supporting its view that industrial pollution was not a major factor in the death of the old lady. The group was provided with relevant information, such as comparison of pollutant quantities produced by industrial sources with other sources; the health hazards associated with various pollutants from industrial sources; the vast scale of action already taken, both nationally and locally, to reduce the pollutants from industrial sources; the achievements in reducing air pollution in the Scottish town, Creswell.

(3) Road Transport Association - Research Department

This group was asked to draw up a brief report presenting evidence supporting its view that air pollution from road vehicles was not a major factor in the death of the old lady. The group was provided with relevant information, such as the increasing numbers of road vehicles in the U.K.; comparison of pollutant quantities produced by road vehicles with other sources; the health hazards associated with various pollutants from road vehicles; the vast scale of action already taken, both nationally and locally, to reduce pollutants from road vehicles.

7.5 HOW THE MATERIAL WAS APPLIED

(a) Teachers were provided with the plan of application, the exercise /

the exercise organisation, the suggested time-tabling of the one-hour period, and guides to their role in the game. The details appear in Appendix 7(c).

(b) An article entitled "AIR POLLUTION AND HEALTH" was prepared for the Experimental Group. Its aim was to provide the pupils with a background about the subject of air pollution before playing the game. Here is a summary of the article content:-

- Air pollution - the problem;
- Types of pollutants;
- Where does the air pollution come from? From domestic fires; industrial furnaces; road vehicles;
- Effects of air pollution - air pollution kills people; affects animals' health; retards plant growth; destroys materials;
- What has been done in the U.K. to reduce the hazard of air pollution?
- What is the effect of legislation in the U.K.?
- What are the achievements resulted by reducing air pollution in the U.K.?
- The cost of the control of air pollution.

This article appears in Appendix 7(d).

(c) A factual article also entitled "AIR POLLUTION AND HEALTH" was prepared for the Control Group. Its aim was to minimize the cognitive variables among different selected schools. The article included /

included the same facts as for the Experimental Group article, but did not include the information causing the impact. This article appears in Appendix 7(e).

7.6 THE ASSESSMENT OF THE UNIT

(a) Pupil Tests

- Cognitive Test : In this test, the pupils were asked to name three sources contributing to air pollution; two diseases to which air pollution contributes; define some terms related to air pollution such as smoke and grit and dust. They were also asked to fill in the spaces in the given exercise.
- Affective Test : Three different techniques were included in this test, Osgood's Method, Likert's Method and Johnstone et al technique.

Both tests appear in Appendix 7(f).

(b) Teacher Questionnaire

It included a list of educational objectives which it was hoped would be achieved. The teacher was asked to indicate how successful the material was in helping pupils to achieve these objectives. The questionnaire appears in Appendix 7(g).

7.7 RESULTS

I. An Evaluation of the Individual Pupils' Performance

• Cognitive Test

Details of the test results of both Experimental Group and Control Group appear in Appendix 7(h). Also, a graph appears in Appendix 7(i), illustrating the results.

Here is a summary of the results:-

From the frequency distribution of both Experimental Group and Control Group, the following were found -

(a) The mode for the Experimental Group was at mark 8 and 9, whereas it was at mark 5 for the Control Group;

(b) The mean for the Experimental Group was 7.24, whereas it was 6.04 for the Control Group.

Discussion

From these results, we can conclude the following:-

(a) The Experimental Group did better in the Cognitive Test in general than the Control Group, i.e. the material contributed to the knowledge reinforcement and recall.

(b) The material was successful in enabling the pupils to -

(i) understand some specific terms related to air pollution, such as smoke, and grit and dust;

(ii) state the types of pollutants of the atmosphere;

(iii) understand some of the -

• sources of air pollution,

• air pollution effects on our health.

• Affective Test

The results of this test appear in Appendix 7(j). Also, graphs were drawn illustrating the results - Appendices 7(k-1A), 7(k-1B), 7(k-2) and 7(k-3). Here is a summary of the results and discussions:-

1. Section 1

A. In the first part of this section, they were asked to give their general impression about the material they had studied.

(a) A significant difference regarding all the items in this test - except item 4 - was found in favour of the Experimental Group. This group found the material more interesting, exciting, enjoyable to study and helpful than the Control Group.

(b) By using a χ^2 test for this part as a whole, a significant difference at the 1% level was obtained in favour of the Experimental Group.

Discussion

We can conclude that the material, i.e. the "AIR POLLUTION GAME" was very successful in encouraging the Experimental Group to develop an interest and enjoyment in the study of "AIR POLLUTION" compared with the pupils in the Control Group who read a factual article.

B. In the second part of this section, they were asked to give their general impression of the subject "Air Pollution". For the Experimental Group, this meant what /

what they had undergone in their normal classroom teaching, had read in the article on "Air Pollution and Health" and had played in the "Air Pollution Game". For the Control Group, this meant what they had undergone in their normal classroom teaching in addition to the factual article on "Air Pollution and Health". The following were found:-

(a) A significant difference was found in favour of the Experimental Group. This group showed that the subject of "Air Pollution" was more interesting, exciting and enjoyable to study.

(b) By using a χ^2 test for this part as a whole, significance at 1% was obtained.

Discussion

From these results, we can conclude that the "Air Pollution Game" was successful in changing the pupils' attitude of interest and enjoyment to the subject of Air Pollution.

2. Section 2

In this section they were given some statements and asked to indicate their opinion.

(a) A significant difference at the 1% level was found in favour of the Experimental Group regarding items 1, 2 and 6.

(b) A significant difference at the 5% level was found in favour of the Experimental Group regarding items 3, 4 and 5.

(c) By using a χ^2 test for this section as a whole, a significance /

a significance at the 1% level was obtained.

The discussion for this section is included in the discussion in Section 3.

3. Section 3

In this section they were given a situation followed by some statements and asked about their opinion.

(a) A significant difference at the 1% level was found in favour of the Experimental Group regarding item 2.

(b) A significant difference at the 5% level was found in favour of the Experimental Group regarding items 4 and 5.

(c) A difference, but not significant, was found in favour of the Control Group regarding item 3.

(d) By using a χ^2 test for this section as a whole, significance at the 1% level was obtained in favour of the Experimental Group.

Discussion

From the results in Sections 2 and 3, we can conclude the following:-

The material, i.e. the "Air Pollution Game" was successful in enabling the pupils to -

(a) appreciate the responsibilities of householders, industrial authorities and road transport authorities in dealing with air pollution problems;

(b) understand individual responsibility for -

(i) causing air pollution;

(ii) financing its reduction.

II. An Evaluation of the Principal Teachers' Responses and Comments

• Teachers' Responses

Details of these responses appear in Appendix 7(l). Also, there is a graph shown in Appendix 7(m) illustrating these responses.

Summary:-

(a) All of them agreed that the material was successful in achieving all the defined objectives except numbers 4(a), 4(b) and 7(b).

(b) The majority of them, 5 out of 6 responses, agreed that the material was successful in achieving objective 7(b).

(c) They differed about the objectives 4(a) and 4(b), i.e., realising the extent of the annual cost of air pollution

(i) in Britain as it was estimated in 1972,

(ii) in Glasgow from 1959 to 1974.

• Teachers' Comments

(a) All of them agreed that:-

(i) The material provided a useful addition to the work normally carried out in the classroom;

(ii) The material encouraged the pupils to communicate their ideas to others, to co-operate, to make their own decisions and to be involved in the problems raised in the study and the ways of tackling /

tackling such problems;

(iii) The project as a whole was interesting, enjoyable and instructive.

(b) Some of them claimed that:-

(i) The groups would need more time to present their evidence;

(ii) Some pupils could not handle such a large amount of facts and figures in the suggested time - one hour.

Conclusion

From the results obtained, we can conclude that teaching science through material of this kind, which was designed to encourage our pupils to be involved in real-life situations, is likely to be more effective than teaching in the normal classroom situations. It has been found that games and simulations, if they are well developed, can simulate the environmental problems in a simple way. By doing so, games and simulations can achieve motivation, recalling earlier learning, and providing new stimuli and new instructional situations.

APPENDIX TO CHAPTER 7

A P P E N D I X 7(a)

CORPORATION OF CRESWELL - TOWN COUNCIL

An old lady called Mrs. Isabella MacDonald, 60 years old, has been found dead in her house at 61 Pinkerton Drive, Creswell, on 2nd December 1974. The post-mortem indicated that:-

1. She had been dead for a week before discovery.
2. She was a non-smoker.
3. The area around her house had not yet become a smoke control area.
4. She had stayed in a highly polluted area caused by the emission of pollutants from domestic fires, industrial fumes discharging from steel works near to her house, and the traffic jam in this area.
5. The wind at the time of her death was light west-south-west.
6. The cause of death was bronchitis, apparently aggravated by local conditions of severe air pollution occuring at the time.

The sketch map of Creswell and the drawing which shows the area in which this old lady had stayed illustrate the circumstances surrounding her death.

You are the Chairman of the Inquiry which has been set up, with the three groups who are thought to have the overall responsibilities for polluting the air.

1. Society for Consumer Protection
2. Industrial Agency
3. Road Transport Association

Your task is :-

(a) To ask each group to draw up a brief report presenting /

presenting evidence supporting their view regarding their responsibility for the death of this old lady.

(b) To question each group on their evidence.

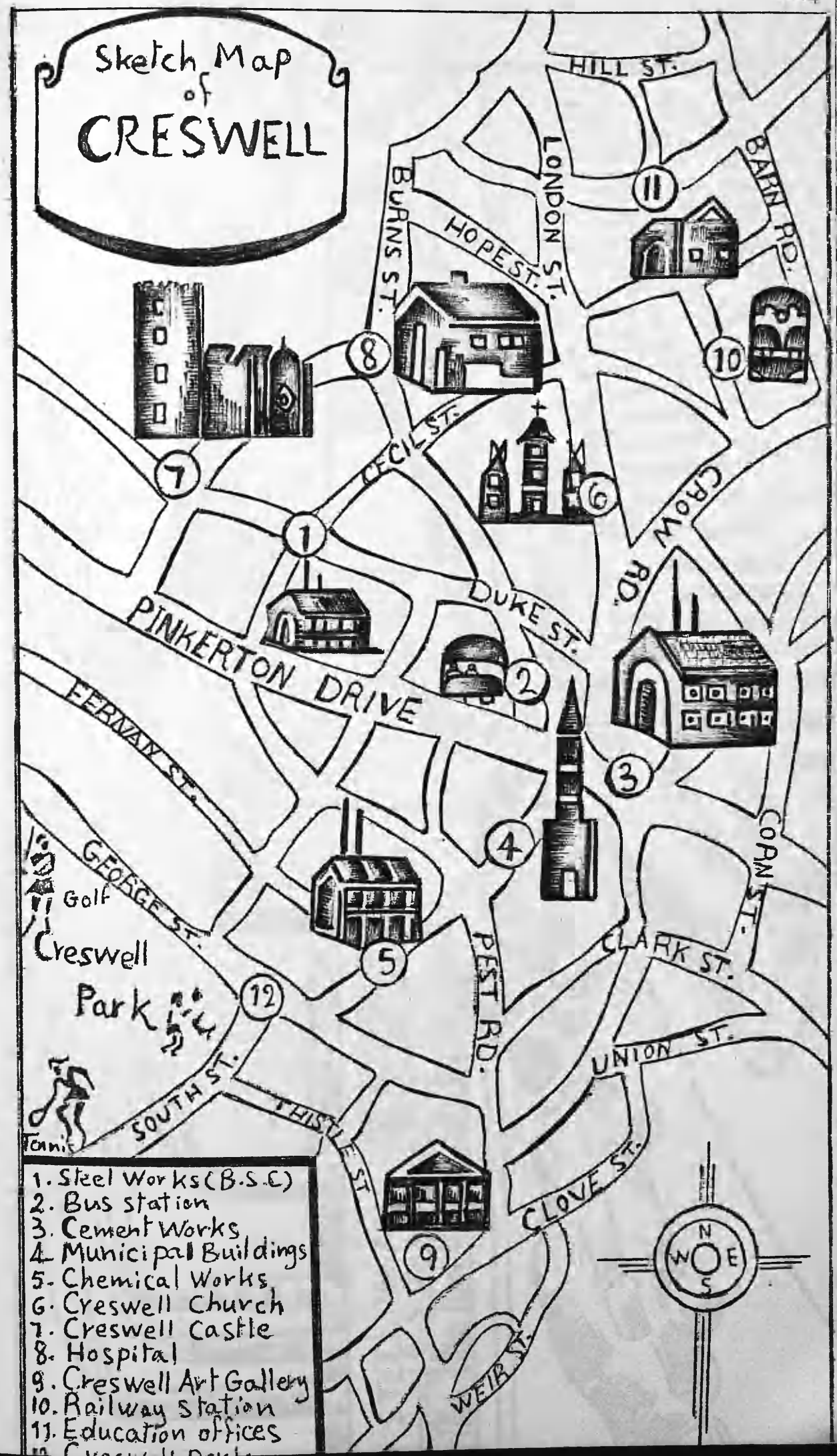
(c) To judge which group had the major responsibility for what happened.

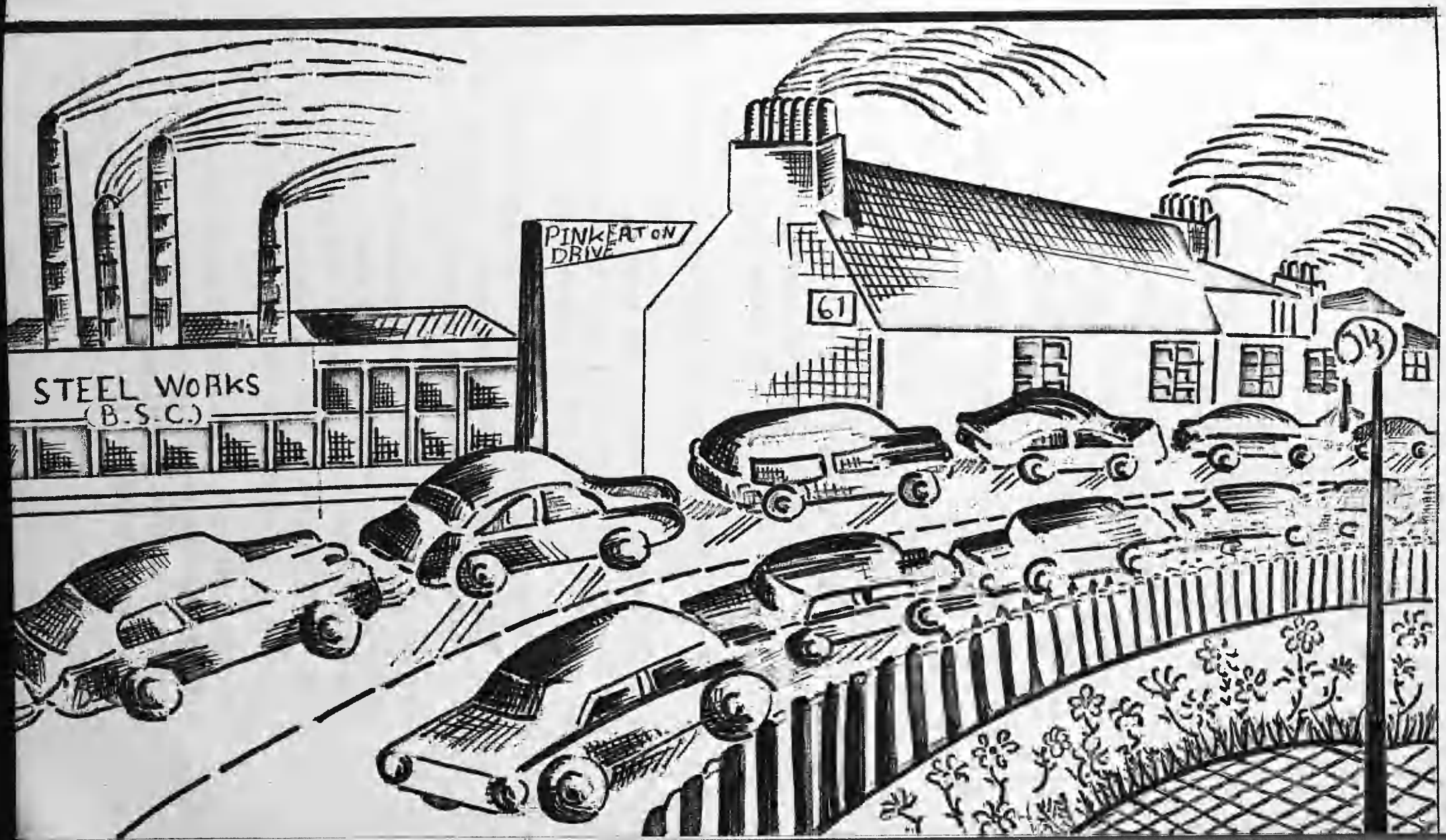
Note: (i) Each group will be allowed four to five minutes to present their evidence to the Inquiry.

(ii) Preparation of this will take them about half an hour.

The following questions may help you in your Inquiry. Each group should be asked the following questions:-

1. What is the pollutant quantity produced by your group compared with other groups?
2. What are the health hazards associated with the various pollutants of your group?
3. What sort of national action has already been taken by your group to reduce air pollution?
4. What sort of local action in this Scottish town has already been taken by your group to reduce air pollution?
5. What has been achieved by your group to reduce air pollution in this Scottish town?
6. What are your conclusions?


Sketch Map of CRESWELL
HILL ST.
LONDON ST.
BARN RD.
BURNS ST.
HOPE ST.
CECIL ST.
CROW RD.
DUKE ST.
PINKERTON DRIVE
FERNAY ST.
GEORGE ST.
Golf
Creswell Park
Tennis
SOUTH ST.
THISTLE ST.
PEST RD.
CLARK ST.
COPAN ST.
UNION ST.
CLOVE ST.
WEIR ST.
N
W
E
S
1. Steel Works (B.S.C)
2. Bus station
3. Cement Works
4. Municipal Buildings
5. Chemical Works
6. Creswell Church
7. Creswell Castle
8. Hospital
9. Creswell Art Gallery
10. Railway station
11. Education offices


PINKERTON DRIVE
61
STEEL WORKS
(B.S.C.)

A P P E N D I X 7(b)

SOCIETY FOR CONSUMER PROTECTION

An old lady called Mrs. Isabella MacDonald, 60 years old, has been found dead in her house at 61 Pinkerton Drive, Creswell, on 2nd December 1974. The post-mortem indicated that:-

1. She had been dead for a week before discovery.
2. She was a non-smoker.
3. The area around her house had not yet become a smoke control area.
4. She had stayed in a highly polluted area caused by the emission of pollutants from domestic fires, industrial fumes discharging from steel works near to her house, and the traffic jam in this area.
5. The wind at the time of her death was light west-south-west.
6. The cause of death was bronchitis, apparently aggravated by local conditions of severe air pollution occuring at the time.

The sketch map of Creswell and the drawing which shows the area in which this old lady had stayed illustrate the circumstances surrounding her death.

On the following pages you will find all relevant information. Your task is to draw up a brief report presenting evidence supporting your view that domestic air pollution (mainly from coal fires) was not a major factor in the death of Mrs. MacDonald.

A guide sheet is provided to form the basis of your report. You may be questioned on your evidence by the Chairman of the Inquiry, as well as by other interested bodies. You will be allowed four to five minutes /

minutes to present your evidence to the Inquiry. Preparation of this will take you about half an hour.

Report

Domestic fires are one of the sources causing air pollution in the United Kingdom. These domestic fires discharge smoke, oxides of sulphur, grit and dust and soot. The following table shows estimates of air pollution from domestic fires in the U.K. in the year 1972-73 in million tonnes.

POLLUTANT	QUANTITY from domestic fires	TOTAL* from all sources
Smoke		
Coal	0.45	0.50
Sulphur Oxides		
Coal	0.28	2.34
Coke	0.08	0.13
Oil	0.02	2.73
Total of Sulphur Oxides	0.38	5.20

* This total includes domestic fires, industry, road vehicles and other sources.

These pollutants can affect our health. The following table shows these effects. Although the weight of smoke is much less than that of many other atmospheric pollutants, it tends to have a greater significance, because, not being a gas, it does not disperse so readily.

POLLUTANT /

POLLUTANT	EFFECT
Smoke	1. On the present state of knowledge, smoke in any concentration is undesirable because it is dirty and unpleasant. But it has not yet been shown that on its own it has any direct ill effects on health. 2. It can constitute a hazard to health when its high concentrations combine with winter fog forming so called smog, i.e. smoke + fog, which may cause death. This happened in London in December 1952 causing the death of some four thousand people who were suffering bronchitis, heart failure and cancer of the lung.
Oxides of Sulphur	Modern research has shown that:- 1. On their own they are not dangerous when their concentrations are not very high. 2. When mixed with smoke, they can constitute a major health hazard.

Action taken to reduce pollution

Since 1956, the date of the introduction of the Clean Air Act, action has been taken by Central Government and Local Authorities in the United Kingdom to reduce air pollution by constructing Smoke Control Areas.

The following table shows the numbers of premises which have been converted to Smoke Control Areas in Scotland and the United Kingdom as a whole at the 30th June, 1974.

	Scotland	Total ** in U.K.
Premises *	536,294	6,843,952

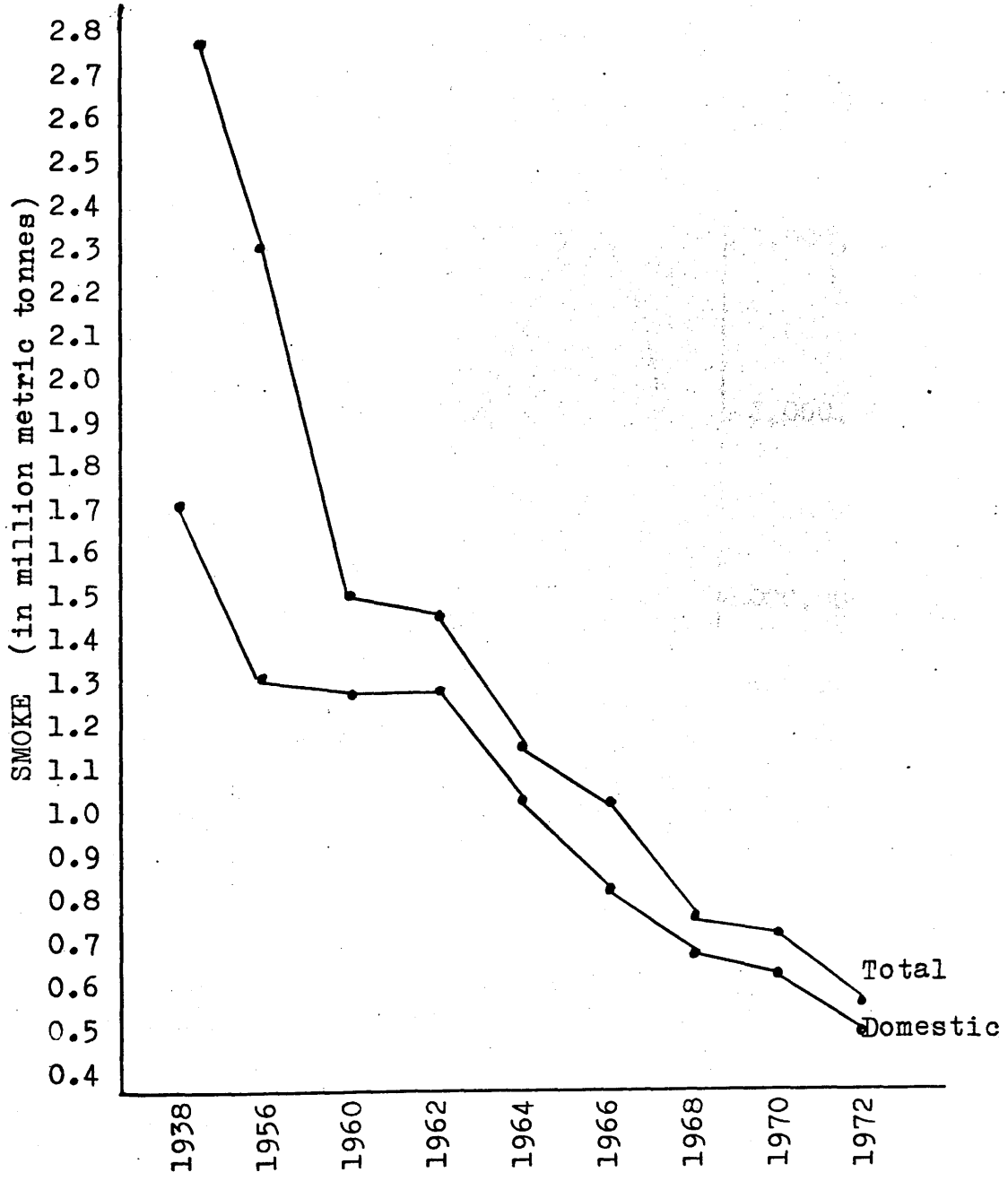
* /

* These premises include domestic, industrial and others.

** From this total, about 6,000,000 are domestic premises.

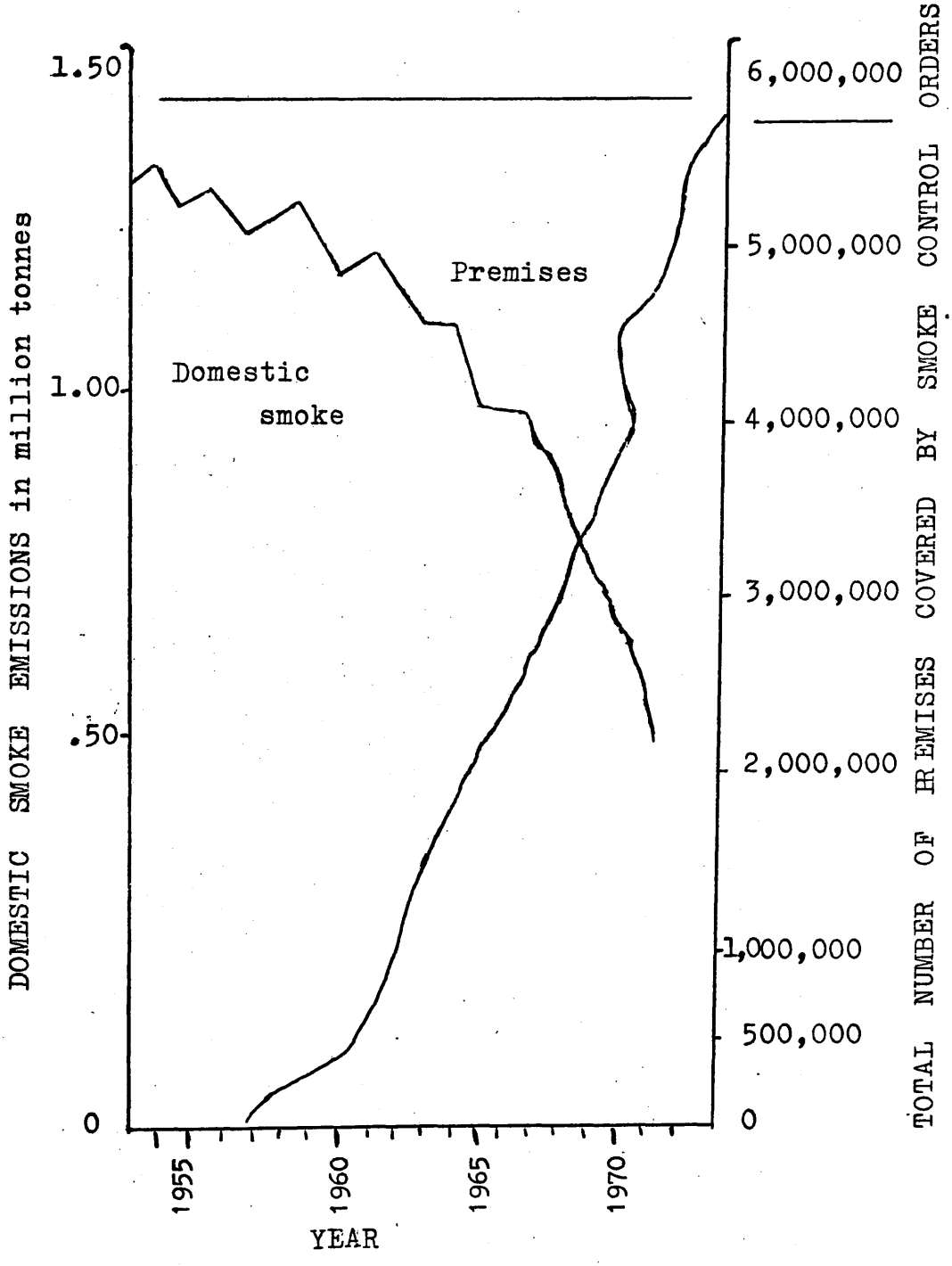
As a result of these efforts, smoke in the atmosphere from domestic chimneys is decreasing as follows:-

A. The following graph shows estimates of the air pollution by smoke of domestic chimneys in the United Kingdom in 1938 and 1956, and from 1960 to 1972, in million metric tonnes.



B. /

B. The following diagram shows comparison of all premises covered by smoke control and domestic smoke emissions, over the last twenty years:-



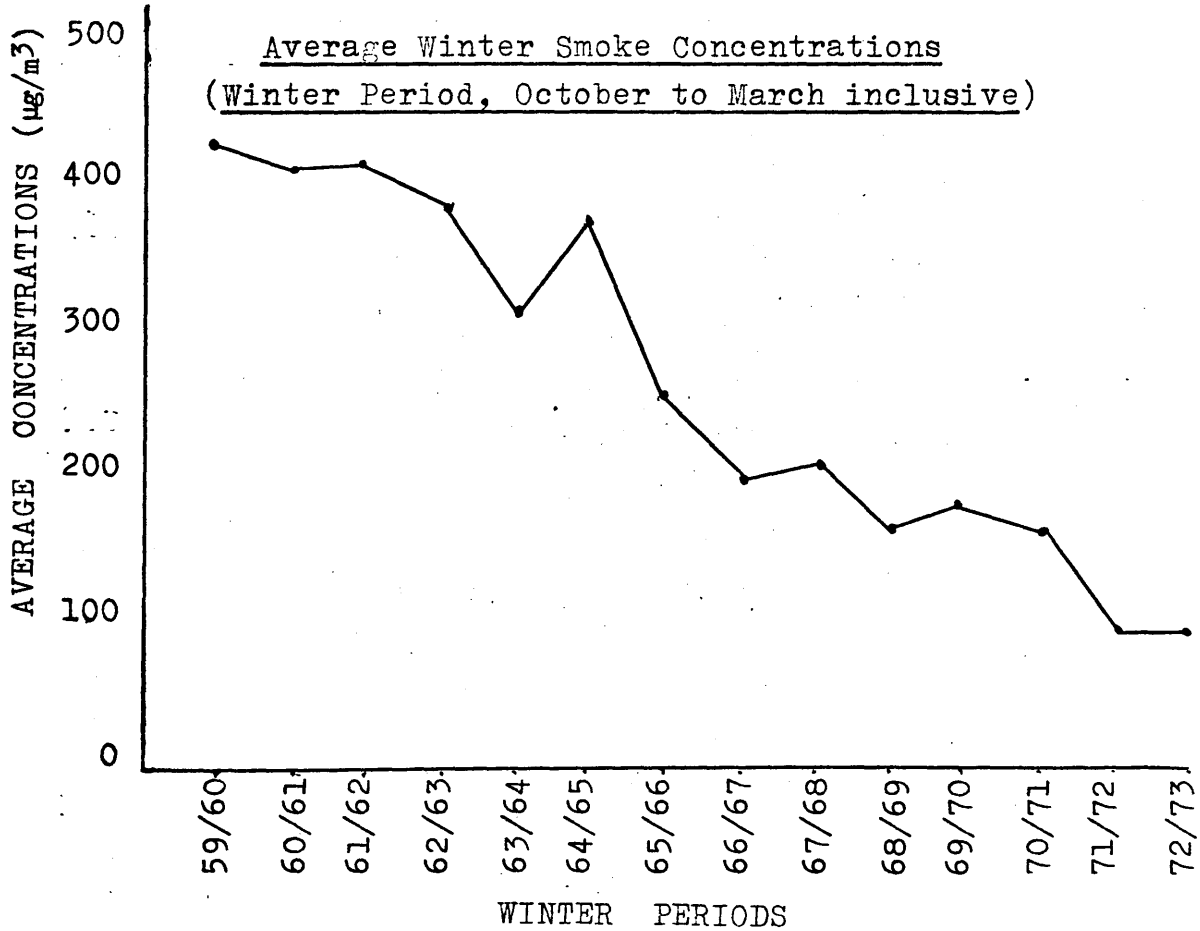
In our town (90,000 population), efforts have also been taking place to reduce air pollution from domestic chimneys. Here is a report showing the facts. The report includes the following:-

A. /

A. Information about programmes and progress from 15th October 1959 to 31st October 1974 (nearly fifteen years), and the cost of the reduced air pollution in our town.

YEAR	Under Smoke Control (Km^2)	Under Smoke Control (Premises)	COST		
			Local Auth. and Central Gov. (70%)	House-holders (30%)	Total (100%)
1959	0	0	0	0	0
1974	11	18,400	£336,000	£146,000	£482,000
1980	16	23,850	← unknown →		

B. The achievements. As a result of the efforts which have been taking place in our town by the Local Authority and Central Government, the smoke has decreased. The following graph illustrates the average winter smoke concentrations in our town from the year 1959/60 to 1972/73.



Evidence submitted to Public Inquiry

1. Comparison of pollutant quantities produced by domestic sources with other sources.
2. The health hazards associated with various pollutants.
3. The vast scale of action already taken, both nationally and locally.
4. The achievements in reducing air pollution in the Scottish town, Creswell.
5. Our conclusions.

INDUSTRIAL AGENCY RESEARCH GROUP

An old lady called Mrs. Isabella Macdonald, 60 years old, has been found dead in her house at 61 Pinkerton Drive, Creswell, on 2nd December 1974. The post-mortem indicated that:-

1. She had been dead for a week before discovery.
2. She was a non-smoker.
3. The area around her house had not yet become a smoke control area.
4. She had stayed in a highly polluted area caused by the emission of pollutants from domestic fires, industrial fumes discharging from steel works near to her house, and the traffic jam in this area.
5. The wind at the time of her death was light west-south-west.
6. The cause of death was bronchitis, apparently aggravated by local conditions of severe air pollution occuring at the time.

The sketch map of Creswell and the drawing which shows the area in which this old lady had stayed illustrate the circumstances surrounding her death.

On the following pages you will find all relevant information. Your task is to draw up a brief report presenting evidence supporting your view that industrial air pollution was not a major factor in the death of Mrs. Macdonald.

A guide sheet is provided to form the basis of your report. You may be questioned on your evidence by the Chairman of the Inquiry, as well as by other interested bodies. You will be allowed four to five minutes to present your evidence to the Inquiry. Preparation of this will take you about half an hour.

Report

Industry contributes to the air pollution in the atmosphere of the United Kingdom. The industrial furnaces emit sulphur oxides, smoke, grit and dust and soot. The following table shows estimates of air pollution from industry in the U.K. in the year 1972/73 in million tonnes.

POLLUTANT (emitted mainly from high chimneys)	QUANTITY industrial furnaces	TOTAL from all sources
Smoke		
Coal	0.05	0.50
Sulphur Oxides		
Coal	0.34	2.34
Coke	0.05	0.13
Oil	2.61	2.73
Total of sulphur oxides	3.00	5.20

It must be remembered that sulphur oxides are gases and disperse rapidly, unlike smoke which tends to gather in the atmosphere close to the ground.

These pollutants can affect our health. The following table shows these effects.

POLLUTANT	EFFECT
Smoke	1. On the present state of knowledge, smoke in any concentration is undesirable because it is dirty and unpleasant. But it has not yet been shown that on its own it has any direct ill-effects on health. 2. It can constitute a hazard to health when its /

	its high concentrations combine with winter fog, forming so called smog, i.e. smoke + fog, which may cause death. This happened in London in December 1952 causing the death of some four thousand people who were suffering from bronchitis, heart failure and cancer of the lung.
Oxides of Sulphur	Modern research has shown that - 1. On their own, they are not dangerous to health unless their concentrations become very high. 2. When mixed with smoke, they can constitute a major health hazard, even in small concentrations.

Action taken to reduce pollution

In this country, efforts have taken place to reduce pollutants discharging from industry. This has been carried out according to the Clean Air Acts passed in 1956 and 1968 which impose controls on smoke and grit and dust from industrial sources, and which give Local Authorities the power to establish smoke control areas - areas in which no smoke of any kind is permitted.

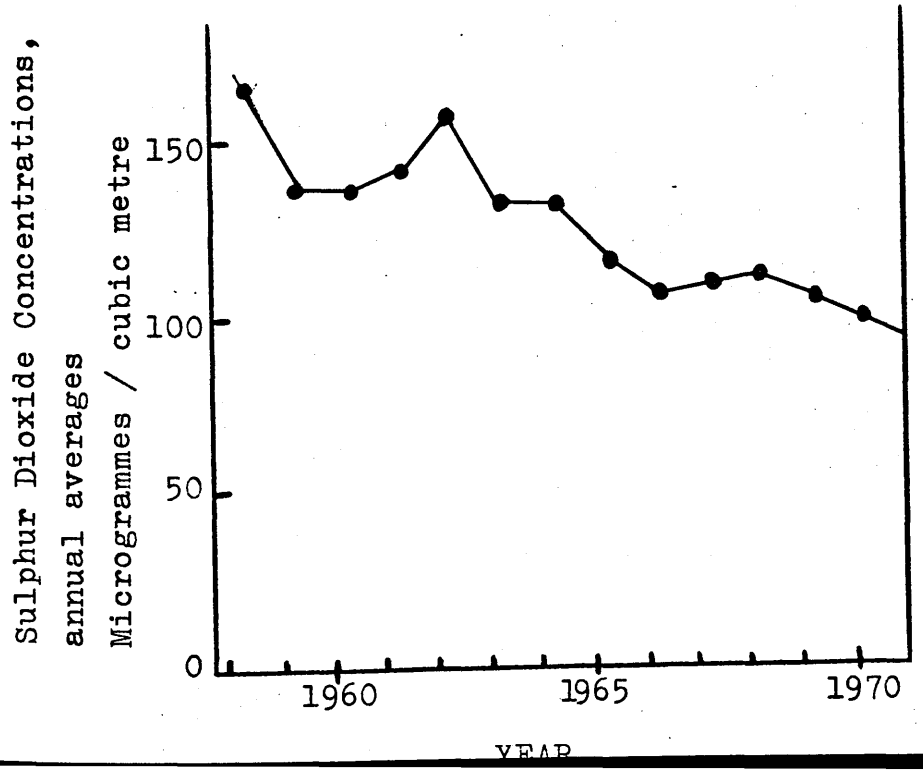
But to reduce pollution from industry money is needed. The following table shows the expenditure on research and development in reducing air pollution from industry during ten years (1958-1968) and the latest year's working costs.

INDUSTRY /

INDUSTRY	Research and Development	Latest Year's Working Costs *
1. Electricity	856,000	15,300,000
2. Cement	301,000	1,000,000
3. Petroleum	536,000	1,788,000
4. Gas	-	350,000
5. Coke Ovens	242,000	710,000
6. Lime	4,000	118,000
7. Ceramics	163,000	382,000
8. Iron and Steel	1,235,000	10,364,000
9. Non-ferrous Metals	656,000	2,262,000
10. Chemical	952,000	6,782,000
TOTALS (£)	4,945,000	39,056,000

* Working costs include depreciation and interest, operations, maintenance, overheads, etc.

As a result of these efforts, the discharge of pollutants from industry, expecially oxides of sulphur, has been decreasing in the U.K. The following graph shows oxides of sulphur trends in urban areas in the U.K.

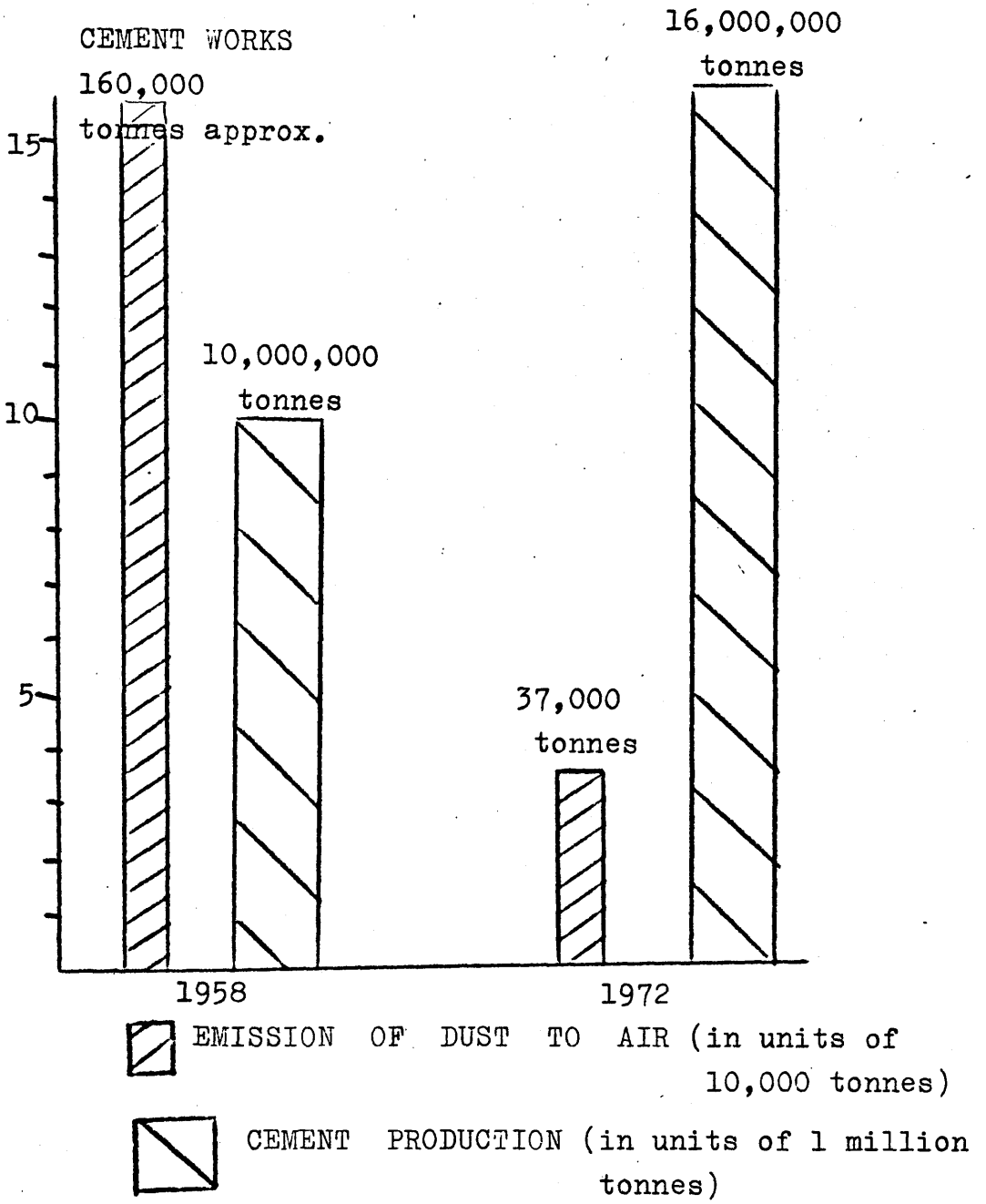


In our town, efforts have also taken place to reduce air pollution from industry. Here is a report showing relevant facts. This report includes the following:-

A. Improvements carried out by our industry. The following table shows the sort of improvements which reduce discharges from our town's works and their cost.

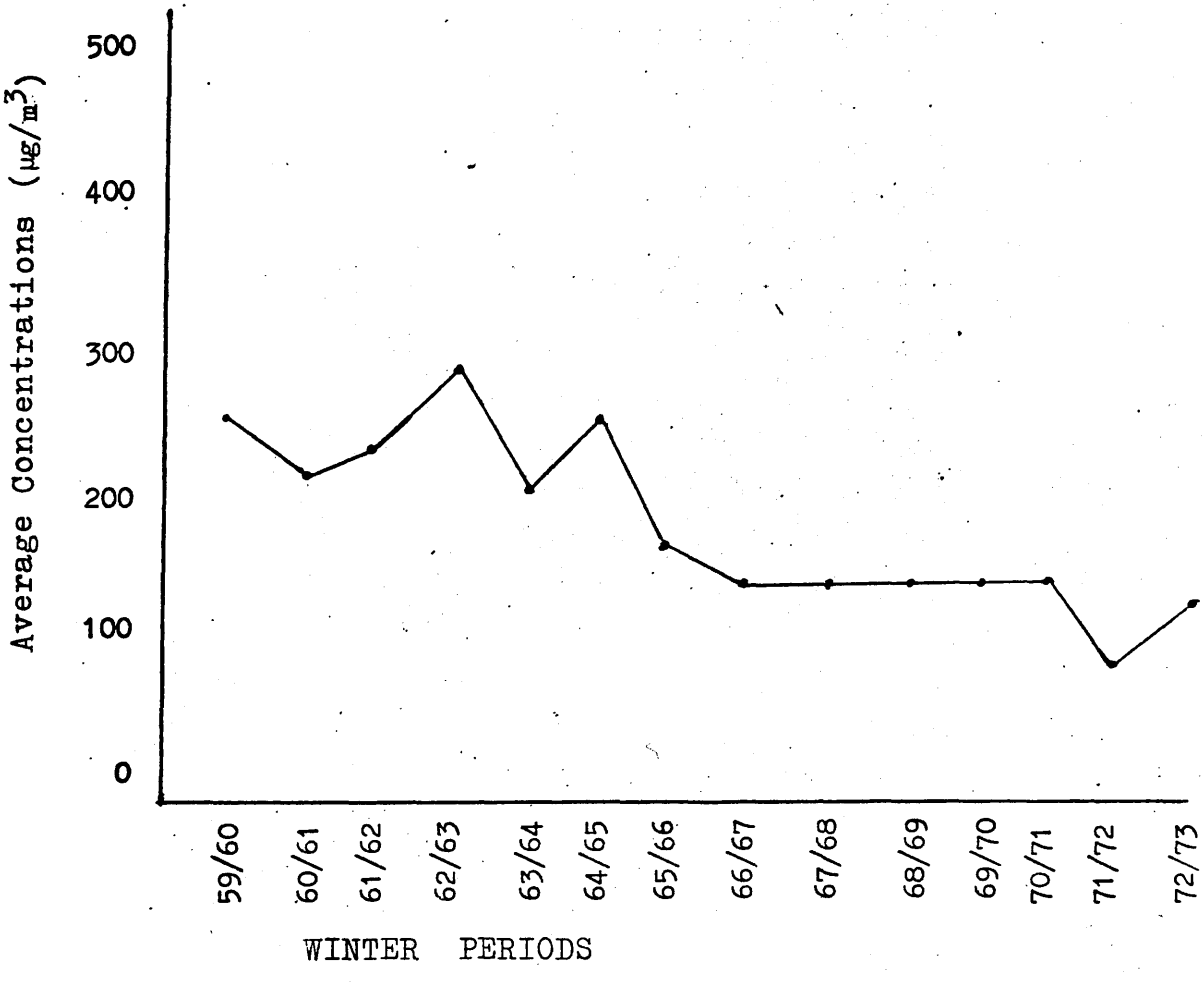
WORKS	SORT OF IMPROVEMENT	COST (£)
Cement Works	Reduction of the emission of dust to air	50,000
Steel Works (B.S.C.)	Oil pollution prevention measures	70,000
Chemical Works (Pharmaceuticals)	Recycling the discharges	26,000

As a result of these improvements to the industry in our town, the discharge of pollutants has decreased, whereas the production has been increased as the following graph shows for one industry:-



B. The achievements. As a result of these efforts which have taken place in our town (Local Authority, Central Government and local industry) sulphur dioxide concentrations in our town's atmosphere have decreased. The following graph illustrates the average winter sulphur dioxide concentrations in our town from the year 1959/60 to 1972/73.

Average Winter Sulphur dioxide Concentrations
(Winter period, October to March inclusive)



Evidence submitted to Public Inquiry

1. Comparison of pollutant quantities produced by industrial sources with other sources.
2. The health hazards associated with various pollutants.
3. The vast scale of action already taken, both nationally and locally.
4. The achievements in reducing air pollution in the Scottish town, Creswell.
5. Our conclusions.

ROAD TRANSPORT ASSOCIATION - RESEARCH DEPARTMENT

An old lady called Mrs. Isabella Macdonald, 60 years old, has been found dead in her house at 61 Pinkerton Drive, Creswell, on 2nd December 1974. The post-mortem indicated that:-

1. She had been dead for a week before discovery.
2. She was a non-smoker.
3. The area around her house had not yet become a smoke control area.
4. She had stayed in a highly polluted area caused by the emission of pollutants from domestic fires, industrial fumes discharging from steel works near to her house, and the traffic jam in this area.
5. The wind at the time of her death was light west-south-west.
6. The cause of death was bronchitis, apparently aggravated by local conditions of severe air pollution occuring at the time.

The sketch map of Creswell and the drawing which shows the area in which this old lady had stayed illustrate the circumstances surrounding her death.

On the following pages you will find all relevant information. Your task is to draw up a brief report presenting evidence supporting your view that air pollution from road vehicles was not a major factor in the death of Mrs. Macdonald.

A guide sheet is provided to form the basis of your report. You may be questioned on your evidence by the Chairman of the Inquiry, as well as by other interested bodies. You will be allowed four to five minutes to present your evidence to the Inquiry. Preparation of this will take you about half an hour.

Report

Road vehicles are one of the sources of air pollution. But the problem is that the numbers of these vehicles are increasing each year in the United Kingdom, as follows:-

Year	Population (millions)	Millions of Vehicles				
		Cars	Motor-cycles	Agri-cultural tractors	Other vehicles	All motor vehicles
1960	51	5.5	1.9	0.4	1.6	9.4
1965	53	8.7	2.6	0.5	2.0	13.8
1970	55	12.4	3.1	0.6	2.4	18.5
1980	59	19.2	3.5	0.6	3.3	26.6

All these vehicles cause pollution by discharging smoke, carbon monoxide, hydrocarbons, oxides of nitrogen, oxides of sulphur and lead.

The following table shows estimates of pollutants from road vehicles in the United Kingdom in the year 1972-73 in million tonnes.

Consumption of Motor Spirit 15.90 m. tonnes
Consumption of Diesel Fuel 5.25 m. tonnes

POLLUTANT	Petrol engines	Diesel engines	TOTAL (from vehicles)	TOTAL* (from all sources of pollution)
Carbon Monoxide	7.5	0.11	7.61	x
Hydrocarbons	0.38	0.022	0.402	x
Oxides of Nitrogen	0.25	0.08	0.33	x
Oxides of Sulphur	0.016	0.03	0.046	5.20
Lead	0.008	0.004	0.012	x

* This total includes road vehicles, domestic fires, industry and other sources.

x Not available.

It must /

It must be remembered that many of the above pollutants are gases, and disperse rapidly, unlike smoke which tends to gather in the atmosphere close to the ground.

The following table shows the effect of each pollutant on our health.

POLLUTANT	EFFECT *
Diesel Smoke	1. Although it is dirty and unpleasant to smell, it has not been shown yet that it has any direct ill-effects on health. 2. Introduces a safety hazard on the road.
Carbon Monoxide	1. Early symptoms are headache, nausea and giddiness. 2. Causes high blood carbon monoxide concentrations which can be aggravated by the intake of carbon monoxide by tobacco smoking. Its effect on health, however, has not yet been fully evaluated, although there is no evidence that it constitutes a serious health hazard.
Hydrocarbons	Many of the unburnt hydrocarbons may induce headaches and drowsiness.
Oxides of Nitrogen	In high concentrations, are highly toxic gases which can cause death, but in less acute exposures, recovery can follow but at the expense of permanent damage to the lungs. But on present knowledge, they do not appear to be a health hazard.
Oxides of Sulphur	Modern research has shown that, on their own, they are not dangerous to health /

	health unless their concentrations become very high. But when they are mixed with smoke, then they can be dangerous, and can constitute a major health hazard, even in small concentrations.
Lead	Evidence suggests that lead additives in petrol give rise to considerable lead emissions in motor vehicle exhaust. There is no general agreement on the effects caused by this. It may cause health hazards to young children who digest paint containing lead.

* There is a considerable difficulty in determining the effects on human health of pollutants emitted from motor vehicles for the following reasons:-

1. There is no specific air pollution disease. Air pollution acts mainly by worsening existing diseases.
2. It is not possible to isolate the effects of motor vehicle emissions from those from other sources.
3. Some of the pollutants emitted by motor vehicles are emitted from other sources as well.
4. Emissions from motor vehicles are rapidly dispersed in the atmosphere and the concentration of pollutants in the atmosphere only a few yards from a motor vehicle is very much less than in the vicinity of the exhaust pipe.

Action taken to reduce pollution

Efforts have taken place in the United Kingdom to reduce polluted emissions discharging from vehicles expecially those which can contribute to health hazard e.g. /

e.g. emissions of carbon monoxide and lead. Investigation has intensified over recent years.

Some of these efforts are dealing with reducing the emission of carbon monoxide. The following table shows the technical control methods developed to reduce the emission of carbon monoxide.

Technical Control Method	Advantages
1. Fuel Injection System The aim of this system, by using electronic control, is to introduce the right quantity of fuel into the air stream at the eye of the inlet parts.	1. Reduces carbon monoxide emission to relatively small proportions. 2. Provides a useful saving in petrol consumption.
2. Modified Carburettors These are new designs of carburettors which can provide substantially better control on carbon monoxide emission.	1. Gives acceptable reduction in carbon monoxide. 2. Gives some saving in petrol consumption.

Both of these controls add up to £160 to the cost of a new car so, as a result, few have been fitted.

In our town, the numbers of vehicles are increasing each year. The following table shows the present numbers and forecasts the future numbers of vehicles in our town.

Year	Population (thousands)	Thousands of Vehicles				
		Cars	Motor-cycles	Agri-cultural tractors	Other vehicles	All motor vehicles
1975	90	28.5	5.7	0.8	4.2	39.2
1980	92	30.7	5.9	0.9	5.3	42.8

It has /

It has been found that adding a chemical additive, called Tetraethyl Lead (TEL), in minute quantities during manufacture of the petrol contributes to the following advantages:-

1. Reduces the fuel consumption by 15%.
2. Enables engine compression ratios to be raised from 4:1 in the 1920's to up to 10:1 today, hence improving performance.
3. Reduces the total volume of gases emitted per car mile.

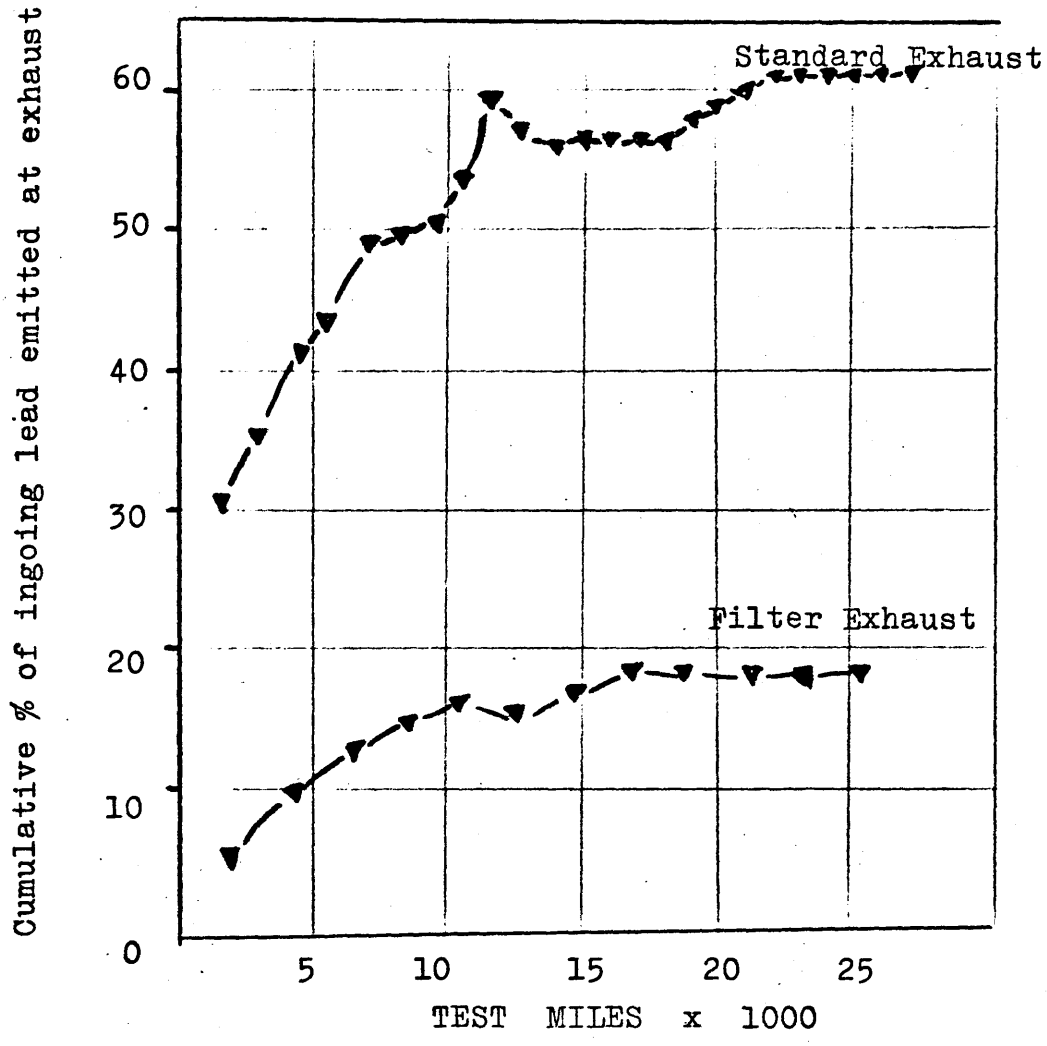
This chemical additive (TEL) is soluble in petrol and combustion converts it to lead compounds. Some of these are retained in the engine combustion space as the white deposit familiar to engine mechanics, the rest being exhausted with the gases contributing to air pollution.

The following table shows the technical control methods which can be used.

Technical Control Method	Advantages	Disadvantages
1. Not adding TEL (Tetraethyl Lead) to petrol	Prevents lead emission	Causes an additional 15% increase in the yearly petrol consumption. It is estimated that each tonne of lead needs to be replaced by 1,700 tonnes of crude oil.
2. Reducing the quantity of TEL added to petrol	1. Reduces lead emission to some extent. 2. Causes a slight decrease in the /	Does not completely solve the problem of lead emissions by vehicles.

	the yearly gasoline consumption.	
3. Keeping lead in the car by using exhaust filter system	1. Reduces lead emission (see the graph below). 2. Reduces the quantity of discharged carbon and general dirt. 3. Controls gaseous emissions. 4. May give slightly lower noise levels than the standard system.	Costs a lot of money. The cost to the motorist of fitting filter systems is expected to be significantly less than twice that of present standard exhaust for the majority of vehicles.

The following graph shows the typical lead emission test results on a saloon car, 1600 cc, 4 cylinders, by using exhaust filter system. This test has been done by the Research Department.



Evidence submitted to Public Inquiry

1. The increasing numbers of road vehicles in the United Kingdom.
2. Comparison of pollutant quantities produced by road vehicles with other sources.
3. The health hazards associated with various pollutants.
4. The vast scale of action already taken, both nationally and locally.
5. Our conclusions.

APPENDIX 7(c)

A STUDY IN AIR POLLUTION

Teachers' Instructions

1. Plan of Application

The following plan of application has been designed. You should have two groups of pupils (called Group 1 and Group 2) matched as far as possible according to their ability in Biology, each group containing the same boy - girl ratio.

GROUP 1 (Experimental Group)	GROUP 2 (Control Group)
A. On the day before application of the study:-	
Issue the article: (AIR POLLUTION AND HEALTH - EXPERIMENTAL GROUP) to be read at home.	No material
B. On the day of application of the study:-	
i. Provide the case study. ii. Give the test (15 mins)	i. Provide the article on: (AIR POLLUTION AND HEALTH - CONTROL GROUP) ii. Give the same test.

Please ask the pupils to indicate clearly when they fill in the required information of the test which group they belong to, also ask them to give only ONE answer.

2. The exercise is planned to last about one hour with 4th year S.C.E. biology and/or chemistry pupils.

3. /

3. You have a major role in this study (game). The description instructions and your role in the game are enclosed.

4. The study (game) will be carried out in pupil groups - it is suggested that four to six pupils could be in each group, and allowed to sit around a table, bench or desk to facilitate discussion.

Note: (a) Three groups at least are required.

(b) Each group will have the full description, instructions and also its role in the game.

5. To organise the exercise, please see the enclosed sheet.

6. The suggested time-tabling of the one hour period is:-

0	Preparation of the brief report by the small groups	(30 mins)
30 mins.	Presenting the evidence by each group	(15 mins) - 5 mins for each group.
45 mins.	Questioning each group about its responsibility.	(15 mins) - 5 mins for each group.
1 hour	END	

7. At the end of the discussion, you have to judge which group had the major responsibility for what happened. You have to explain that domestic fires had the major responsibility, because of the following reasons:-

(a) Smoke from domestic fires forms about 90% of the total smoke from all sources which includes domestic fires, industry, road vehicles and other sources.

(b) The most harmful source to our health is smoke for the following reasons -

(i) /

(i) Although it has not yet been shown that on its own it has any direct ill-effects on health, it can constitute a hazard to health when its high concentrations combine with winter fog, forming so called smog, i.e. smoke + fog, which may cause death. This happened in London in December 1952 causing the death of some four thousand people who were suffering from bronchitis, heart failure and cancer of the lung.

(ii) Modern research has shown that oxides of sulphur on their own, are not dangerous to health unless their concentrations become very high, but when mixed with smoke, they can constitute a major health hazard, even in small quantities.

NOTE: It is preferable to run through the study before using it with your pupils.

THANK YOU FOR YOUR CO-OPERATION

A P P E N D I X 7(d)

Glasgow University - Research in Science Education
AIR POLLUTION AND HEALTH - EXPERIMENTAL GROUP

Air Pollution - The Problem

Britain is one of the countries which has a serious and general air pollution problem. The atmosphere in the United Kingdom has been polluted by smoke, grit and dust, sulphur dioxide, carbon monoxide, carbon dioxide, hydrocarbons, nitrogen oxides and metals to list only some of the main pollutants.

A few years ago, from 5th December 1952 to 9th of the same month, London was exposed to a dangerous dense smog, that is the combination of smoke and fog, in which air pollution reached an unusually high level and was responsible, it is thought, for the deaths of some 4,000 people.

Today, despite the reduction of air pollution in Britain in general by more than 60% leading to improved health, air pollution is still threatening our living, as well as animals, plants and buildings.

The Pollutants

Pollutants are of two types: particulate matter, such as smoke, grit and dust; and gases, the chief of which is sulphur dioxide.

1. Particulate matter

This consists of small fragments of unburnt or partly burnt fuels, ash, and other materials including liquid droplets.

Particulate matter is divided into two categories:-

(a) Smoke 'Smoke' is the name given to very fine particles /

particles of soot and tarry matter which remain suspended in the air for long periods and travel with the air over long distances (may reach up to 50 miles or more). They are invisible unless they happen to float in a sunbeam in a darkened room, but they hide sunlight, and soil buildings and clothes. Smoke particles can be harmful to health because they are small enough to enter the lungs and be retained there. The main producer of smoke is the ordinary domestic coal fire. Smoke emitted from very high chimneys is more easily dispersed by the wind than smoke from low chimneys.

(b) Grit and Dust This is the name given to material coarse enough to settle out of the air. Grit and dust falls near the chimneys that emit it and dealing with it is therefore essentially a local problem. It settles on window-sills and blows into rooms and settles on furniture, and is a nuisance.

2. Gases: Sulphur dioxide, etc.

Most fuels such as coal, coke and oil, contain sulphur. When these fuels are burnt, the sulphur is converted to a corrosive acid gas, sulphur dioxide. Sulphur dioxide, in any concentration, is harmful to our health. It can also retard plant growth, lower vitality or even kill plants. High chimneys help to disperse these gases harmlessly into the upper atmosphere.

Where does the Air Pollution come from?

There are three main sources of air pollution:- domestic fires, industrial furnaces and road vehicles. Let us talk about each source in some detail.

1. Domestic fires /

1. Domestic fires They discharge smoke, grit and dust, sulphur dioxide and soot. It is estimated that domestic fires were responsible for discharging 450,000 tonnes of smoke in the United Kingdom in 1972/73 which is more than 80% of all smoke in the atmosphere. In Glasgow, domestic fires are responsible for about 80% of the total air pollution in the atmosphere.

2. Industrial furnaces They emit a lot of sulphur dioxide which seriously affects our health especially from those factories without tall chimneys. Even in the presence of a chimney, this gas is emitted from the chimney along with other combustion products and, if in excessive concentration at ground level can give rise to harmful atmosphere pollution.

Industrial furnaces were responsible for discharging 50,000 tonnes of smoke and 3,050,000 tonnes of all the pollutants in the United Kingdom (as it was estimated in 1972/73).

3. Road vehicles They contribute to air pollution. In 1972, there were about 20 million vehicles on roads of the United Kingdom. In 1980, it is estimated that there will be over 26 million vehicles. All these vehicles pollute the roads by discharging carbon monoxide, unburnt hydrocarbons which give the typical smell of petrol fumes, oxides of nitrogen, oxides of sulphur and lead. The total annual quantity of all these pollutants was 8,403,000 tonnes (as it was estimated in 1972/73). The harmful effect of road vehicles is that their pollutants are emitted at ground level.

Effects of Air Pollution

1. Air pollution kills people

Air pollution seriously affects our health. In December 1952, during five days, smog, i.e. a smoke-polluted fog, was considered responsible for the deaths of /

of some 4,000 people in London.

Every year, many people, especially old people, die from bronchitis, heart failure and cancer of the lung.

In Britain, chronic bronchitis kills - most unpleasantly - 30,000 people every year. Moreover, bronchitis causes the loss of 20 million working days each year in the United Kingdom. In Scotland in 1972, there were 2,695 deaths from bronchitis. 701 were under the age of 65. In addition, it has been estimated that 3 million man/hours are lost each year in Scotland because of bronchitis.

Cancer of the lung is another disease to which air pollution contributes. At the beginning of the century, about 200 people died from lung cancer each year, now the annual deaths in this country exceed 20,000. Air pollution can also expose people, especially smokers, to be ill with cancer of the lung. In Scotland in 1972, there were 3,538 deaths from lung cancer; 1,565 were under the age of 65. This is the highest rate in the world! And this number of deaths is on the increase. In the last 10 years, Scottish lung cancer deaths have gone up by over 35%. Smoking is, however, probably the main reason for this.

Although air pollution is not the sole cause of bronchitis, heart failure and cancer of the lung, it must be considered as a major factor because these diseases are much more common in towns, which are much polluted, than in the country. Patients suffering from chest or heart disease should be advised in a time of high air pollution to rest indoors and keep warm.

Smoke is the most harmful pollutant which seriously affects our health. Professor P.J. Lawther, the Director of the Air Pollution Unit of the Medical Research Council, has said: "Smoke in any concentrations is /

is undesirable and can well constitute a hazard to health; it should be eliminated as far as economically possible."

2. Air pollution affects animals' health

Some animals are also liable to be affected by a particular pollutant called fluoride. Fluorides can be emitted by some brick works and from certain aluminium works. They deposit on grass near to these works. When this grass is eaten by animals, the deposited fluoride seriously affects their teeth and bones.

3. Air pollution retards plant growth

Air pollution also affects the plant life and vegetation by the loss of sunlight, the blocking of stomata by deposits, the acidification of the soil and by the direct effects of sulphur dioxide.

Experiments have shown that sulphur dioxide alone, particularly in a humid atmosphere, can retard growth, lower vitality or even kill plants. Some plants can resist air pollution, but others cannot such as spinach, orchid, alfalfa, grape, apricot, citrus, etc.

4. Air pollution destroys materials

Even materials do not escape from air pollution. It is not uncommon today to see black buildings in your city or town as a result of air pollution. The most important pollutants discharged from the use of fuels, in relation to their destructive effects on materials, are smoke, grit and dust, and acid oxides of sulphur. The average annual quantity of these pollutants affecting materials in the U.K. is $\frac{1}{2}$ million tonnes smoke, $1\frac{1}{2}$ million tonnes grit and dust, and over 5 million tonnes acid oxides of sulphur.

Pollution by deposited matter in some heavily industrialised areas may be equivalent to more than 500 tonnes per square mile per year, and may reach as much /

much as 2,000 tonnes (0.158 lb/sq.ft !!!). In large cities and some urban areas, total deposits are commonly in the region of 200 to 400 tonnes per square mile, in rural areas and country towns the amount is normally less than the equivalent of 100 tonnes, occasionally as low as 10 tonnes per square mile per year. All these pollutants seriously affect the materials.

What has been done in the U.K. to reduce the hazard of air pollution?

Legislation has been introduced in Great Britain, aiming to reduce air pollution. The principal legislation is contained in the Clean Air Acts which were passed in 1956 and 1968. These acts are now fully in force in Scotland. The aim of these acts is to control smoke, and grit and dust from domestic and industrial sources.

Briefly, these acts do two main things:-

(a) Impose controls on smoke and grit and dust from industrial sources.

(b) Give local authorities the power to establish smoke control areas in which no smoke of any kind is permitted.

This means that householders in such areas must use a fuel which is smokeless. This may be gas, electricity, oil or solid smokeless fuel. The choice is left to the householder.

What is the effect of legislation in the United Kingdom?

As a result of legislation in Great Britain regarding air pollution, the emissions of smoke, grit and dust, and soot from domestic chimneys and industries have been reduced. The National Survey shows that since 1956, over all the country, there has been a 55% drop in the amount of smoke emitted. In the north of England /

England there has been a reduction of 45%, while in the south the reduction is between 60% and 65%, and in London itself it is about 80%.

If we take the City of Glasgow as an example of one of the big industrial cities showing the effect of legislation on the control of air pollution, we would find that considerable improvement has taken place.

(a) The amount of smoke produced by domestic chimneys is estimated to have been reduced by 30% since 1958.

(b) The amount of smoke produced by industry is estimated to have been reduced by 75% over the same period.

(c) There has been a similar trend in the amount of sulphur dioxide.

<u>What are the achievements resulting from reducing air pollution in the U.K.</u>?

The main achievements are as follows:-

1. Now, we can say that we all enjoy better life because we enjoy cleaner air.
2. Control of air pollution, along with education has been responsible for a social revolution, i.e. most of our families have electric fires and cookers.
   Some of them have central heating. Most of them have smokeless fuels.
3. In our houses, now, everything is cleaner, i.e. furnishings, fabrics, paintings, wallpapers, leather, etc.
4. Our buildings are now much cleaner than before.
5. In our cities and towns, there is now much more sunlight. For example, sunshine in Central London today has increased by 70% since 1958. In Glasgow it has increased by 60% in the last 20 years.
6. Winter visibility today has also been increased by threefold /

threefold since the Act of Clean Air came into force in 1956.

7. Birds, which have not been seen for years, are now in our cities. 138 bird species can now be seen in London compared with less than half that number ten years ago.

8. We can also see flowers in squares, streets, offices and houses. Magnificent flowers can now be seen, such as azaleas, camellias, heather, etc.

If we talk about the City of Glasgow, as one of the big Scottish industrial cities, we can see that much has been achieved. In the Glasgow Herald, on Wednesday 5th March, 1975, Mr. Hugh Cochrane, the weatherman, has said: "Climatically, however, Glasgow gets better", and added, "the frequency of fog (calculated on the basis of the number of hours of fog in relation to the numbers of hours of light winds) has declined dramatically since the period 1961-62, shortly after the first smoke control orders. Related to that is the increase in number of hours of winter sunshine. Some years ago the average was 26 hours of sunshine each December. It has risen to a level between 35 and 40 each December."

In his annual report, Mr. MacPherson, the Technical Officer of Health Department - Glasgow, has said, "Each year the citizens of Glasgow see the changes Clean Air is making in our daily lives. The home is cleaner and stays cleaner longer, brighter fabrics are being chosen when in the past the practical housewife would have chosen a fabric more in keeping with the smokey atmosphere. Brighter paints and wallpapers are 'in', in our Smoke Control Areas." He added, "In the heart of the City, office workers sit eating lunch amid the flowers and trees of Glasgow Square. This, in a city where not so long ago one would have thought twice before sitting on a seat le st you ruin your clothes. The floral /

The floral displays and the cleaning of buildings are bringing colour and brightness to the heart of a great city. Floral displays which I may add are being extended into the main streetsof our city centre." He added, "Glasgow citizens are in favour of clean air and it is hoped that with the Corporation's programme to have the whole city smoke-free before the end of the 70's that they may look forward with anticipation to "LET GLASGOW FLOURISH" in a clean and bright atmosphere."

The cost of the control of air pollution

The control of air pollution and the achievement of clean air cost money. Industry spends many millions of pounds on proper control equipment. Also many millions of pounds have been spent by Central Government, by local authorities and by householders themselves in the fitting of proper appliances for the use of clean fuel in the home.

Against this cost must be set the cost of the damage caused by air pollution; not only the cost of damage to health of people but also that of damage to buildings and materials throughout the country.

A lot of money has been spent in this country to control air pollution and achieve clean air. But clean fuel in the home, proper controls in industry and clean exhausts on vehicles will help to achieve even more.

A P P E N D I X 7(e)

Glasgow University - Research in Science Education
AIR POLLUTION AND HEALTH - CONTROL GROUP

Air Pollution - The Problem

Britain is one of the countries which has a serious and general air pollution problem. The atmosphere in the United Kingdom has been polluted by smoke, grit and dust, sulphur dioxide, carbon monoxide, carbon dioxide, hydrocarbons nitrogen oxides and metals to list only some of the main pollutants.

A few years ago, from 5th December 1952 to 9th of the same month, London was exposed to a dangerous dense smog, that is, the combination of smoke and fog, in which air pollution reached an unusually high level and was responsible for the deaths of a lot of people.

Today, despite the reduction of air pollution in Britain in general by more than 60% which has improved the health of the people, air pollution is still threatening our living, as well as animals, plants and buildings.

The Pollutants

Pollutants are of two types: particulate matter such as smoke, and grit and dust; and gases, the chief of which is sulphur dioxide.

1. Particulate matter

This consists of small fragments of unburnt or partly burnt fuels, and other materials including liquid droplets. Particulate matter is divided into two categories:-

(a) Smoke 'Smoke' is the name given to very fine particles of soot and tarry matter which remain suspended /

suspended in the air for long periods and travel with the air over long distances (may reach up to 50 miles or more). They are invisible unless they happen to float in a sunbeam in a darkened room; but they hide sunlight, and soil buildings and clothes. Smoke particles can be harmful to health because they are small enough to enter the lungs and can be retained there. The main producer of smoke is the ordinary domestic coal fire. Smoke emitted from very high chimneys is more easily dispersed by the wind than smoke from low chimneys.

(b) Grit and Dust This is the name given to material coarse enough to settle out of the air. Grit and dust falls near the chimneys that emit it and dealing with it is therefore essentially a local problem. It settles on window-sills and blows into rooms and settles on furniture, and is a nuisance.

2. Gases: Sulphur Dioxide, etc.

Most fuels such as coal, coke and oil, contain sulphur. When these fuels are burnt, the sulphur is converted to a corrosive acid gas, sulphur dioxide. Sulphur dioxide is harmful to our health. It can also retard plant growth, lower visibility and even kill plants. High chimneys help to disperse these gases harmlessly into the upper atmosphere.

Where does the air pollution come from?

There are three main sources of air pollution: domestic fires, industrial furnaces and road vehicles. Let us talk about each source in some detail.

1. Domestic fires They discharge smoke, grit and dust, sulphur dioxide and soot.

2. Industrial furnaces They emit a lot of sulphur dioxide /

dioxide which seriously affects our health especially from those factories without tall chimneys. Even in the presence of a chimney, this gas is emitted from the chimney along with other combustion products and, if in excessive concentration at ground level, gives rise to harmful atmosphere pollution.

3. Road vehicles They contribute to air pollution. They pollute the roads by discharging carbon monoxide, unburnt hydrocarbons which give the typical smell of petrol fumes, oxides of nitrogen, oxides of sulphur and lead. The harmful effect of road vehicles is that their pollutants are emitted at ground level.

Effects of Air Pollution

1. Air pollution affects people

Air pollution seriously affects our health. In December 1952, during five days, smog, i.e. a smoke-polluted fog, was responsible for the deaths of a lot of people in London.

Every year, many people, especially old people, die from bronchitis, heart failure and cancer of the lung.

In Britain, chronic bronchitis kills, most unpleasantly, a lot of people every year. Moreover, bronchitis causes the loss of many working days each year in the United Kingdom. Cancer of the lung is another disease to which air pollution contributes.

Air pollution is not the sole cause of bronchitis, heart failure and cancer of the lung, but it must be considered as a major factor because these diseases are much more common in towns, which are much polluted, than in the country. Patients suffering from chest or heart disease should be advised in a time of high pollution to rest indoors and keep warm.

2. Air pollution affects animals' health

Some animals are also liable to be affected

by /

by a particular pollutant called fluoride. Fluorides can be emitted by some brick works and from certain aluminium works. They deposit on grass near to these works. When this grass is eaten by animals the deposited fluoride seriously affects their teeth and bones.

3. Air pollution retards plant growth

Air pollution also affects the plant life and vegetation by the loss of sunlight, the blocking of stomata by deposits, by acidification of the soil and by the direct effects of sulphur dioxide.

Experiments have shown that sulphur dioxide alone, particularly in a humid atmosphere, can retard growth, lower vitality or even kill plants. Some plants can resist air pollution, but others cannot such as spinach, orchid, alfalfa, grape, apricot, citrus etc.

4. Air pollution destroys materials

Air pollution can seriously affect materials. It is not uncommon today to see black buildings in your city or town as a result of air pollution. The most important pollutants discharged from the use of fuels, in relation to their destructive effects on materials, are smoke, grit and dust, and acid oxides of sulphur.

What has been done in the U.K. to reduce the hazard of air pollution?

Legislation has been introduced in Great Britain aiming to reduce air pollution. The principal legislation is contained in the Clean Air Acts which were passed in 1956 and 1968. These acts are now fully in force in Scotland. The aim of these acts is to control smoke, and grit and dust from domestic and industrial sources.

Briefly, these acts do two main things:-

(a) Impose controls on smoke and grit and dust from industrial /

industrial sources.

(b) Give local authorities the power to establish smoke control areas in which no smoke of any kind is permitted.

This means that householders in such areas must use a fuel which is smokeless. This may be gas, electricity, oil or solid smokeless fuel. The choice is left to the householder.

What has been achieved by reducing air pollution in the U.K.?

As a result of legislation in Great Britain regarding air pollution, the emission of smoke and dust, and soot from domestic chimneys and industries have been reduced.

The main achievements are as follows:-

1. All British people enjoy better life because they enjoy cleaner air.
2. Control of air pollution, along with education, has been responsible for a social revolution, i.e. most families have cookers and electric fires. Some of them have central heating. Most of them have smokeless fuels.
3. Houses now are cleaner, i.e. furnishings, fabrics, paintings, wallpapers, leather, etc.
4. The buildings are now much cleaner than before.
5. In British cities and towns, there is now much more sunlight.
6. Winter visibility today has also been increased since the Act of Clean Air came into force in 1956.
7. Birds, which have not been seen for years, are now in British cities.
8. Flowers can also be seen in squares, streets, offices and houses.

The cost /

The cost of the control of air pollution

The control of air pollution and the achievement of clean air cost money. Industry spends many millions of pounds on proper control equipment. Also many millions of pounds have been spent by Central Government, by local authorities and by householders themselves in the fitting of proper appliances for the use of clean fuel in the home.

Against this cost must be set the cost of the damage caused by air pollution; not only the cost of damage to the health of people but also that of damage to buildings and materials throughout the country.

A lot of money has been spent in this country to control air pollution and achieve clean air. But clean fuel in the home, proper controls in industry and clean exhausts on vehicles will help to achieve even more.

A P P E N D I X 7(f)

University of Glasgow - Research in Science Education

AIR POLLUTION

1. Please fill in the following:- Name of School:_ _ _ _
   Your full name:_ _ _ _
   Girl ☐
   Boy ☐
   School year:_ _ _ _ _
   Date of Birth:_ _ _ _
   Group No.
   Today's date:_ _ _ _ _

2. Please indicate by a tick which of the following most nearly fits your course:-

   (a) Studying for an '0' grade in three sciences.
   (b) " " " " " in two sciences.
   (c) " " " " " in one science only.

THANK YOU FOR YOUR CO-OPERATION

Part 1

Pupil Test

Please answer the following questions:-

A. Name three sources contributing to air pollution.
   1.
   2.
   3.

B. Name two diseases to which air pollution contributes.
   1.
   2.

C. What is meant by -
   Smoke?
   Grit and dust?

D. Fill in the spaces:-
   Air pollutants are of two types. The first type is a particulate matter, such as ..... and ..... ; the second type are gases, the chief of which /

which is called ..... .

Part 2

Pupil Questionnaire

1. The aim of this questionnaire is to get YOUR reaction to a list of statements regarding AIR POLLUTION. You are asked to read each statement carefully then indicate your answer, which represents your serious opinion.

2. There are no 'right' or 'wrong' answers.

Section 1

Please put a tick (✓) in the appropriate box which fits your true opinion of the material you have just studied.

Here is how you are to use these boxes:

If you place your check mark in the first box closing to 'Good'

Good ☑ ☐ ☐ ☐ ☐ Bad

this means that the material is very good.

If you place your check mark in the second box near to 'Good'

Good ☐ ☑ ☐ ☐ ☐ Bad

this means that the material is fairly good.

If you place your check mark in the third box (in the middle)

Good ☐ ☐ ☑ ☐ ☐ Bad

this means that the material is neutral, i.e. not good not bad.

If you place your check mark in the fourth box to 'Good', i.e. the second box to 'Bad'

Good ☐ ☐ ☐ ☑ ☐ Bad

this means that the material is fairly bad.

If you place your check mark in the fifth box to 'Good', i.e. the first box closing to 'Bad'

Good ☐ ☐ ☐ ☐ ☑ Bad

this means that the material is very bad.

Here is /

Here is an example of describing something, for example, a particular flower -

Small			✓			Large
Beautiful	✓					Ugly
Bad smelling				✓		Good smelling

This means that the flower is of medium size and very beautiful, but it has a fairly good smell.

By using the same method of ticking, please give your general impression about <u>the material you have just studied.</u>

<u>IMPORTANT</u>: (i) Be sure you answer <u>ALL</u> the questions, and <u>DO NOT</u> omit any.

(ii) Never put more than one check mark on a single scale.

The material you have just studied is :-

Interesting						Boring
Exciting						Dull
Not enjoyable to study						Enjoyable to study
Easy to understand						Difficult to understand
Unhelpful						Helpful

Again, by using the same method of ticking, please give your general impression about :-

<u>THE SUBJECT OF AIR POLLUTION</u>

The subject of air pollution is :-

Interesting						Boring
Exciting						Dull
Not enjoyable to study						Enjoyable to study
Easy to understand						Difficult to understand
Unhelpful						Helpful

Section 2

Please indicate your opinion by putting a tick in the appropriate column against each statement.

	Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
1. Householders, industrial authorities and motorists who pollute our air must clean up their own pollution.					
2. We must just accept that air pollution is an unfortunate result of modern day living.					
3. Each one of us is the cause of air pollution.					
4. We must instruct Local Authorities to enforce strict legislation against anybody who pollutes air.					
5. In the end, each one of us has to pay in order to overcome pollution.					
6. We cannot afford to take the necessary action to reduce air pollution to a reasonable level.					

Section 3

Please indicate your opinion by putting a tick in the appropriate column against each statement:-

Suppose that you have read the following in your local newspaper -

"AIR POLLUTION COSTS BRITAIN ABOUT 2% OF THE GROSS NATIONAL PRODUCT!"

Air pollution costs Britain each year more than £1,000 million. The following table shows the annual cost of air pollution in Britain as estimated in November, 1972.

ITEMS	The Annual Cost (£ million per annum)
Health	640
Agricultural Produce	195
Amenity (quality of life)	106
Corrosion and protection of metals, textile, paper, etc.	75
Others	174
Total	1190

But air pollution in Britain can be reduced. To do so, however, costs money. The estimated total price for reducing air pollution in Britain was as estimated about £9 million per annum. By dividing this total cost by the total population, it has been found that this cost is roughly 15p per head per year.

	Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
1. Do you consider that air pollution contributes to a health hazard?					
2. Would you sign a petition protesting against householders, industry authorities and motorists who do not control air pollution?					
3. Do you think there is more scope for documentary T.V. programmes concerned with the causes and effects of air pollution?					
4. Do you think that more money should be spent in controlling air pollution through advertising in local press and radio?					

5. /

	Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
5. Should the Government increase the penalties against those who pollute the air?					
6. If you are asked to pay more money to reduce air pollution in your district, would you agree?					

A P P E N D I X 7(g)

University of Glasgow - Research in Science Education

TEACHER QUESTIONNAIRE - AIR POLLUTION

This is a list of educational objectives which may, in part, have been achieved by this case study.

After your pupils have finished the study, please fill in the following questionnaire yourself (as teacher using the material), by indicating with a tick how successful you think the material has been in enabling pupils to achieve these objectives.

How successful has this material been in enabling the pupils to:-	Very successful	Fairly successful	Unsuccessful
1. Understand some specific terms related to air pollution, such as smoke, and grit and dust.			
2. State the types of pollutants of the atmosphere.			
3. Understand some of the (a) sources of air pollution;			
(b) air pollution effects on our health.			
4. Realise the extent of the annual cost of air pollution (a) in Britain as it was estimated in 1972;			
(b) in Glasgow from 1959 to 1974.			
5. See the importance of air pollution as a problem today.			
6. Appreciate the responsibilities of householders, industrial authorities and road transport authorities in dealing with air pollution problems.			

7. /

	Very successful	Fairly successful	Unsuccessful
7. Understand individual responsibility for (a) causing air pollution; (b) financing its reduction.			
8. Communicate their ideas to others on the subject of air pollution.			

Please list here any other objectives which you think have been achieved by using this material.

Please list here any comments about the material, including criticism.

To be completed by Principal Teacher:

Name of Principal Teacher: _____

Name of School: _____

Number of pupils who attempted this Case Study _____

(Boys _____ Girls _____)

Date(s) of Use: _____

Today's Date: _____

THANK YOU FOR YOUR CO-OPERATION

A P P E N D I X 7(h)

ANALYSIS OF THE PUPIL TEST (COGNITIVE TEST)

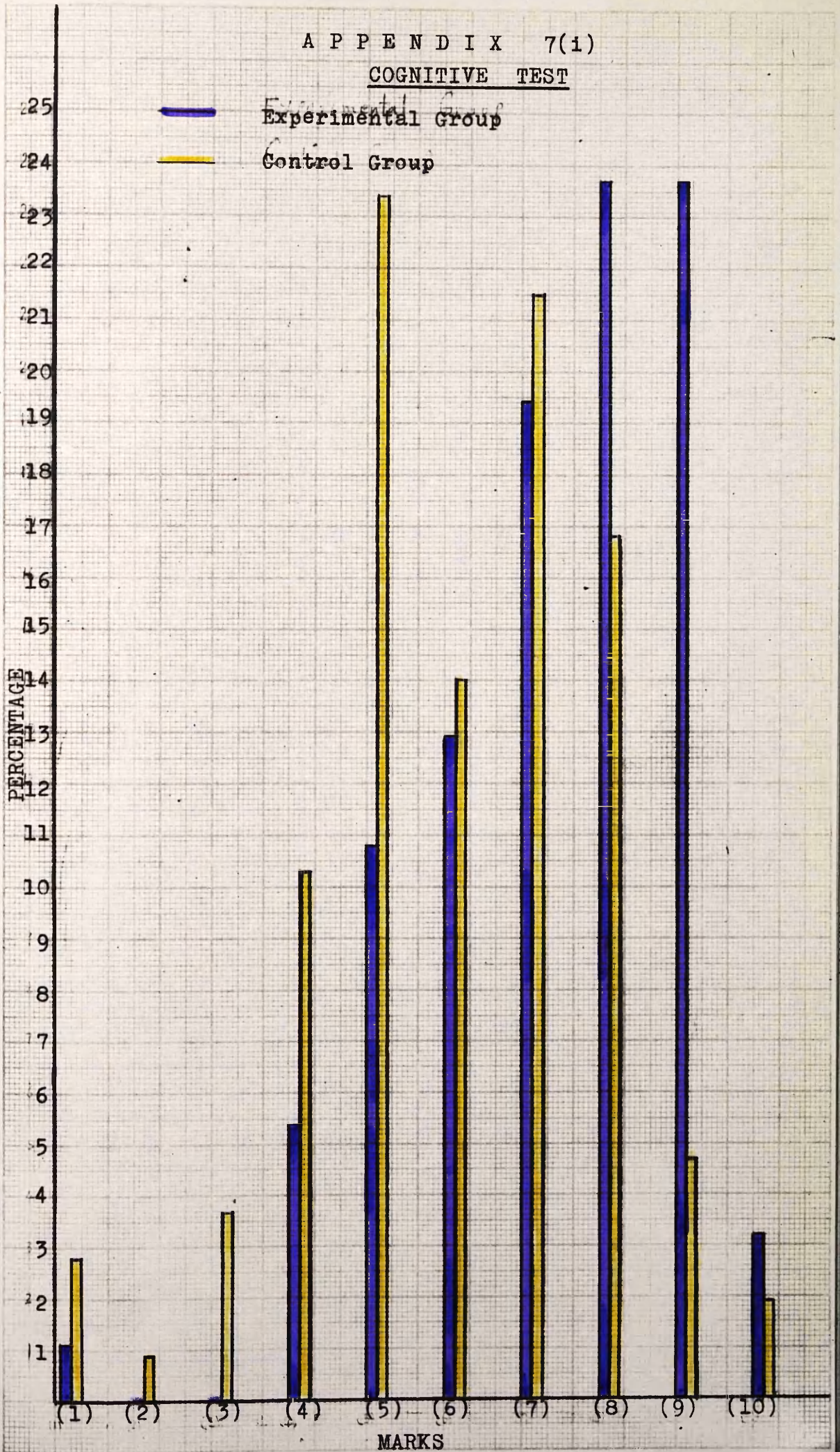
Experimental Group				Control Group				Sig.
Mark (M.)	Frequency (F.)	Percentage Frequency	M. x F.	Mark (M.)	Frequency (F.)	Percentage Frequency	M. x F.	
1	1	1.1	1	1	3	2.8	3	* 1%
2	0	0	0	2	1	0.9	2	-
3	0	0	0	3	4	3.7	12	-
4	5	5.4	20	4	11	10.3	44	* 1%
5	10	10.8	50	5	25	23.4	125	* 1%
6	12	12.9	72	6	15	14.0	90	* 1%
7	18	19.4	126	7	23	21.5	161	* 1%
8	22	23.7	176	8	18	16.8	144	* 1%
9	22	23.7	198	9	5	4.7	45	* 1%
10	3	3.2	30	10	2	1.9	20	* 1%
	93		673		107		646	

μ (for the Experimental Group) = $673 \div 93 = \underline{7.24}$

μ (for the Control Group) = $646 \div 107 = \underline{6.04}$

A P P E N D I X 7(i)

COGNITIVE TEST



SECTION	Ques. No.	A and B					C					D and E				
		Exp.		Cont.		Sig.	Exp.		Cont.		Sig.	Exp.		Cont.		Sig.
		F.	%	F.	%		F.	%	F.	%		F.	%	F.	%	
1 (a)	1.	70	75	50	47	* 1%	17	18	28	26	* 1%	6	6	28	26	* 1%
	2.	36	39	13	12	* 1%	39	42	57	53	* 1%	18	19	37	35	* 1%
	3.	5	5	28	26	* 1%	21	23	40	38	* 1%	67	72	38	36	* 1%
	4.	60	65	70	65	-	22	24	22	21	-	11	12	15	14	* 1%
	5.	7	8	13	12	* 1%	8	9	25	24	* 1%	78	84	68	64	-

178 174 107 172 180 186

Total of Experimental Group responses = 178 + 107 + 180 = 465

" " Control " " = 174 + 172 + 186 = 532

465 532 465 532 465 532

178 174 107 172 180 186

Fe 152 150 163

Fo 178 107 180

$$\chi^2 = \frac{(26)^2}{152} + \frac{(43)^2}{150} + \frac{(17)^2}{163}$$

$$= 4.45 + 12.33 + 1.77 = 17.55 \quad * 1\%$$

Degrees of freedom (V) = 2

SECTION	Ques. No.	A and B					C					D and E				
		Exp.		Cont.		Sig.	Exp.		Cont.		Sig.	Exp.		Cont.		Sig.
		F.	%	F.	%		F.	%	F.	%		F.	%	F.	%	
1 (b)	1.	56	60	47	44	* 5%	15	16	20	19	* 1%	22	24	39	37	* 1%
	2.	25	27	20	19	* 1%	39	42	53	50	* 1%	29	31	34	32	* 1%
	3.	21	23	27	25	* 1%	33	36	40	37	* 1%	38	41	40	37	* 1%
	4.	53	57	68	64	-	21	23	20	19	* 1%	19	20	19	18	-
	5.	7	8	7	7	-	14	15	27	25	* 1%	71	77	72	68	-
		162		169			122		160			179		204		

Total of Experimental Group responses = 162 + 122 + 179 = 463

" " Control " " = 169 + 160 + 204 = 533

	463	533		463	533		463	533
	162	169		122	160		179	204
Fe	128			139			177	
Fo	162			122			179	

$$\chi^2 = \frac{(34)^2}{128} + \frac{(17)^2}{139} + \frac{(2)^2}{177}$$

$$= 9.03 + 2.08 + 0.03 = 11.14 \quad * 1\%$$

Degrees of freedom (V) = 2

SECTION	Ques. No.	A and B					C					D and E				
		Exp.		Cont.		Sig.	Exp.		Cont.		Sig.	Exp.		Cont.		Sig.
		F.	%	F.	%		F.	%	F.	%		F.	%	F.	%	
2	1.	55	60	44	41	* 1%	16	17	41	38	* 1%	21	23	22	21	* 1%
	2.	29	32	30	28	* 1%	7	8	22	21	* 1%	54	60	55	51	-
	3.	51	55	52	50	* 5%	18	20	25	24	* 1%	23	25	27	26	* 1%
	4.	60	65	50	47	* 5%	14	15	32	30	* 1%	18	20	25	23	* 1%
	5.	65	71	50	48	* 5%	12	13	25	24	* 1%	15	16	30	29	* 1%
	6.	13	14	15	14	* 1%	19	21	21	20	* 1%	60	65	69	66	-
		273		241			86		166			191		228		

Total of Experimental Group responses = 273 + 86 + 191 = 550

" " Control " " = 241 + 166 + 228 = 635

	550	635		550	635		550	635
	273	241		86	166		191	228
Fe	209			144			197	
Fo	273			86			191	

$$\chi^2 = \frac{(64)^2}{209} + \frac{(58)^2}{144} + \frac{(6)^2}{197}$$

$$= 19.60 + 23.36 + 0.18 = 43.14 \quad * 1\%$$

Degrees of freedom (V) = 2

SECTION	Ques. No.	A and B					C					D and E				
		Exp.		Cont.		Sig.	Exp.		Cont.		Sig.	Exp.		Cont.		Sig.
		F.	%	F.	%		F.	%	F.	%		F.	%	F.	%	
3	1.	91	99	103	97	-	1	1	2	2	* 1%	0	0	1	1	-
	2.	54	59	41	39	* 1%	26	28	30	29	* 1%	12	13	34	32	* 1%
	3.	63	69	79	75		21	23	22	21	* 1%	7	8	5	5	* 5%
	4.	64	70	48	46	* 5%	18	20	27	26	* 1%	10	11	30	29	* 1%
	5.	65	71	46	44	* 5%	17	19	31	30	* 1%	9	10	27	26	* 1%
	6.	55	61	53	50	-	20	22	29	27	* 1%	15	17	24	23	* 1%
		392		370			103		141			53		121		

Total of Experimental Group responses = 392 + 103 + 53 = 548

" " Control " " = 370 + 141 + 121 = 632

	542	632	542	632	542	632	
	392	370	103	141	53	121	
Fe	321		122		105		
Fo	392		103		53		

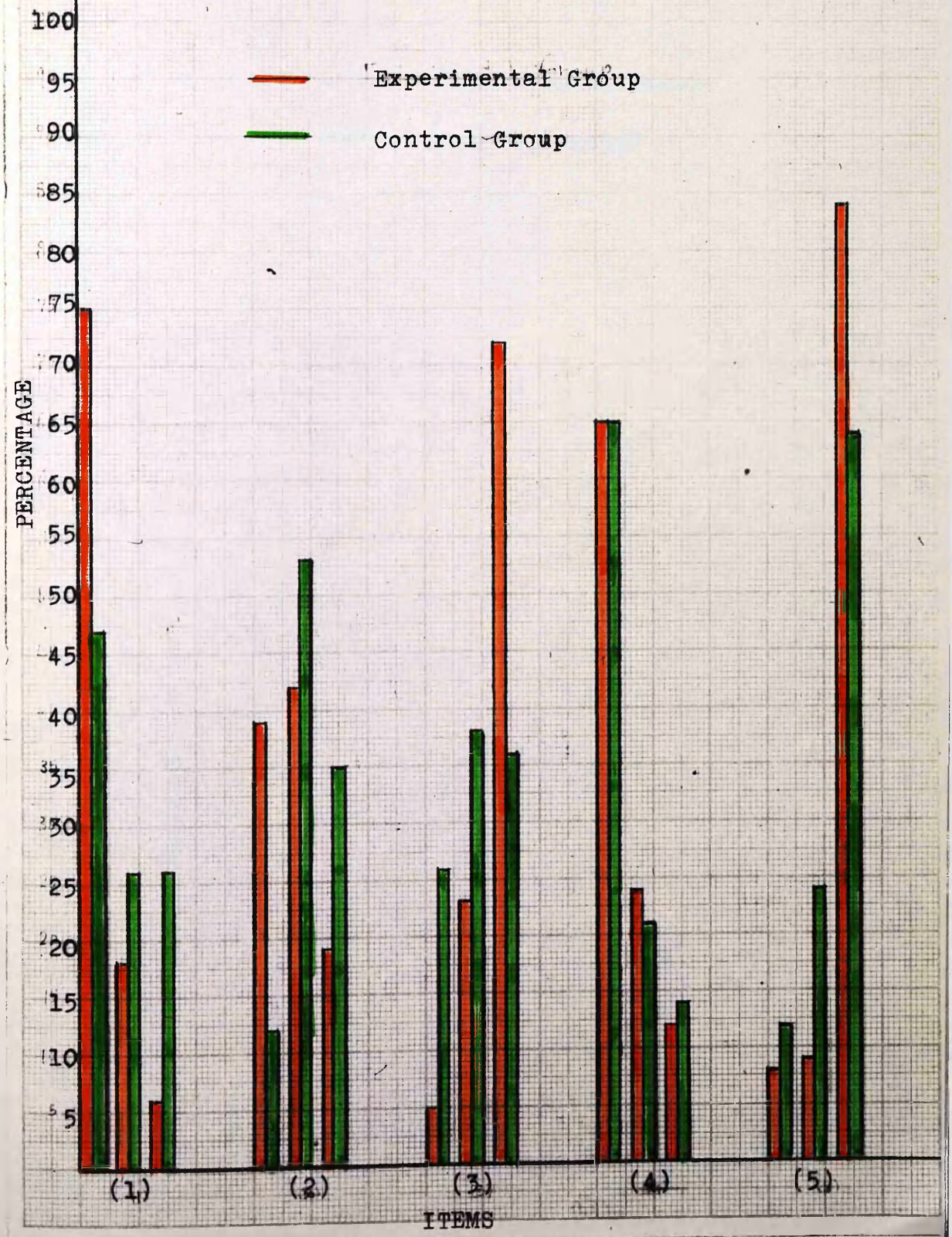
$$\chi^2 = \frac{(71)^2}{321} + \frac{(19)^2}{122} + \frac{(52)^2}{105}$$

$$= 15.70 + 2.96 + 25.75 = 44.41 \quad * 1\%$$

Degrees of freedom (V) = 2

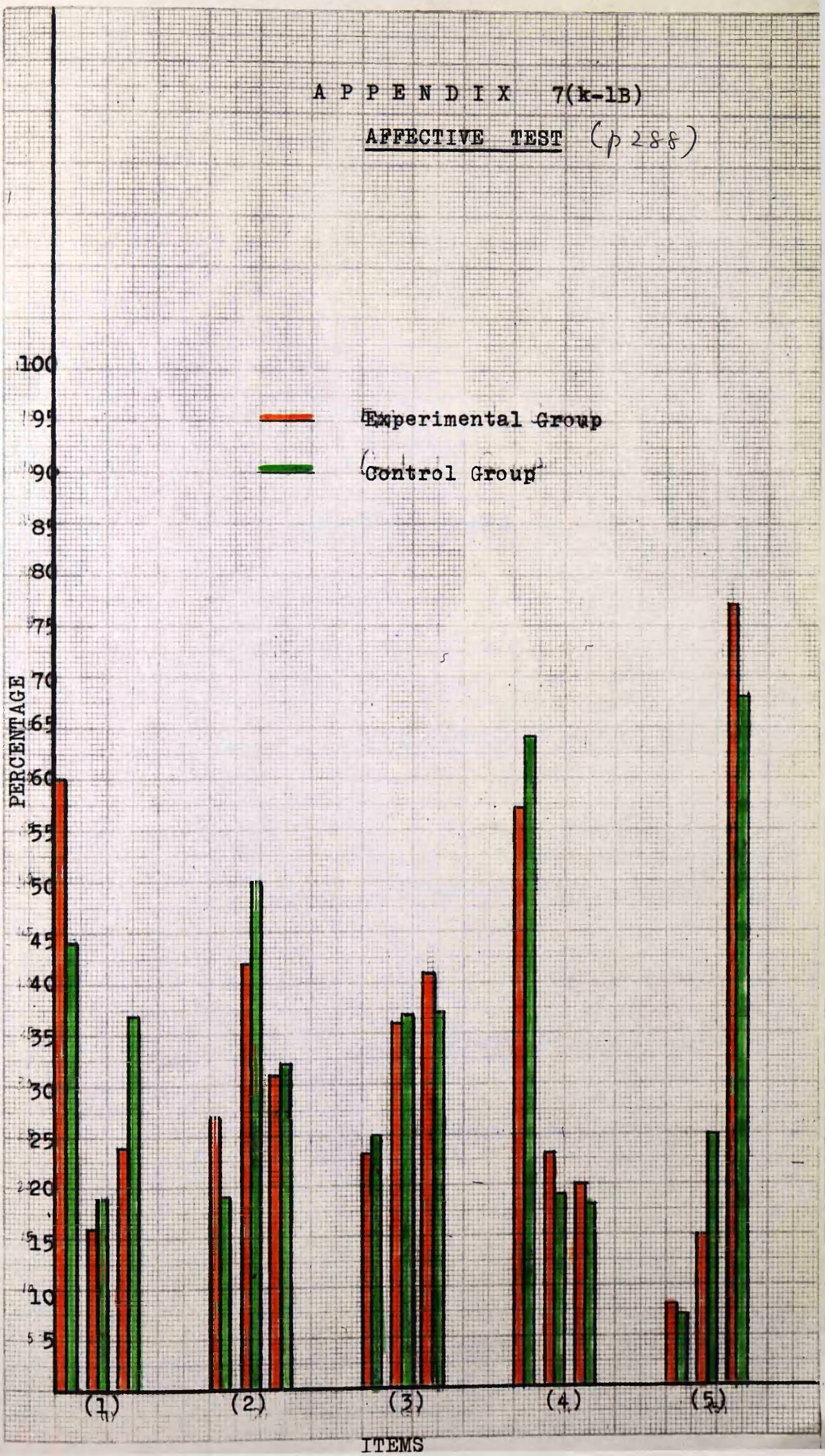
A P P E N D I X 7(k-1A)

AFFECTIVE TEST (p 288)



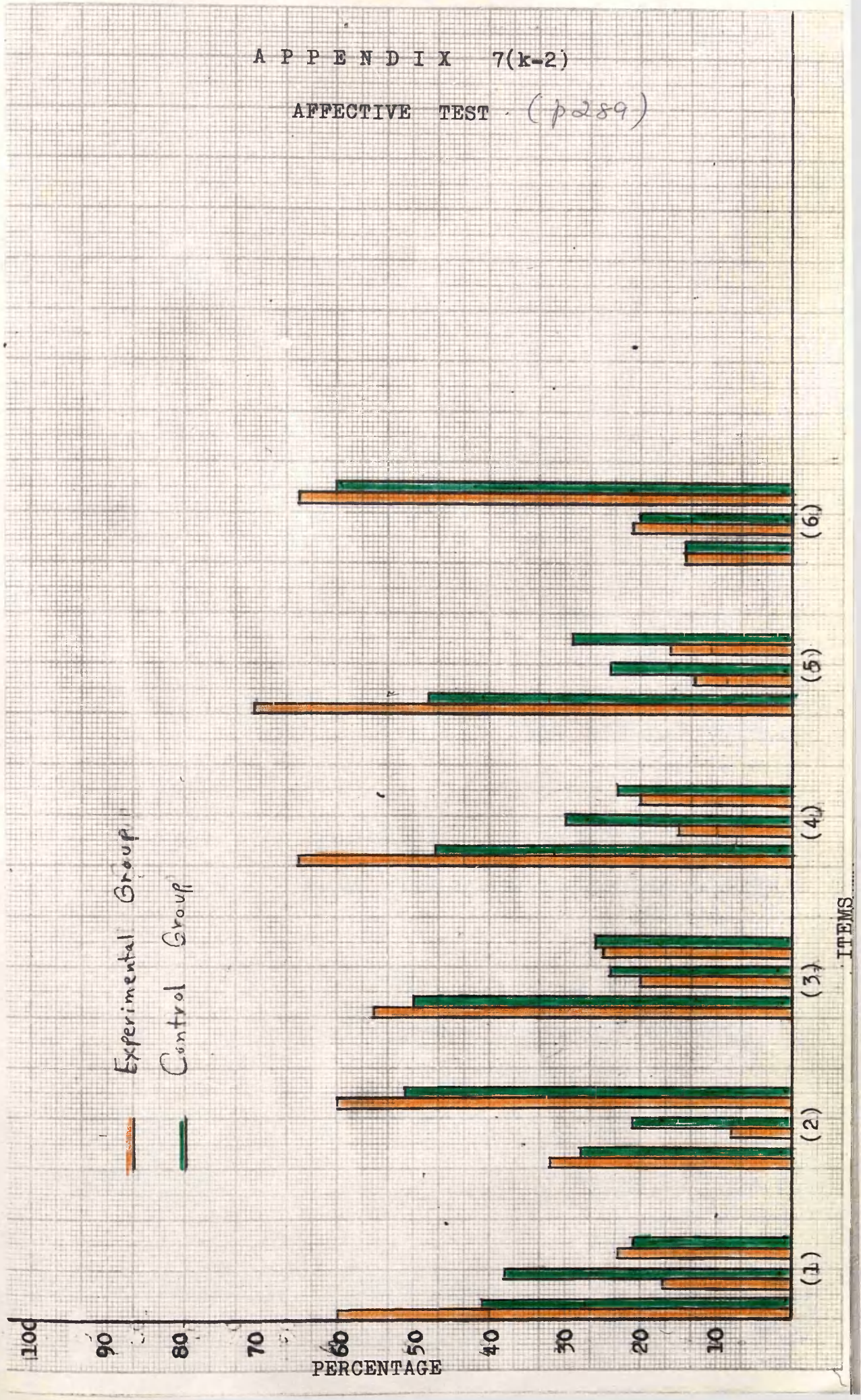
A P P E N D I X 7(k-1B)

AFFECTIVE TEST (p 288)



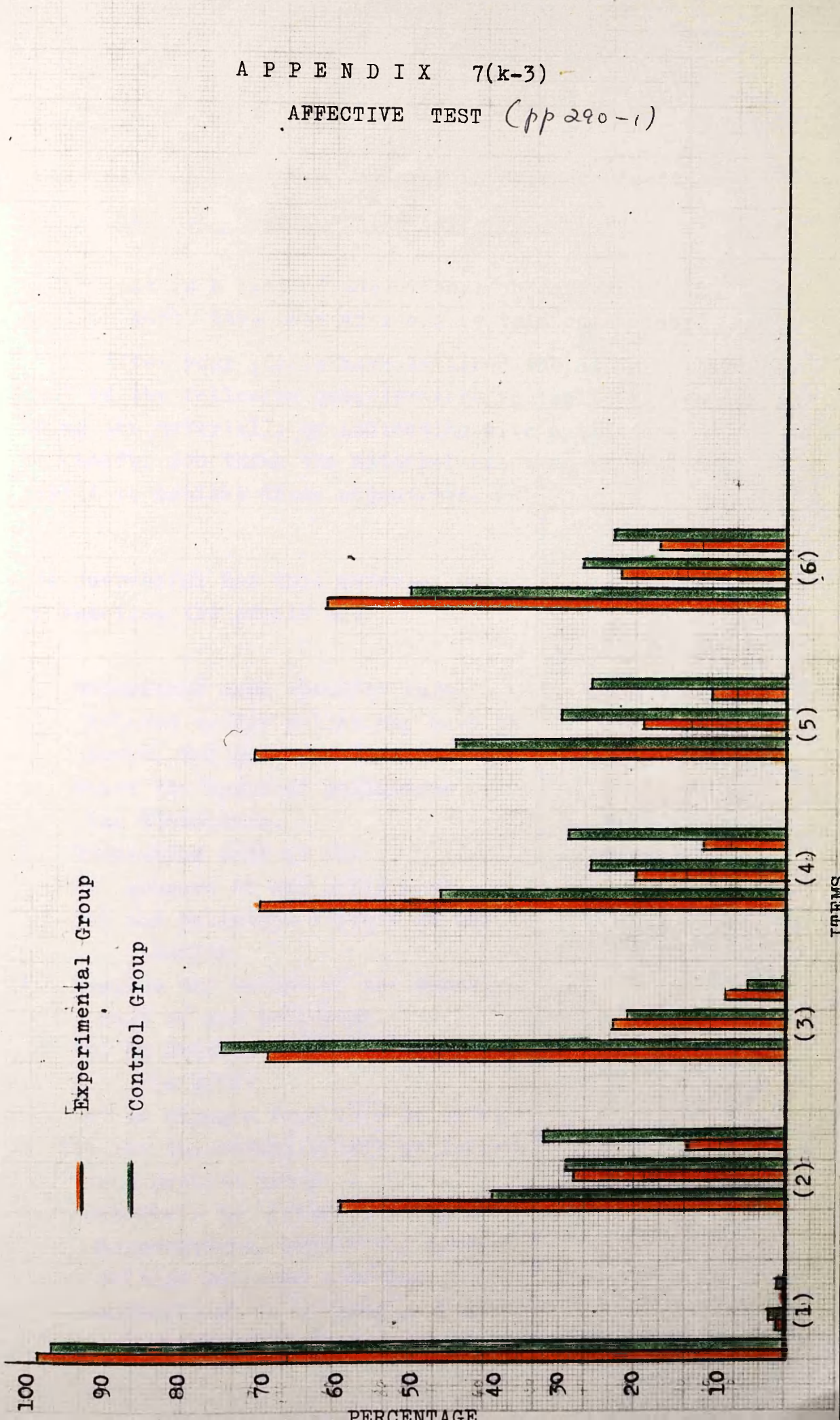
APPENDIX 7(k-2)

AFFECTIVE TEST (p289)



APPENDIX 7(k-3)

AFFECTIVE TEST (pp 290-1)



A P P E N D I X 7(1)

University of Glasgow - Research in Science Education

TEACHER QUESTIONNAIRE (AIR POLLUTION)

This is a list of educational objectives which may, in part, have been achieved by this case study.

After your pupils have finished the study, please fill in the following questionnaire yourself (as teacher using the material), by indicating with a tick how successful you think the material has been in enabling pupils to achieve these objectives.

How successful has this material been in enabling the pupils to:-

	Very successful	Fairly successful	Unsuccessful
1. Understand some specific terms related to air pollution, such as smoke, and grit and dust.	2	4	-
2. State the types of pollutants of the atmosphere.	5	1	-
3. Understand some of the (a) sources of air pollution;	3	3	-
(b) air pollution effects on our health.	1	5	-
4. Realise the extent of the annual cost of air pollution (a) in Britain as it was estimated in 1972;	-	4	2
(b) in Glasgow from 1959 to 1974.	-	4	2
5. See the importance of air pollution as a problem today.	4	1	-
6. Appreciate the responsibilities of householders, industrial authorities and road transport authorities in dealing with air pollution problems.	3	3	-

7. /

	Very successful	Fairly successful	Unsuccessful
7. Understand individual responsibility for (a) causing air pollution;	3	3	-
(b) financing its reduction.	-	5	1
8. Communicate their ideas to others on the subject of air pollution.	-	6	-

A P P E N D I X 7(m)

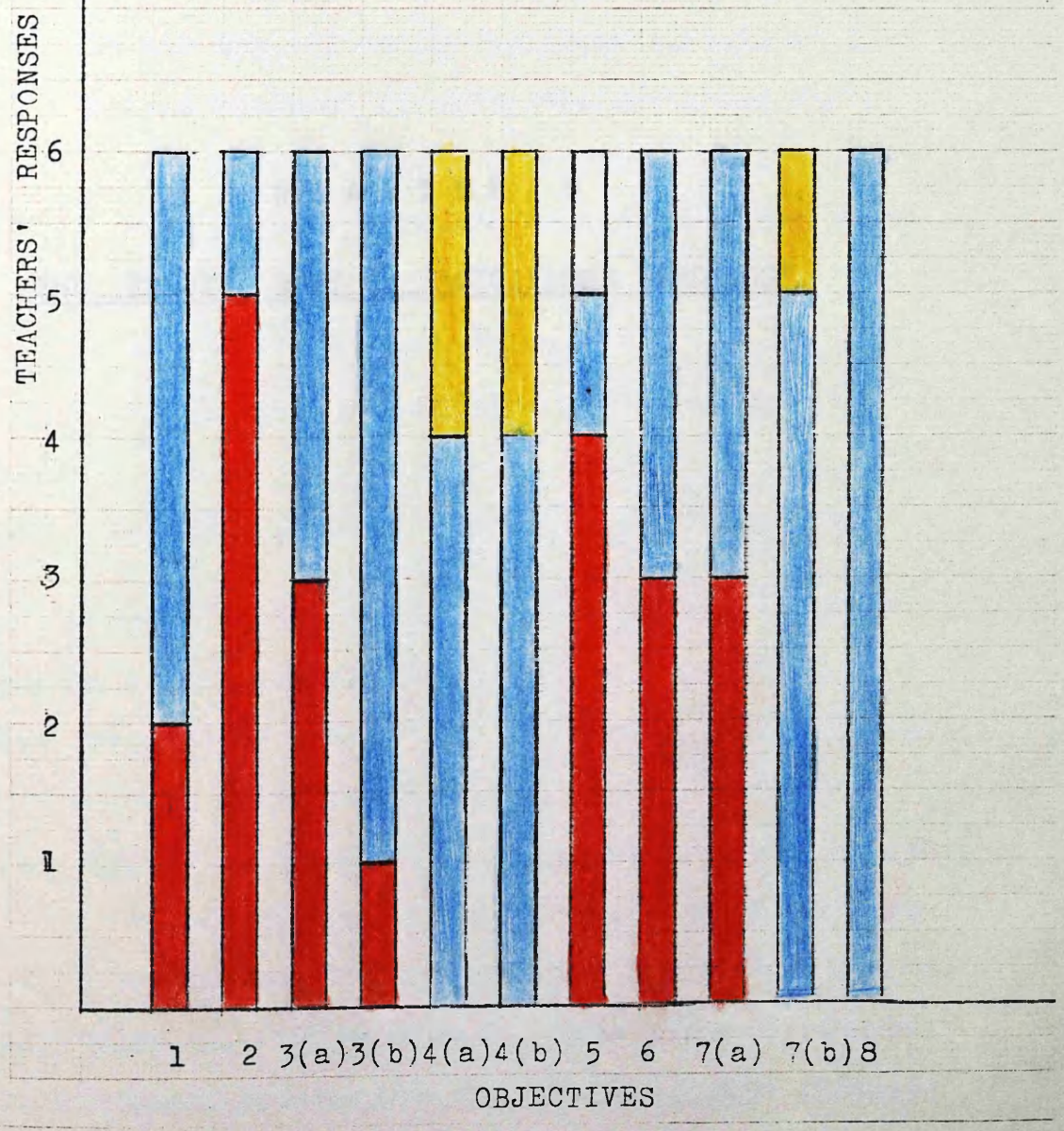
TEACHERS' RESPONSES

Very successful

Fairly successful

Unsuccessful

Blank No answer



C H A P T E R 8

THE FOURTH UNIT : "CIGARETTE SMOKING"

C H A P T E R 8

THE FOURTH UNIT : "CIGARETTE SMOKING"

8.1 THE DESIGN OF THE UNIT

(a) The educational objectives were defined;

(b) The material, including discussion cards, information about the effects of smoking on health, tape slide sequence, proposals for preventing or reducing cigarette smoking, was prepared;

(c) It was applied to the selected schools in 1975-76;

(d) It was assessed by using the following tools:-

(i) Pupil Tests : Cognitive Test and Affective Test were prepared to be given after using the material;

(ii) Teacher Questionnaire.

Let us examine each part in some detail.

8.2 THE EDUCATIONAL OBJECTIVES OF THE UNIT

By using the "STUDY IN CIGARETTE SMOKING", the pupils should be able to:-

(a) Understand some of the factors which may influence them to be cigarette smokers or not;

(b) Understand that cigarette smoking is a contributory factor to diseases like lung cancer, chronic bronchitis and heart disease;

(c) Know that lung cancer, chronic bronchitis and heart disease are the major 'killer' diseases in /

in Scotland;

(d) Recognise that cigarette smoking is more harmful to health than air pollution and most occupational exposure (by occupational exposure, we mean pollution associated with some jobs);

(e) Understand that cigarette smoking is a cause of death;

(f) Know how much smoking costs -

(i) as a source of revenue;

(ii) as a major contributor to Health Service costs;

(g) Take an interest in the problems associated with cigarette smoking;

(h) Appreciate the responsibilities of authorities in dealing with cigarette smoking problems;

(i) Communicate their ideas to others on the effect of cigarette smoking on smokers' health.

8.3 SOURCES OF MATERIAL

To get ideas for the unit the researcher was in contact with the Authorities of the Department of Medical Illustrations in the Western Infirmary (Glasgow), and the Chest Clinic (Glasgow). Also, information was obtained from the Scottish Health Education Unit (Edinburgh), the Scottish Committee ASH (Action on Smoking and Health) at the Royal College of Physicians (Edinburgh), the Department of Education and Science (London) and the Home and Health Department (Welsh Office).

8.4 THE MATERIAL STRUCTURE

It was divided into four parts of which parts 1 and 4 required the teacher's active participation in class discussion. In parts 1 and 2, the pupils were divided into three groups.

Here is a summary of the material structure.

Part 1 Twelve different cards were given to the three groups - four cards for each group. Each card contained two-sided controversial opinions, one was a pro-smoking and the other was anti-smoking. Each group was asked to discuss the statements. The teacher was provided with suggested questions to be discussed with the whole Experimental Group in class discussion.

These cards appear in Appendix 8(a).

Part 2 Each group was provided with specific information regarding the effects of smoking on health.

This part appears in full in Appendix 8(b).

Group A was provided with two different views regarding the association between cigarette smoking and lung cancer. Then, it was asked if it considered the relationship established.

Group B was provided with two different views regarding the association between cigarette smoking and chronic bronchitis. Then it was asked if it considered the relationship established.

Group C was provided with two different views regarding the association between cigarette smoking and heart disease. /

disease. Then it was asked if it considered the relationship established.

Part 3 A tape slide sequence illustrating the relationship between cigarette smoking and lung cancer was shown to the whole Experimental Group. The programme was entitled "CIGARETTE SMOKING AND LUNG CANCER". Details of the script and pictures appear in Appendix 8(c).

Part 4 The pupils were given information about:-

(i) the several approaches which have been adopted to reduce smoking and its harmful health effects;

(ii) some of the practical proposals which have been put forward to prevent or reduce cigarette smoking and consequently the health hazards associated with them;

(iii) the campaign, called, "If you must smoke", in the U.S.A. which aimed to control the health hazards associated with smoking.

Details of this part appear in Appendix 8(d).

8.5 HOW THE MATERIAL WAS APPLIED

(a) Teachers were provided with the plan of application, the exercise organisation, the suggested time-tabling of the one hour period and guides to parts 1 and 4 which required their active participation.

The /

The details appear in Appendix 8(e).

(b) A factual article entitled, "SMOKING AND HEALTH" was prepared for the Control Group. Its aim was to minimize the cognitive variables among different selected schools. Here is a summary of the article contents:-

- Why do some pupils smoke?
- Why do some pupils prefer not to smoke, or give up smoking?
- To what extent can cigarette smoking affect a smoker's health?
- Is cigarette smoking a cause of death?
- What is the cost of smoking?
- How can we reduce the death and disability that result from smoking?
- Is it easy to give up smoking?

This article appears in Appendix 8(f).

8.6 THE ASSESSMENT OF THE UNIT

(a) <u>Pupil Tests</u>

(i) Cognitive Test - It was a multiple choice test consisting of fifteen (15) items.

(ii) Affective Test - Two different techniques were included in this test, Osgood's Method of Semantic Differential and Likert's Method of Summated Ratings.

Both tests appear in Appendix 8(g).

(b) /

(b) Teacher Questionnaire

It included a list of educational objectives which it was hoped would be achieved. The teacher was asked to indicate how successful the material was in helping pupils to achieve these objectives.

The questionnaire appears in Appendix 8(h).

8.7 RESULTS

I An Evaluation of the Individual Pupils' Performance

• Cognitive Test

Details of the test results of both Experimental Group and Control Group appear in Appendix 8(i). Also, a graph appears in Appendix 8(j) illustrating the results. Here is a summary of the results.

(a) There was a significant difference in favour of the Experimental Group in items 2, 3, 10, 11, 12, 13 and 15 (seven items).

(b) Some differences, but not significant, were found in items number 1, 5 and 8 (three items).

(c) Three items (7, 9 and 14) were significantly different in favour of the Control Group.

(d) Two items (4 and 6) showed slight differences in favour of the Control Group.

(e) All the discrimination factors were positive (+) in both the Experimental Group and the Control Group.

Discussion /

Discussion

From the differences which were found in favour of the Experimental Group, we can conclude that the "STUDY ON CIGARETTE SMOKING" was successful in enabling the pupils to:-

(a) understand that cigarette smoking is a contributory factor to diseases like lung cancer, chronic bronchitis and heart disease - items 1, 3, 5 and 11;

(b) know that lung cancer, chronic bronchitis and heart disease are the major 'killer' diseases in Scotland - items 2 and 8;

(c) recognise that cigarette smoking is more harmful to health than air pollution and most occupational exposure - item 11;

(d) understand that cigarette smoking is a cause of death - items 2, 8, 10, 12 and 13.

• Affective Test

The results of this test appear in Appendix 8(k) Also, graphs were drawn illustrating the results - Appendix 8(1-1), 8(1-2) and 8(1-3). Here is a summary of the results and discussions:-

1. Part 1

In this part, they were asked to give their general impression about the material they had studied. The following were found:-

(a) A significant difference regarding items 2, 3 and 5 was found in favour of the Experimental Group. This /

This group found the material more exciting, enjoyable to study and helpful than the Control Group.

(b) A difference, but not significant, was found in favour of the Experimental Group - items 1 and 4.

(c) By using a χ^2 test for this part as a whole, a significant difference at 1% was found in favour of the Experimental Group.

Discussion

We can conclude that the material, i.e. the "STUDY ON CIGARETTE SMOKING" was successful in encouraging the Experimental Group to develop an interest and enjoyment in the study of "The Effects of Cigarette Smoking on Health" compared with the pupils in the Control Group who read a factual article.

2. Part 2

In this part, they were asked to give their opinion on "THE SCHOOL PUPIL WHO SMOKES".

(a) A significant difference was found in favour of the Experimental Group regarding items 1, 2, 4, 6, 7, 8, 9, 10, 13 and 14 (ten items).

(b) A difference, but not significant, was found in favour of the Experimental Group - item 3.

(c) A difference, but not significant, was found in favour of the Control Group - item 5.

(d) By using a χ^2 test for this part as a whole, significance at 1% was obtained.

Discussion

From these results, we can conclude that the attitude /

attitude of the Experimental Group differed from that of the Control Group in respect of "THE SCHOOL PUPIL WHO SMOKES". The Experimental Group saw the pupil smoker as unsociable, poor at school work, not attractive to girls, immature, impatient, unsuccessful, excitable, rebellious, unhappy and unpopular among friends.

3. Part 3

In this part, they were given some statements and asked to indicate their opinion. The following were found:-

(a) A significant difference was found in favour of the Experimental Group regarding items 1, 4, 5 and 6 (four items).

(b) Differences, but not significant, were found in favour of the Experimental Group - items 2, 3 and 7.

(c) By using a χ^2 test for this part as a whole, significance at 1% was obtained.

From these results, we can conclude the following:- The material, i.e., the "Study on Cigarette Smoking", was successful in enabling the pupils to -

(a) Understand that cigarette smoking is a contributory factor to diseases like lung cancer, chronic bronchitis and heart disease.

(b) Recognise that cigarette smoking is more harmful to health than air pollution and most occupational exposure.

(c) /

(c) Take an interest in the problems associated with cigarette smoking.

(d) Appreciate the responsibilities of authorities in dealing with cigarette smoking problems.

II. An Evaluation of the Principal Teachers' Responses and Comments

• Teachers' Responses

Details of these responses appear in Appendix 8(m). Also, there is a graph shown in Appendix 8(n) illustrating these responses.

Summary:-

(a) All of them agreed that the material was successful in achieving objectives 1, 2, 3, 4, 5, 7 and 9.

(b) They differed about the objectives 6(a), 6(b) and 8. These objectives are as follows:-

Objective 6 : To know how much smoking costs -
(i) as a source of revenue;
(ii) as a major contributor to Health Service costs.

Objective 8 : to appreciate the responsibilities of authorities in dealing with cigarette smoking problems.

• Teachers' Comments

(a) All of them agreed that:-

(i) The material provided a useful addition to the work normally carried out in the classroom.

(ii) /

(ii) The material encouraged the pupils to communicate their ideas to others, co-operate, make their own decisions and to be involved in the study of the "Effects of Cigarette Smoking on Health".

(iii) The project as a whole was interesting, enjoyable and instructive.

(iv) Part 1 was very successful in leading to group discussion.

(b) Some of them claimed that -

(i) The time suggested - one hour - was short for the pupils to consider the questions fully. Given a little extra time, the pupils should have been able to cope with the data provided.

(ii) Some of the material (e.g. some graphs) provided was too complex for easy understanding.

Conclusion

From the results obtained, we can conclude that teaching science through material of this kind, which was designed to develop group discussions, is likely to be more effective than the traditional method in both cognitive and affective aspects. These group discussions can encourage the pupils to make their own decisions, communicate their ideas to each other, co-operate, compete and interact. Consequently, these methods of presentation have a reasonable chance of leading to attitude changes.

APPENDIX TO CHAPTER 8

A P P E N D I X 8(a)

THE TWO-SIDED INFORMATION

Part 1 : Group 'A' Do you agree .... ? "Girls are attracted to boys who smoke" Turn over for another opinion	Part 1 : Group 'A' Do you agree .... ? "Smoking, in itself, has no sex appeal" Turn over for another opinion ....
Part 1 : Group 'A' Do you agree .... ? "Smoking gives a person a sense of freedom and responsibility" Turn over for another opinion	Part 1 : Group 'A' Do you agree .... ? "Smoking is more common among people who do less well at school" Turn over for another opinion ....
Part 1 : Group 'A' Do you agree .... ? "Smoking helps pupils to be relaxed and confident at dances and discos" Turn over for another opinion	Part 1 : Group 'A' Do you agree .... ? "Smoking is a sign of immaturity" Turn over for another opinion ....
Part 1 : Group 'A' Do you agree .... ? "Smokers tend to be successful, for example, in exams, or at work" Turn over for another opinion	Part 1 : Group 'A' Do you agree .... ? "Smoking reduces the expectation of life leading, perhaps, to premature death" Turn over for another opinion ....

Part 1 : Group 'B' Do you agree .... ? "Smokers are admired by their friends" Turn over for another opinion	Part 1 : Group 'B' Do you agree .... ? "Smoking is a sign of failure" Turn over for another opinion ....
Part 1 : Group 'B' Do you agree .... ? "Smokers are more relaxed in coping with the problems of life" Turn over for another opinion	Part 1 : Group 'B' Do you agree .... ? "Smoking can cause harmful diseases, such as lung cancer, chronic bronchitis and heart disease" Turn over for another opinion ....
Part 1 : Group 'B' Do you agree .... ? "Smokers are more able to be patient and considerate" Turn over for another opinion	Part 1 : Group 'B' Do you agree .... ? "Smoking is just a sign of pupil rebellion" Turn over for another opinion ....
Part 1 : Group 'B' Do you agree .... ? "Smokers enjoy life better than non-smokers" Turn over for another opinion	Part 1 : Group 'B' Do you agree .... ? "Top sportsmen do not smoke because smoking hinders their performance" Turn over for another opinion ....

Part 1 : Group 'C' Do you agree .... ? "The desire to smoke is a sign that a pupil has grown up" Turn over for another opinion	Part 1 : Group 'C' Do you agree .... ? "Pupils start to smoke merely to show off" Turn over for another opinion ....
Part 1 : Group 'C' Do you agree .... ? "Smokers tend to be sociable and popular" Turn over for another opinion	Part 1 : Group 'C' Do you agree .... ? "Most parents, including smokers, hope their children will not take up smoking" Turn over for another opinion ....
Part 1 : Group 'C' Do you agree .... ? "Smokers worry less than non-smokers" Turn over for another opinion	Part 1 : Group 'C' Do you agree .... ? "Smoking leads to death" Turn over for another opinion ....
Part 1 : Group 'C' Do you agree .... ? "Smokers tend to be more mature than non-smokers" Turn over for another opinion	Part 1 : Group 'C' Do you agree .... ? "The act of starting to smoke is the beginning of drug dependence" Turn over for another opinion ....

A P P E N D I X 8(b)

A STUDY ON SMOKING Part 2 (Group 'A')

EFFECTS OF SMOKING ON HEALTH

THE ASSOCIATION BETWEEN CIGARETTE SMOKING AND LUNG CANCER

It is now fairly clearly established that some relationship exists between smoking and lung cancer.

Read the following report carefully (10 minutes or so), and then as a group, try to agree on the exact nature of the relationship.

At the end of the report, three questions are linked; discuss the answers of these questions. One member of your group will be asked to give the group's answer to the whole class.

REPORT

It has been found that cigarette smoking has been shown to play a part in the development of many diseases, the most important of which are lung cancer, chronic bronchitis and heart disease.

A. LUNG CANCER

1. It has been found that cigarette smoking is a major contributory factor to lung cancer.

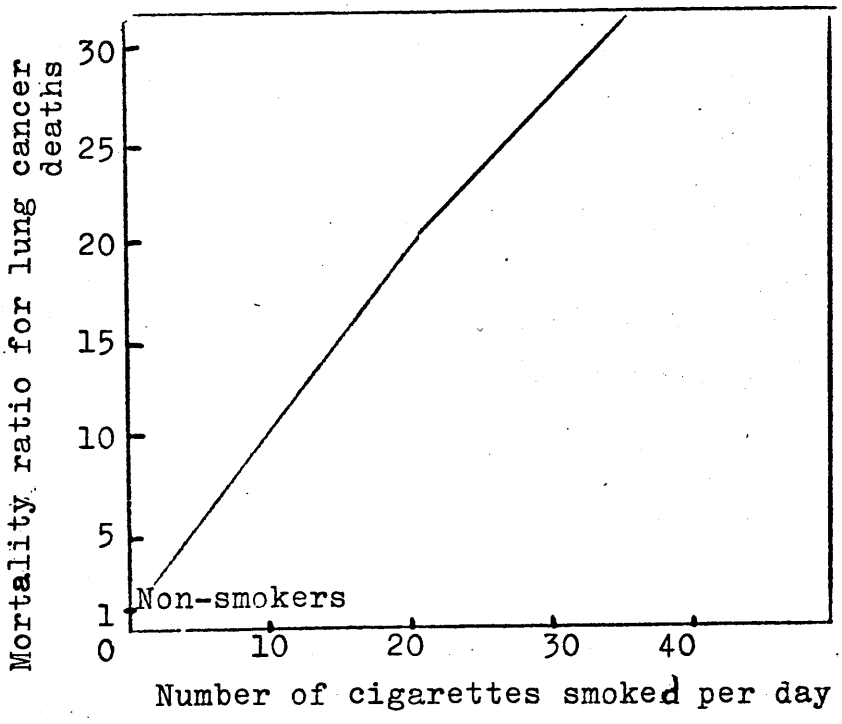
Lung cancer is a dangerous disease which seriously damages people's health and leads to death. In Scotland in 1972, there were around 3,500 deaths from lung cancer. Around 1,550 were under the age of 65. This is the highest rate in the world! In 1971, a total of around 2,800 Scottish males and around 650 females died from this disease compared to around 2,000 males and around 350 females in 1961. This disease alone accounts for one in eight male deaths between age 35 and 64. It has /

has been found that in the last ten years, lung cancer deaths in Scotland have gone up by over 35%.

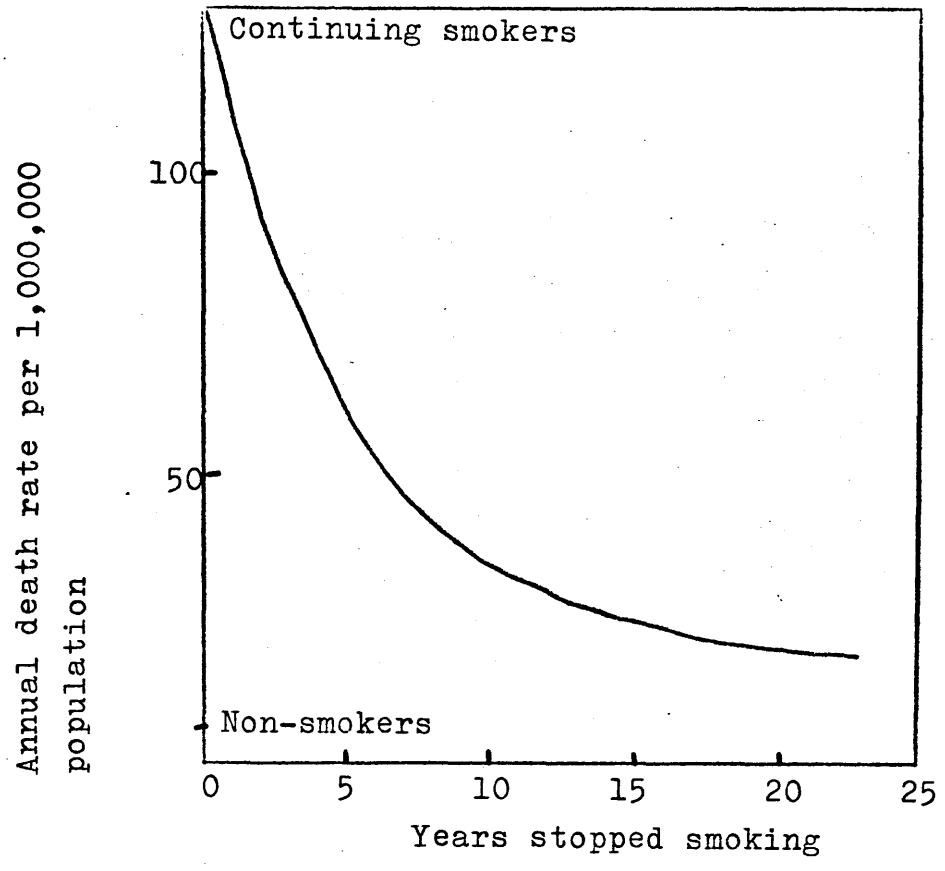
A number of surveys have established a direct link between smoking and lung cancer as follows:-

(a) Studies have shown that the risk of lung cancer increases directly in relation to the number of cigarettes smoked.

The following graph shows mortality ratio (the number of smokers who die from lung cancer for every non-smoker who dies) of deaths among British doctors from lung cancer.



(b) Studies have also shown a reduced risk of lung cancer in cigarette smokers who have stopped smoking. The following graph shows this fact.



(c) Lung cancer death rates are higher in urban than in rural areas. This urban/rural difference is greater in cigarette smokers than in non-smokers.

The following table shows comparison of lung cancer death rates per 100,000 men per annum in rural, mixed and urban areas in Britain in recent years.

	Ages 45-54			Ages 55-64			Ages 65-74		
	Rural	Mixed	Urban	Rural	Mixed	Urban	Rural	Mixed	Urban
Non-Smokers	0	0	31	0	0	147	70	0	336
Smokers	276	354	559	935	930	1450	1167	1132	1185

Although exposure to air pollution, especially by coal smoke, appears to increase the risk of lung cancer, its effect is small compared with that of cigarette smoking.

Experimental Evidence

Dogs who had smoked seven cigarettes per day for 29 months have been found to develop typical cancers in the lung.

2. <u>But, there are arguments suggesting that smoking is not the only, or even the major factor causing lung cancer.</u> The following are the reasons:-

(a) Surveys have shown that non-smokers are also as subject to lung cancer as smokers, that experts differ among themselves about smoking and lung cancer, and that doctors smoke as much as other people.

(b) Lung cancer can be developed by working in some specific industries, even among those who do not smoke. For example, those exposed to chromates, nickel, radio-active materials and the products of coal distillation in the gas industry, have a considerably increased risk of lung cancer.

(c) It has been suggested that lung cancer death rates are higher in urban than in rural areas because of the difference of the rate of exposure to air pollution. This exposure to air pollution, especially by coal smoke, appears to increase the risk of lung cancer.

(d) It has been shown that the risk is increased by inhalation of the smoke, by earlier onset of smoking, by taking more puffs from each cigarette, by keeping the cigarette in the mouth between puffs, and by relighting half-smoked cigarettes. Although the dose relationship has been shown in women as well as in men, the rate in women is lower at the same cigarette consumption than in men. One recent study suggested that smokers of filter-tipped cigarettes may have a reduced risk of developing lung cancer as compared with smokers of unfiltered cigarettes.

<u>Some Questions to be considered</u>

1. List three items of evidence supporting the relationship between smoking and lung cancer.

2. /

2. List three items of evidence which do not support the relationship.
3. On balance, do you consider the relationship established?

A STUDY ON SMOKING Part 2 (Group 'B')

EFFECTS OF SMOKING ON HEALTH

THE ASSOCIATION BETWEEN CIGARETTE SMOKING AND CHRONIC BRONCHITIS

It is now fairly clearly established that some relationship exists between smoking and chronic bronchitis.

Read the following report carefully (ten minutes or so), and then as a group, try to agree on the exact nature of the relationship.

At the end of the report, three questions are linked: discuss the answers of these questions. One member of your group will be asked to give the group's answer to the whole class.

REPORT

It has been found that cigarette smoking has been shown to play a part in the development of many diseases, the most important of which are lung cancer, chronic bronchitis and heart disease.

B. Chronic Bronchitis

1. It has been found that cigarette smoking is a major contributory factor to chronic bronchitis.

In the United Kingdom, chronic bronchitis seriously damages people's health and may lead to death.

In Scotland, statistics give more than 2,500 deaths per annum from this disease. As it is about 2½ times /

times commoner in heavy smokers than in non-smokers, it can be calculated that cigarette smoking is a major factor causing at least around 1,800 of these deaths. In 1972, there were around 2,700 deaths in Scotland from bronchitis. Around 700 were under the age of 65.

A number of studies have established a direct link between smoking and chronic bronchitis, as follows:-

(a) The large studies have shown a steady increase in death from bronchitis with increasing cigarette consumption. Many surveys of samples of the general public in ten or more countries have shown the prevalence of coughing in both men and women is closely related to the number of cigarettes smoked. In smokers of 20 or more cigarettes a day the death rate is some 15 times greater than in non-smokers. In other words, it has been found that chronic bronchitis is about 2½ times more common among heavy smokers as non-smokers. Although exposure to air pollution, especially exposure to smoke from the combustion of coal, dust in mining and the products of coal distillation in the gas industry, appears to increase the risk of chronic bronchitis, its effect is small compared with that of cigarette smoking. In the United Kingdom serious chronic bronchitis is uncommon in non-smokers even in heavily polluted areas or among industrial groups exposed to dust inhalation.

(b) Every aspect of lung function has been shown to be, on average, less efficient in cigarette smokers than in non-smokers of the same age.

(c) It has been found that the serious symptoms caused by the less efficient function of lung usually abate rapidly in those who stop smoking. When younger smokers stop smoking, their lung function usually returns to normal.
Among doctors aged 35-64 in England and Wales, many of whom have stopped smoking cigarettes, there /

there was a 24% reduction in bronchitis mortality between 1953-57 and 1961-65, as compared with a reduction of only 4% in all men of the same age in England and Wales, among whom there was no reduction of cigarette smoking.

Experimental Evidence

Animals exposed to tobacco smoke have been found to develop changes similar to those found in patients with severe bronchitis. Dogs regularly exposed to cigarette smoke developed progressive damage to the lungs by bronchitis.

2. But, there are arguments suggesting that smoking is not the only, or even the major factor causing chronic bronchitis.

They see that the full responsibility lies on AIR POLLUTION and not on smoking for the following reasons:-

(a) It has been suggested that AIR POLLUTION is considered as a major factor causing bronchitis because this disease is much more common in towns which suffer from atmospheric pollution. It has been found that chronic bronchitis death rates are around two times higher in urban than in rural areas because of the difference of the rate of exposure to air pollution. Patients suffering from chest diseases should be advised in a time of high air pollution to rest indoors and keep warm.

(b) Men who work in certain occupations, particularly those exposed to smoke from the combustion of coal, dust in mining and the products of coal distillation in the gas industry, have a considerably increased risk of chronic bronchitis.

Some Questions to be considered

1. /

1. List three items of evidence supporting the relationship between smoking and chronic bronchitis.
2. List two items of evidence which do not support the relationship.
3. On balance, do you consider the relationship established?

A STUDY ON SMOKING Part 2 (Group 'C')

EFFECTS OF SMOKING ON HEALTH

THE ASSOCIATION BETWEEN CIGARETTE SMOKING AND HEART DISEASE

It is now fairly clearly established that some relationship exists between smoking and heart disease.

Read the following report carefully (ten minutes or so), and then as a group, try to agree on the extent of the relationship.

At the end of the report, three questions are linked; discuss the answers of these questions. One member of your group will be asked to give the group's answer to the whole class.

REPORT

It has been found that cigarette smoking has been shown to play a part in the development of many diseases, the most important of which are lung cancer, chronic bronchitis and heart disease.

C. HEART DISEASE

1. It has been found that cigarette smoking is a major contributory factor to heart disease.

Heart disease is one of the leading causes of death in developed countries. It is described as the "modern epidemic". It is occurring more frequently, and at younger ages.

In Scotland /

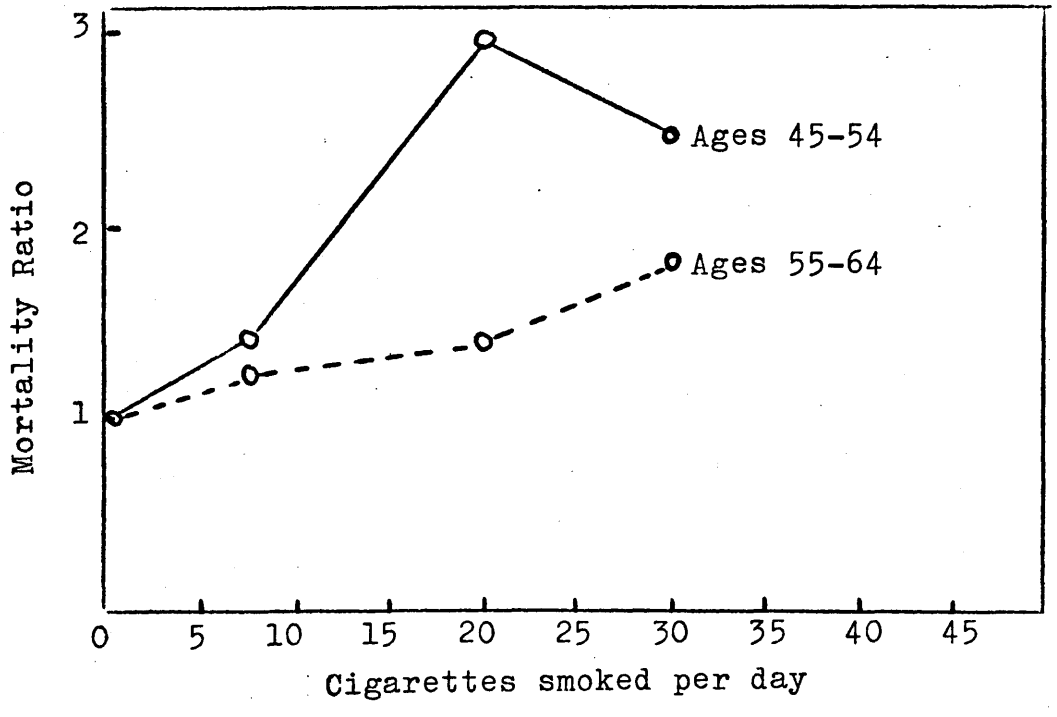
In Scotland, the heart disease death rate for most smokers is about 50% higher than non-smokers. In 1972, there were around 19,000 deaths from heart disease. Around 5,000 were under the age of 65. This is one of the highest rates in the world!

A number of studies have established a direct link between cigarette smoking and heart disease as follows:-

(a) The studies agree in showing that death from heart disease is greater in cigarette smokers than in non-smokers. It has been calculated that cigarette smoking is responsible for 25% of deaths from heart disease in those under 65.

(b) The studies have also shown that the risk of heart disease is directly related to the number of cigarettes smoked, and is significant even at ten cigarettes per day. These studies have also shown that the increased risk is greater in younger smokers than in older smokers.

The following graph shows the association between mortality ratio (the number of smokers who die from lung cancer for every non-smoker who dies) and the number of cigarettes smoked per day among British doctors.



(c) In doctors aged 35-64 in England and Wales who have greatly reduced their cigarette smoking, the reduction of mortality from heart disease was 6% between 1953-57 and 1961-65 as compared with a 10% increase in all males of the same age in the country over this period.

2. <u>But, there are arguments suggesting that smoking is not the only, or even the major factor causing heart disease</u>.

The following are the reasons:-

(a) Heart disease is also frequent among non-smokers, and the proportionate increase of risk in cigarette smokers is relatively small. It has been suggested that it is less directly associated with the number of cigarettes smoked. The increased risk is greater in younger smokers than in older smokers.

(b) It has been found that death from heart disease has been increasing steadily in developed countries in the past three or four decades. Some of the increase may be due to improvements in diagnosis.

(c) The risk of heart disease may be associated with other diseases, such as high blood pressure, obesity, diabetes, raised blood cholesterol levels, physical inactivity, impaired lung function, and personality type. It has been found that the risk of heart disease is increased in people in relation to these mentioned diseases.

<u>Some Questions to be considered</u>

1. List three items of evidence supporting the relationship between smoking and heart disease.
2. List three items of evidence which do not support the relationship.
3. On balance, do you consider the relationship established?

A P P E N D I X 8(c)

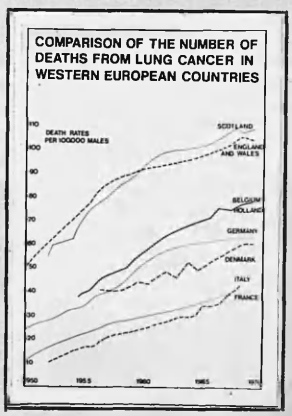
A STUDY ON CIGARETTE SMOKING

PROGRAMME : CIGARETTE SMOKING AND LUNG CANCER

We can now say that cigarette smoking is a major contributor to harmful diseases like lung cancer, chronic bronchitis and heart disease. Let us now turn our attention to Lung cancer - one of the most harmful diseases, and also talk about how much cigarette smoking costs smokers.

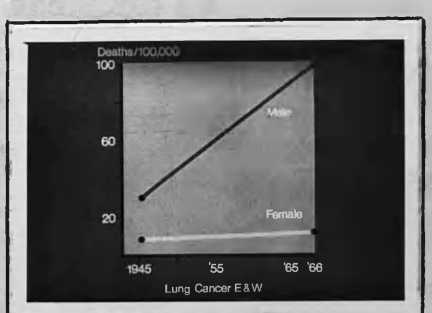
Lung cancer, which is medically called bronchial carcinoma, is very common in the world especially in Western European countries.

Slide 1 This graph shows a comparison of the number of deaths from lung cancer in Western European countries. Scotland has the highest rate. It has been found that Scotland has the highest rate in the world!



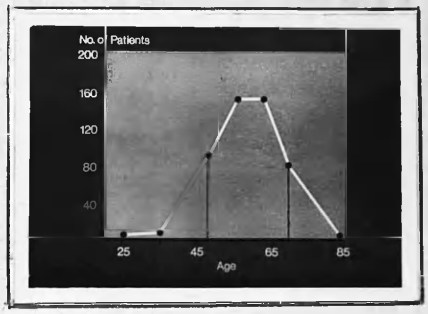
Slide 2 This map shows the incidence of lung cancer in Great Britain. Notice that the disease is more widespread in Scotland than the rest of the country. In 1972, in Scotland, there were around 3,500 deaths from lung cancer. Around 1,550 were under the age of 65. This was the highest rate in the world. But, men and women are not equally affected.

Slide 3 This graph shows the incidence of death from lung cancer in men and women over the years 1945 to 1966. Although the incidence of the disease in both men /

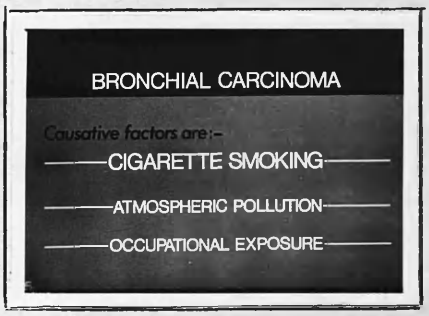


men and women is increasing, men suffer more. But not all ages are equally affected.

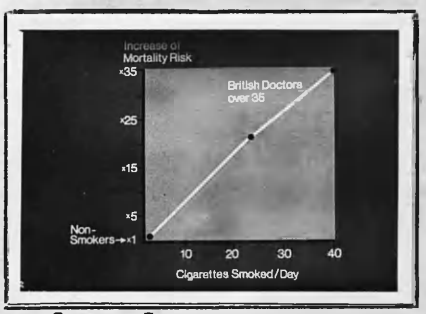
Slide 4 Lung cancer affects a wide age group. But the age group most seriously at risk from lung cancer is around 50 years old.



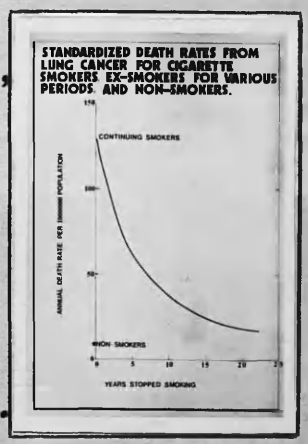
Slide 5 Three factors appear to be important:- cigarette smoking, atmospheric pollution and occupational exposure (by occupational exposure, we mean pollution associated with some jobs).



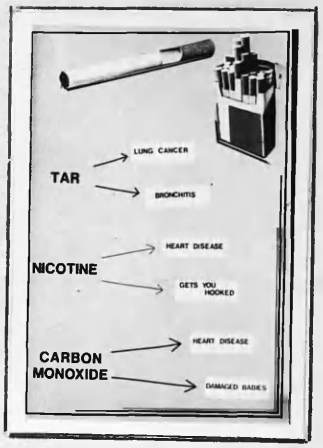
Slide 6 The most important factor by far in developing lung cancer is cigarette smoking. There is an obvious relationship between the death risk from lung cancer and the number of cigarettes smoked per day. About 90% of deaths from lung cancer may be attributed to cigarette smoking. The risk of lung cancer falls rapidly, on giving up smoking.



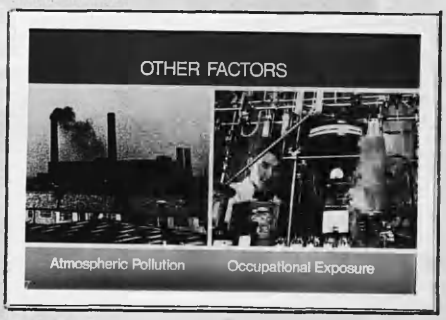
Slide 7 Here we see the annual death rates for lung cancer for cigarette smokers, ex-smokers from various periods, and non-smokers. You notice the clear association between the number of years of stopping cigarette smoking and the death rate. Experiments have been carried out on animals to find out what it is in cigarette smoke that causes damage.



Slide 8 /

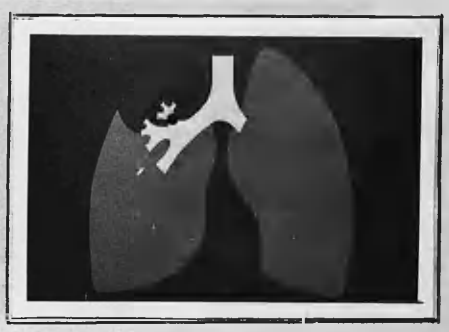


Slide 8 This diagram shows the results of these experiments. The first component is tar which contains extremely harmful chemicals. This leads to lung cancer and bronchitis. The second component is nicotine. This leads to heart disease and gets you hooked. The third component is carbon monoxide. This leads to heart disease and damaged babies. The life expectancy of a moderate smoker is five years less than the non-smoker. It would seem, therefore, that to reduce the incidence of lung cancer, smoking must be actively discouraged.

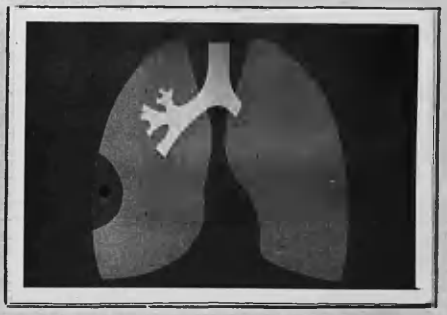


Slide 9 Lung cancer is twice as common in urban areas. This suggests that atmospheric pollution is also important. Also, some people are exposed to dangerous chemicals at work. They may tend to increase lung cancer possibilities.

Now let us talk about the features of lung cancer.



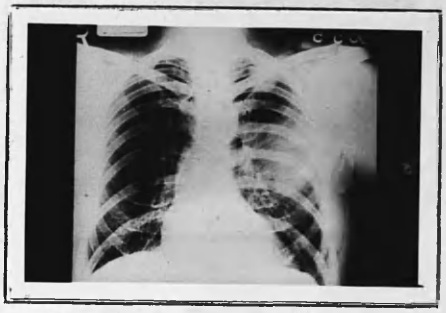
Slide 10 On this diagram, you see a tumour which has become large enough to obstruct the lung cavity. As a result, the patient may complain either of breathlessness, or of some respiratory infection.



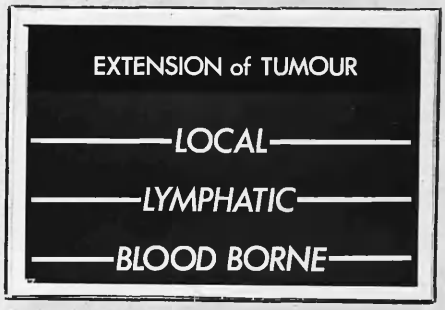
Slide 11 Sometimes, tumours on the edge may grow to a large size without causing symptoms. When they grow outwards, however, they invade the tissue surrounding the lung and the chest wall, giving rise to chest pain.

Slide 12 /

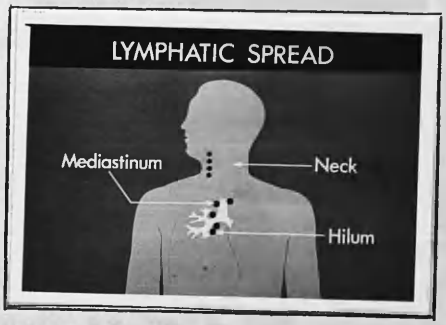
Slide 12 This X-ray shows a left-sided lung cancer which is invading the chest wall. Compare the front ends of the ribs on both sides. Notice that the front part of the fourth left rib is completely invisible. It has been eroded by the tumour. Now let us consider the features resulting from extension of the tumour.



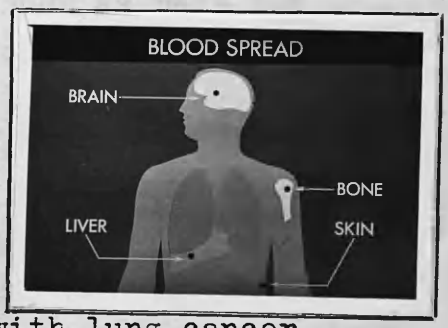
Slide 13 These features may be the result of local spread of the tumour, or spread through the lymph glands or spread via the blood stream. We have already discussed local spread - now let us talk about lymphatic spread.



Slide 14 This diagram shows the common sites of lymphatic spread of the tumour. Now let us turn our attention to the blood spread of the tumour.



Slide 15 This diagram shows the common sites which are affected by the blood spread of the tumour. These common sites are the brain, liver, bone and skin.



Let us look at some patients with lung cancer.

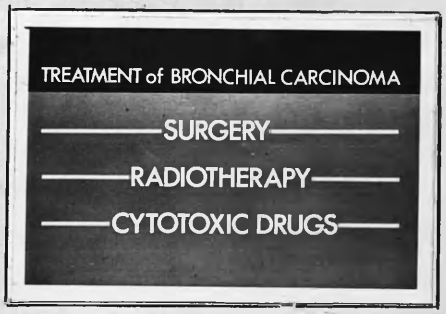
Slide 16 Notice the constriction of her eyelid. She also has impaired sweating on the left-hand side of her face. These symptoms are as a result of a tumour at the top of the lung interfering with nerves in the neck.

Slide 17 /

Slide 17 Here is another patient. Notice the paleness and swelling on his face. These symptoms are as a result of the obstruction in the small intestine.

Slide 18 This is a third patient with advanced lung cancer. He died 24 hours after the photograph was taken.

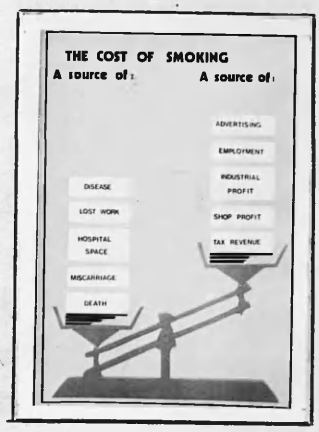
Are there no ways of treating lung cancer patients?



Slide 19 Three possible lines of treatment are available - surgery, radio therapy and drugs. Surgery offers the best hope of cure, but only 20% of cases are found suitable for surgery. Of these, about 25% survive more than five years. Radio therapy is more commonly used to relieve symptoms, such as pain due to chest wall invasion and congestion of the head and neck due to intestinal obstruction. The results of drug therapy are also disappointing. Although various drugs or combinations of drugs have been tried, there is no evidence of an improved two year survival. We can say that the results of treatment are gloomy. However, the next slide shows us how lung cancer could be prevented.

Slide 20 It could be prevented by giving up cigarette smoking and also by continued reduction of atmospheric pollution and industrial hazards. But, cigarette smoking is the most important /

important factor contributing to lung cancer. However, stopping smoking could have many other dramatic effects.



Slide 21 Here we see the balance of the cost of smoking. For example, smoking is a source of advertising revenue. The tobacco industry is a major source of employment, giving considerable profit to the industrial sector. Also, selling cigarettes is a source of profit for small shops, and on a large scale, the government gains vast amounts of tax from the sale of tobacco products. But this must be set against the great cost of ill-health and death, directly caused by smoking. This includes heart disease and bronchitis as well as lung cancer; and 1 in every 10 still births or births of deformed children is caused by smoking during pregnancy. Our hospital over-crowding would be cured if smoking ceased. And in the end, many people - young and old - would be spared painful illness, and perhaps an unpleasant death.

Slide 22 Your best chance of avoiding lung cancer is not to start smoking; or, if you have already started, to give it up immediately.

A P P E N D I X 8(d)

A STUDY IN CIGARETTE SMOKING
PART 4

Prevention

Several approaches have been adopted to reduce smoking and its harmful health effects:

1. Encouraging young people not to start smoking.
2. Encouraging smokers to give up the habit.
3. Encouraging the development of less hazardous cigarettes.
4. Encouraging better methods of smoking.

Some practical proposals have been put forward:-

1. Forbidding cigarette sales to children.
2. Removing cigarette-vending machines from public places.
3. Stating the nicotine and tar content on packets.
4. Encouraging smoking low-tar cigarettes as safe.
5. Reducing social acceptability of smoking, e.g. banning smoking in cinemas, buses, trains, etc.

It is significant that most European countries, as well as countries in both North and South America, have passed legislation strictly controlling or forbidding all T.V. and radio advertising.

Also, in the U.S.A., an "If you must smoke" campaign is aimed at:-

1. Reducing the number of cigarettes smoked.
2. Reducing the depth of inhalation.
3. Reducing the frequency of inhalation per cigarette.
4. Increasing the butt left.
5. Discouraging smoking high tar cigarettes.

But, in the end, two questions remain:-

1. Can you resist the temptation to start smoking?
2. Can you, if you smoke already, give it up?
   (66% of ex-smokers found giving up was easy.)

A P P E N D I X 8(e)

A STUDY IN CIGARETTE SMOKING
TEACHERS' INSTRUCTIONS

1. Plan of application.

The following plan of application has been designed. You should have two groups of pupils (called Group 1 and Group 2) matched as far as possible according to their ability in Biology, each group containing the same boy-girl ratio.

Group 1 (Experimental Group)	Group 2 (Control Group)
a. Provide the case study	a. Provide the article - "SMOKING AND HEALTH"
b. Give the tests (15 mins.)	b. Give the same tests.

Please ask the pupils to indicate clearly when they fill in the required information on the test which group they belong to and also ask them to give only ONE answer to each question.

2. The exercise is planned to last about ONE HOUR with 4th year S.C.E. biology and/or chemistry pupils.

3. It is divided into four parts of which parts 1 and 4 require your active participation in class discussion.

4. In parts 1 and 2, please divide them into three groups; it is suggested that six to eight pupils could be in each group, and allowed to sit around a table, bench or desk to facilitate discussion.

5. To organise the exercise, the following is given:-

(a) For part 1

Issue Group A with the cards marked Part 1 :
Group 'A' (4 cards);
Issue /

Issue Group B with the cards marked Part 1 :
Group 'B' (4 cards);
Issue Group C with the cards marked Part 1 :
Group 'C' (4 cards).

Allow 10 minutes for discussion in Groups.
Allow 10 minutes for a brief class discussion (some questions are attached).

(b) Then issue part 2

To Group A, issue part 2 : Group 'A';
To Group B, issue part 2 : Group 'B';
To Group C, issue part 2 : Group 'C'.

Allow 10 minutes for discussion.
Then ask each Group to present a 2-minute summary of their conclusion.

(c) Now show the tape-slide sequence.

(d) Issue part 4 to each pupil separately.
Allow time (10 mins.).
Discuss the questions with them (5 mins.). (You may use the suggested questions.)

6. The suggested time-tabling of the one hour period is:-

0	Part 1	(20 mins.)
20 mins.	Part 2	(15 mins.)
35 mins.	Part 3	(10 mins.)
45 mins.	Part 4	(15 mins.)
1 hour	END	

NOTE: It is preferable to run through the study before using it with your pupils.

TEACHERS' GUIDE
Part 1

The suggested questions to be discussed with the whole Experimental Group:-

1. /

1. Some pupils believe that cigarette smoking contributes to enjoyment, others don't; some pupils are conscious of health hazards connected to smoking, others are doubtful; what do you think of smoking?
2. Some boys believe that girls prefer boys to smoke. What do you think?
3. Does cigarette smoking help a person to be successful, for example, in exams, or at work?
4. Why do most parents, including smokers, hope their children will not take up smoking?

Part 4

The suggested questions to be discussed with the whole Experimental Group:

1. In what ways would you encourage your friends NOT to start smoking?
2. How can smoking be made less socially acceptable?
3. What are the different approaches in U.S.A. which are trying to encourage the development of less hazardous cigarettes, and methods of smoking?
   Would you agree that these approaches can be used here in Britain? Give reasons.
4. Is it easy to give up smoking? Why?

THANK YOU FOR YOUR CO-OPERATION

A P P E N D I X 8(f)

Glasgow University - Research in Science Education

SMOKING AND HEALTH - CONTROL GROUP

Why do some pupils smoke?

Some pupils smoke because they believe that smoking contributes to increasing their enjoyment of life, or as an aid in coping with the problems which they face. Others believe that smoking helps them in social situations in which they are nervous and shy. For example, smoker boys believe that they are able to achieve status in the eyes of girls. Some boys believe that girls prefer boys who smoke.

Some smoker pupils believe that there is a relation between smoking and maturity. Some of them see that non-smokers are very immature.

Some smoker pupils consider that smoking gives them an "adult-like" freedom. For many pupils the act of starting to smoke is the beginning of a drug dependence.

Why do some pupils prefer not to smoke or give up smoking?

Some pupils prefer not to smoke for many reasons; they might be aware of the following facts about smoking.

1. It has been found that smoking which brings pleasure to many also greatly increases the prospect of death from an extremely unpleasant disease. It has been found that cigarette smoking impairs health, reduces the expectation of life and may lead to premature death. It has been found that cigarette smoking is a main contributor to several illnesses, such as lung cancer, chronic bronchitis and coronary heart disease.
2. It appears that there is an association between cigarette / .

cigarette smoking and lack of educational success. In other words, smoking is commoner among pupils who do less well at school and set themselves lower goals.

3. There is some indication that smoking for some pupils is a symbol of independence and rebellion against the standards set either by the family or by their friends.
4. Smoking in itself cannot make a boy mature, even if many pretend that it does. A boy who smokes may be seen by other boys as a failure.
5. Most parents, including smokers, hope their children will not take up smoking.

<u>To what extent can cigarette smoking affect a smoker's health</u>?

It has been found that cigarette smoking plays a part in the development of many diseases, the most important of which are lung cancer, chronic bronchitis and coronary heart disease. The following shows this association.

A. CIGARETTE SMOKING AND LUNG CANCER

Lung cancer is a dangerous disease which seriously damages people's health and leads to death. In Scotland in 1972, there were around 3,500 deaths from lung cancer; nearly 1,608 were under the age of 65. This is the highest rate in the world!

A number of surveys have established a direct link between smoking and lung cancer as follows:-

(a) Studies have shown that the risk of lung cancer increases directly in relation to the number of cigarettes smoked.
(b) Studies have also shown a reduced risk of lung cancer in cigarette smokers who have stopped smoking.
(c) Lung cancer death rates are higher in urban than in rural areas. This urban/rural difference is greater /

greater in cigarette smokers than in non-smokers. Although exposure to air pollution, especially by coal smoke, appears to increase the risk of lung cancer, its effect is small compared with that of cigarette smoking. Where smokers have been compared with non-smokers who work in certain occupations, particularly those exposed to asbestos dust, chromates, nickel, arsenic, radio-active materials, and the products of coal distillation in the gas industry, the increased risk is largely confined to smokers.

But some people question the extent to which smoking is a contributory factor to lung cancer, for the following reasons:-

(a) Surveys have shown that non-smokers are also subject to lung cancer; that experts differ among themselves about smoking and lung cancer, and that doctors smoke as much as other people.

(b) Lung cancer can be developed by working in some specific industries, even among those who do not smoke.

(c) It has been suggested that lung cancer rates are higher in urban than in rural areas because of the difference of the rate of exposure to air pollution. This exposure to air pollution, especially by coal smoke, appears to increase the risk of lung cancer.

(d) Even if we accept that smoking is a factor contributing to lung cancer, it has been shown that the risk is increased by inhalation of the smoke, by earlier onset of smoking, by taking more puffs from each cigarette, by keeping the cigarette in the mouth between puffs, and by re-lighting half-smoked cigarettes. One recent study suggested that smokers of filter-tipped cigarettes may have a reduced risk of developing lung cancer as compared with smokers of unfiltered cigarettes.

B. CIGARETTE SMOKING AND CHRONIC BRONCHITIS

In the United Kingdom, chronic bronchitis seriously damages people's health and may lead to death.

In Scotland, statistics give more than 2,500 deaths per annum from this disease.

A number of studies have established a direct link between smoking and chronic bronchitis as follows:-

(a) There is a steady increase in death from bronchitis with increasing cigarette consumption.

(b) Every aspect of lung function has been shown to be, on average, less efficient in cigarette smokers than in non-smokers of the same age.

(c) It has been found that the serious symptoms caused by the less efficient function of lung can usually abate rapidly in those who stop smoking. When younger smokers stop smoking their lung function usually returns to normal.

But some people question the extent to which smoking contributes to chronic bronchitis. They think that considerable responsibility lies on air pollution and not on smoking for the following reasons:-

(a) It has been found that this disease is much more common in towns, which are much polluted, than in the country. The death rate caused by chronic bronchitis is higher in urban than in rural areas because of the difference of the rate of exposure to air pollution.

(b) Men who work in certain occupations, particularly those exposed to smoke from the combustion of coal, dust in mining and the products of coal distillation in the gas industry, have a considerably increased risk of chronic bronchitis.

C. CIGARETTE SMOKING AND CORONARY HEART DISEASE

Heart disease is one of the leading causes of death in developed countries. It is described as the "modern /

"modern epidemic". It is occurring more frequently, and at younger ages.

In Scotland in 1972, there were nearly 19,000 deaths from heart disease, 5,350 being under the age of 65. This is one of the highest rates in the world!

A number of studies have established a direct link between cigarette smoking and coronary heart disease as follows:-

(a) The studies agree in showing that death from heart disease is greater in cigarette smokers than in non-smokers.

(b) The studies have also shown that the risk of coronary heart disease is directly related to the number of cigarettes smoked, and is significant even at ten cigarettes per day. These studies have also shown that the increased risk is greater in younger smokers than in older smokers.

(c) It has also been found that the risk of coronary heart disease is increased in people in relation to high blood pressure, obesity, diabetes, raised blood cholesterol, physical inactivity, impaired lung function, and personality type; statistical analyses have shown that cigarette smoking is related to death from coronary heart disease independently of all these factors.

<u>But</u> some people question the extent to which cigarette smoking and coronary heart disease are related for the following reasons:-

(a) Coronary heart disease is also frequent among non-smokers, and the proportionate increase of risk in cigarette smokers is relatively small. It has been suggested that it is less directly associated with the number of cigarettes smoked. The increased risk is greater in younger smokers than in older smokers.

(b) It has been found that death from coronary heart disease /

disease has been increasing steadily in developed countries in the past three or four decades. Some of the increase may be due to improvements in diagnosis.

(c) The risk of coronary heart disease may be associated with other diseases, such as high blood pressure, obesity, diabetes, raised blood cholesterol levels, physical inactivity, impaired lung function and personality type. It has been found that the risk of coronary heart disease is increased in people in relation to these mentioned diseases.

Is cigarette smoking a cause of death?

Many studies have taken place to answer this question. All these studies have shown the following:-

1. Cigarette smoking is the most important factor in production of lung cancer. There is a linear relationship between the death risk from lung cancer and the number of cigarettes smoked per day.
2. There is a reduction of risk to those who stop smoking. The risk of developing lung cancer declines rapidly after giving up smoking.
3. It has been found that cigarette smoking can affect unborn children in pregnancy in many ways -
   (i) The baby is smaller at birth.
   (ii) There is a higher rate of premature births.
   (iii) There are more abortions.

   But if the mother gives up smoking before the fourth month of pregnancy, the chances of a successful outcome are improved.

What is the cost of smoking?

There are two different views regarding the cost of smoking.

A. The First View

This view sees the cost of smoking as follows:-

1. /

1. Tobacco is imported and very heavily taxed.
2. Tobacco is an important source of revenue.
3. In addition, it makes a substantial contribution to the profits of the advertising industry.
4. It is the main stock in trade of many small retailers.
5. Moreover, it has an essential role in international trade, and significance in the balance of payments.
6. Many British people are employees in the cigarette industry.

B. The Second View

This view sees that although tobacco is an important source of revenue, it affects health for the smoker.

1. It is estimated that a lot of people die prematurely each year in Britain, most of them from lung cancer, bronchitis and circulatory disorders in which cigarette smoking is a contributory factor.
   It is estimated that cigarette smoking causes 90% of deaths from lung cancer, 75% of deaths from chronic bronchitis and 25% of deaths from coronary heart disease.
2. A large proportion of the Health Service costs arise from cigarette smoking.

How can we reduce the death and disability that result from smoking?

Several approaches have been suggested:-

(a) Forbidding the sale of cigarettes to children.
(b) Removing cigarette-vending machines from public places.
(c) The nicotine and tar content should be stated on the packet along with the health warning.
(d) Encouraging people to smoke low tar content cigarettes.
(e) /

(e) Trying to make smoking less socially acceptable, e.g. by restricting advertising in newspapers and magazines.

(f) Encouraging the development of less hazardous cigarettes and methods of smoking.

Is it easy to give up smoking?

Studies in Britain have shown that 66% of ex-smokers found that giving up cigarette smoking was easy. We can conclude that smoking is a nuisance and harmful to smokers' health. Studies have shown that 75% of the population in Great Britain were aginst smoking in shops, buses and cinemas.

A P P E N D I X 8(g)

University of Glasgow - Research in Science Education

ANSWER SHEET (SMOKING)

1. Please fill in the following:

Girl ☐
Boy ☐

Group No.: _____

Name of School: _____
Your full name: _____
School Year: _____
Date of Birth: _____
Today's Date: _____

2. Please indicate by a tick which of the following most nearly fits your course:-
   (a) Studying for an 'O' Grade in three sciences.
   (b) Studying for an 'O' Grade in two sciences.
   (c) Studying for an 'O' Grade in one science only.

THANK YOU FOR YOUR CO-OPERATION

PUPIL TEST (SMOKING)

1. The most harmful component in cigarettes, which contributes to the development of lung cancer and bronchitis is -
   A. Tar
   B. Nicotine
   C. Carbon monoxide
   D. Smoke dust

2. Chronic bronchitis deaths per year, in recent years in Scotland thought to be caused by smoking are -
   A. 800
   B. 1,800
   C. 2,800
   D. 3,800

3. For every 100 non-smokers who develop chronic bronchitis, the number of smokers who develop this disease will be, on average, around -
   A. 100
   B. 150
   C. 200
   D. 250

4. /

4. Lung cancer accounts for many deaths in Britain. The fraction of all deaths caused by lung cancer is -
   A. 1/16
   B. $\frac{1}{8}$
   C. $\frac{1}{4}$
   D. $\frac{1}{2}$

5. The most important factor in the production of lung cancer is -
   A. Atmospheric pollution
   B. Cigarette smoking
   C. Occupational exposure
   D. Nervous disorder

6. Compared to non-smokers, lung cancer in men over 35, smoking 20 cigarettes a day is -
   A. 10 times as great
   B. 20 times as great
   C. 30 times as great
   D. 40 times more common

7. The percentage of deaths from lung cancer thought to be caused by cigarette smoking is -
   A. 30%
   B. 50%
   C. 70%
   D. 90%

8. In the last 10 years, Scottish lung cancer deaths have -
   A. Remained about 2,600
   B. Slightly decreased
   C. Gone up by over 35%
   D. Decreased for women

9. If we compare the death rate from lung cancer in urban areas with the death rate from lung cancer in rural areas, we shall find that it is -
   A. The same rate
   B. Twice the rate
   C. Three times the rate
   D. Four times the rate.

10. The age group most seriously at risk from lung cancer is in the range of -
   A. 10-25 years old
   B. 25-40 years old
   C. 40-55 years old
   D. 55-70 years old

11. /

11. Many factors may tend to cause lung cancer, but some are considered more important than others. In which of the following are the factors placed in descending order of importance (i.e. the most important first)?

A. Cigarette smoking, occupational exposure, air pollution.
B. Air pollution, Cigarette smoking, occupational exposure.
C. Cigarette smoking, air pollution, occupational exposure.
D. Air pollution, occupational exposure, Cigarette smoking.

12. Pregnancy is sometimes affected by smoking; the results being still births, or deformed children. What proportion of affected pregnancies are caused by smoking?

A. 1 - in 20
B. 1 - in 10
C. 1 - in 7
D. 1 - in 5

13. The average number of babies who die or are born dead each year as a result of their mothers smoking during pregnancy is -

A. 15
B. 150
C. 1,500
D. 15,000

14. As soon as you stop smoking -

A. Healing of the damaged lungs starts.
B. The lungs' condition remains unaltered.
C. The process of damage slows up.
D. Damage already started continues.

15. The proportion of ex-smokers who found giving up easy, is -

A. 26%
B. 46%
C. 66%
D. 86%

PUPIL QUESTIONNAIRE (SMOKING)

1. The aim of this questionnaire is to get your reaction to a list of statements regarding 'SMOKING'. You are asked to read each statement carefully then indicate your answer, which represents your serious opinion.

2. There are no 'right' or 'wrong' answers.

3. You show your opinion by placing a tick in a box.

Here is how you are to use these boxes.

If you place your check mark in the first box closing to 'Good'

Good [✓] [ ] [ ] [ ] [ ] Bad

this means that the material is very good.

If you place your check mark in the second box near to 'Good'

Good [ ] [✓] [ ] [ ] [ ] Bad

this means that the material is fairly good.

If you place your check mark in the third box (in the middle)

Good [ ] [ ] [✓] [ ] [ ] Bad

this means that the material is neutral, i.e. not good not bad.

If you place your check mark in the fourth box to 'Good', i.e. the second box to 'Bad'

Good [ ] [ ] [ ] [✓] [ ] Bad

this means that the material is fairly bad.

If you place your check mark in the fifth box to 'Good' i.e. the first box closing to 'Bad'

Good [ ] [ ] [ ] [ ] [✓] Bad

this means that the material is very bad.

Here is an example of describing something, for example, a particular flower -

Small	[ ]	[ ]	[✓]	[ ]	[ ]	Large
Beautiful	[✓]	[ ]	[ ]	[ ]	[ ]	Ugly
Bad smelling	[ ]	[ ]	[ ]	[✓]	[ ]	Good smelling

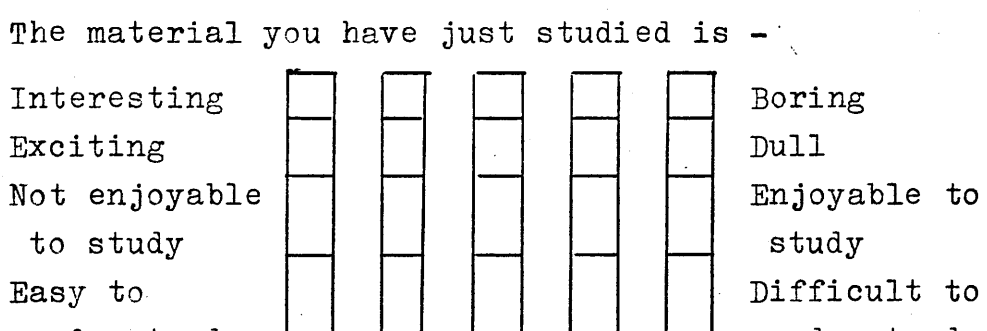
This /

This means that the flower is of medium size and very beautiful, but it has a fairly good smell.

1. By using the same method of ticking, please give your opinion on THE MATERIAL YOU HAVE JUST STUDIED.

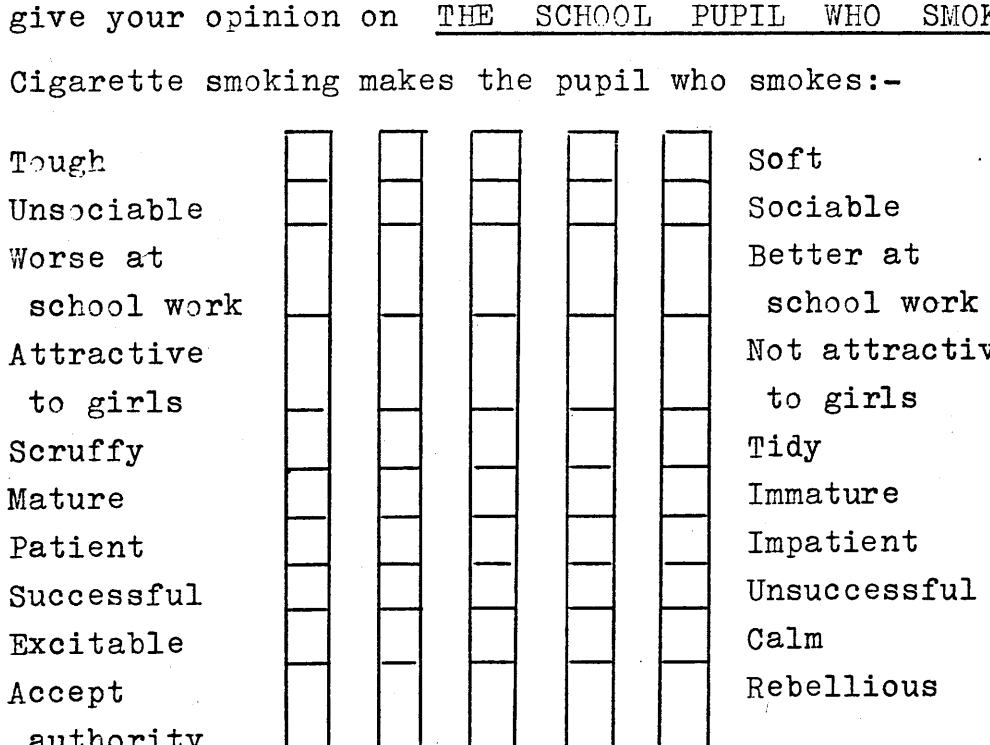
Important: 1. Be sure you answer ALL the questions, do not omit any.
2. Never put more than one tick on a single scale.

The material you have just studied is -



2. Again, by using the same method of ticking, please give your opinion on THE SCHOOL PUPIL WHO SMOKES

Cigarette smoking makes the pupil who smokes:-



Happy						Unhappy
Popular among friends						Unpopular among friends
Unpopular with parents						Popular with parents

3. Please indicate your opinion by putting a tick in the appropriate column against each statement.

	Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
1. Cigarette smoking is the most important factor contributing to lung cancer.					
2. Although cigarette smoking causes pleasure to smokers, its damage to their health is certain.					
3. To reduce the incidence of lung cancer, smoking must be actively discouraged.					
4. Although smokers know that cigarette smoking contributes to lung cancer, chronic bronchitis and coronary heart disease, they cannot give up smoking.					
5. We must accept smoking is an evil of our modern life.					
6. Considerable amounts of money should be spent in helping smokers to give up the habit.					
7. T.V. programmes and advertising against smoking should be increased.					

A P P E N D I X 8(h)

University of Glasgow - Research in Science Education

TEACHER QUESTIONNAIRE - (CIGARETTE SMOKING)

This is a list of educational objectives which may have been achieved by using this case study.

After your pupils have finished the study, please fill in the following questionnaire yourself (as teacher using the material), indicating with a tick how successful you think the material has been in enabling pupils to achieve these objectives.

How successful has this material been in enabling the pupils to -

	Very successful	Fairly successful	Unsuccessful
1. Understand some of the factors which may influence pupils to be cigarette smokers or not.			
2. Understand that cigarette smoking is a contributory factor to diseases like lung cancer, chronic bronchitis and heart disease.			
3. Know that lung cancer, chronic bronchitis and heart disease are the major 'killer' diseases in Scotland.			
4. Recognise that cigarette smoking is more harmful to health than air pollution and most occupational exposure.			
5. Understand that cigarette smoking is a cause of death.			
6. Know how much smoking costs - (a) as a source of revenue; (b) as a major contributor to Health Service costs.			

7. /

	Very successful	Fairly successful	Unsuccessful
7. Take an interest in the problems associated with cigarette smoking.			
8. Appreciate the responsibilities of authorities in dealing with cigarette smoking problems.			
9. Communicate their ideas to others on the effect of cigarette smoking on smokers' health.			

Please list here any other objectives which you think have been achieved by using this material.

Please list here any comments about the material, including criticism.

To be completed by Principal Teacher

Name of Principal Teacher: _ _ _ _ _ _ _ _ _ _ _

Name of School: _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

Number of pupils who attempted the Case Study:_ _ _ _

(Boys _ _ _ Girls _ _ _)

Date of Use: _ _ _ _ _ _

Today's Date:_ _ _ _ _ _

THANK YOU FOR YOUR CO-OPERATION

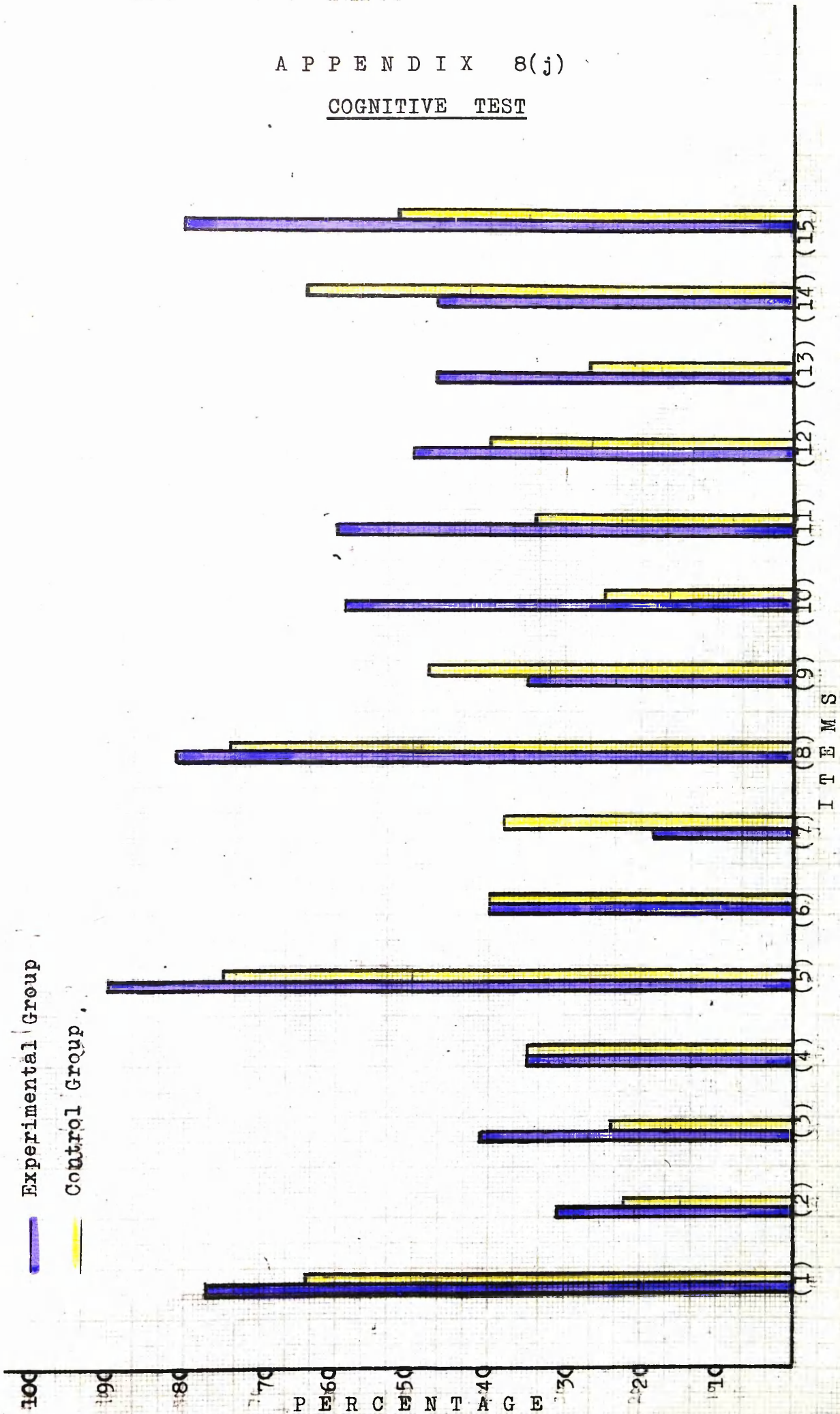
A P P E N D I X 8(i)

ANALYSIS OF THE PUPIL TEST (COGNITIVE TEST)

Ques. No.	Experimental Group		Control Group		Sig.
	Percentage Correct Answer	Discri-mination factor	Percentage correct answer	Discri-mination factor	
1.	76.70	0.30	64.10	0.34	-
2.	31.07	0.04	22.22	0.16	* 1%
3.	40.78	0.32	23.93	0.24	* 1%
4.	34.95	0.37	35.04	0.09	
5.	90.29	0.16	75.21	0.04	-
6.	39.81	0.14	40.17	0.12	
7.	18.45	0.13	37.61	0.39	
8.	80.58	0.12	73.50	0.27	-
9.	34.95	0.04	47.86	0.21	
10.	59.22	0.49	24.79	0.18	* 1%
11.	60.19	0.36	34.19	0.36	* 1%
12.	49.51	0.25	40.17	0.19	* 1%
13.	46.60	0.31	26.50	0.37	* 1%
14.	46.60	0.19	64.10	0.16	
15	79.61	0.19	52.14	0.36	* 1%

APPENDIX 8(j)

COGNITIVE TEST



PART	Ques. No.	A and B					C					D and E				
		Exp.		Cont.		Sig.	Exp.		Cont.		Sig.	Exp.		Cont.		Sig.
		F.	%	F.	%		F.	%	F.	%		F.	%	F.	%	
1	1.	84	82	51	44	* 5%	14	14	17	15	* 1%	5	5	49	42	* 1%
	2.	52	50	14	12	* 1%	43	41	43	37	-	9	9	59	51	* 1%
	3.	15	14	59	51	* 1%	18	17	24	21	* 1%	71	68	33	28	* 1%
	4.	78	75	59	51	* 5%	17	16	16	14	* 1%	9	9	40	35	* 1%
	5.	11	11	35	30	* 1%	4	4	11	9	* 1%	88	85	70	60	-
		240		218			96		111			182		251		

Total of Experimental Group responses = 240 + 96 + 182 = 518

" " Control " " = 218 + 111 + 251 = 580

	518	580	518	580	518	580
	240	218	96	111	182	251
Fe	195		99		224	
Fo	240		96		182	

$$\chi^2 = \frac{(45)^2}{195} + \frac{(3)^2}{99} + \frac{(42)^2}{224}$$

$$= 10.38 + 0.09 + 7.88 = 18.35 \quad * 1\%$$

Degrees of freedom (V) = 2

PART	Ques. No.	A and B					C					D and E				
		Exp.		Cont.		Sig.	Exp.		Cont.		Sig.	Exp.		Cont.		Sig.
		F.	%	F.	%		F.	%	F.	%		F.	%	F.	%	
2	1.	45	44	48	41	* 1%	49	48	52	44	* 5%	9	9	17	15	* 1%
	2.	52	50	44	38	* 1%	32	31	49	43	* 1%	19	18	22	19	* 1%
	3.	68	66	57	49	-	33	32	56	48	* 1%	2	2	3	3	* 1%
	4.	5	5	12	10	* 1%	53	52	45	39	* 1%	43	43	59	51	* 1%
	5.	51	49	73	63	-	48	46	37	32	* 1%	6	6	6	5	-
	6.	6	6	7	6	* 1%	42	42	43	38	* 1%	53	52	62	55	-
	7.	9	9	17	15	* 1%	47	46	63	57	-	46	45	31	28	* 1%
	8.	5	5	17	15	* 1%	42	41	58	50	* 1%	56	54	41	35	* 1%
	9.	47	45	29	25	* 1%	29	28	50	43	* 1%	28	27	37	32	* 1%
	10.	2	2	4	4	* 1%	39	39	60	53	* 1%	60	59	49	43	-
	11.	95	91	106	91	-	5	5	6	5	* 1%	4	4	5	4	* 1%
	12.	96	93	103	89	-	6	6	7	6	* 1%	1	1	6	6	* 1%
	13.	16	16	28	24	* 1%	38	37	54	47	* 1%	48	47	33	29	* 1%
	14.	15	14	17	14	* 1%	47	45	57	48	* 1%	42	40	44	37	* 1%
	15.	84	81	84	72	* 1%	16	15	25	21	* 1%	4	4	8	7	* 1%
		596		446			526		662			421		423		

Total of Experimental Group responses = 596 + 526 + 421 = 1543

" " Control " " = 446 + 662 + 423 = 1531

1543	1531	1543	1531	1543	1531
596	446	526	662	421	423

Fe 449 667 426

Fo 596 526 421

$$\chi^2 = \frac{(147)^2}{449} + \frac{(141)^2}{667} + \frac{(5)^2}{426}$$

$$= 48.13 + 29.81 + 0.06 = 78.00 \quad * 1\%$$

Degrees of freedom (V) = 2

PART	Ques. No.	A and B					C					D and E				
		Exp.		Cont.		Sig.	Exp.		Cont.		Sig.	Exp.		Cont.		Sig.
		F.	%	F.	%		F.	%	F.	%		F.	%	F.	%	
3	1.	96	92	79	69	* 5%	7	7	21	18	* 1%	1	1	15	13	* 1%
	2.	94	90	88	75	-	8	8	16	14	* 1%	2	2	13	11	* 1%
	3.	83	83	74	63	-	7	7	28	24	* 1%	10	10	15	13	* 1%
	4.	38	37	41	35	* 1%	25	25	35	30	* 1%	39	38	42	36	* 1%
	5.	39	38	43	37	* 1%	21	20	30	26	* 1%	43	42	43	37	-
	6.	51	50	40	34	* 1%	18	17	25	21	* 1%	34	33	52	44	* 1%
	7.	86	85	72	62	-	7	7	18	15	* 1%	11	11	28	24	* 1%
		487		437			93		173			140		208		

Total of Experimental Group responses = 487 + 93 + 140 = 720

" " Control " " = 437 + 173 + 208 = 818

	720	818		720	818		720	818
	487	437		93	173		140	208
Fe	386			152			183	
Fo	487			93			140	

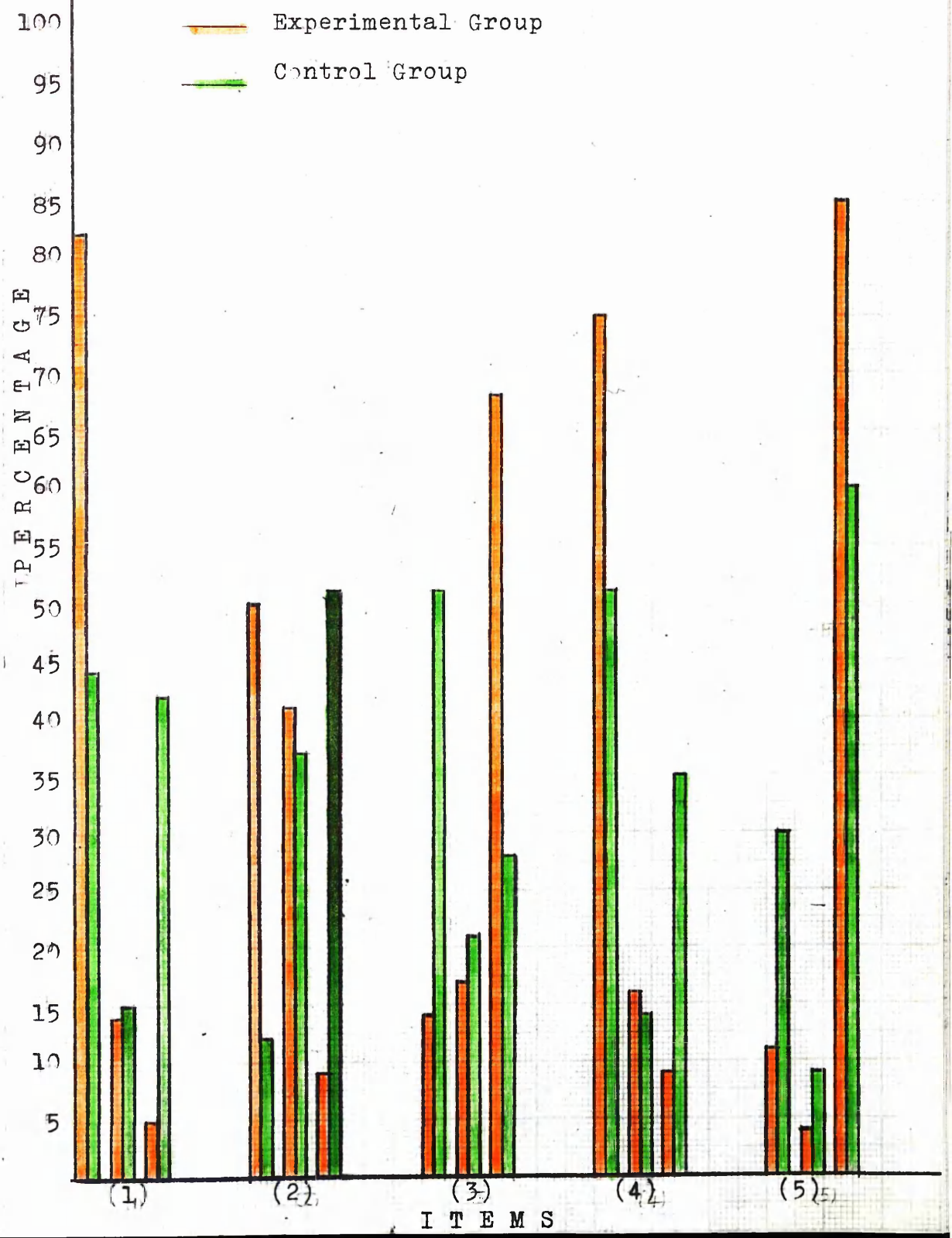
$$\chi^2 = \frac{(101)^2}{386} + \frac{(59)^2}{152} + \frac{(43)^2}{183}$$

$$= 26.43 + 22.90 + 10.10 = 59.43 \quad * 1\%$$

Degrees of freedom (V) = 2

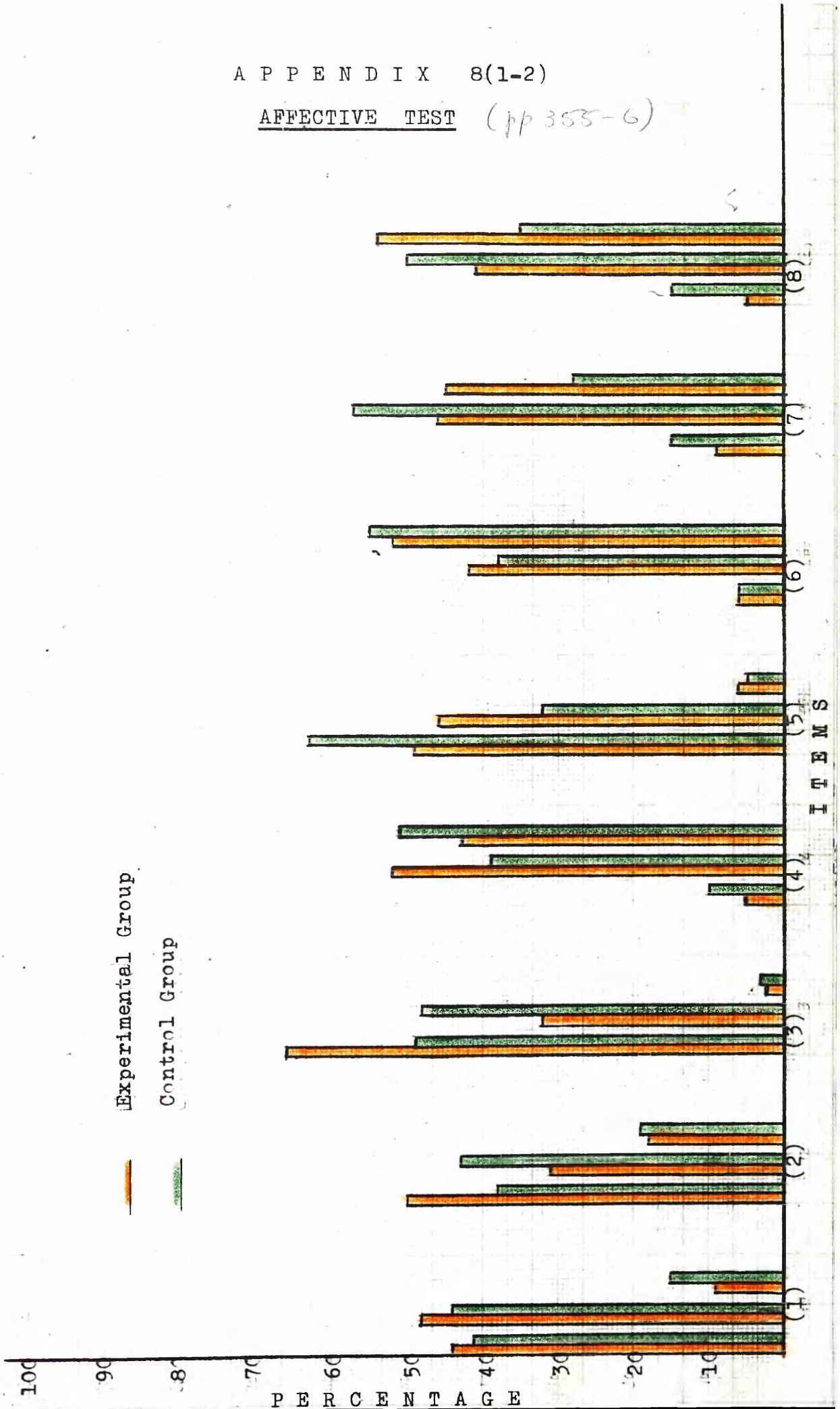
A P P E N D I X 8(1-1)

AFFECTIVE TEST (p 355)



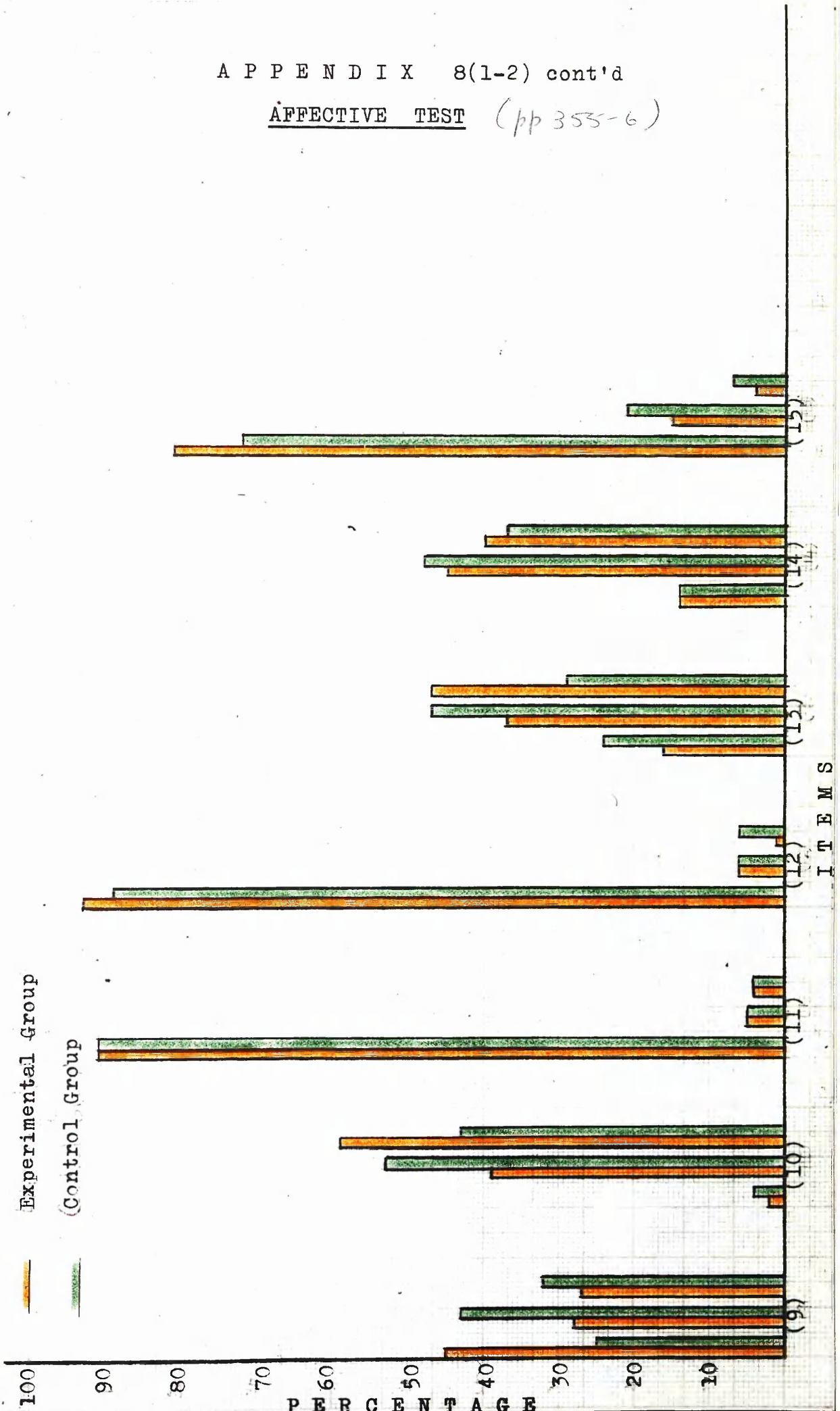
A P P E N D I X 8(1-2)

AFFECTIVE TEST (pp 355-6)



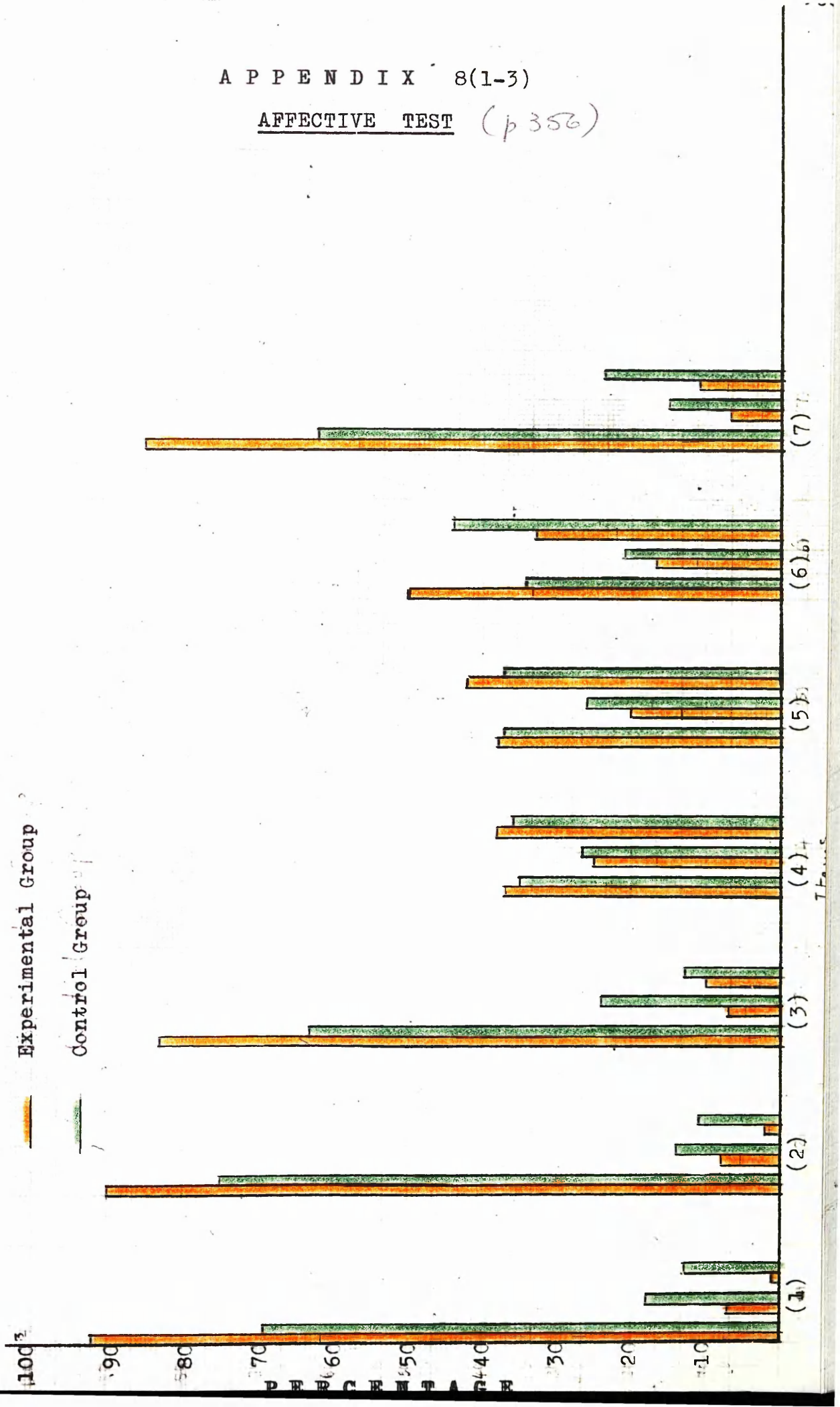
A P P E N D I X 8(1-2) cont'd

AFFECTIVE TEST (pp 353-6)



APPENDIX 8(1-3)

AFFECTIVE TEST (p 356)



A P P E N D I X 8(m)

University of Glasgow - Research in Science Education

TEACHER QUESTIONNAIRE - (CIGARETTE SMOKING)

This is a list of educational objectives which may have been achieved by using this case study.

After your pupils have finished the study, please fill in the following questionnaire yourself (as teacher using the material), indicating with a tick how successful you think the material has been in enabling pupils to achieve these objectives.

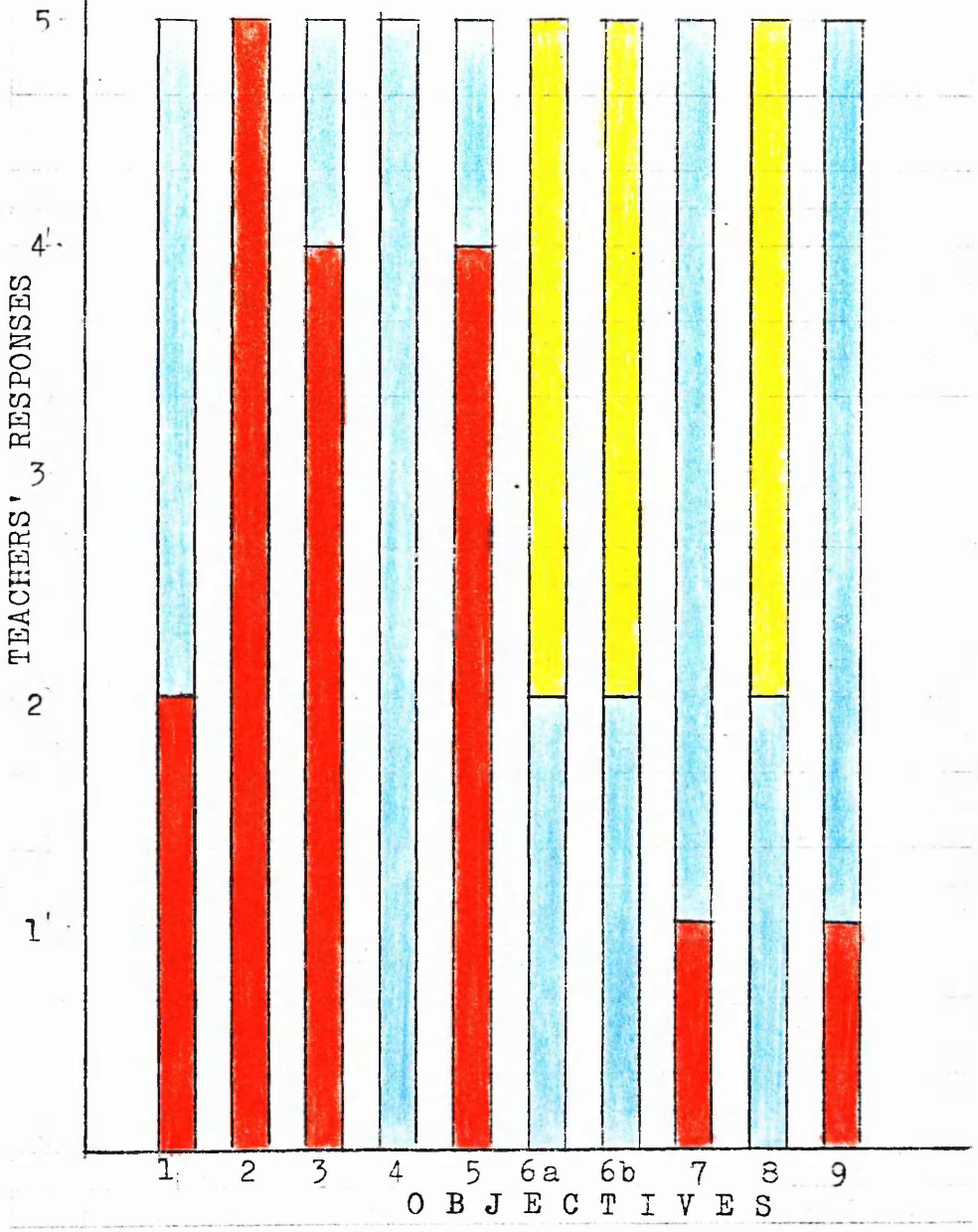
How successful has this material been in enabling the pupils to -	Very successful	Fairly successful	Unsuccessful
1. Understand some of the factors which may influence pupils to be cigarette smokers or not.	2	3	-
2. Understand that cigarette smoking is a contributory factor to diseases like lung cancer, chronic bronchitis and heart disease.	5	-	-
3. Know that lung cancer, chronic bronchitis and heart disease are the major 'killer' diseases in Scotland.	4	1	-
4. Recognise that cigarette smoking is more harmful to health than air pollution and most occupational exposure.	-	5	-
5. Understand that cigarette smoking is a cause of death.	4	1	-
6. Know how much smoking costs - (a) as a source of revenue;	-	2	3
(b) as a major contributor to Health Service costs.	-	2	3

7. /

	Very successful	Fairly successful	Unsuccessful
7. Take an interest in the problems associated with cigarette smoking.	1	4	-
8. Appreciate the responsibilities of authorities in dealing with cigarette smoking problems.	-	2	3
9. Communicate their ideas to others on the effect of cigarette smoking on smokers' health.	1	4	-

A P P E N D I X 8(n)

TEACHERS' RESPONSES



CHAPTER 9

CONCLUSION

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CONCLUSION

9.1 SUMMARY OF THE FINDINGS FROM THIS WORK

In general, we can conclude that the study has provided a useful addition to the work normally carried out in the classroom. It contributed to knowledge, reinforcement and recall; helped the pupils to be willing to communicate their understanding to others (through discussion, argument, presentation and reporting); provided a motivation advantage by helping the pupils to develop a high level of interest, enthusiasm and excitement; helped the pupils to become capable of making their own decisions; encouraged them to work co-operatively with others, provided interaction and peer learning and simulated the environmental problems in a simple way.

Consequently, these methods of presentation are likely to be more effective than the normal classroom teaching methods for these particular purposes.

Most of the results obtained have shown significance, in both the Cognitive and Affective Tests, but especially in the Affective, in favour of the Experimental Group. But this may, to some extent, be accountable by the Hawthorne effect, i.e. the effect of teachers' involvement in new schemes of work. In other words, the teachers may have developed a more favourable attitude /

attitude towards teaching as a result of the interest of the research worker.

The Hawthorne effect can affect the teacher and, through him, affect the pupil. For the parts of the work which depend heavily on the teacher as discussion leader, we would expect a decline in performance as the Hawthorne effect was wearing off over a period of years. However, for the parts of work which are teacher independent, they are always new for the pupils, and so we would expect less of a decline due to the fading of the Hawthorne effect. There is another factor which occurs even in the teacher-independent section of the work, that is the degree of enthusiasm he shows in administrating the material. It may, to some extent, colour the pupil's performance by affecting his attitude.

However, while these possibilities may exist, the study in general made a real attempt to stimulate the pupils to be willing to communicate, to co-operate, to make their own decisions, to interact with each other, in addition to the high level of interest, enthusiasm and excitement which the study provided. All these advantages have convinced us that, presenting science teaching in such a way, has a reasonable chance of leading to attitude changes.

9.2 SUGGESTIONS FOR FURTHER WORK

A. Perhaps future syllabus planners should leave enough time in the syllabus for the conscious development of non- /

non-cognitive objectives.

Examples of the gradual appearance of this approach are to be seen in:-

(a) A series of books called "PATTERNS" published by the Schools Council Integrated Science Project (S.C.I.S.P.) in which the information was presented in an effective way encouraging and stimulating thinking and communication skills.

(b) Revision of Books 3 and 4 of "Chemistry Takes Shape" by Johnstone and Morrison (Heinemann, London) will include material of this kind.

(c) A book entitled, "Everything, Everywhere, Everyone" - Book 1, by Buckie, Sinton and Young (Oxford University Press, London : 1976) in which time is devoted to discussion of newspaper reports and current affairs in a biological context.

(d) Work is being done by N. Reid in the Science Education Research Group in Glasgow University which is supported by the Scottish Education Department (S.E.D.) for incorporation in modified 'O' grade syllabus in Chemistry. This will provide small modules of varying length which will introduce the economic and social consequences of the chemistry directly into the recommended syllabus.

B. It would be interesting to investigate if the teacher independent material maintains enthusiasm compared with the teacher dependent material.

This /

This would give information about the Hawthorne effects and help to separate them from the intrinsic qualities of the material.

C. More research should be done to encourage the development of suitable attitudes through science by material designed for this purpose.

D. More research should be done into the development of suitable attitude assessment in Science Education.

It is suggested here that the use of several techniques will be preferable to the use of only one. The recommended methods are Likert's Method of Summated Ratings, Osgood's Method of Semantic Differential, and the Situation Method designed by Johnstone.

E. Modifications to 'O' grade syllabuses in Science should take place. In these modifications, there should be a reduction in emphasis on the retention of factual information in science teaching, and more emphasis should be placed on the stimulation of decision making and communication skills.

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Completed Thesis for the degree of Doctor of Philosophy (1976) - University of Glasgow

Mohamed A. A. Nasr : "A Study of the Affective Domain in School Science"

ABSTRACT

It has been found that the present science syllabuses to 'O' grade contain material which is of high social relevance. However, normal classroom teaching can take place quite satisfactorily from a certificate point of view but neglect the conscious teaching of these socially important topics. It seems that schools are successful with the cognitive domain but tend to be less successful in helping to develop desirable social attitudes and the willingness to communicate. The purpose of this study is to enable the 'O' grade pupils to develop desirable social attitudes and awareness, change existing attitudes, and as a bonus, to encourage the development of group skills such as communication, co-operation and discussion.

Four topics were chosen for the purpose of the study - "Food and Man" in the third year biology syllabus; "Water Pollution, "Air Pollution" and "Bronchitis and Cancer of the lung", all these three are in the fourth year biology syllabus.

Two different kinds of material were prepared, one for the Experimental Group and the other for the Control Group. For the Experimental Group it included -

(a) /

(a) media : games, simulation games, a multimedia package and audio-visual programme;

(b) pupil tests;

(c) teacher questionnaire;

(d) articles.

For the Control Group it included -

(a) factual articles;

(b) pupil tests;

(c) teacher questionnaire.

Six schools were chosen for the purpose of the study, and the pupils who used the material were in the third and fourth year leading to 'O' grade. The general method of application was that the Experimental Group was provided with the simulation and other new materials, whereas the Control Group was provided with an article containing the same facts as appeared in the simulation, etc. Then both were given the same cognitive and affective tests.

Findings showed that the study for the Experimental Group has -

(a) provided a useful addition to the work normally carried out in the classroom;

(b) contributed to the knowledge reinforcement and recall;

(c) helped the pupils to be willing to communicate their understanding to others (through discussion, argument, presentation and reporting);

(d) provided the motivation advantage by helping the pupils to develop a high level of interest, enthusiasm and excitement;

(e) /

(e) helped the pupils to become capable of making their own decisions;

(f) encouraged the pupils to be able to work co-operatively with others;

(g) provided interaction and peer learning.