A STUDY OF THE EFFECTIVENESS OF AN EXPLICIT

INFORMATION PROCESSING TECHNIQUE (IKR) FOR

INTERPRETING EXAMINATION ESSAY QUESTIONS AT

UNIVERSITY LEVEL

by

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SUMMARY

This thesis presents the results of fourteen experiments designed to test the effect of an explicit information processing technique (IKR) on students' interpreting of examination essay questions. The experiments which took place in the University of Glasgow from February 1990 till December 1992, involved undergraduate students in civil engineering and chemistry, post-graduate students in adult education, and graduate civil engineers preparing for their professional examination.

Chapter One provides an extensive report on some of the existing knowledge about essay-writing, and explains how the researcher developed the "Instruction Key Words, Knowledge Key Words and Relevance Key Words" technique (IKR) for interpreting essay questions. In addition, a summary of current information processing theory is given, and IKR explained in terms of it.

Some of the experiments reported in this thesis examined the effect of IKR on students'
* essay examination results;
* abilities to identify correctly the number of parts required in the answer to questions;
* criteria for deciding on the number of parts;
* perceptions of question difficulty when questions contain statements and when questions vary in length;
* understandings of what different instruction key words (IKWs) entail and the relative difficulty in terms of mental effort that different IKWs imply;
* criteria for deciding that one question entails a more difficult answer than another;
* perceptions of the difficulty they experience in undertaking question interpretation exercises;
* times taken to complete various interpretation exercises;
* quality of descriptions when asked to describe how they would answer a question
if asked to do so; and
* time taken to complete interpretation exercises.

In general, the results show that IKR enhances the information processing skills (question interpretation skills) of many students. A few individuals show considerable improvement. This is evident in the increase of correct responses after a workshop on IKR and in the change of perceptions away from those that will mislead students, to those that are likely to give more accurate interpretations. However, in several experiments it was found that 20% - 30% of students still gave erroneous responses even after an IKR workshop, indicating that more than one workshop is necessary to

alter deep-seated traditional perceptions held by some students.

Some of the more revealing findings were that before a workshop on IKR many students:

- thought (erroneously) that longer questions and questions containing statements were easier because they provided information to help with the answer;
- thought (erroneously) that vague, less specific, less direct questions were easier because they allowed one to "waffle", and to use one's imagination and personal experiences to make up for lack of knowledge;
- had an intuitive understanding of the different degrees of mental effort required by different instruction key words;
- perceived that of sixteen instruction key words, the five most difficult were "analyse", "assess", "evaluate", "justify" and "compare & contrast", with "analyse" being perceived as particularly difficult;
- have unjustified and erroneous perceptions of what some instruction key words require them to do.

Considerable information is presented on how students perceived question difficulty, and the researcher has been able to construct a list of sixty one classifications into which students' perceptions of difficulty can be grouped. It has also been possible to provide a ranking of sixteen instruction words according to the degree of inherent difficulty which students perceive in them. It has also been possible to provide a list of thirty two classifications into which students' reasons for identifying a particular number of parts in a questions, could be grouped.

In Chapter Twelve, examiners are offered six recommendations which could contribute to the designing of more effective essay questions and in turn, to students providing more adequate answers to essay questions. Eight recommendations are offered for future research, including for example, further tests on whether enhanced information processing skills leads to enhanced performance in essay examinations. These recommendations for further research reflect the pioneering nature of some of the experiments, the researcher not having encountered similar work in the literature.

It is recommended in Chapter Twelve that lecturers introduce their students to IKR and eight guidelines are offered for the successful teaching of IKR. This recommendation is based on the results of this research. It is also offered on the grounds of IKR being a more effective way (than traditional scribing-out of essays in full) of developing the thinking skills necessary for solving complex problems in students' personal and professional lives.

ACKNOWLEDGEMENTS

TABLE OF CONTENTS

CHAPTER ONE

METHODOLOGICAL ORIENTATION.
THE IKR TECHNIQUE FOR INTERPRETING ESSAY QUESTIONS AND ITS RELATION TO THE THEORY OF HUMAN INFORMATION PROCESSING

CHAPTER TWO

DOES TUITION IN IKR IMPROVE THE ESSAY EXAMINATION RESULTS OF FOURTH YEAR HONOURS CHEMISTRY STUDENTS?

CHAPTER THREE

CAN IKR IMPROVE THE QUESTION INTERPRETATION ABILITY OF FIRST YEAR UNIVERSITY CIVIL ENGINEERING STUDENTS?

CHAPTER FOUR

THE EFFECT OF IKR ON STUDENTS' ABILITY TO RECOGNISE IRRELEVANT STATEMENTS AND IRRELEVANT QUESTION LENGTH

CHAPTER FIVE

THE EFFECT OF IKR ON STUDENTS' RECOGNITION OF THE NUMBER OF PARTS IN A QUESTION AND ON THE CRITERIA USED TO DECIDE ON THE NUMBER OF PARTS

CHAPTER SIX

THE EFFECT OF IKR ON STUDENTS' ABILITIES TO DESCRIBE HOW THEY WOULD ANSWER SPECIFIC QUESTIONS

CHAPTER SEVEN

THE EFFECT OF IKR ON THE CRITERIA STUDENTS USE IN THEIR PERCEPTION OF QUESTION DIFFICULTY

CHAPTER ELEVEN

THE EFFECT OF IKR ON THE TIME STUDENTS TAKE TO INTERPRET ESSAY QUESTIONS AND ON THEIR PERCEPTIONS OF DIFFICULTY

CHAPTER TWELVE

CONCLUSION.
ASSISTING STUDENTS TO WRITE MORE EFFECTIVE ESSAYS: RECOMMENDATIONS FOR LECTURERS AND EXAMINERS

CHAPTER ONE

METHODOLOGICAL ORIENTATION.
THE IKR TECHNIQUE FOR INTERPRETING ESSAY QUESTIONS
AND ITS RELATION TO THE THEORY OF HUMAN INFORMATION
PROCESSING

1.0 INTRODUCTION

While teaching first-year undergraduate economics students[1], the researcher became concerned about the number of students failing examinations mainly because of inadequate essay-writing. A number of handouts prepared to assist students were combined eventually in a small booklet (Robb 1976)[2]. The advice documented in the booklet was also offered in the University of Glasgow from time-to-time to postgraduate adult education students, graduated civil engineers sitting professional examinations, undergraduate civil engineering students, and others[3].

The booklet, and workshops[4] and handout materials derived from it, were not based on a formal theoretical perspective. However, the researcher reflected extensively on why some students performed badly in answering questions[5]. It was observed that many students wrote on topics not asked for, devoted attention to insignificant comments or quotations used at the beginning of questions, answered only parts of questions and, in some instances, misinterpreted questions entirely. Many lecturing colleagues also noticed students' weaknesses in **interpreting**[6] questions.

It was observed (with many colleagues corroborating it) that students did not fail essay examinations because of poor spelling and grammar, even when these were inadequate. The researcher found as did Nightingale (1986 p1), for example, that: "... most tertiary students have mastered the basis of writing: sentence structure, paragraphing, punctuation, spelling and so on". The fundamental problem seemed to be students' lack

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[1] In the School of Economics in the University of Cape Town from 1976 to 1980.

[2] A copy of this booklet is enclosed in a pocket in the inside back cover of this thesis. The book was reprinted in Glasgow and has sold 3000 copies in total.

[3] The researcher was lecturer in the Department of Adult and Continuing Education from October 1985 till October 1990, and in 1986 was invited by the Department of Civil Engineering to establish a communication skills course for first and second year undergraduates. This invitation was extended to teaching essay-writing to graduated civil engineers who must successfully write a number of essays to gain membership of their Institution.

[4] In lectures on essay-writing, even with large classes, the researcher uses a workshop approach involving discussion and practice as well as lecturettes. Consequently, in this thesis, the word "workshop" is used rather than "lecture" or "tutorial", for example.

[5] To improve expression in this thesis, the term "essay-type question" is shortened to **"question"**.

[6] The term **"analysing"** questions could have been used in this thesis. However, it was decided that "interpreting" is the more accurate term because the goal of analysing questions is to interpret what the examiner requires. Unless otherwise stated all **bold type** is emphasis by the researcher in order to highlight especially significant words or phrases.

of understanding of what is required and then inability to express ideas, views and knowledge in a systematic, and logical way. As Webb (1991 p1) finds: "Probably the most common criticism of the essays written by students new to university culture is that they are not analytical enough." These preliminary observations, indicated for the researcher[7] that **most improvement in essay-writing could be achieved by helping students to gain the skills of interpreting questions adequately.**

This preliminary finding neither means that spelling, word-choice and grammar should be ignored, nor that other skills such as essay-planning, linking one idea to the next, and collecting and organising information, cannot assist students in answering questions adequately. For example, Norton (1990 p420) splits the essay-writing task into two parts - preparing and writing. On asking ninety eight students what they found difficult about essay-writing, Norton recorded the results shown in **Table 1.1.**

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Table 1.1

What students find difficult about essay-writing
(Key: % = Number of students giving a reason expressed as a percentage of the total number of students)

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Preparing	%	Writing	%
Finding sufficient material	38	Selecting material	57
Establishing exactly what the set question meant	31	Writing clearly	34
Organising the time	29	Focussing on the question set	26
Other	16	Presenting an argument	26
		Keeping to a clear framework	21

The researcher was not surprised that 31% of students mentioned that they experienced difficulty **establishing exactly what the question meant** and that 26% experienced difficulty **focussing on the question set**. Although one cannot know what students meant by "organising the time" or "writing clearly", the researcher's experience is that interpreting the question adequately (establishing exactly what the question meant) contributes to making the other difficult tasks in essay-writing easier and more effective. For example, if students know exactly what is required, it is reasonable to assume that they will find it easier to find and select relevant material, to keep to a clear framework, and to focus on the question.

The researcher had an additional concern with Norton's findings as presented in **Table 1.1.** One can ask: How do students **know** whether they have interpreted the question adequately and whether or not they are focussing on the question? Consequently, as

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[7] Use of the word "**researcher**" may seem repetitive. The alternative would be to state "It was found ...", and the reader might ask by whom it was found. However, where there is little danger of ambiguity, "**It was found** ...", has been used.

lecturer, the researcher's approach to helping students so far, has concentrated on enhancing skills of question interpretation, including enabling students **to know that they have interpreted the question adequately.**

On beginning this research in 1989 and up until the time of writing this thesis, a search of the relevant literature did not reveal any empirical study which investigated whether misinterpretation of questions was a contributor to poor essay-writing. There are numerous books on how to write essays and an extensive reported research on essay-writing. However, the researcher found few scientific papers on how to improve performance in essay-writing - much of the advice being based on "commonsense".

This was surprising because essay-writing is a major part of most undergraduate courses. Also, there is evidence[8] that poor performance in essay-writing is widespread in universities in the United Kingdom. Hounsell (1985 p103-106) expresses surprise at the type of research on essay-writing, finding that most of it focuses on the reliability of essay-grading rather than on student learning. The researcher finds, as does Hounsell (1985 p106), and Flower and Hayes (1977), that as a learning activity and process, essay-writing is virtually unexplored territory. It is safe to state that the topic of this research[9] meets a requirement for advanced (doctoral) study, namely that it should have the potential for making an original contribution to knowledge.

It is necessary in any extensive research to limit its scope. Consequently, the assumption that helping students to interpret questions adequately will, in turn, make finding and using information, planning, and linking thoughts, easier and more effective, was not tested. However, the assumption is still a valid point of departure. Even if some future research showed **adequate question interpretation** to be a minor determinant of enhanced essay-writing performance, this would not affect the results of this research. Whether or not instruction in techniques for adequately interpreting questions improves students' interpretation abilities, is a different research question to that of its relative effectiveness when compared to tuition in planning, word-choice, grammar and linking thoughts, for example.

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[8]   See, for example, Hobsbaum, Kay and Milne, *et al* (1981); Hobsbaum (1984 p63) (who found that: "... students characteristically fail, not through ignorance or stupidity, but because they are unable adequately to express that which they know ..."), and Hobsbaum (no date) who lists seventy six individuals who wrote to him expressing concern about students' poor writing. Similarly, the New Civil Engineer of 30.4.81 reports that nearly one third of all those who failed the professional examination for chartered status "... did so solely because they were incapable of writing a simple essay with clarity and good grammar".

[9]   To improve expression in this thesis, the phrase "**this research**" is short for "the research programme to be described in this thesis".

3

However, for advanced study, points of departure must be grounded more thoroughly than the researcher has done so far in this chapter. In addition, it is insufficient grounding to rely only on oral comments of colleagues who also find that students perform badly in essay-writing because of lack of attention to interpreting the question. Consequently, the researcher now presents some documented evidence. A point-form approach has been employed to keep this chapter to a manageable length.

- Moor (1981 p17) finds that: "Too many candidates fail to answer the question set, or substitute questions of their own and write accordingly! Others only read half the question ignoring important aspects of the argument ... Only by a **methodical analysis of the question** will you avoid these pitfalls." He (1981 p22) continues: "... without **thorough probing** - really getting down to **the roots of the question** - one's answers will be at best superficial and at worst irrelevant." Davies' (1986 p120) list of common weaknesses in examination essay scripts begins with: "**An incorrect interpretation of the actual meaning of the question**".

- Jones and Grant (1991 p10) refer to **analysing the question as a crucial skill** - a way of understanding clearly what the marker is looking for. Clanchy and Ballard (1981 p4) give similar advice: "It is expected that your essay will be **clearly focussed on the set topic ...**". Pirie (1985 p13) advises **decoding the question systematically,** and Rouse (1978 p4) advises never beginning an answer or the preparation for it until one is absolutely clear **what the question requires**[10]. He suggests, as does Rowntree (1976 p66) that the first step is to read the question with **scrupulous care** - never hurriedly or superficially.

- Advice to Modern History students (no date p2-3) in the University of Glasgow states that a common error in essay-writing is the inability to **stick to the title of the essay** and that one should read the title of the essay carefully and try to understand exactly what is involved. **Another error is irrelevance**, and students are advised to ask at every stage: "... how does this point ... contribute to my approach to the essay as a whole?". Further advice urges students to read the questions carefully to find out what they mean.

- Sociology (no date p2) students in the University of Glasgow are told that: "A common weakness is **meandering from the real issues** involved in a set essay topic. It is vital to focus directly on the central areas of a topic. ... It pays to **sort out in your own mind what questions should be asked about the essay**

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[10] It important to remember that it is usually **examiners** who set questions and it is they who require the answer.

question itself".

- Part of Borowski's (1979 p1) advice to philosophy students is to: "**Read and re-read** the question, and make sure you have understood it". Madge (1981 p17-18) advises similarly. Students in the Faculty of Arts in the University of Glasgow (1981 p6-7) are advised to scrutinise the **detailed meaning of the essay-title** and to test the relevance of any contribution to the question. Lees (1992 p33) describes how possible **differences in interpretation** of the requirements of an essay title by student and examiner, can lead to a student failing unjustly.

- Kemble (1980 p68) interviewed members of twenty two school examination boards in England, and their unanimous opinion was that failing to answer the question was the candidates' most common mistake. Some examiners reporting on the performance of candidates in various subjects in the Scottish Certificate of Education examination in 1992 found that:

"In some questions, candidates appeared not to have taken sufficient time to **read and comprehend** what was being asked ... many candidates failed to **read questions with sufficient attention to detail.**"[11]; "Some candidates, however, tended to write all they knew about a topic rather than **answering the question** as set."[12]; "Too many others [candidates], however, were prepared only to communicate the factual information they had learned, making little attempt to relate this to the issues raised by the **wording of the particular question.**[13]"; "A significant number of candidates penalised themselves by **failing to read the entire question** before answering, by misinterpreting the tasks set ... ."[14]; "... many candidates wrote about the campaign by Age Concern rather than meeting the specific **requirements of the question.**[15]; "... candidates had particular difficulties in understanding what was required ... the wording or structure of questions in some cases clearly had particular bearing on the success or otherwise of candidates at this Level."[16]

The researcher considers that the examples just listed are sufficient to regard the assumptions that inability to interpret questions adequately is a major cause of poor essay-writing, and that enhancing question interpretation skills will also contribute to enhancing planning and logic skills, as adequate points of departure. The examples also explain why the researcher's advice to students emphasises adequate interpretation of questions. However, one can imagine students asking: "How does one get to the roots of a question? How does one sort out in your own mind what the question requires? What does it mean to read, probe, decode, or analyse a question thoroughly, adequately, systematically, or scrupulously? How will I know what questions to ask of the question itself and how will I know if I have interpreted the question adequately?

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[11] Computing Studies, Higher Grade.
[12] Geography, Standard Grade, Credit level.
[13] History, Revised Higher Grade, Paper I.
[14] Home Economics (Revised) on the Higher Grade.
[15] Modern Studies, Standard Grade, Foundation Level.
[16] Religious Studies, Standard Grade.

It was to help answer the questions just stated that the researcher devised the "IKR technique"[17] for interpreting questions. The IKR technique requires the student to search for three types of key words or phrases - **instruction key words (I)**, **knowledge key words (K)**, and **relevance key words (R)**. As described in detail later in this chapter, IKR[18] was designed to help students understand as thoroughly as possible, what the examiner requires. In the main, IKR does this by helping students to identify where the question **actually begins, how many parts** the question has, and **how to keep the answer relevant** to the question.

According to comments from students and the researcher's lecturing colleagues, IKR appears to assist some students from a variety of disciplines, including economics, adult education, civil engineering and sociology[19]. However, despite the large number of favourable comments and the enthusiasm with which these were given, the researcher wanted to assess scientifically the effectiveness of IKR. Consequently, it was decided to conduct research through the Centre for Science Education in the University of Glasgow.

To orientate the reader further to the aims and methods of this research, it is necessary to undertake three further descriptions in this chapter. Firstly, IKR is described in detail and an explanation is given as to how it should assist students in interpreting questions adequately. Secondly, even at the very early conceptual stages of this research, it became evident that if IKR does improve student performance, it does so because it facilitates more effective **information processing**. Hounsell (1987 p118) hinted at this when he found that a **process-orientated approach** seemed highly desirable. Consequently, it was considered necessary to examine theories of human information processing to find out if they could provide an explanation of why IKR might assist students. Thirdly, the reader is given an overview of how this research was conducted and the rationale for conducting the individual experiments.

1.1 A DESCRIPTION OF IKR

It is a truism that for a question to be a question, the examiner[20] must indicate what knowledge is required (what content must have been studied by students), and must instruct students on how to apply the knowledge. In addition, in a wide-ranging

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[17] As will be seen in Robb (1976), the researcher originally called the technique "KIR". However, as will become evident in this chapter "IKR" describes more adequately what the technique involves.

[18] To improve expression in this thesis the phrase, "the IKR technique" is shortened to "IKR".

[19] Another indication that the advice is helpful is given by the 3 000 sales of "How to write and essay and why bother anyway" (Robb, 1976).

[20] The term "**examiner**" is used in this thesis since the focus is on examination questions. However, since questions are set for purposes other than examinations, the word "questioner" or "marker" would also have been appropriate.

question, the examiner could assist students further by giving some indication of how to keep relevant. As will be shown in the examples to follow, the researcher found that almost all examiners, most likely unknowingly, incorporate knowledge, instruction and relevance key words/phrases in a question. IKR is based on showing students how to identify these three types of key words/phrases in even the most complex questions. Several examples can best illustrate how IKR works in practice.

Example One

Write an essay on "The effects of Intermolecular forces on the properties of pure compounds and solutions".[21]

IKR interpretation

I	write
K	effects of intermolecular forces
R	effect on properties of pure compounds and solutions

To answer this question the student must know the effects of intermolecular forces. However, to keep relevant, this knowledge must be related to the properties of only pure compounds and solutions and no other kinds of compounds and solutions.

Example Two

Discuss the problems of providing relevant adult education for the disadvantaged. Give examples to illustrate the discussion from at least two countries.[22]

IKR interpretation

I_1	discuss
K_1	problems of providing relevant adult education
R_1	for the disadvantaged
I_2	give
K_2	examples of problems of providing relevant adult education for the disadvantaged
R_2	at least two countries

IKR indicates that this question has two parts. The student first has to explain what the problems are and second to give examples from at least two countries. Without using IKR there is the danger that discussion of the problems will become intermingled with the examples and result in a less logical presentation or worse, some of the problems being omitted. The reader may notice that the phrase "at least two" causes some uncertainty as to just how many countries should be referred to. The researcher found many instances of vague or ambiguous wording in questions, creating potential difficulty for students. However, again in the interests of manageable length, the effect

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[21] Researcher's adaption of Question 3, May 1984. Unless otherwise stated, all chemistry questions are taken from examination papers for B.Sc. with Honours (Chemistry), Department of Chemistry, University of Glasgow.

[22] Question 7, Principles of Adult Education, 9th September 1989. Unless otherwise stated, adult education questions are taken from examination papers set by staff of Department of Adult and Continuing Education, University of Glasgow.

of ambiguous question wording on performance, was not examined directly.

Example Three

Do you consider that the staff responsible for the design and those responsible for the construction of a project feel accountable to their respective employers for the quality of their work? Would stricter accountability for performance improve the value for money of the project and how might this be achieved? [23]

IKR interpretation

I_1	do you consider
K_1	staffs' feeling of accountability to employers for quality of work
R_1	staff responsible for design and construction
I_2	would
K_2	stricter accountability for performance
R_2	improve the value for money of the project
I_3	how
K_3	as for K_2
R_3	as for R_2

IKR indicates that this question has three parts. First, students must give their view on whether staff responsible for the design and for the construction of a project feel accountable to their respective employers for the quality of their work. Second, another opinion is required on whether stricter accountability for performance would improve the value for money of the project. In the third part, students must describe how stricter accountability for performance would improve the value for money of the project. Without using IKR, it is possible that some students might overlook the "how" part of the question or merely weave it into the discussion of part two.

The three examples just offered illustrate that IKR can be applied straightforwardly and may hold potential benefits for students. Up until the time of submitting this thesis, the researcher had not encountered a technique for analysing questions as thorough as IKR is. However, some researchers advise similar approaches. For example, Parsons (1976 p63) like Maddox[24] gives the meanings of some instructions and advises students to look carefully at the key words which indicate the sort of essay and treatment of the subject that is required. Although the researcher has not observed this, Nightingale (1986 p4) reports that most writing manuals advise students to examine the **directive words**. Jones and Grant (1991 p9-12) refer to **key structural words** and **key topic words**; they suggest ringing key words and provide detailed explanations (p14-23) of the meanings of several instructions. Pirie (1985 p13) also suggests circling the words that seem essential. But again one must ask how students are supposed to know

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[23] Question 35, 1987. Unless otherwise stated, civil engineering questions are taken from the annual list of questions set by the Institution of Civil Engineers for part of the professional examination.

[24] Reported by Davies (1986 p120).

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what the key words are - what words are essential.

As with most techniques, there are some difficult cases. The researcher considered it necessary to explain briefly in this chapter, the **expected benefits** of IKR and the **difficulties** sometimes encountered in applying it. It is necessary to use the word "expected" since, as already explained, the main purpose of this research is to test whether the perceived benefits from using IKR are real.

1.1.1 EXPECTED BENEFITS OF IKR INTERPRETATION

IKR requires students to identify the number of instructions in a question. As will be explained in more detail, this should assist students by:

* showing where the **question actually begins** and consequently helping them to avoid being distracted or misled by quotations or statements at the beginning of a question;

* indicating the **number of parts** in the question: **as a general rule, the number of instructions equals the number of parts**;

* indicating the **difficulty inherent in a question.**

These expected benefits might not be obvious and further explanation with examples is now provided. It is first necessary to discuss what an instruction[25] is. Most people are aware that **discuss, analyse, describe**, and **compare and contrast**[26], are instructions. The researcher has identified thirty five frequently used instructions and these, together with their dictionary meanings[27] are given in **Appendix I.**

However, instructions are not always the one-word, familiar type just listed. Frequently, they are less obvious, appearing as words and phrases such as **should, could, would, is, are, do you think, in your opinion, to what extent**, and **how does**. The researcher's experience is that, in some instances, some students do not recognise these non-obvious instructions and, consequently, do not answer parts of the question. These kinds of instructions could be called **"hidden instructions"** and students are advised by the researcher to find an explicit instruction that can be inserted to clarify the hidden one. For example, **to what extent** becomes **discuss** (to what extent) and **should** becomes **assess** (whether ... should). With this background it is now possible to explain further, the expected benefits to students from using IKR.

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25 To improve expression in this thesis "**instruction**" is used in place of "instruction key word".

26 The researcher realises that it would have been grammatically more correct to have placed various instructions in quote marks. However, in this thesis, instructions have been emphasised with bold type because the very frequent use of quote marks was becoming distracting.

27 It is understandable that there may be disagreements about the exact requirements of certain instructions. However, describing and resolving these disagreements was beyond the scope of this research.

a) IKR should help students to avoid being distracted or misled by long and irrelevant statements at the beginning of a question

Frequently, questions begin with a statement[28]. Speculation on why examiners employ statements in some of their questions was beyond the scope of this research. However, if examiners are aware of their choosing to include or exclude a statement, it is safe to assume that most who include one, do so because they think it will assist students. The researcher's experience has indicated that some statements are plainly irrelevant, or so long as to mislead students. Two examples can illustrate this.

Example Four: an irrelevant statement

" Nature and nature's law lay hid in night:
God said, let Newton be! And all was light.   *(Pope)*

It did not last; the devil shouting "Ho!
Let Einstein be"! Restored the status quo. "   *(J. C. Squire)*

Discuss the importance of the quantum theory to modern physical chemistry.[29]

As far as the researcher can tell, the **actual question** is: "Discuss the importance of the quantum theory to modern physical chemistry". In this case, the statement does not give an indication of the examiner's expectations. Since IKR requires students to first identify instructions, they should first read the actual question and then realise that they can answer it without reading the statement. The IKR interpretation is as follows:

	IKR interpretation
I	discuss
K	quantum theory and modern physical chemistry
R	importance

The researcher's experience indicates that longer questions sometimes adversely affect students' performances.

Example Five: a statement that is too long

The public inquiry procedure regarding large civil engineering works is intended to bring into consideration the views of any person or group likely to be affected by a proposal. Many such inquiries are time consuming and costly and often create long periods of uncertainty before a decision is given. However, it is often stated that this procedure is a necessary evil to ensure the best interests of the community. List the safeguards used to ensure the best interest of the community during this procedure and describe the role of the independent observer.[30]

Using IKR should enable students to tell quickly that this question has only two parts

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[28] To improve expression in this thesis, "statement or quotation" is shortened to "**statement**".
[29] Question 3, May 1974.
[30] The researcher's adaption of Question 14, 1989.

beginning with the instructions, **list** and **describe**: the rest of the question is merely background information. Although not very relevant, the statement is necessary to clarify "during this procedure" in the last line. The IKR interpretation is as follows:

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IKR interpretation

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I_1	list
K_1	safeguards used to ensure the best interest of the community
R_1	during the public inquiry procedure
I_2	describe
K_2	role of the independent observer
R_2	as for R_1

IKR should assist students to understand what is required in longer questions. The assumption that long statements hinder students must be tested, and in this research, an experiment was designed to do this. So far, the researcher has used summarily the phrase "**actual question**" and it must be explained why the qualification "actual" is necessary. A distinction can be made between the **examination question** (the whole question as it appears on the examination paper) and the **actual question** which begins with the first instruction. It is the actual question which tells the student what is required. Example Five is an **examination question**: it consists of three and a half lines of **statement** and only one and a half lines of **actual question**, which begins with the first instruction, **list**. In effect, IKR should enable students to identify more easily the actual question and hence, what is actually required.

b) Indicating the number of parts in the question: the number of instructions equals the number of parts

All five examples so far illustrate how searching for and identifying the number of instructions, shows students the number of parts in the question. In some questions the separate parts are not distinct and this could lead to some students answering only part of the question. IKR is expected to make identifying the parts in the question easier.

Example Six
The rate of a free-radical polymerisation reaction at a particular temperature is proportional to the monomer concentration and the square root of the initiator concentration. Write down a mechanism which accounts for these facts, and derive the rate expression. Describe how the initiator efficiency and rate constants for propagation and termination may be separately determined.[31]

In the above question there are three instructions: **write down, derive** and **describe**. Consequently, there are three parts.

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[31] Question 10, May 1984.

c) Indicating the difficulty inherent in a question

Most people would agree that the tasks of describing, listing, and explaining, for example, are usually easier than discussing, assessing, comparing and contrasting, for example. Cockburn and Ross (no date p21) corroborate this, finding that compare and contrast involve **higher levels of cognitive operation**. In explaining IKR to students, the researcher refers to instructions such as **describe** and **list** as **Level I** and to those such as **discuss** and **assess**, as **Level II**. Making this distinction enables comparison of the difficulty of various questions. For example, a question comprising two parts both with Level II instructions is likely to be more difficult to answer than a two-part question in which both parts have Level I instructions.

There are some instances when the application of IKR is not straightforward, and the researcher as lecturer attempts to alert students to these as described below.

1.1.2 SOME POSSIBLE COMPLICATIONS IN APPLYING IKR

Only six complications are now briefly described. However, it is likely that others will be identified as more people from differing disciplines use IKR. Incorporating these 'difficult cases' into the explanation of IKR, should make it even more effective.

a) Unnecessary instructions and false instructions

In general, the number of instructions indicates the number of parts in a question. An exception to this arises when examiners use a superfluous second instruction as shown in the two examples to follow.

Example Seven
Spectroscopy has been described as the handmaiden of quantum mechanics; quantum mechanics has been described as the handmaiden of spectroscopy. Write an essay discussing these descriptions.[32]

Example Eight
Describe, concisely, how you would use an electronic digital computer to calculate the minimum-energy molecular conformation of, say, cycloheptane.[33]

The instruction **write** in Example Seven is superfluous since **discuss these descriptions** would have been sufficient. Similarly, in Example Eight, **how would you** is sufficient on its own, making **describe** superfluous. Each of the questions just listed contains one part and not two.

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[32] Question 3, May 1977.
[33] Question 17, May 1977.

b) Instructions implied but not stated

In some questions instructions are implied but not stated explicitly by the examiner, as Example Nine on the following page illustrates.

Example Nine

Infrastructure has become a by-word in debates on employment and capital investment. Explain the importance of the infrastructure and the role of the civil engineer in maintaining its effectiveness.[34]

IKR interpretation

I_1	explain	I_2	(explain)
K_1	the infrastructure	K_2	maintaining the infrastructure
R_1	importance of	R_2	role of civil engineer

It will be noticed that the second instruction (explain) is not stated explicitly.

c) Some instructions following "and"/"or" do not indicate separate parts

In many instances when the words "and" or "or" are followed by an instruction, this indicates another part. Examples Three, Five and Six already given, illustrate this. However, in some questions, as in Example Ten, this rule cannot be relied on.

Example Ten

The construction industry extends and improves the fabric and facilities of society as well as providing employment for many people. Should the industry be used as an economic regulator or should its skilled resources be kept fully employed? Discuss the advantages and disadvantages of these alternatives policies in your country.[35]

The researcher's explanation of IKR so far in this chapter could result in some students arriving at the following IKR interpretation for this question.

IKR interpretation

I_1	should	I_2	should
K_1	an economic regulator	K_2	skilled resources be kept fully employed
R_1	construction industry	R_2	construction industry

I_3	discuss	I_4	discuss
K_3	advantages of alternative policies	K_4	disadvantages of alternative policies
R_3	your country	R_4	your country

While it would not harm a student to have arrived at this understanding of the requirements of the question, it does seem unnecessary to have compartmentalised so finely. For example, with practice, it should become evident that discussing advantages

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34 Question 1, 1989.
35 Question 1, 1986.

and disadvantages is one part and weighing-up whether the construction industry should be used to action policies of full employment or economic regulation, is another part. This example illustrates the potential for IKR to enhance essay-planning and logic skills, as already explained. For example, the unnecessarily detailed IKR interpretation should guide students to assess two economic policies and to give advantages and disadvantages of both policies with special reference to their own country.

d) The actual question comprises only an instruction

It has already been explained that some statements can be irrelevant to the question being asked. However, one frequently encounters actual questions which consist of only the instruction. The knowledge required is contained in the statement. The two examples to follow represent different levels of this occurrence.

Example Eleven

"Adult education has to compete for finance against all other forms of education. To prevent any further decline in provision and standards, students should pay the full economic cost of all vocational courses." Discuss. [36]

Example Twelve

In an attempt to revitalize British industry, certain government departments are rumoured to be considering a revaluation of Boltzmann's constant. Inevitably, opinions differ as to whether an increase or a decrease would be more appropriate. You are invited to consider this problem and discuss such topics as feasibility, consequences for productivity in the chemical industry, possible environmental impact, and so forth. [37]

In both these questions, the student must extract knowledge and relevance key words from the statements. This means that in both cases student's must reformulate the question. In this regard, IKR has the potential to assist.

IKR interpretations

Example Eleven		Example Twelve	
I	discuss	**I**	discuss
K	paying full economic cost as a means of preventing decline in provision and standards	**K**	appropriateness of an increase or decrease in Boltzmann's constant for revitalising British industry
R	vocational courses	**R**	feasibility, consequences for productivity in the chemical industry, possible environmental impact and so forth[38]

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[36] Question 4, Principles of Adult Education, May 1988.

[37] Question 4, May 1984.

[38] The phrase **"and so forth"** is vague and does not give a clear indication which additional matters the examiner might want discussed. The effect of examiners' use of vague or ambiguous terminology on students' interpretations of questions has not been investigated directly in this research.

Practising IKR should give students the skills to identify the main problem (knowledge required) and the subsidiary problem (relevance). Examples Eleven and Twelve may not present severe difficulty to students but the researcher considers that Example Thirteen, on the following page, would.

Example Thirteen
In a recent paper entitled 'Must a molecule have a shape?' it is written "if one starts from a description of a molecule as an isolated dynamical system consisting of a number of electrons and nuclei (implied by the stoichiometric formula) that interact via electromagnetic forces one cannot even calculate the most important parameters in chemistry, namely those that describe the molecular structure."

Write a critical essay explaining why you think the author came to adopt such a view point, and using both experimental and theoretical arguments present a case in support of the concept of molecular structure.[39]

The researcher's assumption is that students would be confused by having to first read the statement and then having to re-read it to understand what the "view point" was. However, the IKR interpretation below should clarify matters. An indication of the knowledge required to answer this question is given in the statement at the beginning of the question. To begin with, the student has to explain why one cannot calculate the parameters that describe molecular structure starting from a description of a molecule as an isolated dynamical system consisting of a number of electrons and nuclei that interact via electromagnetic forces. As IKR also shows, this question consists of two parts. While some students may recognise that a two-part answer is required in this question, it is suspected that IKR makes this recognition easier.

IKR interpretation

I_1 explain
K_1 the viewpoint that one cannot calculate the parameters that describe molecular structure starting from a description of a molecule as an isolated dynamical system consisting of a number of electrons and nuclei that interact via electromagnetic forces
R_1 critical

I_2 present a case
K_2 supporting molecular structure
R_2 use both experimental and theoretical arguments

e) Difficulty in distinguishing relevance and knowledge key words
In most instances, identification of knowledge and relevance key words is straightforward. However, in some cases there may be uncertainty as to which is the (K) and which the (R). Two examples can illustrate this.

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[39] Question 9, May 1984.

Example Fourteen

A recent review started with the statement, "The chemist is a guest at the physicist's table and frequently dines rather well".
To what extent does this statement hold true with respect to the study of reaction mechanisms and short-lived intermediates in organic chemistry? 40

Example Fifteen

What do you consider will be the effects of computer applications on the education and training of an engineer? 41

In Example Fourteen, is the main focus to be the contribution of the physicist's techniques to chemistry and the chemist's frequent use of these techniques, or the study of reaction mechanisms and short-lived intermediates in organic chemistry? Based on the words "with respect to" and on the fact that the instruction - "To what extent" - is related to the physicist's techniques, the researcher's IKR interpretation was as follows:

IKR interpretation

I	to what extent
K	physicist's concepts/methods applicable in chemistry
R	study of reaction mechanisms and short-lived intermediates in organic chemistry

In Example Fifteen, should the students' emphasis be on the education and training of the engineer or on the effects of computer applications? In this instance the researcher decided that the education and training of engineers was the knowledge key phrase because it is on this that the computer applications would have an effect.

Even if students' selection of (K) and (R) was opposite to that of the researcher's or examiner's, this would be unlikely to adversely affect their performance. In Example Fourteen, one could answer the question by taking different aspects of education and training in turn, illustrating how the various computer applications have affected them. Conversely, one might take each computer application in turn and show its effects on education and training. When it is almost impossible to separate (K) and (R), this indicates that extensive description of one or other of the aspects would be a mistake: there must be extensive cross-referral. IKR should indicate to students that they must have extensive knowledge of both computer applications and of education and training

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40 Question 7, May 1984.
41 The researcher's adaption of Question 7, 1986.

of engineers.

f) Lack of relevance key words
While an indication of knowledge must always be given in a question, relevance key words may not be given. This might hinder student performance since the chance of writing on topics unwanted by the examiner is probably increased.

Example Sixteen
Write an essay on education and power.[42]

Although an IKR interpretation of any question is possible, for questions like those in Example Sixteen, it would be unnecessary. IKR at least alerts students to the fact that the relevance key word is omitted and that one might have to explain to the examiner (in the introduction) how one would limit the scope of the answer. It is possible that students would gain clues to what is actually required in this question from the course work they have been doing. For example, if this question was set for students in a department of education the essay would most likely require an emphasis on the role of education in the distribution or concentration of power. Students in a politics or sociology department might be required to take different approaches. In any event, it is likely that having students guess in this way will not help the quality of their essays.

1.1.3 SUMMARY
Having described IKR in some detail and having outlined some of the benefits from, and difficulties in using it, it is possible to make explicit several other relevant observations and assumptions.

- The reader may have noticed that much of the benefit from IKR comes from identifying the type and number of instructions. It is for this reason that the researcher uses the acronym "IKR" instead of "KIR", as used originally in Robb (1976).

- Even if students do not have the knowledge to answer a question, they should in most instances, be able to explain how they would answer. In addition, if IKR enhances essay-writing abilities, this should be true for students in any discipline. A student studying chemistry say, should still be able to state what would have to be done to answer a question on a civil engineering topic. To some extent this is corroborated by Bennett (1974 p2): "Excellence in historical writing consists of simple and solid virtues, not of facile tricks and gaudy gadgets. It can therefore be

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[42] Question 8, Social and Ethical Issues in Education, (MEd), 28th August 1990.

appreciated by all who have the wit and diligence to seek it; it is no monopoly of those who possess superior talents". The researcher expected that IKR could help students from the physical, applied and social sciences.

- In one sense, using IKR should not be new to students: the researcher suspects that IKR is a way of making explicit what the mind does anyway when interpreting a question. However, by making this mental activity explicit one can consciously see what is happening and conduct the interpretation more effectively. Flower and Hayes (1980 p450-451) come to the same finding with regard to other heuristic procedures used to cope with the complexities of writing: " ... heuristic procedures which help us to do this are often surprisingly simple. Such heuristics can often be brought to consciousness and improved by training. A heuristic is an alternative to trial and error. It is simply the codification of a useful technique or cognitive skill. It can operate as a discovery procedure or a way of getting to a goal. ... Because they make an intuitive method explicit, heuristics open complex processes up to the possibility of rational choice". In this way, the researcher expects that IKR enables students to make rational choices about how to answer questions more adequately.

- Some students ask: "What if my IKR interpretation is different to the examiner's?". No matter what technique is used to interpret a question, there is always the possibility that a student's interpretation will not match what the examiner intended. However, the researcher considers that using IKR should lessen this possibility. In addition, as Flower and Hayes (1980 p451) point out: "The important thing about heuristics is that they are not rules, which dictate a right or wrong way, but are alternative methods for doing something - methods which often formalize the efficient procedure a good scientist or journalist would use unconsciously."

- From an IKR perspective, it is not the knowledge content of questions which makes them difficult, but what the student is asked to do mentally (cognitively), as demanded by Level I and Level II instructions. This does not mean that IKR is a substitute for lack of knowledge. However, the researcher's personal experience in using IKR is that because it enables one to focus on one aspect at a time, it helps recall of knowledge which has been learned some time ago.

Until discussions with Johnstone[43], the researcher had not thought of IKR in terms of **information processing**. With preliminary insights provided by Johnstone, it was possible to regard IKR as a mechanism for enabling students to: break a question into smaller parts; use working memory more effectively to understand what is

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[43] Professor A. H. Johnstone, Director, Science Education Centre, University of Glasgow, and the researcher's supervisor for this research.

required, and to retrieve more readily, information stored in long term memory. Continuing the description of methodology used to conduct this research, a brief description of current theory on **human information processing**[44] is now given.

1.2 INFORMATION PROCESSING AND IKR

As might be expected, considerable research has been conducted on thinking processes, interpreting language, problem-solving and the interrelatedness of all three. For example, Hayes and Flower (1980 p388) find four major theoretical viewpoints on the writing process: **psycholinguistic, linguistic, developmental**, and **cognitive processing**. Even narrowing this field to cognitive processing (information processing), reveals a considerable literature. An extensive review of this literature was not undertaken since other researchers had already done this, and because descriptions of information processing by other researchers were considered adequate to explain why IKR appears to be effective and to enable raising of hypotheses.

Consequently, in the brief orientation to follow, the researcher provides a summary of current theory of information processing, based on the findings of Greene (1987), Baddeley (1986), De Bono (1978), Johnstone (1988), Johnstone and Reid (1981 p205-212), and Johnstone and Al-Naeme (1991 p187-192). All of these researchers provide extensive references for their findings. Where relevant insights are also given by other researchers, these are referred to. An attempt is made to show how the model explains why IKR should improve students' essay-writing. Several general hypotheses are then raised, these being the basis of this research.

1.2.1 A CONTEMPORARY MODEL OF INFORMATION PROCESSING

That conscious thought (information processing) takes place in a **working space** or **working memory** is now well established. The term "working memory" is inadequate since working space fulfils two functions, namely holding information to be worked on and the operating on that information (processing). Working memory or **active processing** replaces the traditional theory of short-term memory as a passive store of to-be-remembered items which had to be continually rehearsed if they were not to be forgotten. It is safe to state that the terms **"thinking"** and **"problem-solving"** are frequently used to identify this process (Greene 1987 p5-8) (De Bono 1978 p7).

Although there might be very subtle distinctions between thinking, problem-solving and information processing, the terms "thinker", "problem-solver" and "information-processor" are treated as synonyms in this thesis[45]. Flower and Hayes (1977), Hayes

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[44] In this thesis "information processing" is taken to be **human** information processing. This footnote is necessary to alert the reader to the distinction between human and machine processes.

[45] For example, De Bono (1978 p16) distinguishes between passive, descriptive contemplative thinking and generative thinking which is concerned with solving problems. Note also that active processing and working memory are not the same processes.

and Flower (1980), Blackwell (1980) and Hounsell and Murray (1992 p10), also regard **writing** as thinking, cognitive activity and problem-solving.

It has been found that working space has very limited capacity, being able to process only **five to seven pieces of information** at one time. This capacity can be measured in individuals and it is possible to identify an individual as having low capacity (five) or high capacity (seven) working space. As Greene (1987 p146) summarises: "It is the limit on the number of factors that can be considered simultaneously in working memory which makes thinking so hard." This limitation on working space does not mean that students cannot consider problems requiring more space. As long ago as 1945, Duncker reported by Greene (1987 p9), found that problem-solvers set up **subgoals**. Greene (1987 p107) refers to **heuristic strategies**, the major aim of which is to reduce a problem to manageable proportions. Current evidence suggests that individuals use various strategies to **chunk** information into manageable units for processing. While the term "chunk" seems unusual, it is being increasingly used in the literature. For the researcher it describes more adequately, than "break-up", "group", "parcel" or "cluster", the taking of only part of the information offered (input) into working space, working on that, and then taking another part of the information into working space and so on.

The 'swapping' of information into and out of working memory goes on all the time. This is an integral part of the information processing model. Chunking refers to something else, although the information moving into or out of working memory will be in 'chunks' of variable size. Since a critical factor in information processing theory is the very limited capacity of working memory, the idea of 'chunking' information was developed, based on studies of 'expert' chess players. Chunking is a technique for compensating for the limited capacity of working memory by restructuring the information into fewer items of a larger size. The more structure the information is given, the more efficient is the chunking. Chunking involves synthesis - building up items of information into meaningful, but more complex structures which, for processing, can be treated as a single item.

In this light, the researcher's use of the term "chunking" to mean 'breaking' a question into more manageable bits of information, is different from that used in much of information processing theory.

Input to working memory can be supplied from an outside or internal source. In educational settings an outside source would be a workshop, lesson, practical, passage

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in a textbook or a question, for example. An internal source would be the questions posed by individuals to themselves and also the material recalled in responses to the external stimulus. It is safe to state that it is unlikely that the information offered by lecturers is understood **totally** by students in the way intended. The current theory is that knowledge has to be **reconstructed** as it passes from one person to another.

However, the extent of the match between what the lecturer intends and what students understand, can be diminished by irrelevant information. In physics terminology (adopted to some extent in psychology), the information intended is called the **"signal"** and the irrelevant information **"noise"**. It is safe to state that people who wish to communicate effectively would not want to distract students by cluttering the signal with noise. However, it has been found that this frequently happens because lecturers and teachers are unaware of the possibility.

El-Banna (1987) has found that the ease with which students are distracted by noise varies. This propensity to be distracted is called **field dependence**. As Witkin (1974) explains, those who are field dependent have difficulty separating out relevant material from its surrounding **perceptual field**. Field dependence is measured by a distraction test, a low score indicating that a student is easily distracted. Further experiments show that where students have low working memory capacity, examination results improve as ability to resist distraction increases. However, for students with high working memory capacity there is no significant difference in examination scores. Apparently, students with greater working memory capacity can deal more adequately with noise.

As Greene (1987 p41-48) reports, one of the crucial problems in information processing is **how to limit the selection of relevant inferences**. Johnstone and Al-Naeme (1991 p188) find that: "... if irrelevant or useless input is admitted to an already limited and busy holding and processing space, it will block or further limit the efficiency of the processing ... A learner who is put in a position of having to select relevant from irrelevant input must have, somewhere, in long-term memory, **a model**, which allows him to distinguish between items of output".

In current information processing theory, **long-term memory** contains information about what we already know and understand. There is a relationship between the existing content of long-term memory and the way it influences the use of working space, and in turn, the extent of distractibility. This relationship can be explained as follows. Information processing does not take place without a context. For any individual, upbringing, previous learning, current understandings and attitudes - all stored in long-term memory - affect the approach to a problem. Greene, reporting the

results of other researchers (1987 p8), finds that effective thinking depends on the overall structure of the perceptual field. **Restructuring the perceptual field** could affect the way a problem-solver gains insight into a possible solution.

In short, a person's perception of what is being said and perhaps required of them, is filtered by past experience. In turn, **perceptual filters** may limit one's ability to perform successfully. For example, if a student has come to understand a word to mean one thing and an examiner uses the same word to mean another, working space will be used to overcome this initial difficulty before the actual problem is dealt with. As Johnstone (1988 p3) finds: "What we already know and understand controls how we interpret, process and even store, new information." Although long-term memory capacity is vast, some things are forgotten because the stored information is not always accessible. The brief description of current theory of information processing so far provided, can be summarised in **Figure 1.1**.

Figure 1.1

A diagrammatic representation of current information processing theory
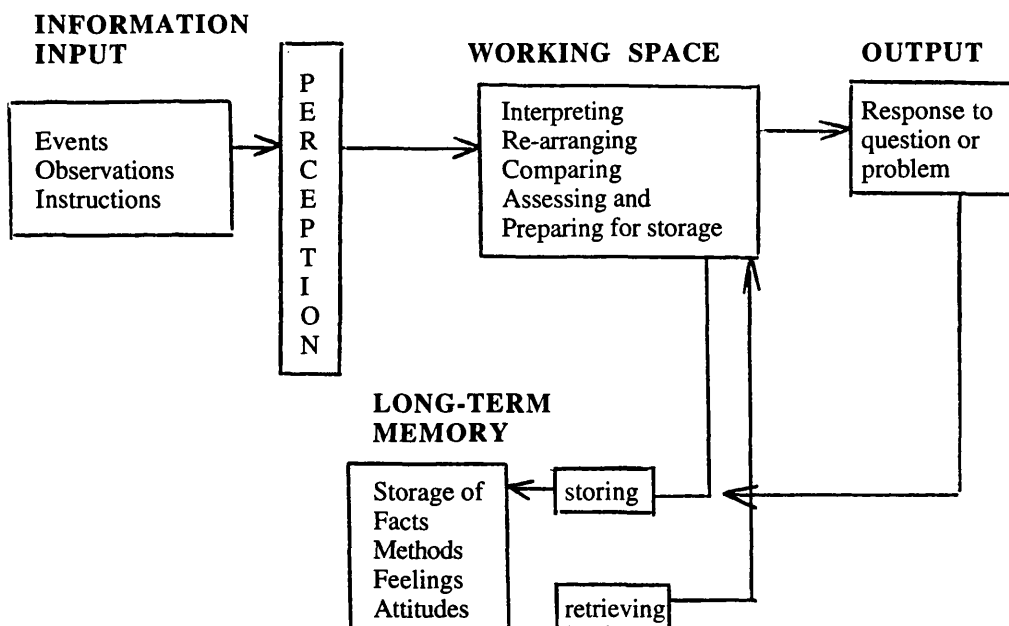
Greene points out (1987 p11) the information processing approach to thinking assumes that there are **general thinking abilities** which people can apply across a whole range of problems regardless of the skills a particular task requires. In other words, intelligent thinking is content free. De Bono (1978 p10) finds similarly: "... the most surprising thing is the **uniformity** of reaction at a basic thinking level across wide ranges of age, ability and interest. From Argentina to Sweden, from Australia to

Switzerland, from Japan to Canada, the fundamental human **thinking operations seem very similar** ...".

For the researcher, the description of information processing theory so far in this chapter has not described adequately the role of **language**. For some researchers, a firm distinction can be made between language skills and thinking skills. For example, De Bono (1978 p37) finds that: "A coherent and fluent essay may show language skill but does not thereby show thinking skill". However, for the researcher, it is difficult to understand how use of language by both the examiner and examinee can be separated from information processing. The initial data on which processing (thinking or solving) acts, is supplied in the case of questions, by written language. Similarly, it is difficult to understand how it would be possible to write a coherent and fluent essay without understanding the meanings of (requirements of) the examiner's instructions.

The researcher's preliminary findings in this regard are corroborated to some extent by Greene and other researchers (1987 p123) who find that **the way a problem is described** has a very important effect on the ease with which people formulate solutions. As Greene (1987 p71-85) finds, we process sentences and texts to understand what is required of us. Greene explains why people find some sentences more difficult to understand than others and why some people **do not wait to read an entire sentence** before wondering what it means. The meaning of a statement can frequently be deduced directly from the word meanings - but this assumes we have a lexicon (dictionary) in our minds to look up. In the course of putting together the meanings of individual sentences, people are constantly making inferences about how they fit together to make a coherent story. It is clear that people remember their interpretations of sentences rather than the exact words and in most cases **only remember a very sketchy gist**. Greene (1987 p82) indicates that if people rely too strongly on inferences based on general knowledge expectations, it might sometimes happen that they simply **do not hear what someone is trying to say**.

Referring to the work of Clark, Greene (1987 p89-90) reports that people can understand sentences only if they already have in mind a given topic to which they can attach new information. If the topic is not obviously stated, the listener must make a **bridging inference** to decide what the topic must be. General knowledge is vital in interpreting all inputs from the environment. **Bridging inferences take extra time**. This means that sentences communicate very little unless written and spoken in a particular context of **mutual knowledge**. Only if both examinee and examiner know knowledge is mutual, can communication be fully effective.

De Bono (1978 p66-77) claims that most thinking is free from visible and logical inconsistencies and that most errors are not so much errors as **inadequacy of perception**. The main error in thinking is **partialism** which involves looking at only one part of the situation and basing arguments on that. He finds further, that the teaching of thinking is not the teaching of logic but the **teaching of perception** and training in thinking improves **perceptual sweep**.

As De Bono finds (1978 p81- 82): " ... **to say that a person needs more information before he can start thinking is pointless**, because thinking is concerned precisely with extracting that information from experience." He (1978 p138 -149) talks of **attention directors**. The **isolation method** isolates an attention area which is normally part of so swift a flow of thinking, that it gets too little attention. The **framework method** involves a sequence of "**boxes**", each box being filled with thinking about a specified part of the problem. Instead of trying to cover all areas at once, thinking is directed to just one area at a time. This is "chunking".

Considering the researcher-as-lecturer's aims for IKR and current information processing theory together, it was realised that how IKR might work, could be explained in terms of the theory. A brief explanation of IKR in terms of information processing theory is now provided.

1.2.2 AN EXPLANATION OF IKR IN TERMS OF INFORMATION PROCESSING THEORY

As is to be expected in an orientation chapter, the researcher is unable to provide a comprehensive explanation of how information processing theory might underlie the workings of IKR. As this research progressed further interrelationships were revealed and these are reported at appropriate places in this thesis.

a) IKR facilitates more effective use of working space

The researcher considers that IKR is a **chunking device** and synonymously, an **heuristic strategy, attention director, isolation method** and a **framework method**. It should enable the setting of subgoals thereby releasing working space to deal more effectively with each part of a problem. IKR is also, therefore, considered to be a problem-solving device. While an examinee's macro-problem could be regarded as passing an examination, each question presents a problem and each part of a question presents a micro-problem. In addition, because IKR requires the examinee to isolate each (I)[46], and the (K) and (R) that relates to each (I), it should enable an increase in perceptual sweep and break the habit of interpreting sentences on only partial reading.

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[46] To improve expression from this point on in the chapter, (I) is used instead of "instructions" and "instruction key words". The same applies to (K) and (R).

At the same time, by requiring examinees to identify (R)s, IKR should enable limiting the selection of relevant inferences, restructuring the perceptual field and the identifying of perceptual filters.

The phrase "should enable" is used purposefully in the previous paragraph to indicate that while IKR holds the potentials referred to, this research was conducted to find out if it fulfilled those potentials, and if so, to what extent. Consequently, the researcher was required to arrive at more specific claims for IKR in the light of information processing theory. The description to follow, is given in point form to keep this chapter to a manageable length. By first searching for (I)s, students can:

- Avoid initially taking into working space, information in a statement at the beginning of a question. This releases capacity for processing (finding out) what is actually required. Once sufficient processing has been conducted it might be found that the statement at the beginning of a question is irrelevant and needs no further attention.

- Chunk by identifying the number of parts to be answered. Each part can then be dealt with separately in working space while the other parts can be held in a **holding loop** for later processing. To ensure that working capacity is totally freed to work on one part at a time, students are encouraged to write down the IKR formula-type interpretation as already shown in the examples in this chapter.

Searching for (K) and (R) also contributes to more effective use of working space by:
- Facilitating even further chunking - one could say "**secondary chunking**". By separating (I) from (K), working capacity is released to deal with understanding what knowledge is required. Similarly, once the matter of what (K) is required is settled, working capacity can be devoted to finding how to keep the answer relevant by reflecting on the (R)s.

- Enabling students to discard from working space those parts of a statement which are irrelevant. As illustrated in Example Five, only a very small part of a statement may be relevant. Once the (K)s in the statement have been identified, the rest of it can be removed from working space.

b) IKR facilitates more effective reconstruction of understanding between student and examiner

By first identifying the examiner's (I), then (K) and (R), and then reflecting on what they mean and their interrelations, students are restating in their own words what the examiner wants them to do. Pirie (1985 p14) suggests that students restate in their own

words what the essay requires. This should increase the likelihood of more adequate transmission of understanding from examiner to student. IKR involves students in consciously reconstructing the examiner's understanding.

c) IKR alters unhelpful perceptual filters

Explaining the meanings of (I)s is an attempt to alter any perceptual filters which might influence adversely, understanding about meanings. While it may be that students have a dictionary of meanings of (I)s, IKR involves attempting to lessen the difference in meaning between the examiner's and the examinees' dictionaries. For example, a student might for some reason, consider that **analyse** indicates a very difficult question. IKR might indicate to the same student that it involves no more difficulty than, say, **weigh-up** or **assess**.

Similarly, requiring students to focus on (K) and (R) gets them to check consciously on the filters operating on their perception and to question their validity. For example, a lecturer might deal with a topic from a United Kingdom (UK) perspective, but ask specifically for a Scottish perspective in an examination question. When students notice a question on this topic, they will likely expect it to be about the UK and may write about the UK instead of Scotland. The (R) would alter this perception by focussing on the word "**Scotland**". In this way, IKR alerts examinees to the **bridging inferences** they are making when analysing a question and if this is a source of difficulty, enables them to explain this to the examiner in the introduction of the essay.

Also, if examiners use IKR in setting questions, they should become aware that the way a question is worded may affect the way it will be processed and answered. In addition, it is expected that examiners will become more conscious of the need to use words in the question which indicate mutual knowledge. If a chemistry examiner uses a quotation or words which have no, or vague, meanings for the examinee, the test is not one in chemistry but in the examinee's ability to make correct inferences from language used. For the researcher, Example Four illustrates a question set without consciousness of the need for indicating mutual knowledge.

The effect of perceptual filters on effective essay-writing cannot be underestimated. For example, Hounsell (1988 p163) explains that students' perceptions of what an essay is and what essay-writing involves, affect performance. Bearing in mind the scope of this research, it was not possible (and it would have been unnecessary) to consider the debate regarding the definition of what an essay is. The researcher considers that IKR, by alerting students to what various (I)s demand, contributes to understanding of what an essay is. However, this is not to claim that more could not be done in this regard.

d) IKR facilitates separating noise from signal

For the researcher, noise created by irrelevance of information in a statement at the

beginning of a question is different to noise created by ambiguous or difficult wording in the question. Take, for example, the following question and its IKR interpretation:

Example Sixteen

Are there advantages to be gained from designing civil engineering works for a limited life or is it better to construct for future generations?[47]

> I = are
> K = designing civil engineering works for a limited life/ constructing for future generations
> R = advantages

By focussing directly on (K) students should become aware of the considerable noise. Firstly, two different words, **"designing"** and **"constructing"** are used, but the context indicates that the examiner is referring to the same concept. Secondly, instead of using the term **"long life"** (to match with **"short life"**), the examiner uses the phrase **"for future generations"**. Devoting working space solely to finding out what (K) is required should enable more students to adequately penetrate this noise and realise that the examiner wishes them to compare the advantages of structures built to last a short time and of structures built to last a long time.

e) IKR can be applied to questions from most disciplines

As already explained, there is evidence that the fundamental aspects of information processing (thinking and problem-solving) are universal. This does not mean that all individuals are equally effective in this regard but that the process itself is universal. For example, Moor (1981 p6) finds that four questions from the subjects of English literature, law, history and biology have a similar form. For the researcher, IKR can be applied to almost any question no matter from which discipline its content is drawn. In addition, since one of the first steps in problem-solving is to turn the problem into a question, it is possible that IKR is a universal problem-solving technique.

f) Can investigating essay-writing from an information processing perspective yield relevant results?

It may be that some researchers doubt that the information processing approach to essay-writing will yield relevant results. Throughout the planning and conducting of this research, the researcher was aware of the danger pointed out by Hounsell (1988 p162-165). In conducting controlled laboratory experiments based on writing as a cognitive process, one may not be researching writing but thinking, and that one's results may lack relevance because the context in which the writing is taking place has

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[47] Question 13, 1987.

not been taken into account.

As already explained[48], the researcher will indeed be researching thinking and, as will be explained later in this chapter, many of the experiments are laboratory-type, using questionnaires and short exercises. After considerable reflection, the researcher was satisfied that criticisms such as those offered by Hounsell can be explained away and that results of experiments would be relevant. This was so for three main reasons.

- As should be evident from the description of IKR and information processing, the **distinction between writing and thinking is a false one**. Even limited reflection on what activities are involved in writing an essay, reveals that what is called "writing" is almost identical with thinking. Greene (1987 p161) finds similarly: because she finds that although the concept of thinking is elusive, in one sense, "... all the activities involved in speech and action can be defined as thinking ...". The researcher advises students to regard **writing as thinking**. The physical act of putting thoughts down on paper could be more accurately called "**scribing**".

- For the researcher, the mere fact of a researcher focussing on a phenomenon to be studied initiates laboratory conditions: what differs is the degree of artificialness. Of course, the more variables that are taken into account the closer the experimental conditions approach natural conditions. However, one must ask what natural conditions are in essay-writing? Is not the writing of essays unnatural and even more unnatural under examination conditions?

- Although in most experiments in this research, students were not asked to scribe essays (write out what they have already thought out), the results will still be relevant. As will now be explained, various experiments examined specific aspects of the way students interpret questions. If an improvement or decline in performance is noted, all that can be claimed is that IKR assists or does not assist students with that aspect of interpreting questions. With this background it is now possible to record several general hypotheses which were raised and on which the research was based.

1.3 GENERAL HYPOTHESES AND STRUCTURE OF THE RESEARCH PROGRAMME

Rather than merely list several general hypotheses it is possible to illustrate how hypotheses were incorporated into the research programme. The term "general" is used since in this introductory chapter it was neither possible nor desirable to predict in detail the specific hypotheses to be tested in individual experiments.

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[48] Paragraph 1.2.1.

1.3.1 THE EFFECT OF IKR ON EXAMINATION RESULTS

So far, the researcher has frequently made explicit the assumption that IKR can assist students to write better essays. If IKR does enhance the effectiveness of using working space, this should be reflected in students' examination essay marks. While according to theory and anecdotal evidence there are reasons to expect IKR to assist students in writing better essays, if it is found that it does not, then there is little point in continuing to give the advice. Consequently, one hypothesis to be tested in this research is that:

Students tutored in IKR will obtain better examination essay results than those who have not been tutored in IKR.

How this hypothesis was tested and the results of the experiment, are described in **Chapter Two**. Whether or not the hypothesis just stated is rejected, the researcher wanted to investigate other aspects of IKR for assisting information processing in an essay-writing context.

1.3.2 THE EFFECT OF IKR ON ABILITY TO RECOGNISE IRRELEVANT STATEMENTS

It is reasonable to expect that questions containing statements will require more processing than questions without statements. Working space will be extensively committed to working out whether the statements are relevant and, if so, what parts are relevant. Consequently, even if two questions are of **equal difficulty in terms of information processing needed to answer them**, some students might perceive the one with a statement to be more difficult. After tutoring in IKR, students are likely to be able to use working space more effectively and recognise that two examination questions, one with a statement and the other without, are of equal difficulty because the **actual questions (what is required)** are of equal difficulty.

As already indicated, in some cases, students' processing time may be wasted and use of working space ineffective because questions with statements contain unnecessary or irrelevant information. Where there is irrelevant information, even though students take time to read and analyse (process) the statements in questions, this effort may not help and may even mislead them. However, if students have as a part of their information processing skills a technique such as IKR for helping them to identify irrelevant information, it is safe to state that they should not experience difficulty merely because they find statements in questions misleading.

With this background it is possible to raise a hypothesis to test these assumptions, but before doing so it is necessary to alert the reader to two subtle, but most relevant, distinctions associated with the word "**difficulty**". Firstly, there is a distinction

between **students' perception of difficulty** and **actual difficulty** in terms of information processing required by the question. The researcher's experience indicates that students' perceptions of a question's difficulty are based on how difficult it is **to read and understand**, not on how difficult it would be **to answer** that question. In other words, it is suspected that students do not perceive question difficulty on the basis of the amount and complexity of information processing required to answer the question. Simply put, **experiencing difficulty in reading** and understanding a question is not the same as **experiencing difficulty in answering** it.

Several implications arise from this distinction.

- Hartley (1983 p74) finds that a criterion students use to choose an essay topic is how easy or difficult the topic is thought to be. Consequently, if students' criteria for assessing question difficulty are inadequate, they may choose to answer questions which are more difficult than they think. Conversely, students may decide not to answer questions which, with further interpretation, would be found to be easier than first thought. It is expected that IKR can provide a way of assessing question difficulty more accurately.

- If students do find a question difficult to read and understand, what is being tested is not their knowledge of the subject matter, but their ability to interpret correctly the examiner's possibly inadequate communication.

- For the researcher, students' perceptions of question difficulty based on how difficult a question is to understand, are based on inadequate information processing skills. It is expected that better information processing skills, as provided by IKR, will change students' perceptions of difficulty **away from the wording of the question to what is required to answer the question.**

- Some students might claim that a question is difficult because they do not have sufficient knowledge to answer it. However, it is safe to state that the difficulty in this perception does not arise from the question, but the students' lack of preparation.

The researcher considers that **difficulty in understanding** a question and **difficulty in answering** it are related to the distinction between the **examination question** and the **actual question**. It is expected that without knowing about IKR, students' perception of difficulty will be based on the examination question, whereas after IKR it will be based on the actual question. This does not mean that all statements are irrelevant. However, students should be better able to concentrate on using working space to answer the question, rather than to struggle with data in statements. With this extensive background the following general hypothesis was raised.

Given a pair of examination questions, one with a statement and the other without, but both containing actual questions of equal difficulty, most students will perceive the examination question containing the statement to be more difficult. After workshops on IKR, more students will recognise the equal difficulty of the two actual questions.

The reader will notice that this hypothesis comprises two part-hypotheses. However, to keep this thesis to a manageable length it was decided not to separate out these two part-hypotheses. A similar approach is taken with other two-part hypotheses and the presentation and discussion of results in the text of this thesis are dealt with accordingly. The methodology used to test this hypothesis is explained in **Chapter Three** and the results of the experiment presented in **Chapter Four**.

1.3.3 THE EFFECT OF IKR ON ABILITY TO RECOGNISE IRRELEVANT QUESTION LENGTH

The reasoning and background provided for questions with statements can also be applied to lengthy questions, and the following hypothesis was raised.

Given a pair of examination questions, one longer than the other, but both containing actual questions of equal difficulty, most students will perceive the longer question to be more difficult. After workshops on IKR, more students will recognise the equal difficulty of the two actual questions.

The methodology used to test this hypothesis is also explained in **Chapter Three** and the results of the experiment presented in **Chapter Four**.

1.3.4 THE EFFECT OF IKR ON ABILITY TO RECOGNISE THE NUMBER OF PARTS IN A QUESTION

Adequate information processing skills (chunking skills in particular) should enable students to identify correctly the number of parts in any question. However, since it is contended that IKR enhances use of working space by showing students how to chunk, it is expected that more students will identify more accurately, the number of parts in several questions. The following hypothesis was raised.

After a workshop on IKR, students will identify more accurately the number of parts in seventeen questions.

The methodology used to test this hypothesis is explained in **Chapter Three** and the results of the experiment presented in **Chapter Five**. The results of testing this hypothesis should provide indications of the effectiveness of IKR as a chunking (heuristic and attention directing) device. The reader might notice that the hypotheses stated so far, enable testing of only fragments of the information processing procedure as far as question interpretation is concerned. During this research it was realised that a

more holistic approach would give another, perhaps more realistic view of the role of IKR in enhancing effective use of working space. It was decided to test the effect of IKR on students' descriptions of how they would answer various questions.

1.3.5 THE EFFECT OF IKR ON ABILITY TO DESCRIBE ADEQUATELY HOW A QUESTION SHOULD BE ANSWERED

As already explained, if IKR does enhance information processing skills then after having IKR explained to them, students should be able to better describe how they would answer any question. It is safe to state that to describe adequately how they intend to answer a question, students must have an adequate understanding of what the examiner requires. In terms of information processing theory, better descriptions of how one would answer a question are indications that there are few hindering perceptual filters and where there are, these have been altered. In other words, understanding of what the examiner requires has been adequately reconstructed. The following general hypothesis was raised.

After workshops on IKR, students' descriptions of how they intend to answer questions will be more adequate than descriptions before such workshops.

A description of the methodology to test the hypothesis and a report of the results are presented in **Chapter Six**.

1.3.6 THE EFFECT OF IKR ON REASONS FOR ONE QUESTION BEING PERCEIVED AS MORE DIFFICULT THAN ANOTHER

Without being initiated into IKR, students' reasons for perceiving a question to be difficult are expected to relate to the **length of the question**, the **confusion caused by a statement**, the **poor wording** of the question and the students' **lack of knowledge** of the topic. However, after tutoring in IKR students should be aware that question difficulty arises from the **number and type of mental steps/processes to be undertaken to answer it**. Consequently, it is expected that reasons for perceptions of difficulty will change from those already stated to the amount of work involved, the number of parts, and Level II instructions, or similar. The results of testing the following hypothesis are presented in **Chapter Seven**.

After workshops on IKR, more of the reasons (than before the workshops) given for one question being regarded as more difficult than another will relate to the extent of mental effort required to answer the questions.

1.3.7 THE EFFECT OF IKR ON RECOGNITION OF THE GREATER DIFFICULTY INDICATED BY LEVEL II INSTRUCTIONS

It has already been explained how Level II instructions such as **compare** and **discuss** involve greater mental effort (processing) than Level I instructions such as **describe**

and **list**. While the researcher suspects that many students will have an intuitive understanding of the greater difficulty inherent in Level II instructions, it is expected that after tutoring in IKR students will be even more aware of the difference in processing required. Consequently, the following general hypothesis was raised.

After workshops on IKR, students' awareness of the greater difficulty inherent in Level II instructions will increase.

The method used in conducting the experiment to test this general hypothesis is described in **Chapter Three**, and the results presented in **Chapter Eight**.

1.3.8 THE EFFECT OF IKR ON PERCEPTIONS OF DIFFICULTY INDICATED BY SEVERAL INSTRUCTIONS.

It has already been explained that students have their own conceptions (perceptual filters) regarding the meanings of some instructions. For example, many students have indicated to the researcher that they do not like questions that begin with **compare and contrast** and **write an essay**. If IKR does improve information processing, students should be able after tutoring in IKR to better distinguish those instructions which indicate more mental work and hence more difficulty. The researcher suspected that the Level I/Level II conception of instruction difficulty would be too simplistic, and wanted to test this. It was possible to raise the following general hypothesis, the testing of which is reported in **Chapter Nine**.

Despite Level I and Level II concepts of difficulty being explained in IKR workshops, a significant number of students will still perceive a difficulty difference between two instructions of the same difficulty level.

The researcher also wondered if it would be possible **to rank a number of instructions** according to their perceived difficulty. If such a ranking was possible, it was expected that because overall perceptions of difficulty are potentially reduced by using IKR, the **range of difference** between the instructions perceived to be most and least difficult would **be reduced**. The following general hypothesis was raised, as reported in **Chapter Ten**.

After workshops on IKR, the overall extent of perceived difficulty will be reduced, and the range of difference between the most difficult and least difficult instructions will diminish.

1.3.9 THE EFFECT OF IKR ON TIME TAKEN TO COMPLETE QUESTION INTERPRETATION TASKS AND ON PERCEPTIONS OF THE DIFFICULTY OF THIS TASK.

Since it should increase the effective use of working space, IKR should lead to most students finding it easier to interpret a group of questions, and should result in less time being taken to complete such interpretation. The following general hypothesis was raised and the results of testing it are reported in **Chapter Eleven.**

After workshops on IKR, students will take less time to complete question interpretation tasks and will experience such tasks as easier.

1.3.10 IKR AS AN EXPLICIT INFORMATION PROCESSING HEURISTIC AND ITS IMPLICATIONS FOR LECTURERS AND EXAMINERS.

It is safe to state that **an effective question is one which tests what the examiner wishes to test and is so free of noise as to make it easy for students to know what the examiner wishes to test.** It is not the researcher's intention to be critical of some questions set by fellow-educators. However, it is reasonable to state that if examiners set more effective questions, this should assist students in improving their essay-writing. It was expected that this research would result in recommendations for examiners. This possibility is discussed in **Chapter Twelve** where conclusions to the research as a whole are given.

1.4 CONCLUSIONS

Essay-writing, and in particular students' ability (or lack of ability) to interpret questions adequately (reconstructing understanding of what is required) is, and is likely to remain, a topical area of study. It cannot be denied that writing is a complex activity and that it is a very difficult topic to research. Blackwell (1980 p401) finds similarly. As far as the researcher can determine, the investigation of the effects of IKR on students' question interpretation is pioneering research. As with all pioneering research, it is expected that this research will contribute in a small way to enhancing knowledge. Just what this contribution might be is assessed in **Chapter Twelve.**

The scope of this research has had to be limited in order to provide meaningful results and to keep the length of this thesis within manageable bounds. It is likely that many valid hypotheses have not been raised. In addition, in the original planning for this research, the researcher designed experiments and collected data in the hope of finding answers to six other research questions.

• Given the same questions, do students and examiners give the same IKR

interpretations?

- If IKR does enhance information processing skills[49], is this enhancement still present after one year?
- If IKR does assist in recognising the difficulty of questions, can it assist students in ranking questions according to difficulty level?
- Does IKR influence the way students select questions during an examination?
- Is it possible to use IKR to devise a question difficulty index?
- Does IKR affect the way students perceive the difficulty of questions whose content is taken from unfamiliar disciplines?

Preliminary analysis of the data relating to the research questions just listed, indicated that further analysis would not have contributed to the main thrust of this research. Consequently, it was decided not to analyse the collected data for inclusion in this thesis. The researcher expected that additional research questions would arise from this research and these, if any, are presented in **Chapter Twelve.**

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[49] The reader will have noticed in this chapter that the phrases "question interpretation skills" and "information processing skills" have been used as if they were one and the same process. While information processing is certainly going on during question interpretation, whether the phrases should be used as synonyms could be debated.

CHAPTER TWO

DOES TUITION IN IKR IMPROVE THE ESSAY EXAMINATION RESULTS OF FOURTH YEAR HONOURS CHEMISTRY STUDENTS?

2.0 INTRODUCTION

The researcher's overall aim in devising IKR was to assist students to write better answers in response to essay questions, particularly under examination conditions. Consequently, it was decided to test the following hypothesis:

Students tutored in IKR will obtain better examination essay results than those who have not been tutored in IKR[1].

The researcher was concerned about testing this hypothesis so early in the research because of the lack of greater insight into the workings of IKR in terms of information processing. For example, results might be biased one way or the other because, in tutoring students, some vital aspect of IKR may be omitted or conversely, because too much information is presented inadequately. However, this is a difficulty facing all researchers conducting pioneering research: one must begin somewhere and it was expected that this experiment would reveal more about student information processing in relation to IKR.

2.1 METHODOLOGY

In 1990, the researcher was invited to tutor on IKR as part of the fourth year honours course in the Department of Chemistry in the University of Glasgow. This group of students is required to sit an essay paper as part of the final examination. To enable students to gain maximum benefit from the practice of IKR, it was decided to offer four, one-hour workshops. The workshops were offered in February/March because this was close enough to the final examination in June to indicate the urgency of the workshops, but not so close that students would be anxious and over-concerned with "swotting". To encourage students to attend, extensive consultation was undertaken, firstly, through lecturing staff and secondly by letter to all forty one students. A copy of this letter is shown in Robb (1993 p2)[2].

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[1] In addition to listing most hypotheses used in this research in Chapter One, each hypothesis is again stated in the chapter where the experiment which tested it is described. This limited repetition is designed to assist the reader.

[2] Many items of documentation and additional data could not be included in this thesis either because they were too bulky or because they would have distracted the reader. However, it was thought that some documentation would be of interest to some fellow-researchers. Consequently, it was decided to compile these documents in an archive (**Robb 1993**) which is kept in the Centre for Science Education, University of Glasgow.

The content of each workshop was designed to convey information, allow practice and to encourage further practice in the students' own time during the days between workshops. A description of the content for each workshop and copies of the handouts used, are provided in Robb (1993 p3-25). A number of methodological problems including ethical ones arose, and how these were dealt with is now explained.

- The researcher wanted to test the effectiveness of only IKR and it was hoped to isolate (hold constant) the beneficial effects of **planning skills** and **thought-linking techniques**. However, not offering tuition in these two skills may have deprived students of additional ways to improve their essay-writing. Since it is the researcher's contention that it is IKR which, to a large extent, determines the quality of planning and thought-linking, it was decided that teaching these additional techniques would not bias the results. Consequently, tuition in planning skills and thought-linking techniques was offered in addition to IKR.

- Ideally, to obtain the greatest statistical adequacy, the researcher should have selected randomly half of the whole class. Apart from the impracticality of the selected students keeping secret from their fellow-students what they learned about IKR, it was decided that to deprive some students of improving their essay-writing was unethical. Consequently, the workshops were offered to all students who wished to attend. The researcher was aware of the danger in this way of selecting. If the two groups were of different abilities to begin with, the result would be biased and it would be necessary when results were being analysed, to test whether there was a significant difference in the abilities of the two groups. It was anticipated that about half of the group of about forty one students would attend the workshops.

- As the four workshops progressed, the number of attendees decreased through twenty eight, twenty two, sixteen and nine, respectively. Although the attendance in Workshop Four was very poor this was not particularly worrying since IKR had been dealt with during the first two workshops. While the reasons given for non-attendance were understandable[3], the researcher wished to maintain the numbers attending so that the comparison of examination results would be meaningful, and to this end the following steps were taken.

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[3] Some students thought the sessions were on Wednesdays and Fridays, but Session Three was on Monday. The reasons given for the low attendance in Session Four were: preparing for talks the following week; rehearsals for a fourth year show; some students had to attend organic chemistry; hangovers from a disco the previous night and Friday at four o'clock was inconvenient. In addition, it was known that this group were under considerable pressure to complete laboratory projects before the end of term.

Those students who had attended Workshops One and Two, but had missed Three and Four, were invited to an additional workshop. Workshop Five repeated the contents of Workshops Three and Four. In addition, those students who had attended at least two workshops, were sent copies of handouts for the workshops they had missed. Handouts were also sent to the students invited to Workshop Five but who did not attend. The objective was to have a group of students (**the attendees**) who had either attended, or had in their possession the handouts for, all four workshops. Samples of the letters just described are provided in Robb (1993 p26-28).

The descriptions of the content of the workshops and the letters to students, as presented in Robb (1993), illustrate that the researcher attempted to enthuse and motivate students about essay-writing. It is necessary to make explicit the reasons for taking this approach because the way the content was conveyed may influence results. The researcher has found from previous experience that many students lack confidence in essay-writing in examinations. Some students are also, to some extent, embarrassed about being unable to perform well in essay-writing: there seems to be an assumption that a university student should be able to write effective essays. The five techniques employed to build confidence are explained briefly in Robb (1993 p29). After the usual University examining procedures were completed, the researcher compared the marks of attendees and non-attendees for the essay-paper.

Before proceeding to report these results, it is possible to report on the results of the process of conducting the workshops. This information is relevant because it must be borne in mind when interpreting the statistical results.

2.1.1 SOME OBSERVATIONS ON THE PROCESS OF CONDUCTING THE WORKSHOPS

None of the students admitted that they had previously read any book or attended any course on essay-writing. Consequently, it is safe to state that prior knowledge of IKR could not have influenced the results[4]. Similarly, there were so few incidents (three in total) of students reporting sharing their handouts with non-attendees that it is safe to state that results would not have been biased by this. However, some students were not used to the informal approach of the researcher (as lecturer) and found this amusing. In addition, it seemed as if half the attendee group did not take the workshops seriously. This improved markedly as the workshops progressed, but the researcher wondered about the effect this would have on the results.

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[4] The precaution of establishing this was necessary because the researcher's book (Robb 1976) containing details of IKR was available in the University Bookshop.

In general, the completion of the exercises (to be completed in the students' own time) was disappointing. Students' estimated average completing time for most exercises was far short of the researcher's estimate for adequate completion. Although most students indicated that they did not need more time, it was evident in class discussion that exercises had not been given adequate attention. Taking in the exercises for 'marking' might have encouraged students to devote more time to them, but doing this may have dissuaded those who did not attempt them, from attending.

This lack of practice was expected to affect the results because no matter how effective a chunking device might be, if it is not used, its potential is unlikely to be realised. Responses to a feedback questionnaire (Robb, 1993 p23-24) issued at the end of the four workshops reassured the researcher on some of the points just raised, but only eleven questionnaires were returned, reflecting the lack of enthusiasm for the workshops. Most respondents thought that attending the workshops would have a beneficial effect on examination results and that the researcher's teaching style did not hinder students' learning.

2.1.2 COMPARISON OF EXAMINATION ESSAY MARKS OF THE ATTENDEES AND NON-ATTENDEES

As already indicated, before comparing the essay-paper marks of the two groups for significant difference, it had to be established whether or not attendee and non-attendee groups were of equal ability. Using students' essay marks it was established that both groups conformed to that of a **normal distribution**. Two t-tests of significance were then conducted, one using the total final examination marks for each student, and the other using the total third-year mark[5].

The relevant data compiled from departmental records to test for normal distributions are shown in **Tables A.1, A.2** and **A.3** in **Appendix II**. The t-tests revealed t-values of **0.1366** and **0.0859** respectively. Both results were checked with a computer statistical package and confirmed values of **0.137** and **0.086** respectively. Consequently, the probability that both groups are not of equal ability (44.35%) and (46.49%) respectively, is acceptable and it can be taken that attendee and non-attendee groups were of similar ability.

Having found both groups to be of similar ability, it was possible to compare the performances in the final examination essay. A t-test was again conducted and a t-value of 0.006 was obtained indicating that there is no significant difference in the essay examination performance of the two groups. This means that those attending the IKR

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[5] In third year, each student sat three papers and the total mark was taken to be the average of the three.

workshop did not gain higher marks in the essay examination, than non-attendees.

2.2 DISCUSSION

The researcher wondered why attendees did not do significantly better in the essay examination paper than non-attendees. Anecdotal evidence had suggested that many students find IKR helpful, and the feedback questionnaire returned by the eleven students at the end of the four workshops confirmed this. Three main possible reasons were identified for attendees not doing significantly better than non-attendees.

Firstly, since attendance at workshops was voluntary, it could be that a higher proportion of attendees experienced difficulty with essay-writing. Although the attendee and non-attendee groups were of general equal ability, perhaps the data used to test this hides the possibility that some attendees had below average essay-writing skills or indeed, had a strong dislike for essay-writing. This difficulty could be overcome by **a before and after analysis of the same group** and the researcher considered using this experimental design in other experiments during this research.

Secondly, the researcher had very little control over, or knowledge of, the extent to which the attendees practised IKR before the examination. As already indicated, most students seemed to devote inadequate time to the "homework" exercises. There is a strong possibility that attendees did not practise sufficiently and did not, or were unable to, use IKR effectively. The requirement for practice cannot be underestimated because, as with any technique, it may seem difficult at first, but becomes easier with practice.

Thirdly, there were several minor factors which concerned the researcher.
- Those students who attended only Workshop One, which concentrated on IKR, may have gained sufficient benefit to perform well in the examination. These students would have been included in the non-attendee group and may have done better in the essay paper than they would have if they had not attended Workshop One.
- The fact that handouts were posted to some attendees could also have contributed to relatively poor performance. Bearing in mind the low attendance at the additional workshop (Workshop Five), this was the only option available to ensure a significant number of "attendees". However, even if many attendees were unable to learn effectively from handouts this should not have affected the result too much since IKR was dealt with in Workshops One and Two.
- Pressure on this particular class of students to complete research projects at this time of the year could have led to less than adequate concentration on the workshops

which were held from four to five o'clock in the evening.

- As information processing theory explains, it is difficult at the best of times to change attitudes with regard to thinking skills. If students have habitually used methods derived from their own experience or learned in school, which they perceive as serving them well, it is likely that they will continue to use them even when shown a new and 'better' one. Unless students have a perceived need and recognise that their existing strategies do not meet their needs, they will not be open to change. The poor attendance rate at workshops and the lack of diligence regarding exercises, already mentioned, corroborate this.

Consequently, it could be that although students attended workshops on IKR and completed exercises (to some extent), some of them reverted to their own methods in the pressure of the examination. As is usual in research of this kind the researcher has attempted to find other variables which might have produced results other than those expected. However, this should not be interpreted as an attempt to ignore the fact that the IKR model itself might require considerable modification if it is to assist students. It could also be that if students had been first asked to write an essay and this had been marked harshly by the students' supervisors, attendees might have performed better. However, this approach may have given rise to another problem: almost all of the class of forty one might have attended, leaving no possibility of comparison with non-attendees.

2.3 CONCLUSIONS

In this study, twenty two, fourth year honours chemistry students who attended four one-hour workshops on IKR did not do significantly better in the essay examination than their nineteen colleagues of equal ability, who did not attend the workshops. There were several possible reasons for this result contradicting the researcher's experience of the usefulness of IKR and the statements of many students claiming that it is helpful.

As is usual in research of this kind, further research requirements were indicated. For example, a group of students could be asked to complete an exercise before knowing about IKR; offered tutoring in IKR, and then asked to complete the same exercise again. The **before and after results** could be compared. The researcher also wanted to find out **just how students perceive question difficulty**. Perhaps wording of some kinds confuses students or worries them unduly. By testing various aspects of question design such as length and layout, it might be possible to isolate some factors in a question which students identify as making that question more difficult than others.

During this first experiment in this research, the researcher became aware of the practical constraints frequently encountered in field research, two of which are now briefly outlined. Firstly, it is evident that many students do not take "**communications skills**" or "**essay-writing skills**" seriously. It is understandable that a student of chemistry, without knowledge of the communication skills required of an industrial/commercial chemist, will be more concerned about the excitement and intricacies of chemistry than about essay-writing. Secondly, the researcher was dependent on the goodwill of students and staff in other departments. For example, although the researcher would have wished to repeat this experiment, modifying it by first asking students to write an essay, it was realised that the workload of chemistry honours students would not permit this.

As already explained, the researcher tutored postgraduate adult education students studying for a professional qualification and graduated civil engineers preparing for their Institution's professional examination. It was expected that these groups, having had work experience, would recognise the benefits of effective essay-writing as a foundation for other modes of communication and would treat IKR exercises more thoroughly. In addition, the researcher also had the opportunity to work with undergraduate civil engineering students who were required, as part of their course work, to submit exercises designed to enhance their communication skills. Consequently, the researcher was able to design further experiments which could be included ethically[6] into the course work of all three of these groups.

The researcher wanted to find out if IKR could enable students to identify more effectively just what examiners require. The first experiment to test this involved sixty five civil engineering undergraduates and was designed to test, among other things, whether after workshops on IKR, students were more effective at identifying the number of parts in a question, and at avoiding being misled by irrelevant statements. Details of this experiment are now described in **Chapter Three**.

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6 All steps possible were taken to ensure that the exercises contributed to learning and were directly related to required course work. It was explained that the exercises would provide data for a doctoral study.

CHAPTER THREE

CAN IKR IMPROVE THE QUESTION INTERPRETATION ABILITY OF FIRST YEAR UNIVERSITY, CIVIL ENGINEERING STUDENTS?

3.0 INTRODUCTION

As mentioned in Chapter One, the researcher's impression gained from experience in assisting students with essay-writing, is that they experience difficulty when questions contain **statements** and when questions are **relatively long**. This impression was gained while marking answers to questions and from explicit statements from students such as: "The question was so long I couldn't understand what was going on", or "I couldn't tell how much of the introduction I should use". In addition, some students performed poorly because they did not answer the question fully, that is, they did not seem to be able to identify accurately all the parts in a question.

The distinction between the **examination question** and the **actual question** has already been explained[1]. It provides a way of testing the effect of question length, use of statements and number of parts, on students' information processing skills. If the wording of the actual question is held constant, but the length of the examination question varied by adding or subtracting words, one can test the effect of length. Similarly, if a statement is included in some questions and not in others, one can test the effect of statements on information processing. In addition, varying the number of parts (as indicated by the number of IKWs[2]) in the actual question, and also varying the length of the examination question, allows one to test the effect of varying examination question lengths on ability to identify the number of parts.

By conducting tests with the same student groups before and after workshops in IKR, one can assess whether or not IKR has enhanced information processing skills when they are confronted with these varying situations. The researcher also wanted to test whether or not students were aware that Level II IKWs such as **discuss** indicate a more difficult answer than Level I IKWs such as **describe**. By removing statements, keeping question length constant, and varying only the IKWs, one can test for **students' recognition of greater difficulty**. In addition, by comparing the time taken by students to complete question interpretation tasks and students' perceptions of the difficulty of such tasks, one can find out if IKR assists students. To enable scientific testing of these informal predictions, five main hypotheses were raised, as already explained in Chapter One[3]. For the reader's convenience, these hypotheses will

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[1] Paragraph 1.1.1a, Example Five.
[2] The reader is reminded that IKW is shorthand for "Instruction key word".
[3] They have already been stated in a preliminary way in Paragraphs, 1.3.2, 1.3.3, 1.3.4, 1.3.7, and 1.3.9.

be stated at relevant points in this chapter.

In order to test these hypotheses, four individual experiments were designed: the fifth hypothesis could be tested using data collected from the four experiments. All four experiments were conducted with the same group of students - eighty civil engineering undergraduate students in the University of Glasgow. Each year from 1988 to 1992, the researcher was responsible for offering four workshops in communication skills to this student group. Two of the workshops involved using IKR.

Part of each experiment employed an exercise, and the four exercises were compiled in a questionnaire. Students were asked to complete, as 'homework', the questionnaire before being tutored in IKR; then offered two workshops on IKR, and then asked to complete the same questionnaire again. Consequently, all four experiments were conducted at the same time. Student performances **Before** and **After**[4]. were compared to find out if there had been a significant improvement in information processing skills. As will become apparent, each of the four experiments employed a somewhat complex design, and each of three of the four exercises comprised numerous pairs of examination questions to be compared. Consequently, the researcher considered how best to describe the methodology employed in, and results of, these four experiments.

Although it might seem ideal to describe the methodology employed in, and results of, an experiment together, this approach was not taken. As will also become apparent throughout this thesis, some of the hypotheses were tested in other experiments with different student groups. Describing the results of the four experiments just mentioned and then the results of similar experiments in later chapters would have led to excess duplication. Consequently, in this chapter, only the design and methodology of each experiment is described. The results of each experiment will be reported and discussed in other chapters in this thesis, as will be indicated.

3.1 CONSTRUCTION OF THE QUESTIONNAIRE, AND THE CONTENT OF THE IKR WORKSHOPS

The Before and After questionnaires were identical (except for the covering directions), each comprising a total of **fifty one pages** in five parts (A, B, C, D and E), with directions for completing each part. Each part contained a different exercise, representing a different experiment. A copy of the whole questionnaire[5] is included in Robb (1993 p30-80), but the covering directions issued Before and After are shown in **Appendix III**, and the directions and a sample page layout for each of the parts

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[4] To improve expression in this report the terms "Before" and "After" are used as shorthand to mean before IKR workshops and after IKR workshops.

[5] Since the Before and After questionnaires were identical, the singular is used.

(excepting Part E)[6] are presented at appropriate places in this and other chapters.

Most of the questions used in the questionnaire were taken from past papers of the examination for membership of the Institution of Civil Engineers, and a few were taken from examination papers in adult education and chemistry. Questions from the two unfamiliar disciplines were included since as already explained, once IKR is explained to students they should not be put-off by unfamiliar content. However, as already explained, to keep the scope of this research within reasonable bounds, a comparison of students' performances on interpreting questions with familiar content and questions with unfamiliar content, was not undertaken in this research. Many of the questions were adapted to meet the conditions of the experiments. Since, in terms of information processing, interpreting question difficulty does not depend on content, the researcher considered that using professional-level examination questions for first year undergraduates would not adversely affect the results.

The content of the workshops offered to this group of students was very similar to that offered to chemistry students as described in Chapter Two, although most of the examples used were taken from the discipline of civil engineering. The additional handouts used are presented in Robb (1993 p81-87). Some problems (similar to those encountered when giving IKR sessions to chemistry students, were encountered during the workshops, and similar steps to those reported in Chapter Two were taken to overcome these. In addition, however, the researcher anticipated that the length of the questionnaire might result in a poor response rate. Consequently, when the Before questionnaire was handed out, considerable care was taken to explain that it was not a test; that there would be no assessment mark and that the size of the questionnaire was due to its presentation - not to the volume of work it would entail.

Another anticipated difficulty was the size of the analysis task for the researcher if all students completed both questionnaires. However, since the questionnaire was part of the students' course work and because using a smaller sample would mean that some of the class might be disadvantaged, it was decided to persevere with the whole class. An advantage of a large number of responses, if they were forthcoming, would be that safe generalisations could result. At the end of the IKR sessions, sixty five students had returned both the Before and After questionnaires, giving sixty five sets to compare.

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[6]   As explained in Paragraph 1.4, some of the data collected has not been used for this thesis. Part E of the
      questionnaire was designed to collect data relating to the ranking of questions according to difficulty.

The researcher was concerned that the length of the questionnaire would discourage students from making the same effort After, as they did Before. This response would have been understandable since, in effect, students[7] were asked to do the same exercises twice. This was of major concern because as already explained, it was predicted that After IKR, students would take less time to complete the exercises and find them easier. If less time was taken, this might have been the result of students being bored or resentful and completing the After exercises in a slap-dash manner. If students did find the After exercises easier, it could be because they devoted less attention to them. To obtain an indication of how much effort students put into the Before and After exercises, a very short, one page, feedback form was issued after the After questionnaire had been collected.

In this feedback form, students were asked to indicate for both Before and After, how much effort they put in: "considerable effort", "some effort", "little effort" and "very little effort". The researcher explicitly asked students to be honest, and it was explained that the only reason for asking these questions was to discard those questionnaires where students put in very little effort. It was also mentioned that the completed feedback form would be destroyed and they would not be used for assessment of any kind. A copy of this feedback form is presented in **Appendix IV**, and the results of the analysis of this feedback are shown in **Table A.4** in the same appendix.

Before IKR, 96.4% of students and After IKR, 73.2% put in "considerable" or "some effort". The researcher considered this sufficient to regard the After data as being of reasonable quality. After IKR, 30.4% of students put in the same effort, 66.1% gave less and 3.6% more effort. It could be, of course, that the decline in effort may not be a cause for too much concern since if students found the exercises easier After IKR, then they would naturally put in less effort.

The researcher found that the recording and analysis of data from 130 questionnaires required extensive effort. For each student within each exercise, an intermediate analysis sheet was structured and the results for each student for each experiment were tabulated and differences calculated. A computer analysis of this raw data was undertaken to gain as much information as possible. A set of intermediate analysis sheets, all raw data, and the computer print-out of more detailed tabulations, is shown in Robb (1993 p88-97). With this general background further description of

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[7]   The frequent changing between **"students"** and **"respondents"** in the text of this thesis led to clumsy expression and it was decided to use "students" throughout. The reader will be able to determine from the context, when students are also respondents.

methodology employed for each experiment is now presented.

3.2 DETAILED EXPERIMENTAL DESIGNS TO TEST THE FOUR HYPOTHESES

3.2.1 EXPERIMENTAL DESIGN TO TEST THE EFFECT OF IKR WHEN QUESTIONS CONTAIN STATEMENTS

The researcher's experience indicates that if students are presented with a pair of examination questions, one with a statement and the other not, but both containing actual questions of equal difficulty[8], the question containing the statement will be perceived by most students as being more difficult. It was also expected that After IKR, the extent of this perception will be reduced: many students should recognise that when both actual questions in a pair are of equal difficulty, the examination questions which contain them are of equal difficulty - even though one contains a statement and the other does not. To test this the following hypothesis was raised.

Given a pair of examination questions, one with a statement and the other without, but both containing actual questions of equal difficulty, many students will perceive the examination question containing the statement to be more difficult. After workshops on IKR, more students will recognise the equal difficulty of the two actual questions.

Eight pairs of questions were devised with both actual questions of the pair being of equal difficulty. Each pair was printed on a separate sheet of paper and numbered A_1 to A_8[9]. In four of the eight pairs (A_1, A_2, A_4, A_7) no statement was present in either question - these four were the control pairs. In the other four pairs (A_3, A_5, A_6, A_8) one question of the pair had a statement and the other did not: these were the experimental pairs. The eight pairs, four with control pairs and four with experimental pairs were placed in random order. In the experimental pairs a further precaution was taken to ensure that the position of the questions containing the statement alternated on the page. Consequently, in A_3 and A_6 the question with the statement is numbered "1" and in A_5 and A_8 the question with the statement is numbered "2".

An illustration of how pages in Part A of the questionnaire were displayed is given in **Figure 3.1** on the following page[10].

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[8] Careful consideration was given to the use of the phrase "**equal difficulty**". While it is unlikely that two questions will be absolutely equal in terms of information processing required to answer them, it is possible, taking into account the number of parts and the level of the IKWs, to design questions that are in effect equal. Consequently, the phrase "**similar difficulty**" was not appropriate.

[9] To improve the expression in this chapter a shorthand way of referring to pairs and questions is used. For example, "Pair A_1" is shortened to "A_1" and "Question One" to "Q_1". Question Two in Pair A_6 is expressed as "A_6Q_2".

[10] As explained, the questionnaire comprised fifty one pages and it would have been impractical to include it in the text of this thesis. Consequently, a copy of the entire questionnaire is provided in Robb 1993 (p30-80).

Figure 3.1
An illustration of the page layout used in Part A

A1

1. **Describe the effects of computer applications on the education and training of an engineer.**

2. **Describe the role of computer applications on the education and training of an engineer.**

Please tick (✓) the box you think indicates the true situation

i)   1 is more difficult than 2 .... ☐

ii)   2 is more difficult than 1................................. ☐

iii)   Both questions are of equal difficulty .... ☐

If you ticked i) or ii) please explain briefly why you think one question is more difficult than the other.

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The directions for completion of this part and a list of all eight pairs of questions, are given in **Appendix V**. Students were asked to decide whether Q_1 or Q_2 in each of the pairs was more difficult or if the two were of equal difficulty. The responses (Before and After) for each pair were recorded on preliminary analysis sheets: the coding being a "1" or "2" for Q_1 or Q_2 being chosen and a "3" for questions being perceived as being of equal difficulty. The correct answer for each pair according to IKR is a "3". A score was given out of eight, for the number of correct responses given and a computer comparison undertaken: the results are reported in **Chapter Four**.

Four precautions were taken to ensure that, as far as possible, both actual questions in each pair were of equal difficulty. Firstly, the same knowledge content was used in each question, and on the direction sheet (see **Appendix V**) it was stated explicitly: "Remember - it is not the knowledge content of the question which is important but the structure of the question itself. Assume that you have swotted hard and that you have all the knowledge you need!". Secondly, although some changes in wording were necessary to avoid the actual questions in the control pairs looking exactly the same, this was kept to a minimum. Thirdly, the IKW was kept the same and fourthly, an attempt was made to keep the length of each question in a pair the same. This was achieved by altering the tab stops. If the question in a pair containing the statement extended over four lines, then the other question without a statement and consequently fewer words, was extended over four lines. These precautions were an attempt to hold all other variables constant, except **having or not having a statement**.

In effect, the researcher was predicting that:
- for A_1, A_2, A_4, A_7, (no question with a statement) very few students would indicate one question of a pair as being more difficult than the other;
- when one question is perceived (erroneously) as being more difficult, this will mostly occur in A_3, A_5, A_6, A_8;
- if a question in a pair is perceived (erroneously) as being more difficult, it will most likely be those with a statement, namely: A_3Q_1, A_6Q_1, A_5Q_2, A_8Q_2.

Since identifying one of the questions as more difficult would be an erroneous perception, the researcher wanted to know why students made these choices. Consequently, students were asked to explain why they thought the question they selected, was more difficult. Although the open-ended data generated would be difficult to record and analyse for the researcher, it was hoped that helpful insights would be gained into how students perceive difficulty. Students' explanations of perceived difficulty were analysed and the results are explained in **Chapter Seven**.

3.2.2 EXPERIMENTAL DESIGN TO TEST THE EFFECT OF IKR WITH LONGER QUESTIONS

The researcher's experience is that many students perceive longer questions to be more difficult than shorter questions. It was expected that if presented with a pair of questions in which both questions had statements and actual questions of equal difficulty, but one being longer than the other, many students would perceive the longer question to be more difficult. If IKR enhances information processing skills, then After IKR the extent of this erroneous perception should be reduced. The following hypothesis was raised to test this prediction.

Given a pair of examination questions, one longer than the other, but both containing actual questions of equal difficulty, many students will perceive the longer question to be more difficult. After workshops on IKR, more students will recognise the equal difficulty of the two actual questions.

Nine pairs of questions, all with statements (B_1 - B_9), were devised and constituted the second exercise (Part B). It was also decided to test the effect of different line lengths. A standard length was taken to be three lines and it was decided to test twice standard length (six lines) and three times standard length (nine lines). This was done because while it was expected that some students might perceive a three-line question and six-line question as being of equal difficulty, almost all students would perceive a difficulty difference between a three-liner and a nine-liner. It was necessary to "pad" questions to extend them to nine lines. The researcher added (in some instances extensively) to the statements from his own general knowledge. The question lengths of each question in each pair (Q_1 given first) were as shown in **Table 3.1.**

Table 3.1

Line lengths for each question in each of nine pairs of Part B

Pair	B_1		B_2		B_3		B_4		B_5		B_6		B_7		B_8		B_9	
Question	Q_1	Q_2	Q_1	Q_2	Q_1	Q_2	Q_1	Q_2	Q_1	Q_2	Q_1	Q_2	Q_1	Q_2	Q_1	Q_2	Q_1	Q_2
Line length	3	3	6	9	3	9	3	6	6	6	3	9	9	9	6	9	3	6

B_1, B_5 and B_7 were controls with line lengths in the two questions in these pairs being equal. As in Part A, students were asked to decide which question, if any, was more difficult. Again, the responses "1", "2", or "3" for each pair were recorded and the raw data analysed by computer. The correct answer was "3" since the actual questions in a pair were of equal difficulty. For each student, the number of correct responses out of nine was given for Before and After responses and these compared. An illustration of the page layout used in this part is given in **Figure 3.2** on the following page, and a list of the nine pairs of questions is given in **Appendix VI**. The directions for completion of Part B are not shown since they are almost identical to those for Part A.

Figure 3.2

An illustration of the page layout used in Part B

B3

1. Adults are more experienced than children and may be offended by another person telling them what is worthwhile.
   Explain how an adult educator should teach adults.

2. Adult educators, like educators of children, are concerned with doing that which is worthwhile. However, this poses a problem because most adults think they know what is worthwhile and would take exception to another person telling then what is and is not worthwhile. Using the principles of adult education, explain how an adult educator
   must select a) teaching aids, b) teaching methods and c) a personal teaching style so as to achieve the learning objectives without offending experienced adult learners.

Please tick (√) the box you think indicates the true situation

i)   1 is more difficult than 2 .... ☐

ii)   2 is more difficult than 1................................. ☐

iii)   Both questions are of equal difficulty .... ☐

If you ticked i) or ii) please explain briefly why you think one question is more difficult than the other.

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It was realised that several predictions were being made, namely:

- for B_1, B_5, and B_7, (questions of the same length) very few students would perceive one question as being more difficult than the other;
- if one question is perceived as being more difficult, this will be most evident in B_3 and B_6 (pairs where the difference in line-length is greatest);
- if a question is perceived as being more difficult, it will most likely be the question which is the longest, that is: B_2Q_2, B_3Q_2, B_4Q_2, B_6Q_2, B_8Q_2 and B_9Q_2.

The results of this experiment are reported in **Chapter Four**. As in Part A, students were asked to explain why they perceived a question as being more difficult (an erroneous perception). These explanations of perceived difficulty were analysed and the results are explained in **Chapter Seven**.

3.2.3 EXPERIMENTAL DESIGN TO TEST THE EFFECT OF IKR ON IDENTIFICATION OF THE NUMBER OF PARTS AND ON THE REASONS GIVEN FOR PERCEPTION OF A CERTAIN NUMBER OF PARTS

As explained in Chapter One, IKR reveals that the number of parts in a question is almost always equivalent to the number of IKWs. IKR should act as a chunking device - a heuristic - to enable more accurate identification of the number of parts in a question. Seventeen questions $(D_1 - D_{17})$[11] were designed and students asked to state whether the number of parts in each, was one, two, three, or more than three.

Students' responses (Before and After) were recorded and compared with the researcher's IKR interpretation of the number of parts for each question. The number of correct responses out of seventeen was obtained (Before and After) for each student. The results of this experiment are reported in **Chapter Five**. An illustration of the page layout for each question in Part D is shown in **Figure 3.3** on the following page. The directions for this part and a list of the seventeen questions, are presented in **Appendix VII**.

The researcher also wanted to find out how three variables affected (if at all) students' abilities to correctly identify the number of parts, namely: i) the complexity of the question in terms of number of parts; ii) hidden IKWs; and iii) question length. It was hoped to find out whether one of these three would be a more serious inhibitor to the correct identification of parts, than the other two. Consequently, the seventeen questions were designed as shown in **Table 3.2** on the following page but one. If students' perceptions were adversely affected by any of the three variables, the researcher wanted to know if IKR could assist in overcoming the problem.

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[11] $D_1 - D_{17}$ refers not to pairs as for Parts A and B, but to individual questions. The exercise in Part C is described later in this chapter.

Figure 3.3

An illustration of the page layout used in Part D

D5

Describe the effects of computer applications on the education and training of an engineer.

How many parts are there in this question?
(Please tick (✓) the relevant box)

One.................................. ☐

Two.................................. ☐

Three.................................. ☐

More than Three.................. ☐

Please explain briefly how you arrived at your answer.

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Table 3.2

The number of lines, number of IKWs and number of hidden IKWs in each of seventeen questions in Part D

Question Number	No of Lines	No of IKWs	No of Hidden IKWs
D_1	6	2	1
D_2	9	2	0
D_3	3	3	2
D_4	4	3	1
D_5	2	1	0
D_6	2	2	2
D_7	9	2	2
D_8	3	2	1
D_9	4	3	0
D_{10}	3	2	2
D_{11}	9	2	1
D_{12}	3	2	0
D_{13}	6	2	2
D_{14}	3	2	0
D_{15}	2	2	1
D_{16}	4	3	3
D_{17}	6	2	0

The researcher had virtually no sound basis for predicting whether it would be question length, hidden IKWs, or question complexity that would be most likely to hinder correct identification of the number of parts. However, it was thought reasonable, on the basis of past experience to predict that:

- if students did not identify all parts in a question, the bulk of parts not recognised would be those beginning with hidden IKWs:
- students would perform relatively badly in the questions that contained two and three hidden IKWs; and
- students would perform worst on questions which have a combination of three or more parts, nine-line length and most hidden IKWs. Consequently, it was expected that students would perform worst on (not in any rank order):

> D_2 (nine lines but no hidden IKWs)
>
> D_3 (three lines and two hidden IKWs)
>
> D_7 (nine lines and two hidden IKWs)
>
> D_{10} (three lines and two hidden IKWs)
>
> D_{11} (nine lines and one hidden IKWs)
>
> D_{13} (six lines and two hidden IKWs)
>
> D_{16} (four lines and three hidden IKWs)

Further predictions were not formulated since these would have involved mere guessing. However, it was expected that some of the seven questions just listed would be among those interpreted poorly. In addition, although it comprised only four lines, the fact that it contained three parts, all of them indicated by a hidden IKW, made D_{16} a

strong possibility for the question on which students would perform worst[12]. It was also suspected that because of their length and hidden IKWs, D_{11} and D_7 would also be amongst the "worst" questions.

It is possible that some students might guess correctly the number of parts in a question. Consequently, students were asked to explain why they perceived each question as having one, two, three, or more than three parts. It was hoped to gain insights into the criteria used do identify the number of parts, and whether IKR changes these criteria. The analysis of these reasons is presented in **Chapter Five**.

3.2.4 EXPERIMENTAL DESIGN TO TEST THE EFFECT OF IKR ON THE IDENTIFICATION OF DIFFICULTY IN LEVEL II IKWS

As already explained, Level II IKWs such as **discuss** require more effort in information processing terms than Level I IKWs such as **describe**. The exercise in Part C of the questionnaire comprised ten pairs of questions. In the three control pairs (C_2, C_5, C_9), the IKWs in both questions were the same level. It was expected that students would perceive questions in these pairs to be of equal difficulty.

In all other pairs one question began with a Level I IKW and the other with a Level II IKW. It was expected that students would recognise the question beginning with the Level II IKW as being the more difficult of the pair. In order to test this expectation the following hypothesis was raised:

After workshops on IKR, students' awareness of the greater difficulty inherent in Level II IKWs will have increased.

Since according to IKR, choice of the question with Level II instruction is a correct response, it was expected that the number of correct responses would increase After IKR. The precaution was taken to present the order of questions on each sheet randomly. Consequently, C_1, C_3, C_7 and C_8 had the question with a Level I IKW, numbered "1", and pairs C_4, C_6 and C_{10} had the question with a Level II IKW, numbered "1". The IKWs for each pair (Q_1 given first), together with the level of difficulty, are shown in **Table 3.3** on the following page.

An attempt was made to keep constant other variables that might affect perception of difficulty. For example, knowledge content and length were the same in each question of a pair and no question had a statement. The length of questions in each pair was kept constant by ensuring that the printed line-length was the same. To avoid distracting students, the questions were kept as short as possible.

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[12] To improve expression in this chapter the long-winded phrase "the question on which students performed worst" is shortened to "worst question".

Table 3.3

The IKW (together with its level of difficulty) in each question in each of the ten pairs in Part C

C_1	C_2	C_3
describe (I)/compare (II)	describe (I)/describe (I)	list (I)/compare (II)

C_4	C_5	C_6
evaluate (II)/list (I)	discuss (II)/contrast (II)	Compare & contrast (II)/describe (I)

C_7	C_8	C_9	C_{10}
write (I)/evaluate (II)	explain (I)/weigh up (II)	describe (I)/list (I)	debate (II)/describe (I)

The same procedure for recording and comparing results was followed as for Part A. The results of this experiment, including reasons given for identifying one question of a pair as being more difficult, are reported in **Chapter Eight**. A sample page layout used in this part is shown in **Figure 3.4** on the following page, and the ten pairs of questions (C_1 - C_{10}) are listed in **Appendix VIII**. The directions for completion of Part C are not shown because they are almost identical to those for Part A.

3.2.5 EXPERIMENTAL DESIGN TO TEST THE EFFECT OF IKR ON TIME TAKEN AND DIFFICULTY PERCEIVED DURING INTERPRETATION EXERCISES

If IKR is helpful in terms of improving information processing skills, it is reasonable to expect most students to complete the four exercises in the questionnaire in less time, and that most students will find the four exercises easier. When students returned their Before and After questionnaires they were asked to:

a) provide their best estimate of how long it took them to complete the questionnaire;

b) indicate on a scale of one (very easy indeed) to ten (very difficult indeed) how difficult they found the task.

This information for each student was recorded, analysed and performances compared. The results of this experiment are recorded in **Chapter Eleven.**

3.3 CONCLUSIONS

There were several reasons why the researcher attempted to obtain a considerable amount of data from this student group with the one fifty-one-page, Before and After questionnaires. For example, it was not possible in the four week period during which the workshops took place, to issue individual questionnaires to test each of the hypotheses. In addition, the opportunity to have access to similar groups may not have presented itself again. If access was possible in the future, the researcher wanted to be able to conduct other experiments with this group in their second year.

Figure 3.4

An illustration of the page layout used in Part C

<div align="right">

C7

</div>

1 Write an essay about the different approaches to preventing deaths and injuries on construction sites.

2. Evaluate the different approaches to preventing deaths and injuries on construction sites.

Please tick (√) the box you think indicates the true situation.

i)   1 is more difficult than 2 .... ☐

ii)   2 is more difficult than 1................................. ☐

iii)   Both questions are of equal difficulty .... ☐

If you ticked i) or ii) please explain briefly why you think one question is more difficult than the other.

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In some of the chapters to follow in this thesis, it will be necessary to refer to the hypotheses and methodologies mentioned and described in this chapter. To minimise repetitiveness and to assist the reader, the chapters in which results of the various experiments described in this chapter, are summarised in **Table 3.4**.

Table 3.4

Summary of chapters in which results of experiments described in this chapter, are reported

Chapter Four: the effect of IKR when questions contain statements and longer length.
Chapter Five: the effect of IKR on identification of the number of parts and on reasons given for perception of a certain number of parts.
Chapter Seven[13]: the effect of IKR on the reasons given for one question being perceived as more difficult than another.
Chapter Eight: the effect of IKR on the identification of difficulty in Level II IKWs.
Chapter Eleven: the effect of IKR on the time taken to complete the question interpretation exercises and perception of the difficulty of this task.

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[13] Chapters Six, Nine and Ten are not listed since they deal with experiments other than those referred to in this chapter.

THE EFFECT OF IKR ON STUDENTS' ABILITY TO RECOGNISE IRRELEVANT STATEMENTS AND IRRELEVANT QUESTION LENGTH

4.0 INTRODUCTION

As already explained[1] the researcher expects that although the **actual questions** are of equal difficulty, most students will perceive (erroneously) **examination questions** with **statements** as more difficult[2] than questions without statements, and **longer questions** as more difficult than shorter questions. As the reader will now be aware, the exercises used in the experiments in this research programme were designed by the researcher using the IKR method for interpreting questions. Throughout this thesis, the words "erroneous" and "incorrect" have been used to describe student responses when they have not corresponded to the response that could arise from using IKR. The use of "erroneous" and "incorrect" does not imply that those students whose responses do not match the IKR response are deficient in some way

In addition, the use of "erroneous" and "incorrect", should not be interpreted as implying that IKR is a perfect model. For example, two questions in a pair may have been carefully designed to have the same difficulty in terms of the mental effort required to answer them, by using the same Level instruction key word and the same number of parts. However, just what "mental effort" means might not be adequately taken account of by the difficulty level of instruction key words and number of parts. There may be other factors involved in mental effort. This means that IKR itself requires to be treated as a model in need of frequent review and improvement.

Up until the time of submitting this thesis, the researcher had not found reports of studies into the effect of question length and the presence of a statement on students' interpretation of questions. Like much of the advice found in the literature, the "commonsense" approach is often applied as Cockburn and Ross (no date p21-22) indicate. Their answer to whether instructions [IKWs] should come at the beginning or at the end of a question is as follows: "Where the instructions are elaborate it seems to be customary for them to precede the passage or passages; this order is reversed when you wish the general tone, style and content of the passage to make an impression on the reader's mind before he turns to consideration of just what he is to do with it."

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[1] Paragraph 3.2.1.
[2] In this chapter, the term **"more difficult"** is shorthand for **"being more difficult to answer"**.

The background to the raising of hypotheses to test these expectations has already been described[3]. In this chapter the results of two experiments to test hypotheses regarding the presence of statements and irrelevant question length are discussed. Each experiment is dealt with separately and conclusions relating to both experiments are presented together at the end of this chapter.

4.1 THE EFFECT OF IKR ON STUDENTS' ABILITY TO RECOGNISE IRRELEVANT STATEMENTS

The hypothesis to be tested was:

Given a pair of examination questions, one with a statement and the other without, but both containing actual questions of equal difficulty, many students will perceive the examination question containing the statement to be more difficult. After workshops on IKR, more students will recognise the equal difficulty of the two actual questions.

4.1.1 RESULTS

Table 4.1 illustrates the Before and After results of the extent to which sixty five students recognised that both questions in a pair were of equal difficulty. The full results of an analysis of the Before and After responses for each question in each of the eight pairs, is presented in **Table A.5** in **Appendix IX**[4].

Table 4.1

Extent of the recognition of both questions in a pair being equally difficult

	Before			After	
Number Correct	Frequency	%	Number Correct	Frequency	%
0	3	4.6	0	1	1.5
1	5	7.7	1	4	6.2
2	17	26.6	2	2	3.1
3	16	24.6	3	5	7.7
4	7	10.8	4	6	9.2
5	7	10.8	5	6	9.2
6	6	9.2	6	8	12.3
7	0	0	7	11	16.9
8	4	6.2	8	22	33.8
Totals	65	100.0	Totals	65	100.0

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[3] Paragraphs 3.2.1 and 3.2.2.
[4] Parts of the print-out from the computer analysis of the raw data for Part A are provided in Robb (1993 98-99).

4.1.2 DISCUSSION

After IKR, there was a substantial improvement in students' recognition that two actual questions are of equal difficulty despite one being preceded by a statement and the other not. Before IKR, 6.2% got all eight correct and 37.0% were correct in four or more pairs. After IKR, 33.8% got all eight correct and 81.5% got four or more correct.

Table 4.2 shows the changes in individual student performances.

Table 4.2

Frequency of the changes between Before and After scores for each student

Extent of change	Frequency	Percentage
-2	1	1.5
-1	2	3.1
0	11	16.9
1	11	16.9
2	9	13.8
3	11	16.9
4	9	13.8
5	3	4.6
6	6	9.2
7	1	1.5
8	1	1.5
Totals	65	100.0

Respondents who:		
a) Improved	51	78.5
b) Stayed the same	11	16.9
c) Declined	3	4.6
Totals	**6 5**	**100.0**

Although the performance of 4.6% of students worsened and 16.9% showed no change After IKR, **78.5% improved their perception.** The researcher wondered why the perception of 21.5% of students did not improve and this is further discussed in the conclusion to this chapter. Overall, total correct responses increased from 218 (42% of total possible responses) to 378 (72.7%). The fact that 42% of responses Before were correct, indicates that some students have intuitive understanding that questions containing statements are not necessarily more difficult. Some individual improvements were extensive: 12.2 % of students improved by six or more and one student each improved by seven and eight responses.

It was also observed that there was improvement in recognition of equal difficulty for each of the question pairs as the data in **Table 4.3** on the following page illustrate.

Table 4.3

Number of students recognising that actual questions are of equal difficulty

	Before			After		
Pair	Number recognising equal difficulty	%	Pair	Number recognising equal difficulty	%	% Improvement
A_1	16	25	A_1	37	58	33
A_2	20	31	A_2	45	69	38
A_3	44	68	A_3	57	88	20
A_4	26	41	A_4	50	77	36
A_5	37	57	A_5	49	75	18
A_6	21	32	A_6	39	61	29
A_7	39	60	A_7	56	86	26
A_8	14	22	A_8	44	68	46

After IKR there was marked improvement in students' recognition that two questions in a pair were of equal difficulty: **Table 4.3** shows improvements ranging from 18% to 46%. Since a two-tailed t-test gave a t-value of 0.0, the significance of the improvement was not in doubt.

As already explained in Chapter Three, four of the pairs (A_1, A_2, A_4, A_7) were **control** pairs where neither question contained a statement. If students' perceptions of difficulty are based mainly on statements, then the control pairs would score highest for recognition of equality of difficulty. Conversely, in the **experimental** pairs (A_3, A_6, A_5, A_8) one question contained a statement and the other did not. It was expected that there would be fewer mentions of these pairs being of equal difficulty. The data in **Table 4.4** enable comparison of the percentage of students who found both questions of each pair to be of equal difficulty, for control and experimental pairs.

Table 4.4

Comparison of the percentage of students who recognised questions in each pair as being of equal difficulty

	Control			Experiment	
Pair	Before	After	Pair	Before	After
A_1	25	58	A_3	68	88
A_2	31	69	A_5	57	75
A_4	41	77	A_6	32	61
A_7	60	86	A_8	22	68

These data illustrate that Before, two experimental pairs (A_3 and A_5) scored higher than two control pairs (A_1 and A_2). This means that despite one question in each of A_3 and A_5 having a statement, more students found both questions to be of equal difficulty

than they did in two of the control pairs A_1 and A_2 where no question had a statement. In other words, for pairs A_3 and A_5 the questions with statements were not perceived, in general, as more difficult. As seen in **Table 4.4**, this trend continued After IKR.

The researcher was surprised at this result because students have frequently stated that the statement in a question confused them. In addition, when marking examination essays, some students are misled into irrelevant discussion by statements. This, of course, is not a perception of difficulty. Consequently, further analysis was conducted to check the finding that, in general, students who did select one question in a pair as more difficult, **selected the question with a statement**. It was expected that because they contained a statement, questions A_3Q_1, A_6Q_1, A_5Q_2 and A_8Q_2 in the **experimental pairs**, would be more likely to be identified (erroneously) as more difficult than the other question in these pairs. It was also expected that After IKR, fewer students would make this erroneous identification. A closer examination of data in **Table A.5 in Appendix IX** yields the results shown in **Table 4.5**.

<div align="center">

Table 4.5

Percentage of students who perceived each question in each of the experimental pairs as more difficult
(Key: * = question with the statement)

</div>

Pairs	A_3		A_5		A_6		A_8	
Questions	Q_1*	Q_2	Q_1	Q_2*	Q_1*	Q_2	Q_1	Q_2*
Before	15	17	35	8	6	62	53	25
After	6	6	14	11	16	23	23	9

In each of the four experimental pairs Before, it was the question **without the statement** which was perceived by students as more difficult. In three of the pairs, (A_5, A_6, A_8) this difference is marked. Again, this trend continues After IKR, but as expected, is much less pronounced. Although erroneous choices declined After IKR, the researcher still considers it relevant that **of the students who did select** a question as more difficult, more selected the question **without the statement**. Consequently, it is safe to state that, some students employ criteria other than the presence of a statement in their perception of question difficulty.

It was in anticipation of this result (and to find out more about perceptions of difficulty) that the researcher asked students to record their reasons if they selected (erroneously) one question of a pair as more difficult. It was decided to present an analysis of these reasons in a separate chapter (**Chapter Seven**), because many reasons were collected, and adequate discussion of the results required extensive effort. In addition, the results from this experiment could be combined with those from other experiments.

4.2 THE EFFECT OF IKR ON STUDENTS' ABILITY TO RECOGNISE IRRELEVANT QUESTION LENGTH

The hypothesis to be tested was:

Given a pair of examination questions, one longer than the other, but both containing actual questions of equal difficulty, many students will perceive the longer question to be more difficult. After workshops on IKR, more students will recognise the equal difficulty of the two actual questions.

The reader will notice that this hypothesis comprises two part-hypotheses. However, to keep this thesis to a manageable length it was decided not to separate out these two part-hypotheses, and the presentation and discussion of results are dealt with accordingly.

4.2.1 RESULTS

The data presented in **Table 4.6** show the extent of students' recognition (Before and After), that both questions in a pair were of equal difficulty, despite one being longer than the other. The full results of an analysis of the Before and After responses for each question in each of the nine pairs, is presented in **Table A.6** in **Appendix IX**[5].

Table 4.6

Extent of recognition (Before and After) that both questions in a pair are of equal difficulty

Before				After		
Number Correct	Frequency	Percent		Number Correct	Frequency	Percent
0	3	4.6		0	1	1.5
1	7	10.8		1	3	4.6
2	11	16.9		2	2	3.1
3	13	20.0		3	9	13.8
4	13	20.0		4	10	15.4
5	10	15.4		5	11	16.9
6	5	7.7		6	10	15.4
7	2	3.1		7	11	16.9
8	0	0		8	5	7.7
9	1	1.5		9	3	4.6
Totals	65	100.0		Totals	65	100.0

4.2.2 DISCUSSION

The Before and After data, show an improvement in students' ability to recognise that two questions are of equal difficulty, despite being of different lengths. Before IKR, only one student got all nine correct and only 27.7% got five or more correct. However, After IKR, three students got all nine correct and **61.5% got five or more correct**. Overall, total correct responses increased from 223 (38% of total possible responses) to 333 (57%).

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[5] Parts of the print-out from the computer analysis of the raw data for Part B are provided in Robb (1993 100-101).

The fact that 38% of responses Before were correct, indicates that students have some intuitive understanding that **longer questions are not necessarily more difficult**. Again, there were some extensive improvements in individual performances which can be examined in **Table 4.7**.

Table 4.7

Frequency of the changes between Before and After correct scores for each student

Extent of change	Frequency	Percent
-3	1	1.5
-2	1	1.5
-1	6	9.2
0	13	20.0
1	11	16.9
2	11	16.9
3	11	16.9
4	6	9.2
5	1	1.5
6	2	3.1
7	2	3.1
Totals	65	100.0

Respondents who:

a) Improved		44	67.7
b) Stayed the same		13	20.0
c) Declined		8	12.3
	Totals	65	100.0

Although 12.3% declined in ability and 20% stayed the same, **67.7% improved** and 7.7% improved by five or more responses. The researcher wondered why the perception of 32.3% (almost a third) of students did not improve and this is discussed in the conclusion to this chapter. However, another way of showing the extent of the improvements is to examine for each pair (Before and After), how many students recognised that both questions were of equal difficulty.

Table 4.8 on the following page shows that recognition of both questions as equally difficult, improves for all pairs: improvements ranged from 6% to 37%. Since a two-tailed t-test gave a t-value of 0.0, the significance of the improvement was not doubted. Without knowing about IKR, just under one third of students are able to recognise that two questions of differing length are of equal difficulty. This fraction rises to just under two thirds After IKR. As already explained, three of the pairs (B_1, B_5, B_7) were **control** pairs where the line length in each question of a pair was identical. If students' perceptions of question difficulty are based mainly on the length of a question, then the control pairs would score highest for recognition of equality of difficulty.

Table 4.8

Number of students recognising that actual questions are of equal difficulty
(Key: * = control pairs where both questions are of equal length)

	Before			After		
Pair	Same	%	Pair	Same	%	% improvement
B_1*	22	34	B_1*	36	56	22
B_2	23	36	B_2	36	55	19
B_3	5	8	B_3	9	14	6
B_4	9	14	B_4	19	29	15
B_5*	55	87	B_5*	60	94	7
B_6	20	31	B_6	40	62	31
B_7*	40	62	B_7*	56	89	27
B_8	22	35	B_8	30	46	11
B_9	26	41	B_9	49	78	37

Conversely, in the **experimental** pairs, it was expected that there would be fewer mentions of questions in these pairs being of equal difficulty. The data in **Table 4.8** support this expectation. For example, Before IKR the percentage of students recognising equal difficulty was the highest for B_5 (six lines each) and B_7 (nine lines each) being 87% and 62%, respectively. This trend continued After. However, in B_1 (three lines each) only 34% of students Before and 56% After, considered the two questions to be of equal difficulty. The fact that B_1, which comprised two questions of almost identical wording and of three lines each, scored relatively low for recognition of equal difficulty, was surprising. It indicates that for some students there are criteria other than question length which influence perceptions of difficulty.

That there are other criteria which influence students' perceptions of difficulty is emphasised by the fact that After IKR, for all pairs, the percent of students who thought one question was more difficult than the other was 44%, 45%, 86%, 71%, 6%, 38%, 11%, 54%, and 22%, respectively. These figures indicate that even after being shown a heuristic technique (IKR) a substantial number of students still regard (erroneously) one question of the pair as more difficult. But one must ask whether it is always the longer question which is perceived as more difficult? In addition, what effect does the **extent of the difference** in line-length between pairs have on students' recognition of equal difficulty? The researcher expected that if students did identify one question as more difficult, it would be the longer question.

Consequently, in the six experimental pairs it was expected that B_2Q_2, B_3Q_2, B_4Q_2, B_6Q_2, B_8Q_2 and B_9Q_2 would be identified most frequently as indicating the greater difficulty. **Table 4.9** on the following page indicates the line-lengths of each question in each pair and the extent to which students recognised equal difficulty.

Table 4.9[6]

Percentage of students indicating either Q_1 or Q_2 (in the experimental pairs) as
more difficult, together with line lengths of each question
(Key: * = longer question of the pair)

Before					After				
Question Pair	Q1	%	Q2	%	Question Pair	Q1	%	Q2	%
B_2	nine	42*	six	22	B_2	nine	25*	six	20
B_3	three	71	nine	22*	B_3	three	52	nine	34*
B_4	six	28	three	58*	B_4	six	34*	three	37
B_6	nine	34*	three	34	B_6	nine	18*	three	20
B_8	six	18	nine	47*	B_8	six	17	nine	37*
B_9	three	36	six	23*	B_9	three	11	six	11*

Both Before and After, only two of the six questions expected to be perceived as more difficult, are so perceived. In addition, both Before and After, in three out of four cases, **the three-line question was perceived as more difficult** than a nine-line or six-line question. This again was a surprising result. It seems as if many students, in many instances, regard a three-line question as more difficult than a nine-line question. In some pairs this perception is quite marked: in B3 Before and After, 71% and 52% considered the three-line question to be more difficult whereas only 22% and 34% considered the nine-line question to be more difficult. Although there is extensive improvement After IKR, there is still sufficient evidence to state that the three-line question is perceived as more difficult.

However, in the case of pairs where the line lengths were nine and six, it was the nine-line questions (as expected) which were perceived as more difficult. **Why should students in many instances perceive a nine-line question to indicate less difficulty than a three-line question, yet more difficulty than a six-line question?** It was to gain additional information regarding perceptions of difficulty that students were asked to record reasons, if they selected one question in a pair as more difficult. As already explained in this chapter, the results of the analysis of reasons given in this experiment are discussed in **Chapter Seven.**

4.3 CONCLUSIONS

After IKR, there was improvement in students' recognition that two **actual** questions are of equal difficulty, even though one contains a statement and the other not, and even though one question is longer than the other. In experiment one 78.5% of students improved and in experiment two 67.7% improved. In addition, total correct responses as a percentage of total possible responses in each experiment increased from

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[6] Adapted from **Table A.2 in Appendix IX.**

42% to 73% and 38% to 57%, respectively.

It could be claimed that these results are to be expected because the same questionnaire was issued Before and After, and students had a second attempt at the same questions. However, since there was at least a full seven days between issuing the Before and After questionnaires and because the questionnaire was fifty one pages long, it is very unlikely that students would have remembered individual pairs of questions.

The possibility that some factors other than IKR effected improvement could have been tested by having a control group of students who were issued with the questionnaire but deprived of the workshops on IKR. For practical and ethical reasons already explained[7], this was not done. Another way of testing this possibility would have been to give students a different After questionnaire. However, if this were done it could not be claimed that the Before and After exercises were identical.

The researcher is aware that improved performance in identifying the equality of difficulty does not necessarily mean that students' essay-writing will improve. While it is reasonable to assume that if students are not misled by statements and irrelevant length, they will gain a clear conception of what is required and therefore write better answers, this assumption needs testing. Further discussion on possible further research is presented in **Chapter Twelve.**

In terms of information processing theory, it is safe to find that IKR as a heuristic device assists many students (and some quite extensively) to filter out noise and to concentrate on the signal. IKR enables most students (with varying degrees of success) to "see through" the irrelevance to what the examiner actually requires. Whatever perceptual filters (criteria for deciding on difficulty) exist and motivate students to select erroneously either Q_1 or Q_2, they are, for most students, altered to a large extent.

However, it is evident that perceptual filters are not altered for all students in all instances. One must ask why 21.5% (experiment one) and 32.3% (experiment two) of students did not improve, why some students' performances declined, and why, even After IKR, 27% (experiment one) and 43% (experiment two) of total possible responses were erroneous. The researcher considers that these non-improvements can be accounted for by those students who are **field dependent**, that is, those students who have more difficulty than others in determining what is relevant from the surrounding perceptual field.

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[7]   Paragraph 2.1.

It is evident that even given an heuristic to assist in identifying that which is relevant, the nature of some perceptual filters is so fixed for some students, that IKR did not assist. Information theory predicts this: if students have over the years developed a way of perceiving the difficulty of questions, it will be difficult to persuade them to use another method even if it is more helpful. It is possible that IKR is initially confusing for some students. However, since so many students were assisted by IKR, it is expected that **additional practice** in using IKR would have improved the performance of field dependent students who are. The scope of this research did not permit undertaking an additional experiment to test this prediction.

Since information processing theory maintains that each individual brings a unique experience to the processing task, the range of the extent of improvements (and non-improvements) was not unexpected. The fact that most students gave one or more erroneous responses indicates that the nature of perceptual filters can be represented as a continuum with different individuals at different points on it. The researcher considers that the results reported in this chapter indicate that using IKR moves individuals further along the continuum (alters filters which produce erroneous results).

A surprising result was that even After IKR, many students, in general, regarded questions with statements, and longer questions as less difficult. However, the results could not be explained as straightforwardly as this. Why, should some students regard a three-line question as more difficult than a nine-line question, yet on the other hand, a six-line question as less difficult than a nine-line question? Clearly, **very short questions are perceived as more difficult.**

Similarly, why for some students do questions with statements indicate more difficulty than those without? For the researcher, this evidence indicates that a substantial number of students use criteria other than (or in addition to) those of the presence or absence of a statement, and question length. Students' reasons for choosing erroneously either Q_1 or Q_2 as more difficult to be discussed in **Chapter Seven**, should help to answer these questions.

CHAPTER FIVE

THE EFFECT OF IKR ON STUDENTS' RECOGNITION OF THE NUMBER OF PARTS IN A QUESTION AND ON THE CRITERIA USED TO DECIDE ON THE NUMBER OF PARTS

5.0 INTRODUCTION

As explained[1], by getting students to focus on the number of instruction key words (IKWs), IKR should enable more accurate identification of the number of parts in a question. In one sense, a statement is a part of the question, but of the **examination question**, not the **actual question**. In addition, just as the phrase "Which question is more difficult?", refers to the difficulty involved in **answering** the question, so "How many parts?" refers to the number of parts to be **taken into account in answering**. The researcher thought about making this distinction explicit for students, but it was realised that the research was attempting to find out whether IKR improved students' ability to recognise the actual question (what is actually required in the answer). To make this distinction explicit would have defeated the object of the research.

Before IKR, it was expected that many students would (erroneously) take items in the statement to be parts of the question. After IKR, most students should not be misled and be able to identify more accurately the number of parts based on the actual question. It is reasonable to suggest that if IKR does improve the accuracy with which students identify the number of parts[2], then the criteria used to identify parts might have changed. As already explained, of reasons given by students for identifying a certain number of parts, should reveal the criteria used for deciding on the number of parts.

It was also expected that Before IKR, students would decide on the number of parts, by counting the number of different **content items** (topics or knowledge areas) in the question, including those in any statement. After IKR, it was expected that most reasons would be based on **the number of IKWs**. The reader will realise that another hypothesis should be raised to test these expectations formally, and this is discussed later in this chapter[3]. However, before examining reasons given for identifying a particular number of parts, the result of the effect of IKR on the accuracy of students' identification of the number of parts, is reported.

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[1] Paragraph 3.2.3.

[2] To improve expression in this thesis, the phrase **"number of parts in the question"** is shortened to **"number of parts"**.

[3] Paragraph 5.2.

5.1 THE EFFECT OF IKR ON STUDENTS' RECOGNITION OF THE NUMBER OF PARTS IN A QUESTION

As already explained, the hypothesis raised to test the expectations outlined in the introduction to this chapter was as follows:

After a workshop on IKR, students will identify more accurately the number of parts in seventeen questions.

5.1.1 RESULTS

The data in **Table 5.1** illustrate the Before and After results of the extent of students' ability to recognise correctly, the number of parts in each of seventeen questions[4].

Table 5.1

Number of correct answers

Before				After		
Number Correct	Frequency	Percentage		Number Correct	Frequency	Percentage
0	0	0		0	0	0
1	1	1.5		1	0	0
2	0	0		2	0	0
3	1	1.5		3	0	0
4	1	1.5		4	0	0
5	1	1.5		5	0	0
6	7	10.8		6	2	3.1
7	4	6.2		7	0	0
8	4	6.2		8	5	7.7
9	3	4.6		9	1	1.5
10	7	10.8		10	2	3.1
11	7	10.8		11	5	7.7
12	11	16.9		12	6	9.2
13	7	10.8		13	10	15.4
14	5	7.7		14	9	13.8
15	3	4.6		15	9	13.8
16	2	3.1		16	14	21.5
17	1	1.5		17	2	3.1
Totals	65	100.0		Totals	65	100.0

5.1.2 DISCUSSION

Before IKR, 27.7% of students identify correctly the number of parts in thirteen or more of the seventeen questions. After IKR this figure **increases to 67.6%** - a considerable improvement. In addition, After IKR, 87.7% of students perceived correctly in ten or more instances, and not one was correct in fewer than six instances. This improvement can be illustrated another way: the **total number of correct responses** Before IKR was 682 (62% of total possible correct answers)[5]. However, After IKR, 857 responses were correct - 78% of total possible correct answers. A t-value of 0.0, indicated that the significance of the positive change was not in doubt.

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[4] Parts of the computer print-out of the analysis of raw data is given in Robb (1993 p102).
[5] $(65 \times 17 = 1105)$

There were some considerable individual improvements as shown in **Table 5.2**.

Table 5.2

The extent of individual improvements or declines After IKR

Extent of change	Frequency	Percentage
-4	1	1.5
-3	2	3.1
-2	1	1.5
-1	3	4.6
0	6	9.2
1	15	23.1
2	8	12.3
3	7	10.8
4	5	7.7
5	3	4.6
6	5	7.7
7	3	4.6
8	3	4.6
9	1	1.5
10	0	0
11	1	1.5
12	0	0
13	0	0
14	1	1.5
Totals	65	100.0

Students who:		
a) Improved	52	80.0
b) Stayed the same	6	9.2
c) Declined	7	10.8
Totals	65	100.0

One student improved by fourteen, another by eleven and another by nine responses. These gains far exceed the individual declines: one student by four and two by three responses each. While 10.8% of students declined in ability and 9.2% stayed the same, **80% improved**. These results mean that although about 30% of students are able to identify, reasonably well, the number of parts in a question Before IKR, most show considerable improvement After IKR.

As already explained, it was expected that students would perform worst on questions with most parts, with hidden IKWs, and on the longest questions. Consequently, it was necessary to identify those questions on which students performed "worst" and "best". A full record of the number of parts recognised for each question both Before and After is given in **Table A.7 in Appendix X**. **Table 5.3**, on the following page, is extracted from **Appendix X** and shows the ranking of each question according to total correct responses as a percentage of total possible correct responses.

Table 5.3 on the following page shows that some percentages are separated by only a few points. Consequently, these rankings of "best" and "worst" performance give only

a rough idea of questions perceived to be easier and more difficult. However, even a cursory examination of the distribution of percentages of correct responses, shows that it is skewed After, towards the 71-80%, 81-90% ands 91-100% bands. It is also revealing that in all but one question (Q_2), students' performances improved.

Table 5.3

Individual questions ranked according to total correct responses as a percentage of total possible correct responses

Question No. & No. of parts	% Correct Before (Rank)	% Correct After (Rank)	Change in %	Change in rank
1 (Two parts)	81 (4)	93 (4)	+12	0
2 (Two parts)	77 (8)	77 (11)	0	+3
3 (Three parts)	89 (2)	95 (2)	+6	0
4 (Three parts)	84 (3)	85 (9)	+1	+6
5 (One part)	38 (13)	76 (12)	+38	-1
6 (Two parts)	80 (6)	94 (3)	+14	-3
7 (Two parts)	58 (11)	87 (8)	+29	-3
8 (Two parts)	37 (14)	68 (13)	+31	-1
9 (Three parts)	73 (9)	89 (7)	+16	-2
10 (Two parts)	81 (4)	92 (5)	+11	+1
11 (Two parts)	8 (17)	22 (17)	+14	0
12 (Two parts)	92 (1)	98 (1)	+6	0
13 (Two parts)	64 (10)	84 (10)	+20	0
14 (Two parts)	80 (6)	92 (5)	+12	-1
15 (Two parts)	25 (15)	52 (15)	+27	0
16 (Three parts)	52 (12)	67 (14)	+15	+2
17 (Two parts)	20 (16)	43 (16)	+23	0

The scope of this research did not permit detailed examination of the group's performance on each question. However, it was decided to pay particular attention to the reasons given for perceiving the number of parts in Q_5, Q_7 and Q_8, the correct responses to which increased by 38%, 29% and 31%, respectively. Results of this examination are reported later in this chapter. The six questions on which students performed "best" and the six on which they performed "worst" are extracted from **Table 5.3** and shown in **Table 5.4** on the following page.

There was extensive consistency Before and After in the six "worst" and six "best" questions. The same six questions in the "worst" group appear Before and After, and similarly for the "best" group. This means that questions which proved difficult to interpret Before, were those found difficult (but to a lesser degree) to interpret After. Three further hypotheses were possible to test **question line-length, number of hidden IKWs** and **number of actual parts** on students' ability to identify correctly the number of parts. However, this was not done for two main reasons. Firstly, the effect of these variables was a minor theme. Secondly, to test the effect of each variable scientifically, the other two variables would have had to be held constant, and this was not included in the experimental design, as already described.

Table 5.4

The six questions on which student performance was a) worst and b) best

	a) Worst			b) Best	
Rank	Before	After	Rank	Before	After
1	Q_{11}	Q_{11}	1	Q_{12}	Q_{12}
2	Q_{17}	Q_{17}	2	Q_3	Q_3
3	Q_{15}	Q_{15}	3	Q_6	Q_6
4	Q_8	Q_{16}	4	Q_1[6]	Q_1
5	Q_5	Q_8	5	Q_{10}	Q_{10}
6	Q_{16}	Q_5	6	Q_{14}	Q_{14}

Consequently, results of the effect of these three variables now to be discussed should be regarded as tentative and possible points of departure for further research. **Table 5.5** compares the six "worst" with the six "best" questions with regard to line-length, number of hidden IKWs, and number of parts.

Table 5.5

Comparison of the six "worst" and six "best" questions with regard to line-length, number of hidden IKWs, and number of parts

Six "worst" questions

Question No.	D_5	D_8	D_{11}	D_{15}	D_{16}	D_{17}	Totals
Line length	2	3	9	2	4	6	26
No of hidden IKWs	0	1	1	1	3	0	6
No of parts	1	2	2	2	3	2	12

Six "best" questions

Question No.	D_1	D_3	D_4	D_{10}	D_{12}	D_{14}	Totals
Line length	6	3	4	3	3	3	22
No of hidden IKWs	1	2	1	2	0	0	6
No of parts	2	3	3	2	2	2	15

From these data it is difficult to determine which of any of the three variables, is predominant in adversely affecting students' performance. However, three general insights can be discussed. Firstly, since the number of **hidden IKWs** for both "worst" and "best" groups is six, it would seem that this variable has little effect. This is corroborated by examination of the distribution of hidden IKWs and number of parts by question length, as shown in **Table 5.6** on the following page.

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[6] Q_{10} and Q_1 Before, were both ranked 4th but are shown here as 4th and 5th for display purposes. Similarly, Q_{10} and Q_{14} After, were both ranked 5th.

Table 5.6

Distribution of hidden IKWs and parts by question line-length

Question	5	15	6	12	14	8	10	3	9	4	16	17	1	13	2	11	7
Line length	2	2	2	3	3	3	3	3	4	4	4	6	6	6	9	9	9
No of hidden IKWs	0	1	2	0	0	1	2	2	0	1	3	0	1	2	0	1	2
No of parts	1	2	2	2	2	2	2	3	3	3	3	2	2	2	2	2	2

The researcher expected that for questions of similar line-length, it would be the questions with the most hidden IKWs that would be in the "worst" group. However, this was not the case in all but one instance. For example, D_5 and D_{15} both have line-lengths of two but have respectively, zero and one hidden IKW. Consequently, the researcher wondered why the two-line question with two hidden IKWs (D_6) which was expected to be more troublesome than D_5 and D_{15}, did not appear in the "worst" group.

Similarly, the two-line and six-line question in the "worst" group (D_5 and D_{17}) were those with no hidden IKWs. While the four-line question in the "worst" group was indeed the four-liner with the most hidden IKWs, caution must be applied since the difficulty could have arisen because it was a relatively short question with three parts. An examination of the "best" group reflects similar findings: the four and six-line questions (D_4 and D_1) were those with one hidden IKW, not the four and six-line questions with zero IKWs, as might be expected.

Secondly, and unexpectedly, the total number of parts in the "best" group exceeds the "worse" group by three: it was expected that as the number of parts increased, students' performances would decline. On the data available it is not possible to state that the actual number of parts and number of hidden IKWs do, or do not affect students' perception of the number of parts. As already stated, the experimental design was not adequate to test the effect of the number of parts: examination of the distribution of the number of parts by question length shows, for example, (**Table 5.6** above) that all the nine-line questions had two parts as did all the six-line questions. A variation in the number of parts for each line-length might have revealed further insights.

Thirdly, although total line-length in the "worst" group exceeds that of the "best" by four, the researcher considers this to be only very preliminary evidence that line-length is a significant variable in hindering students' performances in identifying the number of parts. For example, while there are no nine-line questions in the "best" group, and while all of the three-line (relatively short) questions are in the "best" group, there are

no **two-line questions**. In other words, some of the very short questions were, more troublesome than the slightly longer three-line questions. In addition, and unexpectedly, there are two, two-liners (D_5 and D_{15}) and a three-liner (D_8) (relatively short questions) in the "worst" list. This corroborates some of the results reported in Chapter Four where **some short questions are frequently perceived as more difficult than longer questions**. It was decided to investigate further this preliminary evidence on the effect of line-length. To this end the **number of responses for each perceived number of parts** for each question and related percentages, were calculated. These data are presented in **Table A.8 in Appendix X. Table 5.7** shows a re-analysis of these data according to question line-length.

Table 5.7

Percentage of all responses for each question, analysed by number of parts perceived and question line-length
(Note: "(one)", "(two)" or "(three)" indicates the actual number of parts as indicated by IKR)

Parts perceived:	Before				After			
	1	2	3	3+	1	2	3	3+
Two-line questions								
5 (one)	38	57	2	3	77	23	0	0
6 (two)	2	78	2	8	0	92	2	6
15 (two)	5	27	2	56	3	49	8	40
Three-line questions								
3 (three)	6	2	89	3	0	6	94	0
8 (two)	6	40	51	3	0	75	25	0
10 (two)	2	83	12	3	6	91	3	0
12 (two)	3	92	3	2	0	98	0	2
14 (two)	0	83	17	0	0	92	8	0
Four-line questions								
4 (three)	3	6	85	6	3	9	86	2
9 (three)	3	5	72	20	0	5	89	6
16 (three)	2	30	51	17	0	27	64	9
Six-line questions								
1 (two)	0	80	14	6	0	92	6	2
13 (two)	0	64	30	6	0	86	12	2
17 (two)	0	22	1	67	2	45	8	45
Nine-line questions								
2 (two)	0	78	17	5	12	78	8	2
7 (two)	2	55	30	13	0	85	14	2
11 (two)	5	6	71	18	0	25	66	9

These figures confirm the result already stated; that IKR assists students to perceive the number of parts correctly: the number of correct responses increases After IKR in all but one question (Q_2). It was decided to pay particular attention to the reasons given for Q_{11}, because although it contained two parts, 71% of students Before IKR perceived three parts. This erroneous perception continued to a large extent After IKR (66%). Q_5 with one part was perceived by 57% of students Before, to have two parts. Similarly,

Q_{15} and Q_{17} each with two parts, were perceived by 56% and 67%, of students Before, and 40% and 45% After IKR, to have more than three parts.

From inspection alone it is not easy to assess whether the longer questions (nine-lines and six-lines) misled students. For example, there are **just as many perceptions of "more than three parts" in four-line questions as there are in the nine-line questions.** The researcher devised a way of comparing the performance of students on the questions of different line-lengths and called it the "**degree of incorrectness**". The degree of incorrectness for a question was calculated as follows. The actual (IKR) number of parts was taken to be the zero point. The number of responses incorrect by one (either more or one less) were summed. To this was added the number of responses incorrect by two, multiplied by two. The calculation of the degree of incorrectness for Q_2, a nine-line question, is shown below in **Table 5.8.**

Table 5.8

An illustration of the calculation of the degree of incorrectness

Question 2	Before				After			
Nine-lines and two parts	0	78	17	5	12	78	8	2

- Since there are two parts in this question 78 (Before) and 78 (After) are the zero points.
- The degree of incorrectness Before is $(0 \times 1) + (0) + (17 \times 1) + (5 \times 2) = 27$.
- The degree of incorrectness After is $(12 \times 1) + (0) + (8 \times 1) + (2 \times 2) = 24$.
- The group degree of difficulty for nine-line questions is the average of the individual degrees of incorrectness for each three nine-line question.

The degrees of incorrectness were calculated separately for each group of line-lengths, each group of number of actual parts and each group of number of hidden IKWs (Before and After). These calculations are are shown in **Appendix XI** in **Tables A.9, A.10** and **A.11**, respectively. These degrees of incorrectness can, at best, be only a rough indication, and in some instances the calculations could not be used further in this research because the averages were calculated from unequal items. Although there is no indication that the number of hidden IKWs hinders students, there is some indication that the nine-line and six-line questions hindered students more than the three and four-line questions as shown in **Table 5.9** on the following page.

It will be noticed that the degree of incorrectness is smaller After IKR for all line-lengths, but that questions of two, six, and nine lines prove to be more misleading than those of three and four lines. However, the researcher considers that Q_{15} posed particular difficulty for students and that this skewed the degree of incorrectness for the group of two-line questions. Possible reasons for Q_{15} presenting difficulty will be examined later in this chapter. The degree of incorrectness for questions with only one hidden IKW is higher than that for those with no hidden IKW, but also higher than

questions with two hidden IKWs. In summary, there is **some preliminary evidence that line-length adversely affects students ability** to perceive the number of parts correctly, but that this situation is improved by IKR. It is not possible to state whether the number of hidden IKWs adversely affects students' performance.

Table 5.9

Degrees of incorrectness for questions of differing line-lengths (Before and After)

Question line-length	Degree of incorrectness	
	Before	After
2	68	43
3	25	10
4	33	21
6	68	42
9	66	42

Degrees of incorrectness for questions of differing hidden IKWs (Before and After)

No. of Hidden IKWs	Before	After
0	48	28
1	68	45
2	31	13

Several questions have been posed about the unexpected nature of some of the results in this experiment. In addition, the researcher wondered why some questions such as Q_5, Q_7, Q_8 Q_{11}, Q_{15} and Q_{17}, appeared to cause more difficulty for students than other questions. As already explained, it was hoped that an analysis of the reasons given would reveal further details about what criteria students use in this decision-making.

5.2 THE EFFECT OF IKR ON THE CRITERIA USED TO IDENTIFY THE NUMBER OF PARTS IN A QUESTION

All reasons were transferred from the Before and After questionnaires, onto preliminary analysis sheets. Step two involved listing all reasons for each question (Before and After) separately and grouping similar reasons together. The number of times a reason was offered was recorded. At the end of this preliminary analysis **each group of reasons** represented a different **classification** into which all reasons could be placed. The third step was to examine again, each reason for each question in each pair, both Before and After, and to place it under one of the classifications.

In addition to recording reasons for the experiment as a whole, the researcher wanted to find out if the reasons given for perceiving "one part" were different to those for perceiving "two parts", "three parts" and "more than three parts". Each reason was placed under one of four headings depending on how many parts a student perceived.

As anticipated, analysing students' numerous reasons raised several methodological difficulties. For example, although it would have assisted greatly with the analysis task, the researcher did not to use a **pre-programmed response sheet**. The reason for this was the danger that the researcher's "guessing" of possible reasons, might not have allowed students to express what they really were thinking. Since there is a danger of the transcribing and classification of reasons influencing results, the following precautions were taken. A detailed description of how the transcribing and classifying was undertaken is given in **Appendix XII**. Additional insights into the difficulties encountered and how they were overcome are provided in this chapter.

5.2.1 RESULTS

A total of 2090 reasons was given (1054 Before and 1036 After). During preliminary analysis it was found that almost all reasons could be classified under **sixty one different classifications**. A list of these classifications together with the frequency of mention of each of them is given in **Appendix XIII**. A full record of all 2090 reasons grouped by the sixty one classifications and also under four headings, according to number of parts recognised, is given in Robb (1993 p103-120). For the reader's convenience, a sample of this record for only one question is shown in **Appendix XIV**. In addition, the frequency of each of the sixty one classifications, analysed by number of perceived parts, is given in **Appendix XV**.

For the experiment as a whole, the most mentioned classifications for identifying the number of parts (Before and After) are shown in **Table 5.10**.

Table 5.10

The most mentioned classifications for identifying the number of parts
(Key: No. = number   IKWs = instruction key words   + = and)

Before

Classification	Number	%
5 Number of named IKWs	216	20.5
6 Number of IKWs + number of content items	202	19.2
8 Number of content items	112	10.6
11 No reasons given	77	7.3
1 Number of questions	66	6.3
(These top five reasons make up 63.9% of all reasons Before)		

After

5 Number of named IKWs	466	45.0
6 Number of IKWs + number of content items	123	11.9
14 "Number of instructions"/"instructions"	114	11.0
8 Number of content items	90	8.7
11 No reasons given	59	5.7
(These top five reasons make up 82.3% of all reasons After)		

5.2.2 DISCUSSION

An examination of these results offers some revealing insights, now discussed in summary in order to keep this chapter to a manageable length.

i) Students employed at least **thirteen different individual criteria** to identify the number of parts, as shown in **Table 5.11**. Since there are sixty one classifications (**Appendix XIII**), it is evident that these thirteen criteria are used in various combinations. It must be remembered that these thirteen criteria are also classifications. Although some of the thirteen criteria are self explanatory, their meanings will become evident in the discussion to follow.

Table 5.11

Thirteen individual criteria used to identify the number of parts

- No. of content items
- No. of questions
- No. of question marks
- No. of sentences
- No. of parts/things/tasks to do
- No. of paragraphs
- Punctuation
- No. of named IKWs
- No. of "instructions"
- Introduction
- The word "and"
- Knowledge
- No. of links

ii) The researcher considered it necessary to make the distinction between the student naming **specific IKWs** such as **describe** or **discuss**, and merely stating **"two instructions"**. These criteria are named: "No. of named IKWs" (Classification 5) and " 'No. of instructions' " (Classification 14), respectively. The researcher expected that only these two criteria, would help students identify correctly the number of parts. Consequently, it was expected that the number of mentions in classifications containing these criteria would increase After IKR.

This prediction is borne out, with Classification 5 increasing from 20.5% of mentions Before to **45.0% After**. In addition, it is significant that Classification 14 ("No. of instructions") is not in the top five ranking Before, but is, After. It could be that some students did recognise a specific IKW but merely recorded the general phrase "instructions". If the mentions of Classification 14 (After) are added

to the mentions of Classification 5 (After) then these most correct criteria for identifying the number of parts, increases to 56% of all mentions After.

However, it cannot be assumed that because there is an increase in mentions of criteria to do with IKWs and "instructions" that students are able to identify the number of parts more accurately. To test whether or not this is the case, the researcher calculated (for Before IKR only) the number of mentions of each classification which **gave rise to a correct identification** of the number of parts. This data is presented in **Appendix XVI** and the figures relating to named IKWs and "instructions" are summarised in **Table 5.12**.

Table 5.12

Number of correct responses arising from classifications involving named IKWs and "instructions"

Classification	No. of mentions	No. of mentions giving correct number of parts	Percentages
5 No. of named IKWs	216	193	89
14 "No. of instructions"/"instructions"	12	11	92

As expected, a large percentage of reasons under these two classifications[7] gave rise to correct identification of number of parts. Why, though, should only 89% and 92% correct responses be achieved with these two criteria which were expected to provide maximum performance? Some students named IKWs that were not present in the question: these were recorded as **"content items"** (Classification 8). In addition, some students mistakenly counted words which normally would have been IKWs, but in particular instances were not being used as IKWs. For example, in Q_{11}, the actual question begins: "Using principles of adult education, **explain** ...": Some students counted both **using** and **explain** as IKWs.

iii) As expected, the number of mentions of the "No. of content items" (Classification 8) and the "No. of IKWs + No. of content items" (Classification 6) reduced from 10.6% and 19.2% of all reasons Before, to 8.7% and 11.9% After (**Table 5.10**). But again, it was necessary to check to find out if using these two criteria did mislead students. The data for the two classifications 6 and 8[8], in **Table 5.13** are

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7   As is evident from the list of sixty one in **Appendix XIII**, there are many more classifications including the criteria, "No. of IKWs" or "instructions". Only classifications 5 and 14 were examined because in the other relevant classifications one could not be sure of the influence of co-occurring criteria with "No. of IKWs" or "instructions".

8   As is evident from the list of sixty one in **Appendix XIII**, there are many more classifications including the criteria "No. of content items" and "No. of IKWs + No. of content items". Only classifications 6 and 8 were examined for the reasons stated in Footnote 7 above.

extracted from **Appendix XVI.**

Table 5.13

Number of correct responses arising from the classifications: "No. of content items" and the "No. of IKWs + No. of content items"

Classification	No. of mentions	No. of mentions giving correct no. of parts	Percentages
6 No. of IKWs + No. of content items	202	93	46
8 No. of content items	112	58	52

It is evident that of all the choices of the number of parts based on classifications 6 and 8, only 46% and 52% , respectively, were correct. It is safe to state that the criterion **"No. of content items", substantially misleads students in perceiving the number of parts.** As already explained, IKR alters this perception to some degree.

iv) The researcher also expected that criteria such as **"No. of questions"**, **"No. of question marks"**, **"punctuation"**, **"No. of sentences"** and **"No. of paragraphs"**, would mislead students. Take, for example Q_2:

> The public inquiry procedure regarding large civil engineering works is intended to bring into consideration the views of any person or group likely to be affected by a proposal. Many such inquiries are time consuming and costly and often create long periods of uncertainty before a decision is given. However, it is often stated that this procedure is a necessary evil to ensure the best interests of the community. **List the safeguards used to ensure the best interests of the community during this procedure and describe the role of the independent observer?**

Q_2 comprises four sentences. The last sentence (in bold type), which is the actual question, contains two parts but only one question mark. It would seem safe to state that students who base their decisions on "No. of questions", "No. of question marks", "punctuation", "No. of sentences" and "No. of paragraphs", will be misled. Using data in **Appendix XIII** one can compare the number of mentions of these criteria Before and After. The result is shown in **Table 5.14**.

Table 5.14

The frequency of mentions of the classifications "No. of questions", "No. of sentences", "No. of question marks", "No. of paragraphs" and "punctuation"

Classification[9]	Before	After
1 No. of questions	66	31
2 No. of question marks	14	2
3 No. of sentences	42	0
16 No. of paragraphs	1	0
24 Punctuation	4	0
Totals	127	33

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[9] It must be remembered that the thirteen criteria are also classifications.

Since there is an extensive reduction in the mentions of these criteria from 127 Before to thirty three After, that is, from 12% of all reasons Before to 3% After, it would be tempting to state that IKR improves interpretation ability. However, do these results indicate that IKR is assisting interpretation, or **merely providing students with the terminology which the researcher recognises as a correct response?** For example, what do students mean by **"question"** and **"sentence"**, and how do they recognise a question or a sentence? If some students identify a question or sentence in a **grammatical sense** then it stands to reason that they will be misled. However, if a question or sentence is recognised by recognising the IKW, then they are likely not to be misled.

If students are not misled using "No. of questions" or "No. of sentences" then a large proportion of identifications of number of parts based on them should be correct. To test this, the data in **Appendix XVI** relating to the number of correct responses for four relevant classifications[10] was examined and a summary given in **Table 5.15**.

Table 5.15

Number of correct responses arising from criteria involving questions and sentences

Classification	No. of mentions	No. of mentions giving correct no. of parts	Percentages
1 No. of questions	66	58	88
2 No. of question marks	14	12	86
3 No. of sentences	42	25	60
16 No. of paragraphs	1	1	-
24 Punctuation	4	2	-

It is evident that using the criteria of "No. of questions" and "No. of question marks" enabled students, in the main, to make **correct choices as to the number of parts.** Indeed, students who gave "No. of questions" as their reason for identifying the number of parts were correct in as many instances as those who cited "No of IKWs". However, it is safe to state that obtaining a correct response using "No. of question marks" on its own as a criterion would in most choices result in an incorrect response. In all seventeen questions only three (Q_1, Q_7 and Q_{13}) were amenable to successful interpretation using "No. of question marks" alone. Indeed, of the twelve correct responses given for this classification, nine occurred in the three amenable questions just listed.

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[10] As is evident from the list of sixty one in **Appendix XIII**, there are many more classifications including the criteria "No. of questions" items" and "No. of sentences". Only four classifications were examined, for the reasons stated in Footnote 7 above.

On this evidence the researcher suspects that many students (although they do not make it explicit) recognise an actual question by recognising the IKWs. There is further evidence for this: a few students offered reasons similar to: "Two sentences with **command words**", and "Two sentences with **question words**". Command words and question words are IKWs. It would have been interesting to have re-worked the results for this part of the experiment. However, this was not done because it was not possible to tell for sure which students implied "No. of IKWs" when they mentioned "No. of questions". Clearly, further study is required to find out the extent to which students recognise actual questions by the IKWs.

It is also evident that using the criterion **"No. of sentences" was misleading** in 40% of instances. There was insufficient data to consider whether the criteria of "punctuation" and "No. of paragraphs" were misleading. If face-to-face interviews had been possible, the researcher would have asked students just how they identified the "No. of questions", the "No. of parts" and just what kind of punctuation indicates parts in a question. Similarly, it would be helpful to know what students recognise as a **"link"**.

v) It will be observed in **Appendix XIII**, that **"introduction"** is used as a criterion. Some students regarded the introduction (statement) as a part of the question but others, although stating "introduction", did not include this in the numerical record of the number of parts. In the footnotes to Robb (1993 p103-120), it will be seen that some students explicitly state that the **introduction is only background and is not a part**. If IKR is successful, then most of the classifications containing mention of "introductions" should occur Before and very few After. The results show this to be the case as illustrated in **Table 5.16**.

Table 5.16

The mentions (Before and After) in only three[11] of the classifications containing the criterion "introduction"

(Key: No. = number   IKWs = instruction key words   + = and)

	Before	After
9 Introduction + No. of questions	41	1
10 Introduction + knowledge	7	0
33 Introduction + No. of questions + No. of parts/things	5	0
Totals	53	1

The number of mentions of these classifications containing the criterion

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[11] As is evident from the list of sixty one in **Appendix XIII**, there are many more classifications including the criteria "introduction". Although one cannot be sure of the effect of the other criteria occurring with "introduction", the three classifications were used for comparison because they were the relevant criteria with the largest number of mentions.

"introduction" reduced from fifty three to one. However, one cannot merely assume that a favourable alteration in perception enhances interpretation ability. A further test was conducted similar to those already described, to find out how many of the choices based on this criterion were correct choices. Relevant data from **Appendix XVI** is given in **Table 5.17**.

Table 5.17

Comparison of correct responses arising from classifications containing the criterion "introduction"

Classification	No. of mentions	No. of mentions giving correct number of parts	Percentages
9 Introduction + No. of questions	41	10	24
10 Introduction + knowledge	7	7	100
33 Introduction + No. of questions + No. of parts/things	5	2	40

These data require cautious interpretation because some of the percentages are based on small numbers. It seems difficult to explain the relative success obtained by using Classification 10 (**Introduction + knowledge**). However, almost all reasons in this classification were worded as "Introduction + test knowledge of the subject" or "Introduction + part that tests knowledge". This reason was given for perception of only two parts and it is safe to state that it was mere chance that the reason was given for questions with two actual parts. If it had been used for questions, other than two-part questions, it would have been unsuccessful.

For the researcher, the fact that of all the mentions of classification 9, only 24% gave rise to correct responses, is preliminary evidence that the criterion "introductions" misled some students in their choice of number of parts. These is some additional evidence. In addition to the three classifications just listed there are thirteen others containing the criterion "introduction" (**Appendix XIII**). None of the mentions for these thirteen resulted in correct responses (**Appendix XVI**).

The qualification "**preliminary**" has been used to describe the evidence that the criterion "introduction" will mislead students in the identification of the number of parts, for two main reasons. Firstly, it is not possible to isolate out "introduction" from the other criteria which occur with it in various classifications. For example, Classification 22, comprises two criteria (**introduction + No. of IKWs**). While the number of mentions of all other classifications containing the criterion "introduction" reduced, After IKR, those for Classification 22 increased. This is to be expected since After IKR, students will be aware that use of the IKR criterion is

more likely to give correct results.

Secondly, as already alluded to, the very questions one asks, can influence the results. For example, it could be that if the researcher had asked: "How many parts will there be in your answer to this question?" instead of simply, "How many parts are there in this question?", some students would not have listed "introduction" as a criterion. This is another possibility for further study.

vi) As already explained, each of the sixty one classifications comprised one or more of the thirteen basic criteria. The researcher expected that with longer questions, students would tend to combine three or more individual criteria such as shown in Classification 29: "introduction + No. of content items + No. of questions". However, After IKR, it was expected that the number of mentions of these three or four-criteria classifications would diminish. The researcher selected the questions with two actual parts and summed the number of reasons given for perceiving "three parts" and "more than three parts". As expected, and as shown in **Table 5.18**, the figures for these decreased from 290 Before, to 168 After.

Table 5.18

**Number of reasons given for perceiving "three parts" and "more than three parts"
for questions with only two actual parts**

Question	Before	After
1	12	4
2	14	6
6	11	6
7	25	8
8	35	19
10	11	1
11	56	47
12	3	1
13	22	10
14	11	5
15	44	29
17	46	34
Totals	290	168

vii) The researcher wondered if the rankings of classifications used by students for identifying parts changed as they perceived more parts. The top five classifications for each of "one part", "two parts", "three parts" and "more than three parts" are shown in **Appendix XVII**. These rankings Before IKR are remarkably uniform. Classification 8 appears in all four rankings and classifications 5, 12, and 6 appear in three of the four rankings. It is relevant that even without a workshop on IKR, the classifications containing the criteria "No. of named IKWs" or " 'number of instructions' ", were near the top of all rankings. As expected, this trend was enhanced in all rankings After IKR. This again confirms that many students have

an intuition that IKWs are a guide to the number of parts.

Classification 8 ("No. of content items") is the only one which appears in all rankings. It is relevant that it also appears in all rankings After, albeit at a lower rank. This means that although IKR assisted students in realising that the number of content items was not an adequate guide to the number of parts, some students still had difficulty relinquishing this perception.

The researcher wondered about the prominence of Classification 11 ("**No reasons given**") in the rankings in **Appendix XVII**. In addition, 50% of the 77 mentions of this criterion gave rise to correct responses. It is understandable that Before, some students might not be able to tell how many parts there are and not give reasons. After IKR most students should have had a better idea on how to identify parts and therefore be able to give reasons. However, this is not borne out in the data as **Table 5.19** shows.

<div align="center">

Table 5.19

Percentage of "No reasons given" for each of "one part", "two parts", "three parts" and "more than three parts"

</div>

No. of perceived parts	% Before	% After
One part	0	8.2
Two parts	8.6	7.4
Three parts	0	7.2
More than three parts	6.9	13.1

It is evident that the number of mentions of this classification increased overall. The researcher is satisfied that this can be explained by the fact that some students did not give reasons because having learned about IKR to identify the number of parts, the **reasons for their answers were self-evident**. For example, some students started giving reasons (the relevant IKWs) on the After questionnaire but then stopped part of the way through when it became evident to them that it was repetitive. Consequently, perhaps many of the "no reasons given" After, should have been recorded by the researcher as "the relevant IKWs" or "No. of instructions". This was not done to err on the side of safety.

Throughout the discussion in this chapter, mention has been made of certain questions which showed a particularly large number of incorrect responses, or which showed particularly large increases in student performance After IKR. It was considered that closer examination of changes to these might provide additional insights into how students perceive the number of parts, and the affect of IKR on this perception.

Q_5 contained only one actual part, but 57% of students Before perceived two parts and

23% After. However, after IKR there was an increase of of 39% of students giving the correct response. Q5 is worded as follows:

> Describe the effects of computer applications on the education
> and training of an engineer.

An examination of the reasons for perceiving two parts (Robb 1993 p107) shows that **education** and **training** were perceived as two parts. Clearly, for this question, most students who gave the erroneous response of "two parts" were misled by using the criterion "**No. of content items**". But why did only three students see "three parts and "more than three parts": surely **computer applications** would count as a part if this criterion was used consistently? Of course, if computer applications were not discussed in the essay, the result would be inadequate.

Q_{11} had two actual parts but 71% of students Before and 66% After perceived three parts. Q_{11} is worded as follows:

> Adult educators, like educators of children, are concerned with
> doing that which is worthwhile. However, this poses a problem
> because most adults think they know what is worthwhile and
> would take exception to another person telling them what is and
> is not worthwhile. Using the principles of adult education,
> explain how an adult educator must select a) teaching aids and
> b) teaching methods so as to achieve the learning objectives
> without offending experienced adult learners. Describe the
> teaching style most likely to be suitable for adults.

Just as for Q_5, the main reason for perceiving three parts was related to the number of content items, frequently expressed as "a) + b) + [one other criterion]" or "aids + methods + style" (Robb 1993 p113). Since the criterion for identifying the number of parts was "No. of content items", why did very few students include "**principles**" and "**learning objectives**", for example. It seems as if the criterion "No. of content items" was not used consistently.

Q_{17} with two parts was perceived by 67% of students Before and 45% After, to have more than three parts: some perceived six and even ten parts. Q_{17} is worded as follows:

> A professional civil engineer is usually held responsible for the
> durability, serviceability, design, cost - effectiveness, safety, and
> eye-pleasing aspects of his structures. Describe for each of these
> aspects indicated whether or not laws exempt the engineer from his
> responsibilities. Explain the difference between laws, regulations,
> standards and codes of practice.

Again, almost all the reasons given (Before and After) for this question, were to do with various combinations of **durability, serviceability, design, cost** and so on (Robb 1993 p119-120). In other words, **each topic listed was taken to be a part**. After similar analyses on Q_8, Q_{15} and Q_{16}, it was found again that students had

been **misled by the number of content items** in the wording of the question. This mode of perception is modified by IKR: correct responses to Q_5, Q_8, Q_{11}, Q_{15}, Q_{16} and Q_{17} increased by 38%, 31%, 14%, 27%, 15% and 23%, respectively. However, despite these increases in performance, the data in **Table 5.3** presented earlier in this chapter show, that 24%, 32%, 78%, 48%, 33% and 57%, respectively of students in the questions just stated, **still did not give the correct answer After IKR**. Clearly, students' erroneous perception that the number of parts is best identified by the number of content items can be altered, but in many individuals, not easily.

Reflecting on these results, the researcher considered that while the word **"misled"** is used accurately in this chapter, it could convey the wrong impression. Although using "No. of content items" as a criterion for assessing the number of parts in a question does not give the perfect answer, this **might not be too serious for the quality of students' essay-writing**. For example, in Q_{17} the answer requires a student to state for each of durability, serviceability, design, cost-effectiveness, safety and eye-pleasing aspects of structures, whether or not laws exempt engineers from their responsibilities. If a student perceives six parts then this could be helpful since the requirements of the question are made explicit[12].

It might be in a question such as Q_{17}, that working space is so fully committed to the six topics in the first part, that students do not recognise the second part beginning with **Explain**. However, this did not happen: most reasons given included the word "explain" (Robb 1993 p119-120). Whether or not the identification of six parts or of two, makes for a better essay was a question beyond the scope of this research. However, After IKR a student's essay plan of Q_{17} might begin in the way shown in **Table 5.20**, and if it did, would lead to better logic and expression.

Table 5.20

Possible beginning of a plan for Q_{17} After IKR

Part I
Describe whether or not laws exempt the engineer from his responsibilities

a) durability	b) serviceability	c) design	d) cost-effectiveness
e) safety	f) eye-pleasing aspects of structures		

Part II
Explain differences between

i) laws	ii) regulations	iii) standards	iv) codes of practice

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[12] Some students seemed to be aware of this possibility. Some students stated, for example, that there is **one part but with two sub-parts**, and some others another stated that although there is only one question, there are two parts.

5.3 CONCLUSIONS

Before IKR, a substantial number of students were able to give correct answers to the number of parts in seventeen different questions. For example, total number of correct responses was 62% of total responses and 66% of students were correct in ten or more instances. Information processing theory leads one to expect this to some extent because many students will, from their years of essay-writing experience, have devised their own approach to identifying the number of parts. An intuitive way of doing this is to seek out the instructions, commands or directions (IKWs) given by the examiner.

However, After IKR there was improvement in students' correct identification of the number of parts. Total number of correct responses **increased to 78% and the percentage of students giving correct answers to thirteen or more questions increased from almost 28% to almost 68%**. After IKR, 80% of students improved their performance. For the researcher this indicates that IKR enhances students' information processing skills.

There was insufficient data to conclude on the effect of the number of parts and the number of hidden IKWs, on the effectiveness of students' interpretation. However, there is **preliminary evidence that longer questions adversely affect interpretation**. Again, information theory is supported, because it leads one to expect that working capacity will be so busy attempting to make sense of the volume of information, that vital requirements of the question may overlooked. Students' perception of the number of parts improved on all but one of the six and nine-line questions, showing that IKR assisted them in dealing with the volume of information.

It was found that students used **thirteen different criteria to identify the number of parts** in questions. Because these criteria were used in various different combinations, **sixty one classifications of reasons** were identified. It was observed that the most frequently mentioned classifications for identifying the number of parts did not vary significantly with the number of parts perceived. There was considerable consistency both Before and After. As expected, the classifications which included the criteria "No. of named IKWs" and "No. of instructions" increased After IKR and did result in the majority of choices for number of parts, being correct.

It was found that the criteria "**No. of content items**", and "**No. of sentences**" misled a substantial number of students. This means that if students' perception of the number of parts is based on counting up the content items (knowledge topics) or sentences, they are likely to be incorrect in about 50% of cases. It was found that application of this criterion was not consistent, and further research could ask on what grounds content items are recognised as parts of a question. There is also preliminary

evidence that the criterion "**introduction**" resulted in a large number of incorrect identifications of the number of parts. This means that in many instances students' ability to perceive the number of parts in an actual question can be hindered by the presence of a statement. Again, IKR assisted students to alter their perception and the number of mentions of classifications containing these criteria diminished After IKR.

It was revealing that the criteria, "**No. of questions**" and "**No. of question marks**", resulted in a high percentage of responses being correct. Apparently, many students recognise a question by the IKWs and consequently, many of the reasons relating to the number of questions could have been included under the classification "No. of IKWs". This finding again alerted the researcher to the potential dangers arising from the **complexity of terminology in this kind of research.**

It was found that the criterion "**No. of question marks**" gave rise to a large percentage of correct responses because it had been used mainly on the three questions where, by chance, the number of actual parts did correspond with the number of question marks. If it had been used alone on any other question, it would have produced incorrect responses.

The researcher has explained how in IKR workshops, students were advised that IKR is only a technique to help them think: it is not to be applied mechanistically. In this research it became evident that even though many students gave "incorrect" responses to the number of parts, this would not necessarily hinder the quality of their answers. The fact that IKR alerts students to sub-parts of an answer should be beneficial.

As far as the researcher is aware, this research on the analysis of students' criteria for perceiving the number of parts in a question is pioneering work. This means that there are bound to be aspects which have not been examined and some which require further examination. Perhaps one of the most rewarding ways forward would be to conduct probing, face-to face interviews with individual students to find out in detail:
- why the number of questions, sentences, paragraphs, question marks, and links constitute parts in a question;
- why some content items and not others are perceived as parts of the question; and
- what kinds of punctuation, and in what contexts the word "and", indicates parts of a question.

CHAPTER SIX

THE EFFECT OF IKR ON STUDENTS' ABILITIES TO DESCRIBE HOW THEY WOULD ANSWER SPECIFIC QUESTIONS

6.0 INTRODUCTION

It is safe to state that an adequate essay-plan of how one would answer a question[1] requires a thorough understanding of what the examiner requires. In addition, the researcher has found from experience, that the quality of students' essay-plans is usually a predictor of the quality of the final essay. However, the purpose in the experiment to be reported in this chapter was not to test this anecdotal evidence, but to **find out whether or not IKR can improve the quality of students' plans.** Just what "**quality of a plan**" entails for this experiment is set out in this chapter.

Although the traditional picture of a plan is a number of sub-headings with key phrases listed underneath them, a **description of how one intends answering** a question is also a plan. It was expected that enhanced information processing skills gained through using IKR would enhance students' abilities to describe adequately how they would answer questions. The hypothesis raised to test this expectation was:

After workshops on IKR, students' descriptions of how they intend to answer questions will be more adequate than descriptions before such workshops.

6.1 METHODOLOGY

Before learning about IKR, three groups of students studying **adult education, civil engineering** and **chemistry**, were asked through the medium of a questionnaire, to explain how they would answer a number of questions. Students were **not asked to answer the questions,** but to describe how they would do so. After one week, completed questionnaires were collected and a sixty to ninety minute workshop on using IKR to interpret questions was given. Students were then asked to complete the same questionnaire again, this time using IKR. How the three groups of students were selected and how the questionnaires were designed is now explained.

The researcher has encountered the general view that students studying in the physical and applied sciences are poor at essay-writing by nature (inclination). There also seems to be the general view that students in the Social Sciences (and the Arts) are inherently better at essay-writing than their peers in the Physical and Applied Sciences. However, the researcher's anecdotal evidence denies these assertions. Students from a variety of disciplines struggle with essay-writing and it seems as if Physical and Applied Science

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[1] The reader is reminded that in order to improve expression in this thesis, "question" is used as shorthand for "essay-type examination question".

students can benefit from IKR as can Social Science students.

In addition to the general views just explained, it is common knowledge that many university students throughout the United Kingdom are being encouraged by employers, through professional institutions and government schemes, to enhance their communication skills. For example, The Enterprise in Higher Education scheme has enhancing written communication skills as a major component. In addition, the Institution of Civil Engineers, has asked departments of civil engineering in universities to introduce teaching in communication skills at the undergraduate level. The same Institution requires young graduate engineers to pass two essay examinations to achieve their professional qualification. Moreover, most of those who fail the professional examination do so on the essay paper. In the University of Glasgow, 4th year chemistry honours students must attempt an essay paper.

These examples are indicative of the trend to require professionals to be effective written communicators, no matter what their field of expertise. Since essay-writing can be regarded as a foundation for most written communication, and if IKR can assist students, it will also be making a contribution to success at the professional level. It was for these reasons that the researcher wanted to find out whether or not there are differences in the benefit (if any) from IKR, gained by students of the Physical Sciences (chemistry), Applied Sciences (civil engineering) and Social Sciences (adult education)[2]. Brief details about these groups, why they were specifically selected, how workshops were conducted and how questionnaires were administered, is presented in **Appendix XVIII**. The design of the three questionnaires is now described.

Three similar questionnaires were constructed - one for each of the three groups. Selecting questions for each of the questionnaires was undertaken with considerable care. From the results already reported in this research, the researcher was aware of the almost unavoidable potential for students to see meaning in insignificant words and for the type of question to influence results. To ensure that the questionnaires constituted a worthwhile and realistic learning exercise for students, most questions were taken from past examination papers in the disciplines of the student groups.

A sample of the directions for completing the questionnaires, and a sample page layout, are shown in **Figures 6.1** and **6.2** on the following two pages. The questions used for the three groups are listed in **Appendix XIX**. The full questionnaires for each of the three groups are provided in Robb (1993 p121-156).

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[2] The researcher is aware that this classification could be disputed. For example, educationists could correctly point out that they use philosophical, psychological and empirical methodologies as well as sociological ones. However, further discussion in this regard was outwith the scope of this experiment.

Figure 6.1

A SAMPLE OF THE COVERING DIRECTIONS ATTACHED TO THE QUESTIONNAIRES[3]

UNIVERSITY OF GLASGOW: DEPARTMENT OF ADULT AND CONTINUING EDUCATION

DIPLOMA IN ADULT EDUCATION - YEAR I

INTRODUCTION TO POSTGRADUATE STUDY

ASSIGNMENT ONE - ESSAY QUESTION ANALYSIS
(To be handed in during Session One, Monday 8th October 1990)

OBJECTIVES

a) To prepare you for Session One on effective analysis of examination essay questions;
b) To enable you to experience the underlying thought activity which must be mastered if an essay is to be answered effectively;
c) To illustrate that an essay question can be analysed without knowing details of the subject/discipline.

INSTRUCTIONS

PART A

1. In this exercise you will find twelve examination essay questions. Please read each question carefully and describe in the space provided HOW you would answer the question. DO NOT answer the question - merely explain how you would answer it. There are no "trick" questions.

2. At this stage please do not read any books on essay-writing and please do the assignment without consulting friends or colleagues. If you do, some of the benefit will be lost. We will have the opportunity to discuss how to answer each of the questions during our group work in one of the sessions.

3. Assume that you have all the knowledge you need to answer the question. Assume that you have studied hard during the year and you know your subject thoroughly. If any question is difficult, it is NOT because you don't know the necessary facts but because of the question's structure.

4. To emphasise the importance of the structure of the question you will find four questions unrelated to adult education. Again, assume you have the necessary knowledge to answer the questions and explain, only, HOW you would answer.

PART B

5. For each question indicate on the scale provided your estimate of the difficulty of the question. If you think a question is "difficult" or "very difficult" try to explain briefly why you reached this conclusion.

PART C

6. On Page 14 which is lilac-coloured please rank the 12 questions in order of difficulty starting with the least difficult (easiest).

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[3] Since the directions for the other two groups are similar, only the directions for the adult education group are displayed.

Figure 6.2

A SAMPLE OF HOW EACH QUESTION WAS DISPLAYED AND HOW STUDENTS WERE ASKED TO RECORD DIFFICULTY PERCEPTIONS

1.
The success of adult education depends on effective marketing as much as successful teaching. Discuss this statement.

PART A: ASSUMING YOU HAVE FULL KNOWLEDGE HOW WOULD YOU ANSWER THIS QUESTION?

....

....

....

....

....

....

....

....

....

....

....

....

PART B: IN YOUR OPINION WAS THIS QUESTION:

| very easy | easy | neither easy | difficult nor difficult | very difficult |

If you found this question difficult explain why you found it so.

....

....

....

....

....

....

The order of each question within the questionnaires was randomly selected and each question was placed on a separate page with space provided for a description of how a question would be answered. On each page, a scale was provided to enable students to indicate their perception of difficulty for each question. If a question was perceived as difficult or very difficult, students were asked to give reasons for their perception.

The reader will notice from the description just given and the directions to students, that they were asked to:

- **assume that they had full knowledge** of the content of the questions;
- write down how they would answer each question but **not** to write out the full answers;
- record whether they found each question "very easy", "easy", "neither easy nor difficult", "difficult" or "very difficult";
- explain, if they found a question "difficult" or "very difficult", why they found it so;
- record how long the exercise took them; and
- rank a number of questions according to difficulty.

In Chapter One, it was explained[4] why the researcher wanted to collect data on the effect of IKR on the time students took to interpret questions, and their perceptions of difficulty. It has also been explained[5] why data on the reasons for questions being perceived as difficult, were collected. Data collected in this regard during this experiment is discussed in **Chapters Eleven** and **Seven**, respectively. One part of the questionnaire involved students in ranking questions in order of difficulty. However, as already explained[6], to keep this thesis to a manageable length, data collected in this regard was not analysed for this research.

In designing the questionnaires, it was not possible to predict how long students' descriptions would be. For each question a number of lines were drawn (the same number in each case) on the pages of the questionnaire to give some guidance as to the length of description. It was decided to do this because if descriptions were too long they would in all likelihood be repetitive: if too short, not adequate to express a student's understanding of what was required.

Before examining students' completed questionnaires, the researcher used IKR, to prepare a **"best description"** ("model" or "ideal") of how each question should be answered. The quote marks around "best", "ideal" and "model" indicate that these

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[4]   Paragraph 1.3.8 and Paragraph 1.3.9.
[5]   Paragraph 1.3.6.
[6]   Paragraph 1.4.

descriptions are not regarded as perfect and, in any case, did not have to be perfect for purposes of the experiment. It is likely that even more detailed ways of expressing an "ideal" answer can be found. Since these "best" descriptions are **sets of criteria based on IKR**, it was decided to call them "IKR descriptions". Each IKR description was allocated a **best score (BS)**. The phrase "quality of plan" was used earlier in this chapter and the reader will now be aware that for the purposes of this experiment, the IKR descriptions were in effect, considered to be the best quality plans.

All descriptions for all questions, both Before and After, were transcribed and compared against the corresponding IKR descriptions. Each time a student's description matched the IKR description, a point was awarded. When summed, these points represented a **student's score (SS)** for each question. The difference between **SS (Before)** and **SS (After)** was calculated to see whether the quality of descriptions had improved. On completing this analysis the researcher had data relating to the performance of the groups overall, the performance of each individual student and the overall performance on each question.

Again, the researcher was aware that the act of transcribing and analysing students' descriptions could influence results. The precautions to keep this influence to a minimum are detailed in **Appendix XX**. A sample of IKR descriptions and students' descriptions is given in **Appendix XXI**, and a full record of all the IKR descriptions and students' transcribed descriptions for each question (Before and After and for all three groups), is presented in Robb (1993 p157-210).

6.2 RESULTS

Twelve adult education students, sixteen civil engineering students and eight chemistry students, completed both the Before and After questionnaires. For comparative purposes the researcher would have preferred a better response from the chemistry group. However, it was the objective of this experiment to offer only indications of the effect of IKR (if any) on the description quality of these groups. For broader generalisations much bigger samples would have been necessary: the description and results of this experiment could provide the ground work for such further experimental work. The data obtained from comparing Before and After SSs for all questions in all three groups, is presented in **Tables A.12, A.13 and A.14 in Appendix XXII.**

Overall data can sometimes hide other significant facts, and it was decided to examine the data in more detail. Since IKR is expected to improve quality, if a student's description quality shows no change or declined, then IKR has not assisted. By subtracting the sum of the **number of declines** and **number of no-changes** from the **number of improvements**, for each student, one obtains the **net number of improvements**. These calculations are shown in **Tables A.15, A.16,** and **A.17** in **Appendix XXIII. Table 6.1** summarises the results.

Table 6.1

Net changes in number of improvements or declines, for each student, by group
(Key: NI = net number of improvements)

Adult education		Civil engineering		Chemistry	
	NI		NI		NI
SL	-2	SB	-4	AH	-2
PB	-8	PJ	2	SF	-2
KL	-2	LO	-10	AD	-4
JA	2	CS	-10	SN	2
AP	2	GR	-6	CG	-6
HS	6	GU	-6	HM	-8
CB	0	GD	4	IG	-8
LB	-2	DJ	-10	BM	-6
JR	10	DM	-10		
SH	8	CB	-2		
SR	-4	FM	-12		
SF	0	JM	6		
		AP	4		
		WS	-4		
		FB	-2		
		MG	0		

The data in **Table 6.1** show that show that in the adult education group five of the twelve students achieved net improvements[7]. In the civil engineering group only four of the sixteen students achieved net improvements and in the chemistry group only one of the six students achieved net improvements.

It would have been possible to calculate the overall percentage change for each student in each group. However, these percentage figures would have been meaningless. For example, JR and SH in the adult education group achieved overall percentage increases of 130% and 222% respectively. These improvements were gained from base (Before) scores of 20 and 9 respectively, illustrating that comparison in any form would be meaningless.

It is clear from the NI columns in Table 6.1 that some students made considerable

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[7]   To improve expression in this chapter "**Improved**" or "**Improves**" is shorthand for "**quality of descriptions improved/improves**". The same applies to the words "**declined**" and "**declines**".

improvement. For example, JR, SH and HS (adult education) showed net improvements of 10, 8 and 6 respectively. However, in all three groups, some of the net declines were extensive. For example, PB (adult education), LO, CS, DJ DM and FM (civil engineering) showed net declines of 8, 10, 10, 10, and 12 respectively.

Comparing the percentages of number of improvements, number of no-changes and number of declines, gives a similar view, as the data in **Table 6.2** shows.

Table 6.2

Percentages of the number of improvements, number of no-changes and number of declines for each group

	Adult education	Civil engineering	Chemistry
Number of improvements	53	66	23
Number of no-changes	28	42	47
Number of declines	19	23	30
Σ(declines + no-changes)	47	65	77
Difference of improvements and Σ(declines + no-changes)	6	1	-54

Of all descriptions in the adult education group, 53% showed an improvement while 47% showed no change or a decline. In the civil engineering group there was also a small net improvement, the equivalent figures being 66% and 65%. However, for the chemistry group, 77% of all descriptions showed no change or a decline.

6.3 DISCUSSION

Overall results show that IKR assisted most adult education students and many civil engineering students to write better quality descriptions of how they would answer several questions. However, IKR was not helpful to half of the chemistry students. In addition to improvements in description quality, there were also declines, indicating that for **eleven out of the thirty six students, IKR made matters worse.**

Examination of the number of improvements for each student compared to number of no-changes and number of declines shows that only ten of the thirty six gained a net improvement. In addition, of all descriptions in the adult education group, 19% became worse: the equivalent figures for the civil engineering and chemistry groups are 23% and 30%, respectively. Again, in many instances, **IKR has diminished rather than enhanced quality** in a substantial number of descriptions.

The researcher considers that information processing theory goes some way to explaining the substantial improvements in the quality of description achieved by a few

students and also the declines in quality experienced by some others. These explanations are now given, after which other possible factors contributing to the extent of the declines, are considered.

a) Information processing theory and the extensive improvements

It cannot be denied that the improvements shown by students JR and SH are extensive. It could be claimed that low scores on the Before questionnaire would prepare the way for a substantial improvement. However, there is no *a priori* reason why this should be so. In addition, as shown in **Appendix XXII**, JR's Before score of twenty is not much different from scores of twenty five, twenty eight and twenty nine. SH's Before score of nine is very low in relation to other students' scores, which indicates that there may be some truth in low Before scores leading to high percentage improvements. However, the fact is, that there was improvement.

On examining the Before descriptions of JR and SH, it became evident that they had no idea on how to interpret questions. There are many irrelevancies in JR's and SH's descriptions such as those listed in **Table 6.3**.

Table 6.3

Examples of irrelevant phrases from Before descriptions of students JR and SH

JR	SH
Q_1 "Decide how to best debate"	Q_1 "Both the statements are true."
Q_2 "Divide my time equally between"	Q_5 "Watch for the borderline in the issue of power
Q_4 "Select the main issue"	struggle."
Q_5 "Describe some changes in Law or	Q_7 "Weight on training to relate with industrial training
Government Policy"	programme."
Q_6 "Personal aims and hopes"	Q_{12} "I will discuss it rather than give a positive or
	negative answer."

The researcher's immediate impression was that JR and SH are two of those students who have had little or no previous experience of question interpretation and hence few opportunities to develop information processing skills in this regard. Examination of JR's and SH's After descriptions shows that the number of irrelevances is extensively reduced, indicating that IKR may have assisted two field dependent students to reduce the "noise". This can be only a tentative interpretation.

Three other factors contributed to a low Before score for SH. Being foreign, his/her[8] English was not as fluent as other students. In addition, Q_2 was not answered because she/he claimed insufficient knowledge - despite the exercise directions asking students to assume full knowledge. Also, descriptions on how to answer Q_6 and Q_{10} were not attempted at all. Although Q_{10} is a civil engineering question (and hence unfamiliar),

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[8] "His/her" is used to protect the student's' identity.

Q_6 is an adult education question - SH's own discipline. The fact that SH did not attempt descriptions for three questions indicates the difficulty of question interpretation for him/her. However, After IKR, descriptions for these three questions are given.

In summary, information processing theory explains, that most students will have their own idiosyncratic method of interpreting questions. On learning a new technique they may or may not use it, and if they do, it might be used in conjunction with their existing approaches. However, for those students who have next to no habitual approach, perhaps because they have not written many essays, IKR will be **their initiation into using an explicit technique for question interpretation**. In these instances, question interpretation skills would be expected to improve rapidly. The researcher considers it likely that this is what happened with those students who gained net improvements.

b) Information processing theory and the number of declines

It could be that to some students, IKR with its formula-like approach may seem more complicated than the way they work habitually. Students may become too bound up in making the technique work than in using it to solve the problem at hand. Also, techniques worked out by oneself are difficult to dislodge: there has to be some conviction of gain before well-held methods are abandoned. In addition, for some students, the technique may seem very difficult because they are not familiar with it. An analogy would be a person who plays the piano reasonably well "by ear", but when trying to progress further by learning to read music finds playing the favourite songs more difficult - at first. However, further practice leads to gradual improvement and to greater levels of performance.

There is some evidence for this in the reasons given by students for questions being perceived as difficult, as will be explained in later in **Chapter Seven** of this thesis. For example, student SF (adult education) makes the following remarks on the After questionnaire:

Q_1 "The impulsive part of me finds it extremely frustrating to discipline myself to break down the question into different parts."
Q_4 "I still find myself thinking more about the content of the question than about how I would answer it."
Q_5 "I feel under pressure to find your three concepts in each question."

In addition, as will be shown later in this thesis, of the twenty five reasons given by the adult education group for a question being perceived as difficult After IKR, seven were similar to SR's experience: of Q_1: "**[Difficult] to distinguish knowledge and relevance**". It is to be expected that some students will not be able to apply a new technique as quickly as some others, and will require additional practice. If the IKR

workshops had been extended to allow for more practice of IKR, it is possible that the number of declines would have been reduced.

The researcher is aware of the danger in stating that "IKR assisted" or "IKR has not assisted". There could have been factors influencing students' performances other than IKR itself. Even if control groups[9] had been employed and asked to complete the After questionnaire after a "placebo" workshop, it is not possible when undertaking research with human beings to take account of all eventualities. For the researcher, this means that in this experiment **the IKR technique cannot be separated from the methodology used to test it**. Consequently, IKR in the statements "IKR assists" or "IKR hinders" is shorthand for "**IKR and the way of testing it ...**". This distinction is relevant because there are three additional factors related to methodology which could have contributed to the number of declines.

c) The identical nature of the Before and After questionnaires may have led to boredom

The researcher detected in the shortness and untidiness of some responses that some students might have become bored or impatient with the After questionnaire. Some students' direct statements on the questionnaires do indeed indicate boredom. This could account for some decline in quality because if students have already thought out an answer to a question in the Before questionnaire and expressed it as well as they could, they might not take as much care in expressing their thinking the second time[10]. The researcher wondered if a shorter questionnaire with different questions in the After questionnaire would reduce this apparent boredom or familiarity factor.

Consequently, this experiment was modified and repeated in 1992 with a different civil engineering group comprising seventeen students. Instead of twelve questions only eight were used. In addition, the Before and After questionnaires contained different questions. Care was taken to ensure that the maximum number of points that could be awarded if all descriptions matched the IKR descriptions exactly, was the same, that is, thirty eight. This means that Before and After results could be compared.

The page lay-out on the questionnaires and the directions for completing them were almost identical to those already displayed in this chapter. The full questionnaire is shown in Robb (1993 p211-230) The method for transcribing and analysing students' descriptions was identical to that already described. The list of questions used is given in **Appendix XXIV**, and all students' transcribed descriptions for all questions are

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9   An explanation has already been given in Paragraph 2.1, as to the practical and ethical reasons for not using control groups in the experiments in this research.

10   An analogy would be a lecturer who after giving the same lecture, say three times to different groups, begins in the fourth lecture (unless a conscious effort is made to correct it) to leave out some parts.

presented in Robb (1993 p231-249). The resulting Before and After description qualities for each student and for each question are displayed in **Tables A.18** and **A.19** in **Appendix XXV**. A summary of the changes in quality of description are shown in **Table 6.4**.

Table 6.4

Changes in description quality in a modified experiment with civil engineering students

Student	SH	NS	SC	AW	JM	SD	SB	DT	FP	CM	SL	CL	PK	JG	GG	AB	Tot
Before	23	22	21	22	22	19	17	16	22	13	24	25	22	34	29	18	349
After	29	21	25	24	26	24	26	24	22	23	25	16	23	26	26	19	379
Change	6	-1	4	2	4	5	9	8	0	10	1	-9	1	-8	-3	1	30

Although, again, overall descriptions increased in quality, (by 30), this is only marginally better than the improvement over the group tested with the longer questionnaire. While in the first group of civil engineers, ten out of sixteen showed improvements with the longer questionnaire, **eleven out of seventeen in the second group showed improvements with the shorter questionnaire** - again marginally better. While there are three extensive individual improvements (10, 9 and 8) there are again declines (-9, and -8,). While there is slight overall improvement, these modified results do not make it safe to state that the length of the questionnaire and the repetitiveness of questions can account for the number and extent of declines in quality of description. Of course, similar experiments with larger numbers of groups might reveal a pattern: perhaps there **will always be a proportion of students who are inhibited by IKR,** or any technique, on encountering it for first time.

d) Having a fuller mental picture of what is required could negate the need to scribe[11] it down

Since IKR shows students how to make the distinction between the **knowledge required** and the **specific aspect of that knowledge** (relevance) which is required, it could be that students, **knowing** they have an accurate picture of what is required, may not need to scribe this out. The researcher encountered this unknowingly, when analysing the quality of After descriptions. As pointed out in the explanation of how the transcribing was done (**Appendix XX**), when the terms "in relation to"; "relative to" or "compared to" were encountered only one point was awarded because the researcher could not be sure that the student would describe or discuss that aspect mentioned after "relative to", for example. This caution could have hidden the fact that if students had been interviewed and asked what "in relation to" really entails, that a more step-wise approach would have been given. The researcher wondered if there would be any change to the overall results if extra points were awarded for **the relevant occurrences of "in relation to"**, for example.

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[11] The reader is reminded of the distinction made in Paragraph 1.2.2f, between writing and scribing.

Consequently, the After descriptions for the adult education group only, were re-examined, extra points awarded for relevant occurrences of "in relation to", and the SSs re-calculated. The additional points are indicated in the students' descriptions (in Robb 1993 p157-176) by a "+". Not every occurrence of "in relation to" was awarded a point because some of the occurrences were not strictly used as relational clauses. A new SS (if any) for each question for each student is given in brackets. The calculations in **Table A.12, Appendix XXII** and **Table A.15, Appendix XXIII**, were re-cast and are presented in **Tables A.20** and **A.21**, in **Appendix XXVI**.

With this minor change, all students' descriptions in this group improved with student PB showing no change as opposed to a decline when the relevant occurrences of "in relation to" were not taken into account. As **Table A.21** shows, the number of students improving increases from five to six. While overall improvement is small, the extensive improvement of PB and the more than doubling of improvements as a percentage of total descriptions, is relevant.

It could be that because the speed of information processing far exceeds the speed of scribing, students and people in general, take for granted certain steps they take in answering a question and may not scribe these out. Without detailed knowledge of what students mean by "in relation to" or "compared to", for example, it could be that further research on the quality of descriptions could be hindered by researchers **not being able to recognise when students are indicating their understanding of what is required**. The researcher considers that the evidence just presented gives an insight into the complexity of how students express what they are thinking. Research at a more fundamental level is required and it would seem as if face-to-face interviews could provide answers to finding out just what students are thinking about how they will answer a question.

e) Lack of incentive to complete the After questionnaires carefully

It is clear from the data provided for the three groups that adult education students seemed to benefit considerably more from IKR than did civil engineering and chemistry students. However, the adult education students had to submit the questionnaires as part of their course work, whereas the other two groups did not. The civil engineers were young professionals attending evening courses on essay-writing in order to pass their professional examination. Although the chemistry students were expected to attend the workshops there was no compulsion to complete and submit the

questionnaires. Although the researcher attempted to motivate this group by explaining the value of the exercises in the questionnaires, it was evident that students' attempts on the After questionnaire were not as enthusiastic as on the Before questionnaire. The researcher suspects that requiring students to complete the questionnaires as part of course work would result in even more extensive improvements.

6.4 CONCLUSIONS

With some caution, it is possible to state that just **one short workshop on IKR assists adult education and civil engineering students to understand better** what is required from essay questions and consequently, to improve the quality of descriptions of how they would answer them. However, for the chemistry group, the workshop on IKR did not improve the quality of descriptions. Caution is required in making these statements regarding improvements since the net number of improvements (improvements less no-changes and declines) for each student shows that of the total of thirty six students only ten gained a net number of improvements.

While boredom might have been a factor in the poor quality After IKR, this was found not to be a significant contributor to the number of declines. However, a significant factor in this regard, for the adult education group, was the researcher's decision not to award a point for items after relational clauses such as "in relation to" or "with regard to". A re-calculation awarding points for relational clauses resulted in significant further improvement in the adult education group's performance. The theory of information processing indicates why a few students obtained extensive improvements and also, to some, extent why some students experienced declines.

Further research is required into how students **express what they think is required by the examiner,** and to finding out if longer IKR workshops with more, and perhaps compulsory, practice could reduce the number of declines. The reader may have noticed that data presented in the appendices relevant to this chapter included information on the improvements on each question. These data could assist in identifying those questions which caused particular difficulty. For example, those questions on which students showed no improvement or a decline in quality of description could be identified as those causing more difficulty than others. **Table 6.5** on the following page shows those questions in each group which seemed to have caused particular difficulty.

Table 6.5

Those questions which seemed to have caused particular difficulty

(Key: % = percentage improvement or decline (-) in description quality)

Adult Education		Civil Engineering		Chemistry	
Question	%	Question	%	Question	%
3	0	1	9	3	-9
12	0	2	-15	4	-17
4	8	5	-11	6	0
		9	-4	7	-4
				8	-8

It was decided that when reasons for perception of difficulty were examined, particular attention would be paid to the questions listed in **Table 6.5**.

CHAPTER SEVEN

THE EFFECT OF IKR ON THE CRITERIA STUDENTS USE IN THEIR PERCEPTION OF QUESTION DIFFICULTY

7.0 INTRODUCTION

In Chapter One[1] two interrelated expectations were explained regarding the reasons given by students for perceiving one question to be more difficult than another. First, without knowing of IKR, students' reasons would relate mainly to **length of the question, confusion caused by a statement, poor/vague wording** of the question and students' **lack of knowledge** of the topic. Second, After IKR, reasons would be expressed mainly in terms of **amount of work involved, extent of thinking** needed and **number of parts to be answered.** These expectations were considered reasonable because IKR, as a way of enhancing information processing skills, should enable students to "see through" length, vagueness and statements to the actual **number and type of mental steps/processes to be undertaken to answer a question.** To test these expectations the following hypothesis was raised.

After workshops on IKR, more of the reasons (than before such workshops) given for one question being regarded as more difficult than another will relate to the extent of mental effort required to answer the questions.

In Chapter Three, it was explained how students were presented with numerous pairs of questions in which both **actual questions** were of equal difficulty. In one exercise (Part A) some questions had a statement and others did not. In another exercise (Part B) some questions were longer than others. If students found (erroneously) that one question in a pair was more difficult than the other, they were asked to give reasons. In Chapter Six it was explained how three groups of students were asked to state for each of a number of questions, whether they found them to be "very easy", "easy", "neither easy nor difficult", "difficult" or "very difficult". If they identified a question as being "difficult" or "very difficult", students were asked to give reasons for their perception.

Consequently, from three separate experiments, three sets of data were available on how students perceived question difficulty. In this chapter, the sets of data are referred to as "Set One", "Set Two" and "Set Three". The researcher hoped that insights into how students perceive question difficulty[2], might reveal whether or not these perceptions are based on rational or spurious grounds. It was also hoped that implications for examiners would be revealed.

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[1] Paragraph 1.3.6.

[2] For ease of expression in this chapter "question difficulty" is shortened to "difficulty".

7.1 METHODOLOGY

How students were asked to record their reasons has been explained in the previous chapters in this thesis. As anticipated, analysing students' reasons for one question in a pair being perceived as more difficult than the other, or for a question bring considered difficult or very difficult, raised several problems. The way the many reasons were recorded and analysed was similar to that described for identifying the number of parts in a question as explained in Chapter Five[3]. Because the transcription and analysis of reasons may influence results, more detailed descriptions of how reasons were transcribed and analysed for all three sets are given in **Appendix XXVII**.

After preliminary analysis of Set One, twenty two **classifications** were identified, and for Set Two, six additional classifications were identified. Analysis of reasons in Set Three, revealed four additional classifications, making **thirty two** in all. All reasons given were then grouped according to these thirty two classifications in that set. A sample of how reasons in each set were recorded and classified is given in **Appendix XXVIII** and a full record of all reasons given for each set with their classification numbers (1-32) is provided in Robb (1993 p250-270). The numbers of mentions for each classification, for each set, are shown in **Appendix XXIX**.

In effect the thirty two classifications into which all reasons were grouped, constitutes a **list of criteria** that students use in their perception of difficulty[4]. Consequently, it was decided to refer to "**criteria**" and "**criterion**" in this chapter. Also, the number of reasons in a classification is synonymous with the **number of mentions of a criterion**. Up until the time of submitting this thesis, the researcher had not found a similar list of criteria in the literature, and in the conclusion to this chapter, suggestions are offered for further research in this regard.

It has been explained previously[5] why the most accurate perception of difficulty will be obtained by **identifying the number and type of mental steps/processes** to be undertaken to answer a question. Since the mental effort involved in answering a question can be assessed by examining the IKWs (instruction key words) any criterion relating to this could be called an "**IKR criterion**". Using other criteria not related to identifying the mental effort involved should not provide a consistent basis for perceiving difficulty and they could be referred to as "**spurious criteria**". If IKR does change students' criteria for perceiving difficulty it would be expected that After

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[3] Paragraph 5.2.
[4] Notice the difference in terminology compared to that in Chapter Five when reasons for numbers of parts in a question were reported. In Chapter Five eleven criteria were reported and these, in various combinations, made up sixty classifications. In this experiment each of the thirty two classifications is in itself, a criterion.
[5] Chapter One, Paragraph 1.1.3.

IKR, the number of IKR criteria would increase[6].

Consequently, each of the thirty two criteria (Before and After) was judged to be either a spurious or an IKR criterion: it was found that only four were IKR criteria, namely:

4   Must give both sides/advantages and disadvantages/pros and cons/
5   More discussion/argument/thinking/precision/deciding/comment/application of knowledge needed
11   More parts/work. Longer/intricate/detailed answer required
23   Question structure causes problems

Without knowing of similar research to refer to, the researcher was concerned about deciding which criteria constituted IKR criteria. However, care was taken to identify those of the thirty two criteria which showed definite evidence of difficulty in terms of information (mental) processing. The percentages of the number of mentions given for each of the IKR criteria was compared Before and After.

7.2 RESULTS

The total numbers of reasons given in each set, Before and After (from **Appendix XXIX**) are shown in **Table 7.1**. The numbers of mentions of the four IKR criteria (Before and After) expressed as a percentage of total mentions for each set are given in **Table 7.2**.

Table 7.1

Total reasons given Before and After for each of the three sets

	Set One	Set Two	Set Three	Totals
Before	348	440	154	942
After	158	264	120	542
Difference	190	176	34	400

Table 7.2
Mentions of each IKR criterion expressed as a percentage of all mentions in a set

IKR Criteria	Set One		Set Two		Set Three	
	Before	After	Before	After	Before	After
4	0.3	0.6	0.2	1.5	0	0
5	8.3	3.2	4.3	3.8	7.1	13.3
11	1.4	2.5	7.5	16.3	2.5	3.3
23	0.0	0.0	0.7	0.0	7.8	27.5

7.3 DISCUSSION

To achieve the balance of obtaining the maximum relevant information from the results without making the length of this thesis unmanageable, it was decided to conduct the

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6   As already explained in Chapter Four, IKR does assist most students to perceive difficulty more accurately.

discussion in two parts. Firstly, the number of IKR criteria Before and After are compared to find out if the hypothesis stated in Paragraph 7.0 can be supported. Secondly, the most frequently mentioned criteria in each set are examined to gain insights into how students perceive difficulty.

7.3.1 CRITERIA FOR PERCEIVING DIFFICULTY, BEFORE AND AFTER IKR

As expected, **Table 7.1** shows that the **number of reasons given for each set drops substantially** as does the total number of reasons overall - from 942 Before to 542 After. Since the actual questions in the pairs of questions in Set One and Set Two, were of equal difficulty, any perception of difficulty was erroneous. Since as shown in Chapter Four, IKR assisted students to avoid this erroneous perception, it is to be expected that the number of reasons given for perceiving difficulty would diminish.

As expected, in most instances (seven out of ten), **mentions of the IKR criteria for deciding on difficulty increased.** This means that in general, **After IKR, students use criteria which are more likely to assist them to evaluate more accurately the relative difficulty of a question.** The qualification "more likely" is necessary because although students may know of the more accurate criteria After IKR, **they may not apply them adequately.** Indeed, for Sets One and Two, giving any reason - even one which falls within an IKR criterion - would be incorrect because both questions in each pair were of equal difficulty.

Since any perception of difficulty in Sets One and Two was erroneous and hence any reason unjustified, it is understandable that the number of mentions of IKR criteria made up a very small proportion of all mentions in these two sets After IKR (**Appendix XXIX**). Most students who perceived (erroneously) one question as more difficult than another - even After IKR - did so because they were **using criteria which would indeed lead to erroneous perceptions.** Each criterion for each set was ranked according to its number of mentions. These rankings made it possible to reveal which criteria are most frequently used in perceiving difficulty.

7.3.2 THE CRITERIA AND THE INSIGHTS THEY PROVIDE INTO STUDENTS' PERCEPTIONS OF DIFFICULTY

The top six most mentioned criteria for each set have been extracted from **Appendix XXIX** and are presented at appropriate places in this discussion. The choice of "six" as the cut-off point for considering criteria in detail was not entirely arbitrary. This number should enable maximum expression of implications of the findings while keeping this thesis within a manageable length. Also, it was considered that if a

criterion gained only 5% or less of all mentions for that set, its occurrence was relatively insignificant. It so happens that using this cut-off point resulted in only six or seven criteria being indicated as the most frequently mentioned. It was also decided to examine any particularly unusual criteria.

a) Set One

The six most mentioned criteria for Set One are presented in **Table 7.3**.

Table 7.3

The number of mentions for each of the most mentioned criteria in Set One, and this number expressed as a percentage of all reasons

	Classifications (criteria)	Number	Percentage
	Before		
2	One word/phrase in the question indicates difficulty	93	26.7
3	Poor/complex wording/flow/expression/phrasing: too long/long-winded, confusing, vague	44	12.6
5	More discussion/argument/thinking/precision/deciding/ comment/application of knowledge needed[7]	29	8.3
18	Not split into question and statement/two questions	23	6.5
8	Scope much narrower/less general/less vague/ambiguous/ definite/varied. More specific	22	6.2

(These six classifications account for 60.3% of mentions)

		Number	Percentage
	After		
2	One word/phrase in the question indicates difficulty	47	29.7
1	Less/not straightforward/clear/direct/understandable	17	10.8
3	Poor/complex wording/flow/expression/phrasing: too long/long-winded, confusing, vague	16	10.1
8	Scope much narrower/less general/less vague/ambiguous/ definite/varied. More specific	12	7.6
6	More knowledge/detail/indepth required	10	6.3
18	Not split into question and statement/two questions	9	5.7

(These six classifications account for 70.2% of mentions).

The reader may remember[8] that in the exercise (Part A) used to collect this data, students were presented with eight pairs of questions, in four of which one question had a statement. In the other four pairs neither question had a statement. The researcher expected that many of the reasons would relate to criteria to do with **the presence of a statement**. However, the data in **Table 7.3** does not support this. Almost 27% of mentions related to **one word or phrase in the question** (Criterion 2). This result is striking since the next most mentioned criterion only accounts for about 13% of

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[7] Also expressed as "not just yes/no or textbook answer".
[8] Paragraph 3.2.1.

mentions. Closer examination of which words were perceived as indicating difficulty, revealed that almost all the mentions given under this criterion referred to the questions in Pairs A_1, A_2 and A_4 as displayed below.

A_1
1   Describe the **effects** of computer applications on the education and training of an engineer.
2   Describe the **role** of computer applications on the education and training of an engineer.

A_2
1   Discuss the **influence** of industrial relations on site activities with particular reference to flexibility in working practice.
2   Discuss the **role** of industrial relations on site activities with particular reference to flexibility in working practice.

A_4
1   List at least ten principles that adult educators **should** follow when teaching adults.
2   List at least ten principles that adult educators **should attempt** to follow when teaching adults.

In A_1, 78% of all reasons given for Q_1 related to **effects**[9] being more difficult than **role**, and in Q_2, 59% to **role** being more difficult than **effect**. In A_2, 60.1% of reasons given for Q_1 related to **influence** being more difficult than **role**, and for Q_2, 62.5% to **role** being more difficult than **influence**. In A_4, 36% of reasons given for Q_1 related to **should** being more difficult than **attempt**, and 28.5% to **attempt** being more difficult than **should**.

In the experimental design, the researcher had attempted to ensure that both questions in any pair were of equal difficulty and the one word in the second questions of the pairs was changed merely so that the two questions **would not be obviously identical**. It cannot be doubted that although any meaningful change in the questions was not intended, **many students perceived the change of one word to indicate a difficulty difference**. However, the researcher was surprised at the **extent of the contradiction, regarding which word indicates the more difficult question**. This illustrates that students have quite different experiences and interpretations of the meanings of certain words. Initially, the researcher thought that students' perceptions of the meanings of the words in question would be mostly subconscious feelings. However, some very specific reasons are given for why one word is perceived as indicating more difficulty than another.

While a detailed examination of these secondary reasons[10] was beyond the scope of this research, it was considered that a brief examination of them could provide additional evidence of students' tendency to perceive spurious difficulty in one word or

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[9]   The frequent need for quote marks to indicate words in questions would have been distracting. Consequently, it was decided to use bold type as emphasis.

[10]   The term **"secondary reason"** is used to distinguish these reasons for one word being perceived as being more difficult, from reasons for one question being perceived as being more difficult than another question. These secondary reasons are compiled from the copious footnotes recorded when all reasons were being recorded. (See the full list of reasons and their classifications in Robb (1993 p250-270).

phrase. **Table 7.4** gives some of the secondary reasons why a word or phrase was considered as indicating difficulty.

Table 7.4

Some secondary reasons given for one word or phrase (Criterion 2) indicating difficulty

Effect
• requires greater understanding/ analysis/explanation/weighing-up [three mentions]
• involves many things, role being only one [four mentions]
• is less general/more technical and specific [two mentions]
• involves giving the effects of the role

Influence
• demands an opinion
• is not as definite as role
• asks how the role affects the situation
• it needs more weighing-up

Should
• what you should do and what you should try to do are different

Attempt
• does not allow vagueness
• is not necessary
• disrupts meaning
• indicates one cannot always attain the level
• gives wider scope and is not clear-cut

Role
• is more difficult than describing

The debate about whether students' interpretations of everyday words are accurate, is not relevant in this discussion. However, it is relevant that some of the secondary reasons such as **requires more analysis/weighing-up** and **demands an opinion**, could be classified under one or other of the thirty two criteria. This finding reveals further complexity. Students may have identified that **effects** implies more discussion, argument or thinking, but recorded as their reason **more discussion, argument or thinking required** (Criterion 5). It is likely that if students who indicated that a particular word indicates more difficulty were asked "why?", the frequency of mention of other criteria would have been greater.

It is also relevant that **even After IKR, 31.1 % of all reasons related to one word** indicating difficulty. Caution is necessary because of the lower number of reasons given[11]. However, reasons relating to one word indicating difficulty, expressed as a percentage of all reasons given for each question in Pairs A_1, A_2 and A_4,

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[11] The reader is reminded that this is an encouraging sign. Since both questions in a pair were of equal difficulty, IKR helped if students did not identify one question as being more difficult and consequently, did not have to give reasons.

were: Q_1, 81% and Q_2, 42%; Q_1, 72% and Q_2, 40%; Q_1, 33% and Q_2, 100%, respectively. This indicates that for a small but significant number of students, **it is difficult to shift conceptions of question difficulty** away from preconceptions about the meanings of some insignificant (to the examiner) words.

Criterion 3 was the next most frequently mentioned Before, indicating that 12.7% of all reasons given in Set One were related to **poor/complex/confusing wording**. This criterion appeared third in the ranking After, making up 10.6% of all mentions. Face-to-face, interviews with students might have given insights into why a question was perceived as having poor wording, poor flow or vague expression. Practical considerations prevented the researcher conducting the interviews as did the need to keep the research within manageable bounds.

However, some relevant information can be gleaned from this crude data. For example, one student (A_3Q_2B)[12] found that the question was asked in a confusing way because it was **all in one question and there was no chance to think over the previous statement**. Others found, for example, that: there was **too much in the first sentence**; it was **too long** and "**too much of a mouthful**"; **it did not look like a question that could be developed, it read a lot harder, needed to be read a few times**, the **English was strange**, and it was **too long to digest**.

Since two questions in a pair were of almost identical line-length, some students' perceptions of one question being too long, were erroneous. However, some of the secondary reasons just listed, indicate that the perception of poor or complex wording relates to whether or not the question has a **statement/introduction**[13]. This was tested by comparing the number of mentions of this reason given for questions with, and questions without a statement. If one excludes the control pairs in which neither question had a statement, the total number of mentions of this criterion was fifty three and of these, forty three (81%) were given in response to questions **without statements**. In other words, although the amount of work in answering both questions would be the same, most students who used the criterion **poor/vague wording** perceived questions **with a statement, as easier.**

A particular example of this is given by A_6 on the following page, to which 40% of all reasons relating to poor wording (Criterion 3) in Set One can be attributed. This pair of questions is shown on the following page.

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[12] A_3Q_2B, is short for Part A, Question Two, Before. The researcher considered referencing all statements listed in this way so that the reader would be able to find them in the full record of reasons in Robb 1993. However, it was soon realised that this would make the expression clumsy.

[13] Although students use the term "**introduction**", for consistency of expression the term "**statement**" is retained.

A6

1   As the richer nations of the world develop their technologies the gap between them and the poorer countries widens. Are engineers playing their proper role to stem this drift apart?

2   Are engineers playing their proper role to stem the richer and poorer nations drifting apart because of the technology gap?

Although the researcher considers that Q_2 is shorter, and to the point, 34.8% of all reasons given for this question (Before and After) relate to poor/complex wording. The following experimental questions were the ones without a statement: A_3Q_2, A_5Q_1, A_6Q_2 and A_8Q_1. The percentage of students mentioning these questions as more difficult as opposed to those that mentioned the twin of the pair (with a statement) as more difficult, were respectively: 17% against 15%; 35% against 8%; 62% against 6%, and 53% against 25%. It cannot be doubted that **most students regard questions with a statement as being easier**. This finding corroborates the same finding reported in Chapter Four[14].

But why should this be so? A comment by one student gives some clues: **All in one question and no chance to think over the previous statement**. On this combined evidence it is reasonable to state that shorter sentences and the division of the question into statement and the actual question, makes questions easier to read. But **being easier to read does not necessarily mean that a question is easier to answer**. Indeed, information supplied by students who thought the opposite to the majority - that the question with the statement was more difficult - indicates that: **A lot of waffle in Q2 can be cut out**, and **The shorter sentences in Q2 are easier to follow**. Further reliable insights could not be drawn from this very limited data but the researcher was alerted to the importance of secondary reasons.

It is revealing that 8.4% of students (Before) regarded a question as being more difficult because it involves **more discussion, argument, application of knowledge or thinking**, for example (Criterion 5). It is difficult to understand why students hold this perception because in both questions of a pair the IKWs were the same and the content of the questions was identical. Additional information given by some students is unhelpful in this regard. Some comments were: questions require more thinking or discussion because they require **more than textbook answers** (three mentions); **more than just a description**; and **do not just involve telling or reciting**. Even though students' perceptions in this case are not justified, it is still relevant that they regard the **requirement to think and discuss more**, as indicating more difficulty. The fact that this criterion does not appear in the six most mentioned criteria After, indicates that IKR has had some effect. It could be that, After IKR, **thinking and more discussion** is no longer considered an aspect of difficulty

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[14] Paragraph 4.1.2.

or that students learned that each question in a pair required the same level of thinking.

The fact that Criterion 18, (**question not split into question and statement**), accounts for 6.6% of mentions Before and 6.0% After, is additional evidence that some students erroneously perceived more in the statements of some questions than was intended by the researcher. All but one of the thirty three mentions given for this criterion were given in response to questions with no statement. Some of the secondary reasons for "no split" in the question creating difficult were: **fact and question are mixed**; and **cannot be broken into more answerable sections**. Two students were even more direct: **Facts first then the question is easier**, and **In Q$_2$ the first two sentences present facts and then the question**. Together with the other findings so far presented, this indicates that some students find questions with statements easier than those without.

For the researcher, a question which is more specific, of narrower scope and less general, less vague and less ambiguous, would be easier to answer than a question with the opposite qualities. However, this criterion was fifth in the ranking (Before) and fourth (After). Some of the secondary reasons indicate that because a question is more specific, (less general): **it cannot be applied to any course; it does not allow a varied answer; and gives no chance to use imagination**. Other secondary reasons included: **less room for error or no leeway; less choice of principles; does not allow more points to be mentioned; does not give as much to chose from; and does not permit an answer with a variety of points**. In other words, it seems as if the vague, less specific, question is easier because **one can waffle by drawing on general knowledge or imagination**.

Without face-to-face interviews with students, caution is necessary to avoid too much being read into the reasons offered. However, the researcher gained the general impression that students regarded the vague, less specific question as allowing one to **cover-up for lack of knowledge** of the content. For example, a question which offered less choice of principles, less variety of points and did not enable drawing on one's general knowledge or imagination certainly would not give the unprepared student room for error. Further analysis of the number of occurrences of this reason according to whether a statement was or was not present in the question was unhelpful: almost half of the reasons were given for the control questions (those with no statements). Of the thirteen reasons given for the experimental questions, eight were given for questions with a statement and five for the questions without.

It is not possible to draw safe conclusions from such small numbers. It is evident, though, that answers to why a narrower scope represents difficulty are likely to be

complex. Some students regard narrow scope and lack of generality as **not allowing them to write on more topics** and perhaps expose their lack of knowledge: others perceive that a statement narrows the scope because **the answer must be about the statement**. Others still, see the lack of a statement as the examiner **not providing more points to write about**. The relevant fact is that all of these perceptions are not justified. As already explained, the statements were not intended by the researcher to give more to write about: many were merely irrelevant appendages made up to fit the experimental design. The implications of holding these erroneous perceptions will be discussed later in this chapter.

Criterion 1 (**one question in a pair being less straightforward, unclear, not direct or not understandable**) made up 6.1% of reasons (Before) and 11.3% (After). Bearing in mind the evidence so far, it was expected that mentions of this criterion would have a similar cause. Considering only the mentions for the experimental pairs, 41.3% were for the question with a statement and 58.6% for the question without. Again, it must be found that the **question with a statement is perceived to be easier**. However, the fact that almost 42% of mentions of this criterion (being unclear or difficult to understand) referred to questions with a statement, indicates that some students find that statements contribute to difficulty.

An insight into these aspects of difficulty can be obtained by considering the additional information given by some students. For example, for a question with a statement, the difficulty arises because it is: **harder to spot what is being asked** (two mentions); is **very difficult to follow; takes too long to get to the question** (four mentions); and is **disjointed**. For a question without a statement the difficulty arises because: **it does not give information;** what you must discuss **is not put clearly in a separate sentence;** it **does not say exactly what duty is;** it **hard to discover what is being asked;** and it **does not explain the question fully.** The researcher noticed that the secondary reasons given for the questions with and without statements seemed of a slightly different nature. On the one hand, those students who gave this reason **for questions with a statement** indicated that the statement hinders them in getting to **understand quickly what is required.**

On the other hand, those students who gave this reason **to questions without a statement** seemed to think that they were **being given less information or that additional helpful information is hidden and difficult to locate.** However, this perception is unjustified since the statements could be almost entirely omitted and the questions would stand on their own. Indeed, as already explained, the researcher made-up statements in some instances and no additional relevant (helpful) information was supplied. Although this finding is based on small numbers of responses, it could

be very relevant to students' success in essay-writing. If students think that statements contain helpful information, they may be misled, and indeed, give irrelevant answers.

There is a considerable change in the ranking of Criterion 1 After IKR - from sixth to second. Because IKR teaches students to analyse carefully the wording of questions, it could be that this leads to perceiving more difficulty where there is none. If this is so, then IKR could be detrimental to some students without additional tuition in its use. On analysing After reasons, no clues were given according to whether or not the question has a statement : eight reasons each were offered in the experimental pairs.

It is difficult to understand why 5.8% (Before) and 6.6% After, of students perceived one question of a pair as requiring **more knowledge, detail or depth** (Criterion 6). The wording of each question in a pair was carefully structured to indicate equal knowledge requirements. It could be that some students meant more thinking or discussion (Criterion 5) but this is indicated in only one secondary reason: **asks for more detail - not a yes/no answer.** However, sixteen of the thirty reasons given for this criterion related to those questions (A_1, A_2 and A_4) where one word or phrase (Criterion 2) was perceived as causing greater difficulty. It is likely that it was words such as **effects, influence** and **role** which led students to believe more knowledge was required. Even After IKR, (that is, even after being shown that knowledge does not affect difficulty), some students **perceived difficulty in terms of the knowledge content.**

Criterion 9 (**not being given part of the answer /information/knowledge**) appeared in the After ranking but not in the Before ranking. Only eight mentions were made of this criterion and the researcher suspected that it would again relate to those questions without a statement. This was confirmed by a study of the secondary reasons given. Questions without statements were perceived as **not having given information in the first sentence; as requiring description of something not already known; not giving helpful information** (three mentions) and **giving no assumptions thus requiring argument.** Once again, even After IKR, some students perceived that irrelevant statements contained helpful information and that questions without statements somehow posed more difficulty.

Although the number of reasons was considerably reduced After IKR (in line with the reduction in erroneous perceptions), it is relevant that a substantial number of students still perceived difficulty in terms of statement/no statement, additional words, additional knowledge needed, and so on. The reason for this surprise is that IKR instructs

students that question difficulty (the amount of thinking work necessary) depends on the number and type of IKWs: the more IKWs there are and the more there are of Level II IKWs, the more difficult the question. It could be that most of the 158 reasons given After, related to only a few students, but this was not the case: most students gave at least one or more reasons After. This indicates to the researcher, that for some students more extensive coaching in IKR will be required if it is to be effective.

b) Set Two

The six most mentioned criteria for Set Two are presented in **Table 7.5**.

Table 7.5

The number of mentions for each of the most mentioned criteria in Set Two, and this number expressed as a percentage of all reasons

	Classifications (criteria)	Number	Percentage
	Before		
3	Poor/complex wording/flow/expression/phrasing too long/long-winded, confusing, vague	88	20.0
14	Does not give helpful background/ideas/information/guidelines /hints/clues	74	16.8
9	One is not given part of the answer/information/knowledge in the question	57	13.0
1	Less/not straightforward/clear/direct/understandable	40	9.1
11	More parts/work. Longer/intricate/detailed answer required	33	7.5
2	One word/phase in the question indicates difficulty	27	6.1

(These six classifications account for 72.5% of mentions).

	After		
14	Does not give helpful background/ideas/information/guidelines /hints/clues	43	16.3
11	More parts/work. Longer/intricate/detailed answer required	43	16.3
3	Poor/complex wording/flow/expression/phrasing: too long/long-winded, confusing, vague	33	12.5
2	One word/phrase in the question indicates difficulty	31	11.7
9	One is not given part of the answer/information/knowledge in the question	26	9.8
1	Less/not straightforward/clear/direct/understandable	23	8.7

(These six classifications account for 75.3% of mentions.

The reader may remember that in the exercise (Part B) used to collect this data, students were presented with nine pairs of question, six of which contained one question longer than the other[15]. In the other three pairs, both questions were of equal length. Consequently, it was expected that if students did perceive difficulty, the reasons would be related mainly to the length of the question.

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[15] Paragraph 3.2.2.

Criterion 3 (**Poor/complex wording/flow phrasing or the question being too long**) accounted for 20.2% of reasons Before and 12.9% of reasons After. Some students offered additional information to explain why they found the wording clumsy, awkward or poor. Analysis of some of the mentions of this criterion reveals that "poor wording" **relates to a question being too long. Table 7.6** records the researcher's paraphrasing of only a sample of those reasons (some mentioned frequently) which support this finding.

Table 7.6

Some secondary reasons given for Criterion 3 (poor/complex wording), showing that difficulty is related to question length

- Possible to get lost in the wording
- All the writing is off-putting
- Easy to miss the point on reading quickly in an exam
- Much extra info to wade through before getting to the question
- Takes longer to say the same thing
- Listing at the beginning of the question confuses
- You may forget main points
- More to take in and remember
- The continuous list sends you to sleep
- Goes around in circles
- I lost track of the question
- Easy to lose your way
- Bores you with facts
- More of an article than a question
- Too much info - confusing
- More information makes it look difficult
- The length makes you want to panic!
- Easy to lose track or interest in what is actually being asked.

For the researcher, this indicates that some students who perceived a difficulty difference, did so because of the **differing question lengths**. This is corroborated by three figures. Firstly, the number of mentions relating to length (eighty eight, Before and forty three After) make up 72.7% of all reasons in Criterion 3. Secondly, in the control pairs where question lengths were equal, there were very few mentions in Criterion 3 related to length (B_1 - one, B_5 - none, B_7 - three). Thirdly, in the experimental pairs, it was the longer questions which attracted most mentions related to length in Criterion 3. This was particularly true of the nine-line questions: B_2Q_1 attracted twenty nine mentions in Criterion 3 to do with length and B_6Q_1, twenty three.

These results leave little doubt that **question length is a significant factor in students perceiving that one question is more difficult than another** even though the actual work in terms of thinking is almost identical. While IKR can correct this perception to some extent (in this experiment a 7.3% reduction in Criterion 3, After), the reduction is small and like many of the erroneous perceptions already described is likely to take some effort to change.

It might be claimed that if students find a question more difficult to read or they "get lost in the wording", then the question is more difficult. As previously explained, this is not the case. It was to help students make this subtle distinction that IKR was devised. Although a long question can hinder students' understanding of what is required, it is likely that **if they are able to unravel the wording, the actual thinking effort required to answer it may be no more than other questions**. As already described in Chapter Four, IKR does help students to "see through" the impression of difficulty given by excess length.

The fact that Criterion 14 (**does not give helpful background/ideas/ guidelines/hints/clues**) is the second most mentioned Before and the first most mentioned After, seems to contradict Criterion 3, just discussed. Again, it can be seen that a number of hours exposure to IKR does not substantially alter the frequency of mention of this criterion. From the 117 total (Before and After) mentions of this criterion it is possible to summarise that some students consider (erroneously) that **longer questions give more hints or information which will assist them in answering the question**. Some paraphrases of students' secondary reasons presented in **Table 7.7** illustrate this.

Table 7.7

Some secondary reasons given for Criterion 14 which indicate that question difficulty is related to lack of guidelines on how to answer.

- No guidelines on how to answer
- Gives less idea of what to do
- Does not give hints as to what the answer should contain
- Answer not planned for you
- Does not help to structure
- No conclusion to bend the answer towards
- Does not emphasise what is required
- Does not provide a good start and areas to build on

Of the 117 mentions of this criterion, only five were offered for questions in the control pairs. This is to be expected since questions in these pairs were the same length. In all the experimental pairs, as might also be expected, **almost all mentions of Criterion 14 were given to those questions of shorter length**. Striking examples of this are B$_3$Q$_1$ (three lines) with fifty eight mentions of Criterion 14 and B$_4$Q$_2$ (six lines) with twenty mentions.

It cannot be denied that some students think that **the longer the question the more information it contains and consequently the easier it will be to answer**. In the case of the questions in this experiment, this perception is incorrect since some of the perceived additional information or hints on how to answer were mere padding by the researcher to build up the questions' line-lengths. It is safe to state that the longer

the question the more information it seems to contain and many students will take this as an indication that their answer must be related to that information.

It might seem that Criteria 3 and 14 pose a contradiction. On the one hand, **length indicates difficulty because the question is difficult to read and to grasp mentally**, but on the other hand, **length is helpful because it contains information to help with the answer**. As already explained, both perceptions are incorrect: the complexity of an answer does not depend on how difficult the question is to read. Similarly, a question would not necessarily be easier to answer because it contains more information. This explains why some students regard length as an indicator of difficulty and others as an indicator of helpfulness.

The researcher considered initially, that there was a distinction between Criterion 9 (**not being given part of the answer/information/knowledge**) and Criterion 14 (**not being given helpful background/ hints/clues/ideas/information**). However, on undertaking more detailed analysis it was found that students were using slightly different terminology to express the same perception. **Table 7.8** lists the researcher's paraphrasing of some students' secondary reasons regarding Criterion 9.

Table 7.8

Some secondary reasons given for Criterion 9 causing difficulty

- Dealing with an unknown
- Exact knowledge not specified
- Does not give you part of the answer
- Lack of information
- No detailed questions posed
- Does not give a clear description of what the teaching process is
- Does not give you a lot of responsibilities to judge
- Everything is not specified
- Does not make clear the premise on which the answer is based
- Does not start by saying that hydrocarbons cause greater pollution - you have to decide

As for Criterion 14, almost all mentions for Criterion 9 are offered in relation to the longer questions in the experimental pairs. For example, B_4Q_2, B_6Q_2 and B_9Q_1 received twenty one, fifteen and twenty mentions as opposed to none, one and none, for the other questions in those pairs. Again, it is safe to find that students consider longer questions to be easier because they contain part of the answer or information to help structure the answer. Criterion 9 is third in the Before ranking, but if mentions of Criteria 9 and 14 are added they account for 30% of mentions Before and 27% After. On this basis, the perception of information in the length of a question contributing in some way to the answer, would be at the top of both rankings.

Just what students mean by a question being more difficult than another because it is **less straightforward/clear/direct** (Criterion 1) can be detected from some secondary reasons given, as listed in **Table 7.9**.

Table 7.9

Some secondary reasons given for Criterion 1 causing difficulty

- Takes too long to get to the question
- Difficult to digest
- Difficult to locate the question
- What is required is not set out well
- Less concise - does not get to the point straight away
- Must search for the question
- Choices not given in a simple manner
- Points more scrambled - not clear

This criterion would seem to be a combination of Criterion 3 and Criterion 14. The fact that thirty three of the sixty three mentions for this criterion are given for the longer questions in the experimental pairs, again indicates that **length is perceived as presenting difficulty**. However, this conclusion is not as safe as those already presented for this experiment for two reasons. Firstly, fourteen mentions were given for the control pairs, and since the questions in each of them were the same length, this is difficult to explain. The researcher suspects that it has something to do with students' interpretation of individual words or phrases as found in the reasons for Set One.

Secondly, sixteen mentions were given for the shorter questions in the experimental pairs. This can be explained by most of these mentions being related to lack of information or it not being clear what has been asked for. In this sense, these mentions could have been included under Criterion 14 or Criterion 9. Nonetheless, it can still be stated that the fourth most mentioned criterion for students finding one question of a pair more difficult, related to **longer questions being difficult to understand, read and interpret**. It will be noticed that there is a consistency in the number of mentions of this criterion Before (9.2%) and After (9.0%).

More parts/work - longer/intricate/detailed answers required (Criterion 11) was the fifth most mentioned, Before. Examining the seventy six (both Before and After) mentions revealed that most of them simply stated **more parts** or **more work/detail required**. However, some of the mentions as expressed in **Table 7.10** on the following page, supply clues as to why some students perceived that more work was required in the answer to one question and not the other of a pair.

123

Table 7.10

Some secondary reasons given for the perception that one question requires more work than another of equal difficulty

- You must convince as opposed to only list
- You must choose and then back-up your choice
- Must describe as opposed to list only
- Must explain 'why' not just 'what'
- Throws you in at the deep end
- Needs more explanation
- Must answer on six distinct topics
- Must take each separate aspect in turn
- Raises more issues

There are two main themes in these secondary reasons. Firstly, some students are aware that **explanation** or **convincing**, for example, requires more work than merely **describing** or **listing**. This means that Before and After IKR, some students are intuitively aware that some tasks require more mental work than others. IKR reflects this by explaining that Level II IKWs indicate more work (greater difficulty) than Level I IKWs. However, in this experiment the IKWs used in both questions of a pair were the same level, and in some instances, even identical. Consequently, there must be some other reason for perception of difficulty.

Secondly, most of the mentions refer to more parts or more topics. However, since each actual question in a pair was structured to have the same number of parts, one can only conclude that the "more parts" **perception arises from the information contained in the statement of the question.** This is confirmed on further analysis: of all seventy six mentions, fifty three (70%), referred to the longer questions in the experimental pairs.

The reader will again realise that the perception of a question as more difficult because of the topics/issues mentioned in the statement, is erroneous. As already explained, most statements were made up by the researcher to extend the line-length of some questions. It is understandable how a student's choice of question, and ultimately the answer to any question, could be adversely affected by erroneous perceptions. The researcher was surprised that the percentage mentions of Criterion 11 increased substantially After IKR (from 7.6% Before to 16.8% After). In the IKR workshops, students were shown how Level II IKWs indicate more work and that the number of parts can be calculated by adding up the number of IKWs. In addition, students were specifically alerted to the fact that statements at the beginning of questions are sometimes irrelevant and of little help. This again indicates that some students did not benefit sufficiently from IKR because of the brevity of the IKR workshop, and that more intensive sessions would be necessary for them.

As in the reasons for Set One, Criterion 2 (**one word or phrase in the question indicating difficulty**) appears near the top of the rankings. An analysis of the frequency of the mentions reveals that forty two of the total fifty eight, 72.4% (Before and After), relate to the questions in B_1. Further examination of the mentions for these two questions indicated that the key to difficulty perception was the words **student** and **friend**. For example, phrases similar to "Convincing a student is more difficult than convincing a friend", accounted for twenty seven mentions, and "Convincing a friend is more difficult than convincing a student", for twelve mentions.

For the researcher this was a most surprising finding: that the difficulty inherent in answering a question is, in some students' minds, on **whom one is addressing**. Of course, the researcher did not intend this to be conveyed by the wording of the question, and the only reason for using **friends** in B_1Q_2 was to prevent the questions looking identical. One students noted that **'would' puts one off**. This is difficult to understand since both questions in B_1 incorporate **would**.

In B_2Q_1, **steps** was regarded as more difficult than **how might**, and in B_2Q_2 **list** is regarded as easier than **how**. These results confirm those already reported for Set One, that some students, **perceive difficulty in everyday words insignificant to the examiner**. After IKR, mentions of Criterion 2 increased to 12.1%, making it fourth in the After ranking. This could be explained by IKR heightening students' awareness of the need to focus on IKWs. If this is so, the raising of awareness did not have the desired effect on some students since some perceptions were still erroneous. Clearly, some students require further explanation that it is mainly the IKWs which indicate difficulty and not so much the knowledge content.

c) Set Three

The six most mentioned criteria for Set Three are presented in **Table 7.11** on the following page. This data was collected during an experiment in which students were asked to indicate whether they found a question "difficult" or "very difficult", and if so, to provide reasons for their decision[16]. In this set, some of the thirty two criteria were expressed differently than in Sets One and Two. For example, in Sets One and Two, Criterion 6 is expressed as **More knowledge/detail/indepth required**, whereas in this set (Three) it is expressed as **Do not know enough/lack of knowledge**. Rather than change the wording merely to provide a neat classification system, the researcher thought it best to show how a different group of students expressed the same criteria.

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[16] Paragraph 6.1.

Table 7.11

The number of mentions for each of the most mentioned criteria in Set Three, and this number expressed as a percentage of all reasons

	Classifications (criteria)	Number	Percentage
	Before		
6	Do not know enough/lack of knowledge	21	13.7
3	Ambiguous/confusing/vague wording	21	13.7
22	No reason given	17	11.0
14	No guidance on how to structure answer	14	9.1
23	Number of parts/structure	12	7.8
1	More difficult to describe rather than answer/not knowing where to begin	12	7.8

(These six classifications account for 63.1% of mentions).

	After		
23	Number of parts/structure	33	27.5
5	Requires a lot of thought/work	16	13.3
3	Ambiguous/confusing/vague wording	12	10.0
29	Difficult to distinguish K, R and I	9	7.5
6	Do not know enough/lack of knowledge	8	6.6
25	Factual answer (nothing to get your teeth into)	6	5.0

(These six classifications account for 69.9% of mentions).

As was expected, a large number of mentions Before (13.7%), referred to **lack of knowledge** - Criterion 6 and also to Criterion 3 - **ambiguity or vagueness of wording** (13.7%). The corresponding After figures support the hypothesis in Paragraph 7.0 because After IKR, the mentions of these two criteria drop to 6.6% and 10.0% of all mentions. This is preliminary evidence that IKR assists students to "see through" the ambiguity and vagueness and to realise that the number of knowledge items does not determine question difficulty.

The Before figure of 11.0% for **no reason given** (Criterion 22) is to be expected since Before IKR students might not know why they perceive a question to be difficult. The fact that the number of mentions of this criterion After, was so small that it was not included in the top six, was also expected. Clearly, After IKR, more students know why a question is difficult.

No guidance on how to structure the answer (Criterion 14) accounted for 9.1% of mentions Before, and again reflects the erroneous perception of some students that shorter questions are unhelpful because they do not contain information to be used in the answer. As expected, this criterion does not appear in the list of the six most mentioned criteria, After IKR. The appearance of Criterion 23 (**number of parts/structure**) in the Before list of the top six criterion with 7.8% of mentions, is relevant because it indicates that even without workshops on IKR some students use

criteria similar to that recommended by IKR. As expected, After IKR, the proportion of mentions in this criterion rises extensively to 27.5% of mentions, that is, from 5th most mentioned Before, to 1st most mentioned After IKR.

Criterion 1, (**not knowing where to begin**) (7.8% of all mentions) is also a criterion one would expect to see in the top six Before IKR. This is one of the predicaments that IKR was designed to help students avoid. Indeed, After IKR, the mentions of Criterion 1 drop to 3.3% and it does not appear in the After list of top six.

Examination of the list of top six criteria After, shows that as expected, IKR has changed the way of perceiving difficulty. More mentions of IKR criteria, that is Criterion 23 and Criterion 5 are given. The number of these two criteria taken together accounts for 40.8% of all reasons. If one includes Criterion 29 which is also an IKR criterion, this percentage increases to 48.3%. In other words, almost 50% of students who perceived a question to be "difficult" or "very difficult" did so for correct reasons.

It is relevant that 7.5% of mentions related to the distinguishing of knowledge (K) and relevance (R) key words. The very distinction of K and R is an indication that the student has made the fine distinction between parts of the question. The researcher considered it relevant that 6.6% of mentions still related to **not having enough knowledge** (Criterion 6). Students were asked to assume full knowledge, not only on the direction sheets accompanying the questionnaires, but also during the IKR workshop before the After exercise was to be completed. Again, the researcher considers this to be a manifestation of the difficulty of changing perceptions and that some students would need more practice than others.

The fact that Criterion 25 (**factual answer**) appears in the top six After, with 5.0% of all mentions, indicates that some students still consider that longer questions with more words contain information to assist them, or to allow them to waffle. The question gaining the most mentions of Criterion 25 was in the civil engineering group: **Should environmental impact assessments be required by legislation? (Q12)** Clearly, this very short question was perceived as difficult to answer. The researcher checked students' responses to the shortest question in the adult education group and the chemistry group and found the same pattern. Q12 in the adult education group (**Is there a Scottish tradition in the philosophy of adult education?**) obtained the most mentions of Criterion 3. Q5 in the chemistry group (**Compare and contrast the possible dangers of the two main methods for producing hydrogen gas from water**) obtained most mentions of Criterion 14 and contained the most mentions of difficulty of all eight questions.

7.4 CONCLUSIONS

Examination of 1484 reasons given by 101 students as to why a question is perceived to be difficult, makes it possible to offer a summary of main findings and suggestions for further research. Implications (if any) for examiners will be presented in the overall conclusions to this research in **Chapter Twelve**.

7.4.1 MAIN FINDINGS

a) **The total number of reasons declines** After IKR for two main reasons. First, reasons declined for Set One and Set Two in correspondence with the increase in correct responses that one question in the experimental pairs was not more difficult than the other. Secondly, in Set Three, the decline in reasons arose because **students found fewer questions to be difficult.**

b) **The way students perceive question difficulty changes significantly After IKR**, from, for example, presence of a statement, length of question and vague/ambiguous/confusing wording, to, for example, the structure of the question and the amount of mental work/thinking to be done in answering the question. In many instances this change in perception is likely to be helpful to students. Before IKR, many students would not have been able to identify an easy question because of vague wording or length. This is preliminary evidence that IKR enhances students' information processing skills.

c) **Many students perceive difficulty in apparently insignificant words.** For example, some students perceived that it would be more difficult to describe the **effect** or **influence** of something, than to describe its **role**. Other students hold the opposite view. Similarly, some students perceived that it would be more difficult to explain something to a **friend** than to an **'A' level student**. Some students considered that **should follow** implies more difficulty than **should attempt to follow** and some others perceived the opposite. For one group of students (Set One), this criterion was mentioned the most and by substantial margins. It is clear that students' distinction of difficulty implied by words is not merely guesswork. Some students gave specific reasons why they thought one word indicated more difficulty. For the researcher this finding corroborated two themes running throughout this research: that students approach questions with established meanings of words which may differ from the examiners' meanings, and that not enough is known about students' and examiners' meanings.

d) **Many students consider that questions with a statement are easier** because they contain clues as to what is required, provide information that can be used in the answer, or offer suggestions for structuring the answer. This perception

was prevalent even though almost all of the statements in the experimental questions were irrelevant padding. A substantial number of students preferred questions with statements, one criterion of difficulty being, **question not split into question and statement** (Criterion 18). A few students indicated that they preferred to have the statement (the facts) first, then the question.

e) **Some students think that less specific, less direct and vague questions are easier** because, for example, they allow more: use of imagination/experience; room for error; choice; and points to be mentioned. Ellington (1987 p1-2) makes the distinction between **unstructured** and **structured** questions. Unstructured[17] questions give the student maximum possible freedom to determine the nature and scope of the answer. The results from this experiment indicate that students erroneously perceive unstructured questions to be easier. The researcher's overall impression was that some students think less specific questions are easier because they enable one to waffle when knowledge is insufficient. Consequently, question difficulty is perceived by some students in terms of whether or not they have undertaken sufficient study.

f) **Substantial numbers of students perceived longer questions to be more difficult** than shorter ones. Many students gave specific reasons why longer questions indicated more difficulty, most of these relating to the distracting nature of the wording. It might be considered that this finding contradicts the finding already stated in **d)** above, but this is not the case. All questions in Set Two contained statements and in addition, some questions with statements in Set One, were short questions. Care is necessary in interpreting the finding that longer questions are perceived as being more difficult because there is also some evidence that some students find very short questions to be more difficult. There seems to be a **cut-off line-length below which the question is perceived to be more difficult** - even more difficult than questions of nine-lines. In particular, numerous reasons were given for questions of only one line. There is another apparent complicating factor to this finding as expressed in **g)** below.

g) **Shorter questions are perceived by some students as being more difficult because they do not contain helpful information.** The apparent contradiction between long questions being perceived as more difficult and short questions as being more difficult can be explained. The reasons given for finding the longer questions more difficult are not to do with the difficulty of answering the question, but with the **difficulty of being able to read and understand the**

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[17] He uses **extended-response** questions and **free-response** questions as synonyms for unstructured questions.

129

question adequately. On the other hand the expressions of difficulty related to shorter questions are about answering the question. The researcher has learned from this experiment to emphasise in IKR lectures, the distinction between **difficulty of understanding** and **difficulty of answering**. It would be a mistake to make this distinction too stark, because if the student cannot understand the question, it would be irrelevant whether it was easy or difficult to answer.

h) **Even without knowing about IKR, many students are aware that some mental tasks involve more work than others.** For example, some students are aware that **explaining** or **convincing** requires more work than **describing** or **listing**. In designing this research, the researcher took into account the possibility of testing students' perceptions of difficulty of different IKWs. The results of two experiments to test this are reported in **Chapters Eight** and **Nine**.

i) **Students' perceptions of difficulty based on Criterion 11: (more parts), arise because information in the statement is regarded (erroneously) as relevant to the answer.** This finding corroborates the same finding reported in Chapter Five[18].

j) **For some students, some perceptions are resistant to change.** While overall, IKR substantially changes perceptions of difficulty from the spurious to the beneficial, some perceptions persisted even After IKR. For example, the criteria, **poor/complex/vague wording, does not give helpful information, one word/phrase** and **too narrow/specific**, show considerable persistence. For the researcher this illustrates what information processing theory maintains: it will be difficult for some students to break the habits of information processing they are accustomed to. Clearly, some students will require more than one workshop in IKR, if they are to make maximum beneficial use of it.

k) **The numerous instances of 'opposite' criteria indicate that there are differing perceptions about the difficulty of certain mental tasks.** For example, some students gave, **give both sides - advantages and disadvantages** (Criterion 4) as an indication of difficulty, while others gave the opposite: **does not need/allow both sides** (Criterion 33). Similar contradictions were evident in: **personal views are not allowed/required** (Criterion 7) and the opposite: **must give personal/own views/opinions** (Criterion 10); **does not give information in a single sentence** (Criterion 21) and the opposite **not split into question and statement/two questions** (Criterion 18); **does not put information/background/statement first**

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18 Paragraph 5.2.2.

(Criterion 20) and the opposite **statement/too much wording/first before question** (Criterion 27). For the researcher, these examples show that not only do individuals hold different meanings of insignificant words, but they also hold different perceptions of **what difficulty is.** Clearly, extensive research is needed to find out why particular mental tasks are perceived as difficult by some students.

l) **Some unusual perceptions of difficulty require further investigation.** For example, some students' concerns included: **having to defend a statement given as true or defend a preferred answer** (Criterion 15); **the questioner not sounding friendly/gentle or sounding forceful** (Criterion 16); **the question being more formal/clinical/academic** (Criterion 17); and the question **not allowing discussion or being simplistic and dealing with facts** (Criterion 25). Just why an examiner not seeming friendly should influence a student is unclear, as is why a question dealing with facts seems more difficult than one that does not. It is interesting to note that having to defend a statement given as true, is given as a reason for difficulty. Students stated that they would find this difficult if they did not agree.

The researcher considers that the findings just summarised are likely to make a contribution to changing the way students perceive questions and the way examiners set them. However, the results reported in this chapter are only the merest beginning: there is ample scope, and necessity, for further research.

7.4.2 FURTHER RESEARCH

a) **Is it possible to refine the criteria of difficulty perception?** As already explained, the classification of students' reasons for perceiving difficulty, has not yet been seen elsewhere by the researcher. Further research may on the one hand find that there has been duplication and the list of thirty two criteria can be reduced. On the other hand, perhaps the researcher has grouped together some types of reasons that would give a better picture of students' perceptions if given their own classification, that is, an additional criterion. On a similar theme, the way of expressing the criteria might be able to be refined. In addition, the whole procedure for allocating a student's reasons into one of the thirty two criteria could be given greater attention. However, further research of this kind would entail a study in itself and was, consequently, beyond the scope of this research.

b) **Do students and examiners attribute the same meanings to frequently used words?** Since students seem to attach particular meanings to certain words, it would be revealing to find out whether students' meanings on the one hand and examiners' meanings on the other, coincided. In addition, more detailed meanings

of: **less straightforward, clear, direct, understandable** (Criterion 1), **poor, vague, ambiguous wording** (Criterion 3) and, **too general/wide-ranging/many ways to answer** (Criterion 12), should be helpful.

c) **Does using IKR to identify question difficulty, result in better essays?** In this chapter, IKR criteria have been identified and it has been claimed, in line with information processing theory, that using IKR criteria as against other criteria is more likely to lead to students identifying more accurately, one question as more difficult than another. The implication is that better essays will result. A future experiment could entail showing one group of students how to interpret questions using IKR criteria and another group (the control group) using non-IKR criteria. The quality of the resulting essays could then be compared. Naturally, any potential "damage" done to the control group would have to be made good by offering them insight into IKR after the experiment ended.

d) **Why do specific tasks imply difficulty for some students and not for others?** It is likely that understanding how students interpret questions can be enhanced by examining, for example, why one student perceives giving two sides of an argument difficult, and another does not. Similarly, valuable information is likely to arise from further investigation into why unusual reasons for perceptions of difficulty, such as the **examiner being unfriendly**, arise.

The scope of the this research did not permit any of the further experiments just mentioned. However, the researcher did conduct experiments to gain insights into students' perceptions of the difficulty indicated by certain IKWs. These experiments are now reported in **Chapters Eight** and **Nine**.

THE EFFECT OF IKR ON STUDENTS' PERCEPTIONS OF THE DIFFICULTY INHERENT IN VARIOUS INSTRUCTION KEY WORDS (IKWS)

8.0 INTRODUCTION

In Chapter One it was explained[1] how Level I IKWs[2] such as **describe** and **list** usually involve less mental work (information processing) than Level II IKWs such as **compare** and **discuss**. Consequently, questions which contain Level I IKWs are likely to be easier to answer than questions containing Level II IKWs. In Chapter Three it was explained[3] how sixty five students were given an exercise (Part C) comprising ten pairs of questions, in seven of which, one question contained a Level I IKW and the other a Level II IKW. In the other three pairs the IKWs in both questions were the same level. Students were asked to state which question in a pair was more difficult. It was expected that After IKR, there would be an increase in the recognition of questions with the Level II IKWs, as the more difficult questions. To formally test this expectation, the following hypothesis was raised.

After workshops on IKR, students' awareness of the greater difficulty inherent in Level II IKWs will increase.

8.1 METHODOLOGY

The method used for collecting and analysing data for this experiment has already been explained in Chapter Three[4]. If they selected one of the questions of a pair as being more difficult, students were asked to give reasons for their choice. It was possible that students might give the correct responses by simply guessing. It was decided to examine the reasons for their choices to see if they were correct for the right reasons, that is, either: **one IKW indicating more difficulty than another IKW or the IKWs indicating the same degree of difficulty.** In addition it was hoped that reasons would give initial insight into the meanings students give to, that is, what students understand is required by, various IKWs.

The method for analysing reasons was the same as that explained in Chapters Five and Seven. It should be remembered that in two other experiments (Part A and Part B) already described, both questions of a pair were of equal difficulty and any choice of one question as being more difficult was erroneous. However, in this experiment (Part

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[1] Paragraph 1.1.1c.
[2] The reader is reminded that for ease of expression, the term "Instruction key word(s)" is abbreviated to "IKW(s)".
[3] Paragraph 3.2.4.
[4] Paragraph 3.2.4.

C), one question in each of the experimental pairs was more difficult, and should be identified as such, because the IKW is Level II.

8.2 RESULTS

Table 8.1 illustrates the extent of students' correct responses both Before and After IKR, and **Table 8.2** illustrates all responses analysed by question. Parts of the computer print-out from the analysis of raw data can be seen in Robb (1993 p271-272).

Table 8.1
Extent of students' correct responses

Number Correct	Before Frequency	Percentage		Number Correct	After Frequency	Percentage
0	1	1.5		0	0	0
1	2	3.1		1	1	1.5
2	0	0		2	0	0
3	5	7.7		3	6	9.2
4	7	10.8		4	6	9.2
5	17	26.2		5	4	6.2
6	10	15.4		6	7	10.8
7	14	21.5		7	16	24.6
8	5	7.7		8	11	16.9
9	4	6.2		9	10	15.4
10	0	0		10	4	6.2
Totals	65	100.0		Totals	65	100.0

Table 8.2

The extent to which Q_1 or Q_2 of a pair were perceived as being more difficult ("Same" indicates neither Q_1 nor Q_2 being perceived as more difficult, that is, both questions perceived as being of equal difficulty)

	Before							After					
Question Pair	Q_1	%	Q_2	%	Same	%	Question Pair	Q_1	%	Q_2	%	Same	%
1	11	17	37	58	16	25	1	11	17	45	70	8	13
2	23	37	17	27	23	37	2	18	28	6	9	41	63
3	8	12	49	77	7	11	3	0	0	61	94	4	6
4	50	77	5	8	10	15	4	57	87	3	5	5	8
5	10	15	22	34	33	51	5	16	25	7	11	42	67
6	49	77	7	11	8	12	6	56	86	4	6	5	8
7	8	12	32	50	24	38	7	14	22	26	40	25	38
8	6	10	29	46	28	44	8	4	6	38	59	22	34
9	42	66	4	6	18	28	9	45	69	1	2	19	29
10	38	59	12	19	14	22	10	52	80	1	2	12	18

A total of 1057 reasons was given: 536 Before and 521 After IKR. This large number was expected since one question in each of the seven experimental pairs was indeed more difficult. A preliminary classification of the reasons found that the list of thirty

two criteria identified in other experiments (see **Appendix XXIX**) could be used, but that **seven additional criteria** were needed. The need for additional criteria was expected, since in this experiment students were asked to make difficulty distinctions between IKWs, an aspect of question difficulty not previously tested. Consequently, for this research as a whole, the list of criteria (classifications) students use in determining difficulty of a question, increased to **thirty nine**. All reasons given for each question (Before and After) are recorded in Robb (1993 p273-283) with indications given of the classification within which they were grouped. The distribution of mentions of each of the thirty nine classifications is given in **Appendix XXX.**

8.3 DISCUSSION

The discussion to follow is conducted in two parts. Firstly, the number of correct responses Before and After IKR are compared to find out if the hypothesis stated in Paragraph 8.0 can be supported. Secondly, the most frequently mentioned criteria for selecting one question as being more difficult than another in the pair, are examined to find out the extent to which students' perceptions of difficulty are related to the difficulty level of IKWs.

8.3.1 EFFECT OF IKR ON THE NUMBER OF CORRECT RESPONSES

As the data in **Table 8.1** show, Before IKR no student gained ten correct responses, only four gained nine correct responses, and 50.8% of students were correct in six or more responses. After IKR, four students gained ten correct responses and 73.9% were correct in six or more responses. The number of correct perceptions increased from 364 (56% of total possible responses) to 435 (67%). As the data in **Table 8.3** on the following page show, there were some extensive individual improvements.

One student each improved from zero correct responses Before, to ten, seven and six correct responses After. Although the number of correct responses declined for 23.1% of students and stayed the same for 18.5% of students, 58.5% of improved. The data in **Table 8.2** further support the hypothesis stated in Paragraph 8.0. **For all seven experimental pairs, the extent of recognition of the question containing the Level II IKW as more difficult, increased After IKR.** After a two-tailed t-test which yielded a t-value of 0.0, it is possible to state that After IKR, students' recognition that Level II IKWs indicate more difficulty than Level I IKWs, increases.

It is relevant that **even Before IKR, at least half the students intuitively understood that question difficulty depends partly on the difficulty inherent in IKWs.** When this intuitive understanding is made explicit through workshops on IKR, almost 60% of students improve their perception of difficulty.

Table 8.3

The extent of change of individual's correct perceptions After IKR

Extent of change	Frequency	Percentage
-5	1	1.5
-4	2	3.1
-3	2	3.1
-2	5	7.7
-1	5	7.7
0	12	18.5
1	10	15.4
2	11	16.9
3	8	12.3
4	4	6.2
5	2	3.1
6	1	1.5
7	1	1.5
10	1	1.5
Totals	65	100.0

Students who:

a) Improved	38	58.5
b) Stayed the same	12	18.5
c) Declined	15	23.1
Totals	65	100.0

However, this general improvement in students' perceptions was not as extensive as expected. Since it was explained to students that Level II IKWs indicate more difficulty than Level I IKWs, it was not expected that almost a quarter of the students would decline and almost a fifth would stay the same. The data in **Table 8.2** show that many students regarded questions with the **Level I IKW as being more difficult, not easier.** For example, even in the three control pairs where the researcher tried to ensure that both questions in a pair began with IKWs of the same difficulty level, many students selected one or other of the questions as being more difficult.

This perception continued After IKR, albeit to a lesser extent. For the researcher, this means that while many students can benefit from IKR in identifying the difficulty inherent in IKWs, some other students become confused by IKR. The extent of the declines and no-changes could be partially explained by one or more of the following:
• those students who declined could have been those who put in the **least effort;**
• as with all techniques, practice is required for effective use. It could be that those students who declined were those that **did not practice sufficiently;**
• it could also be that some students did not pay attention during the lectures and therefore were **insufficiently aware of the distinction between Level I and Level II IKWs;**
• just as some students may or may not have an aptitude for mathematics or design, other students may not have an aptitude for written communication. The IKR technique **may seem very strange at first** and some individuals may need more

136

extensive tuition than others.

However, the researcher considered that another reason would account for most of the declines and no-changes. The results of other experiments already reported in this thesis, show that, in general, **students give very specific meanings to words.** It could be that some students struggled to identify Level I and Level II IKWs - even though specific examples of each were given in the IKR workshops. An examination of students' reasons would reveal whether the researcher's understanding in this regard was accurate or not.

8.3.2 INDIVIDUAL CRITERIA AND THE INSIGHTS THEY PROVIDE INTO STUDENTS' PERCEPTIONS OF DIFFICULTY INHERENT IN IKWs

The top five most mentioned criteria (Before and After) are listed in **Table 8.4**.

Table 8.4

The five most mentioned criteria

	Classifications (Criteria)	Number	Percentage
	Before		
34	One IKW (by relevant name)	178	33.2
11	More parts/work. Longer/intricate/detailed answer required	85	15.9
4	Must give both sides/advantages and disadvantages/pros and cons/	45	8.4
2	One word/phrase in the question	34	6.3
5	More discussion/argument/thinking/precision/deciding/ comment/application of knowledge needed	34	6.3

(These five criteria account for 70.1% of all reasons).

		After	
34	One IKW (by relevant name)	211	40.5
11	More parts/work. Longer/intricate/detailed answer required	107	20.5
36	"Level I Vs Level II"	56	10.7
35	One IKW (by non-relevant name)	33	6.3
5	More discussion/argument/thinking/precision/deciding/ comment/application of knowledge needed	31	6.0

(These five criteria account for 84.0% of all reasons).

As expected, **IKW (by relevant name)** (Criterion 34) was top of the ranking Before and After by a substantial margin, making up 33.2% and 40.5% of all mentions, respectively. The qualification, "(by relevant name)" was necessary because in some instances students simply stated **"instruction"** or gave an IKW which did not appear in the questions. To classify the latter, the classification, **IKW (by non-relevant name)** (Criterion 35), was used. It could be that when students gave Criterion 35 and even Criterion 36 (**Level I and Level II**) they had in mind an IKW by relevant name. However, there was no way to tell this and it was decided safer to classify

mentions in the way just described.

It must also be pointed out that **IKW (by relevant name)** does not mean that students gave the correct response. For example, in C_1Q_1, six mentions state that **describe** indicates greater difficulty than **compare**[5]. In C_3Q_1B, one student finds **list** to indicate more difficult than **compare**: most people would be aware that **compare** involves a much greater thinking effort than **list** or **describe**. Some students gave clues (secondary reasons) as to why they perceived some IKWs as more difficult than others. These are presented in **Table 8.5** on the following page.

From these examples it is safe to find that students do, whether they are aware of it or not, hold specific perceptions about the implications of some IKWs. It is also evident that some of the perceptions are irrational, such as **list** being perceived as **involving an endless list**, and **evaluate, making it difficult to decide on the length of an answer**. It is also relevant that a few students used emphatic language in expressing the difficulty they perceived in some IKWs. **Table 8.6** on the following page shows that some students appeared to fear the inherent difficulty in some IKWs.

Ideally, one would want to know why **compare** is confusing and why **contrast** is perceived as harder to understand, for example, and why some students "hate" some IKWs. It was not possible to conduct the face-to-face interviews that might have provided answers to these questions: this could be a rewarding field for future research. However, since IKR had been reasonably successful in getting many students to understand that questions containing Level II IKWs are usually more difficult than those containing Level I IKWs, it is reasonable to assume that IKR can also **alleviate apprehension about any IKW**.

There is some preliminary evidence for this. The total number of strong remarks relating to fear or loathing of an IKW was thirteen, and eleven of these were offered Before. More research is required before it can be stated with certainty that IKR can alter students' deeply-held and erroneous perceptions of certain IKWs. It was realised that just how students **perceive the relative difficulties** implied by different IKWs would be relevant to this research and an additional experiment was conducted as described in Chapter Ten.

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5   It might seem long-winded to state: "**Indicates greater difficulty than**". It must be remembered that students were asked to identify which question, if any, in a pair was the more difficult one. Consequently, it is the IKW that **indicates** the difficulty of the question. However, since this experiment is, in effect, testing students' perceptions of the difficulty inherent in different IKWs, it was decided to write in terms of **one IKW being perceived as being more difficult than another IKW.**

Table 8.5

Some students' reasons for an IKW being difficult

Compare

- = 2 parts Describe = 1
- is confusing
- includes list
- needs more depth
- needs fact and comparison
- involves listing in your head.

Describe

- means a bigger answer
- needs more than a list
- includes list
- means more effort
- loses clarity
- drops you in at the deep end
- does not give you you starting blocks - for and against

Evaluate

- includes list
- gives several ways of answering
- means greater depth
- makes it difficult to decide on length
- conjures up pictures of maths problems
- means more work
- requires more thinking

Contrast

- is harder to understand
- needs more planning

Compare and contrast

- is two tasks

List

- is difficult because it could be endless

Debate

- means argue both sides
- = think, explain, argue, conclude

Writing

- takes longer than evaluating

Table 8.6

Some secondary reasons indicating some students' aversion to some IKWs

- Compare puts me off
- Compare throws me off
- I don't like evaluate
- I hate questions that begin with 'compare and contrast' - they throw me
- I don't feel comfortable with compare and contrast.
- I hate evaluation
- I dislike questions beginning with 'write an essay'
- 'Write an essay' puts me off immediately
- Debate is frightening

Another relevant observation can be made from the list of secondary reasons given in **Table 8.5**. Some students indicate that an IKW indicates **more work** (Criterion 11), **more thinking** (Criterion 6) or that **an answer requires greater detail** (Criterion 5). It could be that in mentioning these three criteria, some students **thought of the IKW first, but then thought beyond it**, and gave the secondary reason instead of the IKW. This means that many of the mentions for other criteria could have been included within Criterion 34 (**IKW by relevant name**). However, there was no way of knowing how many students thought in this way, and it was decided that the classification system should reflect actual reasons offered.

Criterion 11 (**More parts/work. Longer/intricate/detailed answer required**) was the second most frequently mentioned both Before (15.9%) and After (20.5%). The increase in the percentage After IKR was expected because workshops informed students that Level II IKWs indicate more work than Level I IKWs. Since question length did not vary and there was no quotation in any question, an analysis of why some students offered **more parts** or **more detailed answer needed**, as reasons, would be revealing. Further analysis, by question, reveals that of all 192 mentions of this criterion, 152 (79.2%) referred to the question with the Level II IKW in the experimental pairs. This is evidence that some students did recognise that Level II IKWs indicate more difficulty, but **thought past this** to give the secondary reason as to **why a particular Level II IKW indicates more difficulty**.

Of particular interest were the pairs C_6, C_{10} and C_9. Pairs C_6 and C_{10} were experimental pairs in which Q_1 in both pairs contains the Level II IKW. The number of mentions attributed to each question in these two pairs is shown in **Table 8.7**

Table 8.7

Number of mentions for each question in pairs C_6 and C_{10}

Pair	C_6		C_{10}	
Question	Q_1	Q_2	Q_1	Q_2
IKW	Compare	Describe	Debate	Describe
No of mentions	64	1	51	1

It cannot be doubted that **compare** and **debate** indicate more difficulty than does **describe**. C_9 is a control pair in which both IKWs were of the same level (describe/list). However, since **describe** was mentioned eighteen times and **list**, zero, it is clear that **describe** is regarded as more difficult. The other controls, as expected, show little relative difficulty perceptions. The researcher again realised that finding out the **relative difficulty perceptions between IKWs could be helpful to examiners in their designing of questions.**

It is understandable that a question requiring both sides of an argument, (**giving both advantages and disadvantages**) (Criterion 4) will be perceived as more difficult than one that does not require this. This criterion was third in the ranking Before. It could be that **giving both sides of an argument** is regarded as more difficult because it involves more work or a more detailed answer. Hence, this reason could be a secondary reason to Criterion 11 (**more work/detail**). It is noticeable that Criterion 4 does not appear in the After ranking. However, it is not possible to say whether IKR changes this perception of difficulty or whether this reason is mentioned in another form such as **IKW (by relevant name)** or **instructions**.

But what IKWs give rise to this perception? The distribution of mentions for Criterion 4 among all twenty questions shows that C_8Q_2 has fourteen mentions and $C_{10}Q_1$, thirty five. The other questions had relatively small numbers of mentions. C_8Q_2 has the IKW **weigh-up** and $C_{10}Q_1$, **debate**. This means that many students take these IKWs to mean that both sides of an argument must be given. As expected, most other Criterion 4 mentions were given for Level II IKWs. However, in C_2, a control pair where both IKWs were identical (**describe**), there were mentions for Q_1. The only possible explanation for this, based on results of previous experiments[6], is that a few students were misled by the words **effects/role**. Consequently, these three mentions could have been classified under Criterion 2 (One word/phrase), but there was no way of knowing this until the analysis now being reported had been undertaken.

Criterion 2 (**one word/phrase**) was fourth in the Before ranking, indicating that Before IKR, 6.3% of students regard insignificant words (to the researcher) as indicators of difficulty. As expected, this criterion was not in the top five most mentioned criteria After. The few words or phrases that did mislead were: **effects/role** in C_1 (nine mentions) and **effects/role** in C_2 (twenty three mentions). This finding corroborates findings already reported[7] that some students sometimes perceive erroneously, insignificant words as major contributors to question difficulty.

Criterion 5 (**more discussion/argument/thinking**) accounted for 6.3% of mentions Before and 6.0% After. An analysis by questions shows that the bulk of mentions were for Level II IKWs as expected. However, it was relevant in two of the control pairs (C_5 and C_9) that **discuss** had more mentions than **contrast**, and **describe** more than **list**, respectively. For the researcher, this is further evidence that even After IKR, students do not regard IKWs as difficult **merely in terms of Level I and Level II, but in a more complex way**. One can understand how **describe** might be perceived as indicating more difficulty than **list**. However, it is more difficult

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6   Paragraph 7.3.2a and Paragraph 7.3.2b.
7   Paragraph 7.3.2a and Paragraph 7.3.2b.

to understand why **discuss** is perceived as indicating more difficulty than **contrast**. This further motivated the researcher to consider a further study into the relative difficulties perceived in various IKWs, as reported in **Chapter Ten**.

It is understandable that Criterion 36 (**Level I Vs Level II**) appears only in the After Ranking, since students would not have heard this terminology before the IKR workshops. This classification indicates that those students who offered it, most likely could have given the specific name of the relevant Level II IKW, but **chose to give the principle instead**. Consequently, this could have raised the number of mentions of Criterion 34 (**IKW by relevant name**). However, the researcher had no way of knowing for sure whether students did recognise the specific IKW and it was decided to make Criterion 36 a separate classification.

The researcher was surprised that a large number of mentions were given for Criterion 35 (**IKW by non-relevant name**). As explained this classification was necessary because some students mentioned IKWs that were not in the question. **Table 8.8** shows some examples of non-relevant IKWs referred to and the IKW actually in the question. This observation indicates that some students equate some IKWs with others, that is, regard them as synonymous. This is understandable to some extent because **discuss** and **weigh-up** imply similar mental tasks, as do **explain** and **write**.

Table 8.8

Examples of non-relevant IKWs mentioned and the actual IKW in the corresponding questions

Question	Non-relevant IKW	Relevant IKW
C_3Q_2A	discuss	compare
C_3Q_2A	consider	evaluate
C_4Q_1A	weigh-up	evaluate
C_4Q_1A	consider	evaluate
C_5Q_2A	compare	contrast
C_7Q_2A	weigh-up	evaluate
C_7Q_2A	explain	write
C_8Q_2A	describe	explain
C_9Q_1A	discuss	describe

However, **compare** does not, for the researcher, imply the same tasks as **contrast**, just as **discuss** does not for **describe**. Clearly, this matter requires further study.

8.4 CONCLUSIONS

Examination of the Before and After choices of sixty five students regarding which question of a pair (for ten pairs) was more difficult, and of the 1057 reasons given for

these choices, makes it possible to offer a summary of main findings and suggestions for further researcher. Implications for examiners (if any) will be presented in the conclusions to this research in **Chapter Twelve.**

8.4.1 Main findings

a) **After an hour workshop on IKR, there was an increase in students' awareness** that a question containing a Level II IKW, is more difficult to answer than a question containing a Level I IKW. This was shown not only statistically but qualitatively too: the most accurate criterion for identifying a question as being more difficult **(IKW by relevant name)** increases from 33.2% of mentions Before to 40.5% After.

b) **Even without a workshop on IKR, many students are intuitively aware** that Level II IKWs indicate greater difficulty than Level I IKWs. Many students are intuitively aware that the difficulty arises with Level II IKWs because they involve **more work, thinking,** and **planning,** for example.

c) **A small number of students hold unjustified perceptions** about the implications of some IKWs such as **list** involving an endless list, and **evaluate** making it difficult to decide on the length of an answer. In addition, **a few students have irrational fears** about, or aversions to, some IKWs such as hating **evaluation,** disliking **write an essay** and finding **debate** frightening. There is some preliminary evidence that IKR can alleviate these unjustified and irrational perceptions.

d) **For some students, being required by IKR (perhaps for the first time) to pay particular attention to IKWs, accentuates the uncertainty of the meaning of, and relative difficulty implied by, some IKWs.** This conclusion is possible for two main reasons. Firstly, while the fact that almost a quarter of students performed worse After IKR could be partly explained in terms of lack of effort, practice and aptitude, there was no evidence in other exercises completed by the same students, that these failings were evident. Secondly, unexpectedly, some students perceived **some Level I IKWs as indicating more difficulty** than Level II IKWs, and equated some IKWs in questions with other IKWs **that did not even appear** in the questions. In addition, as just explained, it became clear that some students hold irrational fear of some IKWs and have unjustified perceptions of what some IKWs require. These findings indicate that some individuals will require more extensive coaching in IKR to be able to gain maximum benefit from it.

e) **Students' recognition of difficulty inherent in IKWs are not based merely on the simplistic distinction of Level I and Level II IKWs,** but on a more complex gradation of difficulty perception.

f) **It is likely that the classification system of reasons (students' criteria for recognising difficulty) can be improved.** For example, Criterion 36 (**Level I and Level II**) and Criterion 35 (**IKW by non-relevant name**) are very similar and could be reflecting similar perceptions. In addition, **give both sides of an argument** (Criterion 4) could be merely another way of stating **involves more work/thinking** (Criterion 5). Similarly, it is possible that some students regarded a question as more difficult because it contained a Level II IKW, but instead of recording the name of the IKW **thought past it and recorded their impression of why that IKW implies a difficult task.** However, this need for improvement does not detract from the results of this experiment - it is the way of all scientific work that improvements in methodology become evident for application in future experiments.

8.4.2 Further research

The four suggestions for further research stated in Chapter Seven[8] also apply to the findings in this chapter. However, there are two additional questions arising from this experiment that deserve further attention.

a) **What specifically, do students understand various IKWs require of them?** The scope of this research did not permit undertaking the extensive interviews that would have been required to answer this question. However, an alternative experiment, outlined in the sub-paragraph below, was conducted which could provide further grounding for such interviews in the future.

b) **What are the relative difficulties of some frequently used IKWs?** Some of the results of this experiment leave no doubt that most students perceive the difficulty inherent in IKWs in **a more complex way than merely two levels (Level I and Level II).** Perhaps some IKWs are perceived as very much more difficult than others. In addition, it cannot be doubted that students vary in their understanding of what the same IKW requires of them. Perhaps asking students to compare the difficulties inherent in two IKWs can reveal more about students' perceptions of what particular IKWs mean. Two experiments conducted to answer these questions, are described in **Chapter Nine** and **Chapter Ten.**

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8   Paragraph 7.5.2.

CHAPTER NINE

THE EFFECT OF IKR ON STUDENTS' PERCEPTIONS OF THE RELATIVE DIFFICULTY INHERENT IN SOME IKWs AND THE CRITERIA USED TO PERCEIVE INHERENT DIFFICULTY

9.0 INTRODUCTION

Results already reported in this thesis[1], show that students' perceptions of the difficulty indicated by IKWs is a complex matter. Although many students recognise accurately the potential difficulty of a question merely from examining the IKWs, (this recognition becoming more accurate After IKR for many students), some students give unexpected and unjustified reasons as to why some IKWs indicate difficulty. Consequently, there is some evidence that some students do not understand the meaning of some IKWs.

The phrase, **"understanding the meaning of some IKWs"**, implies more than is evident on first sight. Understanding the meaning of an IKW implies understanding what it requires one to do - the mental (information processing) tasks that must be undertaken. For this reason the researcher refers to the "inherent difficulty" of, and the "difficulty indicated by", IKWs. The accurate recognition of difficulty inherent in IKWs is relevant to success in essay-writing since with insufficient understanding, some students might decide to avoid easy questions simply because they "look" more difficulty than they really are. It was decided to conduct further experiments to examine more thoroughly, students' understandings of the difficulty inherent in some IKWs and, in particular, what criteria are used to assess inherent difficulty.

As already explained[2], the IKR workshops explained that IKWs can be regarded as being of two types of difficulty - Level I and Level II. It was expected that when presented with several pairs of IKWs, **with both IKWs in a pair being of the same level of difficulty**, a significant number of students would perceive **one IKW as indicating more difficulty, even after the Level I and Level II classification had been explained to them**. This was expected because students' perceptions of difficulty seemed to be more complex than a neat classification of Level I and Level II. To formally test this expectation the following hypothesis was raised.

Despite Level I and Level II concepts of difficulty being explained in IKR workshops, a significant number of students will still perceive a difficulty difference between two IKWs of the same level.

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[1]   Chapter Seven and Chapter Eight.
[2]   Paragraph 1.1.1c.

145

9.1 METHODOLOGY

During their first workshop[3] on communication skills, a class of seventy eight first year civil engineering students at the University of Glasgow were asked to copy down **nine pairs of IKWs**. Students were asked to prepare for the next workshop by deciding which IKW, if any, in each of the nine pairs, **indicated the question of greater difficulty**. Students were asked to ring the IKW which indicated the question of greater difficulty, but to ring the word "or" between IKWs of the pairs if both indicated questions of equal difficulty. If students decided that one of the IKWs in a pair indicated a question of greater difficulty, **they were asked to give reasons.**

The phrase, **"indicated a question of greater difficulty"** just stated, accurately expresses that it is not an IKW itself that is difficult, but **what it requires the student to do in answering a question containing it**. However, this phrase is clumsy and to improve expression in this chapter the shorter phrase **"the more difficult IKW"** and similar shorthand phrases are used.

The students were given an additional exercise in order to collect data for another experiment to be described in **Chapter Ten**. They were asked to copy down **a list of sixteen IKWs** read out by the researcher, and as preparation for the next workshop, to decide for each, the potential difficulty of a question containing it. A scale from 1 to 6 was used, "1" indicating very easy and "6" indicating very difficult. The two exercises were to be completed without students being taught about IKR, and are therefore referred to as the **Before exercises**.

Presenting the Before exercises orally rather than as a questionnaire was expected to achieve a maximum response for two main reasons. Firstly, since the communication skills workshops were offered at the beginning of the students' first year, a questionnaire may have been intimidating. Secondly, it was hoped that this informal approach rather than a test-like questionnaire, would enable students to make use of their past experience (intuition) of the effect of particular IKWs on question difficulty.

During the second workshop[4] the completed exercises were collected and students shown how to use IKR to interpret questions and how to distinguish between **Level I** and **Level II** IKWs. The content of the IKR workshops has already been described[5]. In summary, students were shown that IKWs such as **discuss, evaluate** and **assess**, for example, indicate the requirement for more thought (consequently, making questions more difficult) than IKWs such as **list, describe** and **comment**. At the end

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[3]   Monday the 14th October 1991.
[4]   Monday 21st October 1991.
[5]   See Robb (1993 p3-25).

of the workshop a questionnaire was issued to the class requiring **exactly the same exercises to be completed** as were requested in the Before exercise. A copy of the questionnaire is shown in **Figure 9.1** on this and the following page.

Figure 9.1

A copy of the questionnaire used in the After exercises

a) Page one

In this exercise you will find nine pairs of instruction key words.
First, decide which one of the instruction words in each pair indicates the more difficult question and ring it. If you think both words indicate questions of the same difficulty ring the word "or".

Second, if you think one instruction indicates a more difficult question, explain why you think this in the space underneath each pair.

describe	or	list

....
....

write	or	explain

....
....

discuss	or	evaluate

....
....

define	or	outline

....
....

analyse	or	justify

....
....

weigh up	or	assess

....
....

explain	or	describe

....
....

illustrate	or	give examples

....
....

debate	or	justify

....
....

b) Page two

On this page you will find sixteen instructions that frequently begin examination essay questions. Based only on the instruction words alone, how difficult do you expect each question to be? Please ring where on the scale of difficulty you think the question will sit.

	very easy					very difficult
Analyse	1	2	3	4	5	6
Assess	1	2	3	4	5	6
Compare	1	2	3	4	5	6
Contrast	1	2	3	4	5	6
Compare and contrast	1	2	3	4	5	6
Discuss	1	2	3	4	5	6
Describe	1	2	3	4	5	6
Evaluate	1	2	3	4	5	6
Explain	1	2	3	4	5	6
Illustrate	1	2	3	4	5	6
Justify	1	2	3	4	5	6
Show	1	2	3	4	5	6
Comment	1	2	3	4	5	6
Suggest	1	2	3	4	5	6
Write	1	2	3	4	5	6
List	1	2	3	4	5	6

Since students had, by this time, been undertaking numerous exercises in questionnaire format, it was thought that for the **After** exercises, a questionnaire would not be intimidating. The completed After exercises were collected during the third workshop[6]: sixty seven students had completed the Before exercise and thirty the After exercises.

To improve explanation in this chapter only the results of the first experiment involving the comparison of perceptions of difficulty in nine pairs of IKWs are reported and discussed. The results of the experiment regarding the ranking (1 - 6) of IKWs according to perceived difficulty, are reported and discussed in **Chapter Ten**.

While designing this experiment, the researcher was aware of the arbitrariness of deciding on pairs of IKWs of equal difficulty. However, a start had to be made somewhere. Indeed, an objective of this research was to find out whether or not some IKWs are perceived as being equally difficult. As far as it is possible to know, the researcher selected pairs of IKWs, that from experience, are of equal difficulty. If students perceive difficulty of IKWs in a simplistic Level I/Level II way, then most students would ring the word "or" between the two IKWs in a pair indicating that they are perceived as being equally difficult. In this case, the hypothesis stated in Paragraph 9.0 would not be supported. However, as already explained, there is preliminary evidence that the difficulty inherent in IKWs is not perceived in a simple, Level I/Level II way. It was expected that even after specific tuition in Level I and Level II (IKR), a significant number of students would still perceive difficulty differences.

9.2 RESULTS

For each pair, the number of responses for each IKW perceived as more difficult and the number of responses for equal difficulty, were summed and expressed as a percentage of the total number of responses. These calculations (Before and After) are presented in **Tables A.24** and **A.25** in **Appendix XXXI**. This data was re-arranged and is presented in **Table 9.1** on the following page, to illustrate the percentage response (Before and After) for each IKW of each pair, and the extent of difference between the more and less difficult IKWs.

Before IKR, **361** reasons were given by sixty seven students and After, **143** by thirty students. Some students gave more than one reason, and for completeness, all reasons were recorded. The researcher's approach to recording and analysing reasons has already been explained in detail[7]. A preliminary analysis revealed that many of the thirty nine criteria (classifications) used for grouping reasons in other experiments, could be used. However, another twenty one criteria were necessary to classify all 504

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6   Monday 28th October 1991.

7   In Appendix XII and Appendix XXVII.

reasons given in this experiment, making **sixty criteria** in all.

Table 9.1

Percentage responses for each IKW of a pair perceived as more difficult, for the two IKWs being perceived as equally difficult (Or), together with the percentage difference between mentions for the more difficult and less difficult IKWs of a pair (Diff)

Before				After			
Describe	List	(Or)	Diff	Describe	List	(Or)	Diff
81.1	4.1	14.8	77	79.4	10.3	10.3	69.1
Write	Explain	(Or)		Write	Explain	(Or)	
16.2	56.8	27.0	40.6	17.2	62.1	20.7	44.9
Discuss	Evaluate	(Or)		Discuss	Evaluate	(Or)	
12.1	56.8	31.1	44.7	24.1	44.9	31.0	20.8
Define	Outline	(Or)		Define	Outline	(Or)	
54.1	5.4	40.5	48.7	44.8	10.3	44.8	34.5
Analyse	Justify	(Or)		Analyse	Justify	(Or)	
33.8	39.2	27.0	5.4	34.5	24.1	41.4	10.4
Weigh-up	Assess	(Or)		Weigh-up	Assess	(Or)	
5.4	17.6	77.0	12.2	3.4	17.2	79.4	13.8
Explain	Describe	(Or)		Explain	Describe	(Or)	
36.5	6.8	56.7	29.7	41.4	6.9	51.7	34.5
Illustrate	Give examples	(Or)		Illustrate	Give examples	(Or)	
40.5	6.8	52.7	33.7	55.1	0	44.9	55.1
Debate	Justify	(Or)		Debate	Justify	(Or)	
40.5	25.7	33.8	14.8	44.9	20.6	34.5	24.3

A full record of reasons given for each IKW being perceived as more difficult (Before and After) and classified by the sixty criteria, is given in Robb (1993 p280-283). A summary of the list of the sixty criteria showing the distribution of their mentions by IKW is given in **Appendix XXXII**. While it is reasonable to expect that many of the reasons would be about **the amount of work involved** in answering any question, detailed responses were not predicted. **Table 9.2** on the following page shows the most frequently mentioned criteria.

9.3 DISCUSSION

Since there are two major themes in this experiment - students' perceptions of difficulty, and the reasons for these perceptions, it was decided that the discussion could be more effectively presented in two parts.

Table 9.2

The most frequently mentioned criteria

	Criterion	No. of mentions	% of all mentions
	Before		
11	Requires more detail/work/depth	101	27.9
4	Needs more than one viewpoint[8]	38	10.5
5	More thorough case needed/ More thinking/thought needed	24	6.6
41	Must give reasons for list/conclusions	24	6.6
3	Does not give clear indication of what is required/what examiner wants/Not specific/vague/ Long-winded approach	22	6.1
26	More factual/specific/direct	21	5.8
50	Definite answer/conclusion needed	21	5.8
	After		
11	Requires more detail/work/depth	40	27.9
26	More specific/accuracy	15	10.5
41	Must give reasons for list/conclusions/ Conclusion/decision needed/ Must argue about reasons not just give them	13	9.1
4	Must give pros and cons/both sides/ Needs two separate arguments	12	8.4
18	Needs examples/picture description	10	7.0
3	Does not give clear indication of what is required/what examiner wants/Not specific/vague/ Long-winded approach	8	5.6
5	More thorough case needed/More thinking/thought needed	8	5.6
6	Requires more knowledge/understanding/ Needs more than just facts/Requires a picture in words	8	5.6

9.3.1 STUDENTS' PERCEPTIONS OF DIFFICULTY

The data in **Table 9.1** show that Before IKR there was some recognition of the equal difficulty ("Or") within all pairs, but that it is not extensive. For only three pairs did this recognition exceed 50%. Consequently, it can be stated that over three-quarters of mentions recognised the equality of difficulty of **weigh-up and assess**[9] (77% of mentions), while just over half (56.7%), and (52.7%), recognised the equality of difficulty in **explain and describe**, and **illustrate and give examples**, respectively. Despite the recognition of equal difficulty not being extensive, the researcher considers that the Before figures indicate that many students have some intuition of the difficulty inherent in some IKWs.

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[8] Also expressed as "needs both **advantages and disadvantages**".

[9] To be grammatically correct, references to pairs of IKWs and criteria should be in quote marks. However, so many quote marks were required that they may have distracted the reader and are consequently, omitted. The bold text and context should avoid misunderstanding.

The After data show that IKR, instead of enhancing recognition of the equality of difficulty, lessened it. For only four of the pairs did the recognition of the equality of difficulty increase, and in only one of these by a substantial amount (**analyse and justify** - from 27% to 41%). The other three increases of recognition were insignificant. Because of the already extensive recognition of equal difficulty for the pair **weigh-up and assess**, it is understandable that an increase might not be observed. However, on this data alone it is possible to state that the **hypothesis stated in Paragraph 9.0 is supported** - even After IKR most students do not perceive difficulty in a simplistic Level I/Level II way. Indeed, After IKR, perception of differences of inherent difficulty, increased overall.

The overall decline in students' recognition of equal difficulty is shown again in **Table 9.3** which presents the percentages of students recognising equal difficulty ("Or") for each pair of IKWs.

Table 9.3

Percentage of students recognising both IKWs in a pair as being of equal difficulty

	Before	After	Difference
Describe/list	14.8	10.3	-4.5
Write/explain	27.0	20.7	-6.3
Discuss/evaluate	31.1	31.0	-0.1
Define/outline	40.5	44.8	+4.3
Analyse/justify	27.0	41.4	+14.4
Weigh-up/assess	77.0	79.4	+2.4
Explain/describe	56.7	51.7	-5.0
Illustrate/give examples	52.7	44.9	-7.8
Debate/justify	33.8	34.5	+0.7

Sum of positive changes = 21.8.   Sum of negative changes = 23.7

Clearly, even though students were taught about Level I and Level II IKWs during workshops on IKR, most do not use this heuristic alone, in perceiving the difficulty inherent in IKWs. It cannot be doubted that most students have a complex way of perceiving difficulty and that these perceptions must be very deep-seated (persistent). In addition, the decline in recognition of equal difficulty After, for some students, could indicate that IKR encourages students to think more about what IKWs require of them. It was hoped that the reasons given for choosing one of a pair of IKWs as more difficult would give clues as to what students understand various IKWs require.

However, before examining reasons, the researcher wondered if valuable insights could be obtained by examining which IKWs in each pair are perceived most frequently to be more difficult. The figures in **Table 9.1** leave no doubt that many students in this group found that:

describe indicates more difficulty than **list**;

explain indicates more difficulty than **write**;

evaluate indicates more difficulty than **discuss**;

define indicates more difficulty than **outline**;

assess indicates more difficulty than **weigh-up**;

explain indicates more difficulty than **describe**;

illustrate indicates more difficulty than **give examples**; and

debate indicates more difficulty than **justify**.

The pair, **justify** and **analyse**, has been omitted from the list above because it was only for this pair that students' perception **switched entirely**, After IKR. Whereas Before, **analyse** was regarded as indicating more difficulty, After IKR, **justify** was thought to indicate greater difficulty. For all other pairs the perceptions of relative difficulty After were consistent with those (to a lesser or greater degree) being expressed Before IKR. It was possible to calculate the direction and extent of shift in perceptions After IKR and these are presented in **Table 9.4.**

Table 9.4

Differences between Before and After percentage differences (between the more and less difficult IKWs of a pair)

	B	A	DIFF
Describe/list	77	69.1	-7.9
Write/explain	40.6	44.9	+4.3
Discuss/evaluate	44.7	20.8	-23.9
Define/outline	48.7	34.5	-14.2
Analyse/justify	5.4	10.4	-15.8*
Weigh-up/assess	12.2	13.8	+1.6
Explain/describe	29.7	34.5	+4.8
Illustrate/give examples	33.7	55.1	+21.4
Debate/justify	14.8	24.3	+9.5

Sum of positive changes = 52   Sum of negative changes = 41.6

* Note: Because of the reversal After IKR, the difference Before (5.4) must be added to the difference After (10.4) but in a negative direction, making a total of -15.8.

These data indicate that After IKR, four differences decreased (-) and five increased (+). A **negative change** indicates that some students changed their minds **away from the Before choice** and a **positive change** means that even more students **selected the Before choice.** In all but one case (**analyse/justify**), the IKW selected as more difficult Before, did not change After IKR. Consequently, there is consistency in those IKWs identified as more difficult. It is not possible to tell why some students changed their minds After IKR, but it was expected that the reasons given by students for perceiving difficulty would contribute to an explanation.

The researcher was surprised at the extent of the perceived difficulty differences between some pairs. For example, **describe and list** shows a difference of 77%, **define and outline** 48.7%, **discuss and evaluate** 44.7% and **write and explain** 40.6%. Some of these wide differences can be explained. For example, **define** may be perceived as requiring a memorised, precise statement, while **outline** might be perceived as allowing a more wide-ranging but still brief statement.

However, for many instances it is difficult to understand why these wide differences in difficulty perception occur. For example, **write** and **explain** would require tasks that are not too different. One can even imagine two identical questions beginning with: "**Write an essay on how**" .... and "**Explain how ...**". The same reasoning can be used for the pair **explain and describe**. However, students clearly find that **explain** indicates more difficulty than both **write** and **describe**.

Similarly, in the pair, **illustrate and give examples**, almost all those students who did perceive a difficulty difference identified **illustrate** as more difficult. But why should this be so? One can imagine a question that begins: "**Illustrate with five examples why ...** ", or two identical questions beginning with:

   "**Illustrate using your own experience, why ...** "; and
   "**Give examples from your own experience to explain why...** ".

Clearly, even though some IKWs seem to involve the same amount of mental effort, some students perceive a difficulty difference. These results confirmed the researcher's impression gained from the results reported in Chapter Eight, that **IKWs could be ranked according to their perceived difficulty**. It was decided to conduct another experiment to test this: the results are reported in **Chapter Ten**.

The researcher considers that these results have implications for examiners. Although an examiner might think that it does not matter which of the two IKWs, **illustrate** and **give examples**, are used in wording a question, it is clear that many students would regard a question beginning with **illustrate** as more difficult. It could be that the examiner's choice of IKW influences the student in answering or not answering a particular question. Possible recommendations for examiners in this regard are discussed in **Chapter Twelve**. The researcher hoped that the reasons given by students for their choices would reveal why some very similar IKWs are perceived as indicating different degrees of difficulty.

9.3.2 STUDENTS' REASONS FOR THEIR RELATIVE PERCEPTIONS OF DIFFICULTY

This experiment does not duplicate the investigation on reasons for perception of difficulty, carried out in experiments already reported in this thesis. Other experiments

investigated the effect of IKWs **in complete questions** and this experiment investigated students' perceptions of difficulty with the **IKW standing alone.** Investigating perceptions about isolated IKWs is an artificial approach since students would hardly ever be asked to do this in practice. However, the researcher wanted to **'hold constant'** the many variables that arise when a full question is used and to attempt to isolate the perception of difficulty arising only from individual IKWs[10].

As reported during the discussion of results of other experiments, considerable initial difficulty was encountered in finding meaning in the many reasons given. Consequently, the **sixty criteria** revealed in this and other experiments are regarded as a mere pioneering step toward a more refined classification of difficulty perceptions. It is relevant that as a result of the cumulative nature of this research, sixty criteria for perceiving difficulty have been identified and that many of these occur consistently in different experiments. For the researcher this indicates the possibility of **a taxonomy of difficulty-perceptions,** a possibility discussed in **Chapter Twelve.**

The data in **Table 9.2** show that of all reasons given, 28% Before were related to **greater work involved** (Criterion 11). This result is striking since the next most frequently mentioned criterion accounts for only 11% of all reasons. It is also relevant that the percentage mentions of this criterion does not change After IKR, indicating a stable occurrence. Ideally, the researcher wanted to interview students to find out why they perceived a particular IKW to involve more detail/work/depth, but this was beyond the scope of this research.

However, some other reasons give clues as to what students mean. For example, **giving more than one viewpoint** (Criterion 4), **having to give reasons or conclusions** (Criterion 41), and **must take the problem to pieces and work on each piece** (Criterion 55), could be interpreted as expressions of "more work and detail". If students had been interviewed, it is likely that some of the mentions for Criterion 11 would have been re-distributed among some of the other criteria.

Similarly, although some criteria seem self-explanatory, face-to-face interviews would be necessary to gain fuller understanding of perceptions of difficulty. For example, one could ask **why more thinking is required; why not allowing personal views** (Criterion 7) **leads to difficulty; and why an IKW indicates a wide-ranging/all encompassing question** (Criterion 12)? For each reason given for an IKW indicating difficulty, one could ask why the other IKW also does not indicate difficulty in this way. It is likely that many students would find fundamental thinking of this nature frustrating, but it could be beneficial in exposing the subconscious beliefs

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[10] Of course, all research is to some extent, artificial.

and feelings - perhaps unjustified - about certain IKWs, so they can be dispelled.

It is relevant that so many of the reasons imply that "more work/detail" is to do with **complex thinking that involves decision-making.** For example, **giving more than one view, giving reasons for a conclusion, having to answer why** and **must give own views,** all involve extensive thinking. In addition, this perception of **more work** as meaning **more thinking** is stated explicitly by some students. Of all mentions, **More thinking/more thought needed** (Criterion 5) makes up 6.6% Before and 5.6% After. This is relevant because it indicates that many students perceive difficulty in terms of the **amount of information processing required** to answer the question.

However, it must be remembered that when pairs of IKWs were constructed for this experiment, an attempt was made to ensure that the two IKWs indicated equal difficulty. Consequently, it is relevant that considerable numbers of students mentioned a difference, and indicates that they **perceive gradations in the amount of thinking required** in different IKWs. This reinforced the researcher's impression that a number of IKWs could be ranked according to students' perceptions of difficulty.

Examining the many mentions for criteria 41, 26 and 50, (Robb 1993 p280-283), enabled the researcher to uncover another finding: a main concern of some students is that **they cannot "waffle",** and this poses a difficulty. This finding is reflected in criteria such as **more thorough case needed, must give reasons, must be more factual/specific/direct, does not allow personal view point,** and **one side of the argument has already been decided and you must support it.** This corroborates a finding reported in a previous experiment that the vague, less specific, more general question is easier because one can "waffle" by drawing on general knowledge or imagination[11]. It is not surprising that students perceive difficulty in this way because many people, find the requirements of effective writing (being direct, specific, and giving reasons) difficult to fulfil, even after years of practice.

The appearance of Criterion 3 (**does not give a clear indication of what is required**), in the list of most mentioned Before, was also surprising. The researcher wondered how some students could perceive this merely from the IKWs alone. The three IKWs to which most of the mentions of this criterion were attributed were **write** (six mentions), **outline** (four mentions) and **illustrate** (four mentions). It is understandable that students perceive these three IKWs as not giving sufficient

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[11]   Paragraph 7.3.2a.

direction or guidance on what is required. It could be that some students perform poorly in essays because IKWs such as the three just mentioned and others similar to them, do not give sufficient direction.

After IKR, the most mentioned criteria are almost the same as Before, except for the addition of criteria 6 and 18. It was surprising that Criterion 6 (**requires more knowledge/understanding**) made up 5.6% of reasons After IKR. (The percentage of mentions of this criterion Before was 5.5%) The implications of this are extensive. Since students were presented with only the IKWs, **there was no question (knowledge content) on which to judge** the extent of knowledge required. **This means that some students perceive the amount of knowledge they need to answer a question, from the IKW alone:** some IKWs indicate the requirement for more knowledge and others for less.

This finding re-emphasises the necessity of understanding the information processing requirements of IKWs, for effective interpretation of questions. Most of the mentions for Criterion 18 (**must give examples**) were for the IKW **illustrate.** But why should the need to provide examples be perceived as a difficulty, unless one has not studied sufficiently and does not know the examples? It will be noticed that Criterion 50 (**definite answer/conclusion needed**) does not appear in the After list, and does not obtain even one mention After. This could reflect the fact that IKR explains that all questions require a conclusion.

Although some important findings have been revealed in this discussion, the researcher has also illustrated how it is necessary to ask **more fundamental questions** to uncover more about students' perceptions of IKW-difficulty. It was partly to achieve this that it was decided to record and examine the reasons given for **each IKW within each of the nine pairs of IKWs.**

At this stage in the analysis, a methodological problem arose. On the one hand, merely listing reasons under subheadings of each pair of IKWs would not reveal much. Clearly, a more interpretative approach would be needed. However, some reasons were mentioned only once and some generalisations could not be well-grounded. In addition, further lengthy discussion would lead to an unmanageable chapter length. As in all research of this kind a balance had to be found, and the summary descriptions to follow are the researcher's interpretations as far as the data allow.

a) Describe and list

In many responses **describe** was regarded as including **list**. It also includes giving reasons for a list and is perceived to involve **more technical information and**

facts. Students are also aware that describing involves **linking paragraphs, more writing** and **more care with layout.** However, and unexpectedly, four valid reasons were given for **list** indicating more difficulty. For example, it was perceived that **formatting a list into sentences** would be difficult; that it would be difficult to write down a list **without being boring** and that a list may involve **a complex list of reasons** or consequences.

This is a most revealing finding. On the one hand some students have given valid reasons for the **mental task** of **describing** being more difficult, and on the other, some students have also pointed out that **listing** may cause **difficulties in presentation.** This means that when some students are confronted with a question which begins with **list,** they will be worrying about how best to express what they know: **the difficulty is not in information processing, but in presentation.**

b) Write and explain

Some of the reasons given for **explain** were difficult to understand because they could equally apply to **write.** For example, one would think that **must show thoughts interlock, requires logical setting out** and **must give reasons or justifications,** would also apply to **write.** However, it is also possible to observe that some students considered **explain** to require **a more formal, less creative approach. Write** was regarded as indicating greater difficulty because of its **vagueness** and **broad-ranging nature,** a matter already discussed. In summary, although **explain** and **write** could very well be identical IKWs in an examiner's mind, **explain** is perceived as indicating greater difficulty.

c) Discuss and evaluate

Most of the reasons given for **evaluate** are not justified. For example, **a definite answer/conclusion needed,** applies to both IKWs. Similarly, some of the reasons given for **discuss,** such as **more than one viewpoint/argument needed** also apply to **evaluate.** The researcher was surprised to find, **does not allow for my own evaluation** given for **discuss** and, **cannot include input from others in the discussion,** given for **evaluate.** Further research is necessary to find out, for example, why some students think **evaluate** prevents them using others' views.

d) Define and outline

It is clear that **define** was regarded as requiring **much more specific detail, precision and formality** than **outline. Outline,** was regarded as indicating greater difficulty because it is **vague and general.** One student indicates that he/she may go into more detail than is required. The number of reasons given for **define** indicating greater difficulty was unexpected because **define** and **outline** would seem to require

very similar mental tasks.

e) Analyse and justify

This pair of IKWs produced an interesting result because the perception of greater difficulty reversed After IKR. Before IKR, **justify** was regarded as indicating greater difficulty because, primarily, **reasons had to be given for conclusions**. Three students regarded **justify** to indicate that **one side of an argument had already been decided as true** and that they had to support it even if they disagreed with the decision. One student felt that **justify** held the **danger of being side-tracked** because of the many arguments involved.

It is clear from the extent of switch of perceptions of difficulty After, that IKR influenced many students to perceive **analyse as indicating more difficulty**. One reason for selecting **analyse** as more difficult is quite understandable: it involves **taking a problem to pieces and working on each piece**. Finding reasons to support a position (justifying) would be easier in information processing terms than first taking a problem to pieces, then dealing with each part individually. Again, these results indicate that some students are capable of, and do make, subtle distinctions between IKWs with regard to the extent of information processing involved.

f) Weigh-up and assess

It is interesting to note that **assess** is regarded as **more formal and less friendly: sounds less down-to-earth** and that it involves **more than just adding up pros and cons**. Surely these reasons would also apply to **weigh-up? Weigh-up** is regarded as indicating greater difficulty, because it is **vague (ambiguous)**. One student **did not know what it meant**. These two reasons were surprising because it was explained during workshops that **weigh-up** requires weighing up both sides of the argument or discussing the advantages and disadvantages. For the researcher, although the two IKWs imply the same complexity, **assess** is perceived to indicate greater difficulty. It seems that **the more formal, less familiar IKW is perceived as more difficult**.

g) Explain and describe

Explain is regarded as more difficult because one **must take an example to pieces and then describe**. In other words, **explain** includes **describe**. In addition, one must **assist others to understand** and one **must give reasons for why one reaches an answer**. It seems as if **explain** is perceived as involving being responsible to another - being able to make oneself understood - whereas **describe** involves a more impersonal approach which is easier. Of course, the distinction although rational, is false: there is a requirement on the student to make

himself/herself understood whether describing or explaining. Only four reasons are given in total for **describe** and three of these involve **greater depth**. Again, this is an instance of the **more formal or less familiar** sounding IKW being perceived, for no sound reason, as more difficult.

h) Illustrate and give examples

The researcher expected that these two IKWs would be recognised as almost identical in difficulty. However, **illustrate** was regarded as indicating greater difficulty, not only because of the reasons already listed in **Table 9.2**, but because it is **more to the point (offering less scope and choice for answering), not allowing the pictorial approach** and **needing more examples**. Also, it implies to some students that there is **no limit to what is required in an answer**, and that **examples plus a picture are needed**. In other words, **illustrate** includes within it, **give examples**. It is not clear why students perceive that **illustrate** needs more examples than **give examples**. The researcher's best conclusion is that the more formal and unfamiliar word is being perceived as the more difficult.

i) Debate and justify

Debate was considered as indicating greater difficulty mainly because it **required a balanced argument**. Two reasons given for **debate** perceived it only as a **face-to-face encounter and not a written event**, and another as involving a **long-winded approach**. The main reason given for **justify** indicating difficulty was that **one side of the argument had already been decided** and **a less biased approach was needed**. The researcher wondered why this should indicate greater difficulty because one would expect that justifying an already given position would be easier than trying to give both sides of an argument. The difficulty arises not from the question but from having to justify a view **one may not personally agree with**. Clearly, there are some misconceptions here that could be hindering students' performances in essay-writing.

9.4 CONCLUSIONS

It cannot be doubted that students perceive the difficulty inherent in IKWs in a complex way which depends on their understanding of what IKWs require them to do. Consequently, while the IKR-based Level I or Level II-type difficulty is helpful[12], students are likely to benefit even more if the meaning of (requirements of) various IKWs are clarified for them. It is also evident that some IKWs are perceived as indicating more difficulty than others. Consequently, it is possible that by choosing carefully the IKW used in a question, examiners can assist students to give more adequate answers. Recommendations in this regard are offered in **Chapter Twelve**.

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[12] Paragraph 8.4.1a.

It seems as if workshops on IKR encourage students to think more intensely about the meaning of IKWs. This is evident because had students been thinking merely in terms of Level I and Level II as taught to them, the overall recognition of equal difficulty of IKWs in a pair would have increased, not decreased as it did. After IKR there were some changes in perceptions in varying degrees and directions for each pair of IKWs. Overall, the trend was for more students to select that IKW which had been identified by most students Before IKR. For four pairs there was a net change towards the IKW not selected Before. Consequently, for some students IKR initiated a change of mind, but for far more, **it reinforced their original perception of difficulty.** To answer why IKR encourages these different responses would require indepth interviews with students.

An analysis of the many reasons given make it safe to state the following main findings.

a) **The main perception of difficulty is that of the extent of decision-type thinking required.** This is expressed explicitly and in many implicit ways such as, the recognition that an IKW may require more work, detail and depth, giving two sides of an argument, arriving at conclusions, and giving reasons for conclusions. It is relevant that many students perceive the extent of information processing to be the difficulty, even without being introduced to IKR. The researcher expects that it is because many students already have an intuitive understanding of inherent difficulty that IKR assists students: it brings this intuitive understanding to consciousness.

There is also encouraging news for educators in this finding. Many of the tasks which students perceive as difficult, such as, **giving two sides of an argument, presenting definite answers,** and **showing how thoughts interlock,** are the very tasks they must master to ensure examination answers are adequate and communication in professional employment is effective. For the researcher this finding **supports the role of the essay as a didactic technique.** The essay confronts and tests the student with a whole range of information processing difficulties which are largely independent of the question's content.

b) **Some of the reasons given for perception of greater difficulty are justifiable.** They show that answering questions with some IKWs will require more mental effort than answering questions with other IKWs. Consequently, it is reasonable to predict that IKWs can be ranked according to how difficult students

perceive them to be. The results of an experiment to test this are reported in **Chapter Ten**.

c) **Some of the reasons given are not justifiable**. These unjustifiable reasons could be applied to both IKWs in a pair. It would be revealing to find out **why some IKWs are perceived as requiring certain tasks to be done** and also, **why some required activities attributed by students to certain IKWs pose difficulty**. In some instances, the difficulty-causing tasks attributed to some IKWs could be applicable to any writing task, and the researcher considered that some students were merely reflecting writing itself as a difficult task. In addition, some of these unjustified reasons are likely to mislead students as to what a IKW does or does not require of them. For example, some students perceive that **evaluate** does not allow them to use the views of others and that **debate** indicates only a verbal exercise!

d) **There are instances of apparent contradictions**. For example, on the one hand, greater difficulty is perceived because one **cannot "waffle"** and on the other, because the IKW indicates **vagueness, does not tell one what to do exactly** and is **not specific enough**. Similarly, on the one hand, difficulty is perceived because an IKW **requires personal views**, and yet on the other hand, some students offer, **cannot give my own views**, as the reason for difficulty. These contradictions are **only apparent contradictions** because one student might find it difficult to give personal views, while another finds it difficult if prevented doing so.

e) **There is some indication that some students perceive difficulty in not being able to "waffle"**. The only explanation the researcher has for this is that when one lacks knowledge, being able to express one's own view (general knowledge), and to give general rather than specific answers, does appear to make answering a question easier. However, altering this perception is likely to assist students, since "waffling" which deviates from the point of the question, cannot result in effective essay-writing.

f) **Some IKWs, indicate for some students that the examiner has not been as helpful as he/she could have been and indicate the extent of knowledge needed to answer a question**. For example, **write, outline** and **illustrate** are perceived as not giving a clear indication of what is required. Similarly, from the IKWs alone, about 5% of students perceived that **much more knowledge was required**. It would be valuable to find out why students perceived in this way and it is also likely that this finding will assist examiners in

setting more effective questions.

g) **There is some evidence that some IKWs are perceived as indicating more difficulty merely because they are unfamiliar to the student.** For example, the researcher found no justifiable reason for **illustrate** being perceived as more difficult than **give examples**. However, from the researcher's experience, **illustrate** is used less frequently by examiners and is more formal than **give examples**.

h) **There is a distinction between difficulty of thinking and difficulty of presenting the results of thinking.** Some of the reasons indicate that students perceive difficulty not so much in information processing, but in scribing (writing out what one has thought out). Reasons such as **cannot be formatted into sentences, more care with layout needed,** and **must not be boring,** are only a few which reflect this concern of students. Consequently, examiners should be aware that choosing an IKW does not only indicate to students the amount of knowledge they will need, but also, how the answer should be presented.

i) **The six most mentioned criteria do not change significantly** after workshops in IKR, indicating that the perceptions of difficulty are deep-seated and will require more than a few workshops to alter them. For example, it was expected that After IKR, many more students, than actually did, would have made more explicit that **more work** means **more thinking**.

The results of this experiment on how and why students perceive various IKWs as indicating difficulty, are a beginning for more detailed work. Understanding how students perceive the requirements of IKWs is necessary to be able to alter any unjustifiable and misleading perceptions. A number of times in this chapter and also in the previous chapter, the possibility of a ranking of IKWs according to perceived inherent difficulty was expressed. In the next chapter the results of an experiment to test this possibility are reported.

THE EFFECT OF IKR ON THE RANKING OF SOME INSTRUCTION KEY WORDS (IKWs) ACCORDING TO THEIR PERCEIVED DIFFICULTY

10.0 INTRODUCTION

Results reported in **Chapters Eight** and **Nine**, led to the impression that IKWs could be ranked according to students' perceived difficulty of them. If there are some IKWs which are perceived as indicating considerable difficulty and some perceived as indicating very little difficulty, this information could be valuable to examiners in setting questions. It might be possible to avoid the IKWs perceived as most difficult, if another IKW requiring the same tasks, but of less perceived difficulty, could be found.

The researcher decided not to offer a detailed prediction of a ranking of IKWs because it would have been mere guess-work, and in addition, it was the students' ranking that was being sought. However, from information processing theory already explained and the results of experiments already reported[1], it was expected that Level I IKWs such as **describe, explain, list, show,** and **comment,** would be among those perceived as easiest. Conversely, is was expected that Level II IKWs such as **analyse, justify, assess** and **evaluate** would be perceived as among the more difficult.

Since workshops on IKR explain what various IKWs require, and which IKWs are similar in terms of information processing requirements, the researcher had two main expectations. Firstly, After IKR, overall perceptions of difficulty would be reduced, and secondly, the **range of difference** between the IKW perceived to be most difficult and the IKW perceived to be least difficult, **would be reduced.** To test these expectations formally the following two-part hypothesis[2] was raised.

After workshops on IKR, the overall extent of perceived difficulty will be reduced, and the range of difference between the most difficult and least difficult IKWs will diminish.

10.1 METHODOLOGY

The method for collecting data has already been described in **Chapter Nine.** The choice of some IKWs rather than others for use in this experiment must be explained. The researcher attempted from his personal and teaching experience, to **compile a list of frequently used IKWs which would reflect a range of difficulty - from**

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[1] Paragraph 1.2, Paragraph 8.4.1e and Paragraph 9.3.1.

[2] Strictly speaking two hypotheses should have been raised, but this two-part approach was employed to avoid over-complicating the description of results and discussion.

very easy to very difficult. For manageability, only sixteen IKWs were selected: it was realised though, that the same experiment could have been conducted with a different list. As already explained, a six-point scale was used to record students' perceptions of question-difficulty indicated by the IKWs. Scores of **1 & 2** were designated "easy" (E), **3 & 4** as "neither-easy-nor-difficult" (N), and **5 & 6** as "difficult" (D). To improve expression, the shorthand E, N and D is used in this chapter.

10.2 RESULTS

Sixty seven students completed the Before exercise and thirty, the After exercise. **Perceived difficulty**[3] was calculated for each IKW by expressing the sum of the mentions of each score (1 through 6) as a percentage of total mentions. These calculations (Before and After) are shown in **Tables A.26, A.27** and **A.28 in Appendix XXXIII.** From these data the highest number of mentions for an IKW was identified in one of the E, N or D categories. This, in turn, gave a general idea as to whether the IKW was perceived as easy, neither-easy-nor-difficult, or difficult. This categorisation is shown in **Table 10.1.**

Table 10.1

Categorisation of each IKW as E, N or D according to the category gaining the highest number of mentions expressed as a percentage of total mentions

Before			After		
E	N	D	E	N	D
compare	assess	analyse	compare	analyse	analyse[4]
list	contrast		describe	assess	
comment	compare		show	compare	
describe	& contrast		write	contrast	
discuss	discuss		list	compare	
show	evaluate			& contrast	
write	explain			discuss	
	illustrate			evaluate	
	justify			explain	
	suggest			illustrate	
				justify	
				comment	
				suggest	

Table 10.2 on the following page shows Before and After rankings of the sixteen IKWs by **highest number of mentions of difficult scores (5+6)**[5].

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[3] It must be remembered that the perceived difficulty is the students' perceptions of the difficulty of questions containing the various IKWs.

[4] An IKW appears in two categories when the percentages for the two are the same.

[5] It would also be possible to rank by the highest number of easy scores (1+2). This was done, but is not discussed because (excepting one or two minor cases), it merely presented the reverse of ranking by difficult scores [5+6].

Table 10.2

Rankings of IKWs according to the highest number of mentions of difficult scores (5+6) expressed as a percentage of total responses (%TR)

(Key: 1 = most difficult and 16 = least difficult)

Before	%TR	After	%TR
1 analyse	50	1 analyse	46
2 assess	38	2 assess	37
2 justify	38	3 justify	30
4 evaluate	37	4 compare &	
5 compare &		contrast	26
contrast	33	4 evaluate	26
6 illustrate	17	6 discuss	23
7 discuss	12	7 contrast	17
8 contrast	10	8 illustrate	13
9 comment	6	8 write	13
10 describe	5	8 compare	13
11 explain	4	11 explain	10
11 suggest	4	12 comment	7
13 write	4	13 suggest	3
14 compare	1	14 describe	0
15 show	0	14 list	0
15 list	0	14 show	0

10.3 DISCUSSION

In many instances the categorisation of IKWs into E, N and D was as expected. For example, since **list, describe, comment, show** and **write**, are Level I IKWs, it is reasonable to expect them to be categorised as E. However, the researcher did not expect that:

- **compare** and **discuss** would be in the E category (Before), because these are Level II IKWs entailing significant mental effort and also because, from the researcher's experience, some students mention these as causing difficulty. It is noticed though, that **discuss** shifts to the N category After IKR. The researcher wonders why **compare** did not shift: clearly further research is required into the specific **mental effort loads** of different IKWs;

- only one IKW (**analyse**) would be in the D category, since **assess, justify** and **evaluate** would seem to be very similar in terms of information processing required, and some students state these as causing difficulty. The sole appearance of **analyse** in D, indicates that this IKW is regarded by many students as **the most difficult IKW**. Some students' reasons for considering **analysing** to be difficult have already been discussed[6].

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[6] Paragraph 9.3.2e.

It is also relevant that:

- **comment** shifted from E to N. One the one hand, this IKW could be seen as similar to, for example, **describe** or **write**. On the other hand, if used in the context of "Comment on the reasons for ...", it would be similar to other Level II IKWs such as evaluate and discuss. Clearly further research is required into the specific **mental effort loads** of different IKWs;

- in the After results, **compare** is mentioned in both E and N. The researcher wondered why **compare** was considered easy by so many of the students, because one could reasonably expect most people to recognise that the mental task of comparing would be more taxing than the mental task of describing;

- even After IKR, students still regarded most IKWs as indicating neither-easy-nor-difficult, questions. Since workshops in IKR explained to students that IKWs could be generally classified as Level I and Level II, it was expected that there would be a more distinct division of difficulty perception. For the researcher, this result indicates that the IKR division of Level I and Level II, while helpful rule-of-thumb in many instances, is too simplistic and that considerable further research is required into the complexity of the information processing required by each IKW.

The results of this experiment do not support the hypothesis[7] because After IKR, more IKWs were categorised as N. In other words, overall, difficulty perception increased rather than the expected decrease. Again, the indications are that the simplistic division on IKWs into two levels of difficulty requires further modification if it is going to predict adequately, students' perceptions of the difficulty implied by an IKW.

It is possible that the calculation of perception of difficulty by summing the mentions for each score (1-6) is too simplistic and hides other relevant insights. The researcher considered calculating the overall perception of difficulty of each IKW another way: by **summing the products of the number of mentions of a score and the value of the score,** for each IKW.

Take, for example, the hypothetical case of only twenty students and an IKW "p" which obtains ten mentions of score 4 on the difficulty scale and ten mentions of score 6. Using the simplistic E, N and D categorisations, "p" would appear in both N and D. However, using the more refined calculation of Σ[**mentions of each score** x **value of score**] $(10 \times 4 = 40$ and $10 \times 6 = 60)$, clearly puts "p" in the D category. However, since the (1 - 6) scale is an ordinal scale, and not a nominal one, there is no justification for carrying out mathematical operations on an ordinal scale. Just because

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[7]   In this chapter "hypothesis" refers to the hypothesis stated in Paragraph 10.0.

the six different classes/categories are designated by numbers does not mean that the degree of difficulty is the same between each step of the scale. Consequently, although for completeness sake these calculations were carried out[8], they cannot be, and are not, used for further analysis in this chapter.

It is possible to add another observation. Since two IKWs shifted from E to N, and since there was no **movement from N to either E or D**, this is preliminary evidence that After IKR, students' perceptions of difficulty are **altered from extremes of easiness to neither-easy-nor-difficult.**

On examining the rankings of IKWs according to largest number of difficult [5+6] scores as a percentage of total responses, as presented in **Table 10.2, analyse, assess, justify, evaluate** and **compare & contrast** are, as might be expected, in the top five (both Before and After). Consequently, it is safe to state that, generally, questions containing these IKWs will be perceived as more difficult to answer. In addition, it is safe to state that questions containing **list, show, describe, suggest** and **comment,** will be regarded as among the easiest to answer.

It is evident that IKR had some influence on students' perceptions of difficulty. Twelve of the sixteen IKWs changed rankings, but not in any significant way. **Analyse** is at the top of the rankings by substantial margins, indicating that it is perceived to indicate much greater difficulty than any of the other IKWs. There seems to be a marked difference in the difficulty perceptions after rank 5 or 6. For example, difficult scores [5+6] for **compare & contrast** (ranked 5th Before) account for 33% of all responses, but for **illustrate** (ranked 6th) they account for only 17% of all responses. Although a similar break in the level of difficulty is observed in the After ranking (between ranks 6th and 7th) it is not as marked. This phenomenon possibly indicates that while Before IKR many students were thinking in terms of either difficult or not difficult, **After IKR, they were perceiving more gradations of difficulty.**

It will be noticed in the After ranking that the mentions of difficult scores for **comment, describe, explain, suggest** and **write** result in the same, or almost the same, percentage of total responses. This grouping is understandable because it is likely that for a large number of students, some IKWs have almost the same meaning. For example, a question which reads: **"Describe why civil engineers should protect the environment.",** could also be worded in the following ways with almost identical requirements on the students:

• "Suggest why civil engineers should protect the environment".

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[8] See Tables A.29 and A.30 in Appendix XXXIV.

- "Explain why civil engineers should protect the environment".

- "Write an essay on why civil engineers should protect the environment".

- "Comment on why civil engineers should protect the environment".

The consistency of Before and After rankings, again indicates that many students are able to perceive intuitively which IKWs indicate difficult questions. In all, there were changes in perception of difficulty for eleven of the sixteen IKWs. However, because in many cases the extent of the differences between rankings was very small, it is not possible to draw further meaningful conclusions.

While the rankings do reflect to some extent, groupings of similar-difficulty IKWs, there is no way to judge the meaningfulness of the extent of the differences. For example, it is clearly evident that an IKW attracting mentions of difficult scores (5&6) that result in 46% of all mentions, is perceived as indicating much more difficulty than an IKW with an equivalent 17% of all mentions. However, one cannot tell whether an IKW attracting mentions of the difficult scores that result in 17% of all mentions indicates a far greater difficulty perception than one with an equivalent of 13% of all mentions.

The consistency of the rankings Before and After, was striking. Just how little change there was After IKR is shown in **Table 10.3**.

Table 10.3

The difference in rank position for each IKW After IKR

Instruction	Rank Before	Rank After	Difference
Analyse	1	1	0
Assess	2	2	0
Justify	2	3	+1
Evaluate	4	4	0
Compare & contrast	5	4	-1
Illustrate	6	8	+2
Discuss	7	6	-1
Contrast	8	7	-1
Comment	9	12	+3
Describe	10	14	+4
Explain	11	11	0
Suggest	11	13	+2
Write	13	8	-5
Compare	14	8	-6
Show	15	14	-1
List	15	14	-1

After IKR, Five IKWs were ranked as more difficult and seven as less difficult. The largest movements arose with **compare** (-6), **write** (-5) and **describe** (+4),

indicating that compare and write were perceived overall as less difficult and describe as more difficult. The researcher considers that this result is further preliminary evidence that the range of perceptions of difficulty and easiness is reduced. Again, although further research is required, it could be that After IKR, some IKWs previously perceived as easy are likely to be treated with more caution, and some IKWs previously perceived as difficult are unlikely to be feared and avoided to the same extent.

The researcher wanted to find out if there was firmer evidence for this shift in perception, and decided to examine the change After IKR in the number of mentions for each IKW for each category (E, N and D), expressed as a percentage of all mentions. Calculations to examine these changes are shown in **Tables A.27 and A.28** in **Appendix XXXIV** and the differences extracted are presented in **Table 10.4**.

Table 10.4

The differences After IKR for each category of difficulty for each IKW based on number of responses as a percentage of all responses

SCORE	(E) [1+2]	(N) [3+4]	(D) [5+6]
IKW			
Analyse	-7	+11	- 4
Assess	-4	+5	- 1
Compare	-17	+5	+12
Contrast	0	-7	+7
Compare & contrast	+12	-5	-7
Discuss	-17	+6	+11
Describe	-9	+14	-5
Evaluate	+3	+8	-11
Explain	-15	+9	+6
Illustrate	+12	-8	-4
Justify	-1	+9	-8
Show	-1	+1	0
Comment	-13	+12	+1
Suggest	+7	-5	-2
Write	-11	+2	+9
List	+4	-4	0
Net shift	-57	+53	+4

Just how the data in **Table 10.4** can be interpreted can be explained by using the IKW **analyse** as an example. The percentage mentions of **analyse** in the E and D categories change by -7 and -4 respectively. This means that as a percentage of all mentions, the number of mentions of easy scores **declined** by 7% and the number of mentions of difficult scores **declined** by 4%. As a result, the number of **mentions of the** neither-easy-nor-difficult scores **increased by 11%** as recorded by the "+11" in

170

column "N".

These data can be expressed another way: while 7% of students changed their perception of **analyse** from easy to neither-easy-nor-difficult, 4% changed from difficult to neither-easy-nor-difficult.

The individual results for each IKW are revealing. For example, After IKR, **compare, discuss,** and **write** are perceived by 12%, 11% and 9% more students, as indicating difficult questions than Before. However, both **compare & contrast** and **illustrate** are perceived by 12%, and **suggest** by 7%, more students to indicate easiness, than Before. A revealing result is that most of the change in perception is **from easiness to neither-easiness-nor-difficulty**: there was a 57% shift away from perceptions of easiness to neither-easiness-nor-difficulty. In particular, **analyse, describe** and **comment** were perceived, respectively, by 11%, 14% and 12% more students, as indicating a question which is neither-easy-nor-difficult.

Again, the researcher must conclude that while some IKWs previously perceived as easy are likely to be **treated with much more caution,** some IKWs previously perceived as difficult **are unlikely to continue to be feared and avoided.** However, the result of a net shift of -57 from E, and +4 to D, again does not support the hypothesis: perceptions of difficulty increased rather than decreased.

10.4 CONCLUSIONS

Both Before and After IKR, students' perceptions of difficulty enable the ranking of IKWs according to their perceived inherent difficulty. The inherent difficulty of an IKW could be described as the extent of the information processing required to answer a question containing it. There is considerable consistency in the rankings Before and After IKW, and it is safe to state that the five IKWs perceived as indicating most difficulty were **analyse, assess, evaluate, justify** and **compare & contrast.**

There is evidence that **analyse** is perceived as being particularly difficult. The five IKWs perceived as indicating least difficulty were **list, describe, show, write suggest** and **comment.**

These findings should assist examiners in designing more effective questions because choosing IKWs other than the five perceived to be most difficult is likely to enhance the confidence with which students approach questions. The implication of this finding for examiners is discussed further in **Chapter Twelve**[9].

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[9] Paragraph 12.2 a and 12.2b.

The part-hypothesis that after workshops on IKR, the overall extent of perceived difficulty of IKWs will be reduced, cannot be supported. In fact, perceived difficulty increased as witnessed by shift of IKWs from category E to category N, and also as seen in the net shift of -57 from E. After IKR there is a very small decrease in the range of perceived difficulty calculated as a percentage of total responses (as shown in **Table 10.2**). However, this change was so small that it is not possible to support the second part-hypothesis that the range of difference between the most difficult and least difficult IKWs will diminish.

The considerable movement of IKWs from being perceived as easy to being perceived as neither-easiness-nor-difficulty is to be expected from students learning about IKR. On the one hand, IKWs which might have been perceived as easy are likely to be perceived as not so easy when it is explained in more detail what those IKWs require. Similar reasoning can be used for IKWs that are initially perceived as difficult.

Consequently, it is possible to present another preliminary finding which will require further testing: **that IKR reduces the extremes of perception of easiness and difficulty and that most IKWs appear to students to indicate neither difficulty nor easiness.** Considerable further work must be undertaken to find out just how to measure the "mental effort load" of various IKWs. The current IKR approach of a simple Level I and Level II division is insufficient to adequately describe students' responses.

CHAPTER ELEVEN

THE EFFECT OF IKR ON THE TIME STUDENTS TAKE TO INTERPRET ESSAY QUESTIONS AND ON THEIR PERCEPTIONS OF DIFFICULTY

11.0 INTRODUCTION

If IKR enhances information processing skills then it is reasonable to expect that after workshops on IKR, students should find the **task of interpretation** easier. In addition, it is reasonable to expect that students should **experience less difficulty in answering** a number of questions. If IKR does contribute to making interpretation easier, then it is reasonable to expect that the time taken to complete exercises in question interpretation will decrease after workshops on IKR. To test these expectations the following hypothesis were raised.

After workshops on IKR, students will take less time to complete question interpretation tasks and will experience such tasks as easier.

However, it was soon realised that three expectations were being tested and three separate hypotheses were raised.

After workshops on IKR, students will experience the tasks of question interpretation to be easier.

After workshops on IKR, students will experience a number of questions to be less difficult to answer.

After workshops on IKR, students will take less time to complete question interpretation tasks.

11.1 METHODOLOGY

It has already been explained[1] how data relating to sixty five civil engineering students was collected regarding times taken and the difficulty experienced, in completing question interpretation exercises. Students were asked to record these details for both Before and After questionnaires. They were asked to record their perceptions of difficulty in **completing the questionnaire as a whole**, on a ten-point scale, "1" indicating "very easy indeed" and "10" indicating "very difficult indeed".

The reader will notice from the description of methodology, that the researcher again used an ordinal scale (1 to 10) to gain an indication of students' perceptions of difficulty. The researcher is aware that mathematical operations on ordinal numbers cannot be justified. For example, a "3" on the scale is not three times the measure

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[1] Paragraph 3.2.5.

(whatever it might be) of "1" on the scale. However, in some experiments to be reported in this thesis it was difficult to measure certain changes in students' responses and ordinal scale data has been used in an attempt to detect trends and patterns. In these instances, in this study, the researcher is assuming that the "distance" between ordinates on the scale are equal. This approach has been used only in order to obtain an overview of the general shifts in students' perceptions.

The raw data resulting from preliminary analysis is shown in Robb (1993 p90-91) and copies of the relevant pages of the computer print-out are shown in Robb (1993, p284-287). In this chapter, the data collected from this experiment is referred to as "**Set One**".

It has been explained[2] how twelve postgraduate adult education, sixteen graduate civil engineering and seven chemistry honours students provided data on the time they took to complete a question interpretation exercise, and how difficult they thought **each question** would be to answer. Students were asked to decide how difficult they thought each question was on a five-point scale: "very easy", "easy", "neither-easy-nor-difficult", "difficult" or "very difficult". Taking into account its dangers, a five-point scale[3], was decided appropriate because in reality, some students would find a question to be neither-easy-nor-difficult. In this chapter, the data collected from this experiment is referred to as "**Set Two**". To enable comparison in those few instances where students did not indicate a degree of difficulty, these non-responses were recorded as "3" - neither-easy-nor-difficult.

The reader will notice that Set One tests difficulty for that experiment as a whole, whereas Set Two tests difficulty for each question in that experiment. For ease of recording, difficulty perceptions in Set Two were converted into a numerical scale from 1 to 5, "1" representing "very easy" and "5" representing "very difficult".

11.2 RESULTS

For clarity of expression, the reporting of results and the discussion in this chapter are conducted in three parts, namely the effect of IKR on: **experiences of difficulty in interpretation** (using data from Set One); **perceptions of question difficulty** (using data from Set Two); and **time taken** (using data from Sets One and Two).

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[2] Paragraph 6.1. Note that one of the eight chemistry students did not submit time and difficulty-rating data.

[3] The danger with a five-point scale is that the middle option is an easy option in times of indecision. If the middle point of the scale is used in this way, it should become evident when the results are examined. A four-point scale may have forced students into a decision on whether each question was easy or difficult - a decision they may not have wanted to make.

11.2.1 RESULTS RELATING TO THE EFFECT OF IKR ON EXPERIENCES OF DIFFICULTY IN INTERPRETATION

Table 11.1 compares students' assessments of the difficulty they experienced both Before and After. To provide another way of examining this data, the ten item scale of difficulty was reduced to only three groupings, namely, "easy", "neither-easy-nor-difficult" and "difficult". On the difficulty scale, 1- 3 were regarded as "easy", 4-7 as "neither-easy-nor-difficult" and 8-10 as "difficult". **Table 11.2** compares difficulty perceptions by these three groupings and **Table 11.3** shows the number of students who perceived the exercises After IKR to be easier, the same, or more difficult.

Table 11.1

A comparison of students' perceptions of difficulty
(Key: 1 = very easy indeed 10 = very difficult indeed)

	Before			After	
Item on difficulty scale	Frequency	Percentage	Item on difficulty scale	Frequency	Percentage
1	0	0	1	1	1.5
2	0	0	2	2	3.1
3	1	1.5	3	11	16.9
4	5	7.7	4	20	30.8
5	11	16.9	5	11	16.9
6	12	18.5	6	14	21.5
7	22	33.8	7	4	6.2
8	10	15.4	8	2	3.1
9	3	4.6	9	0	0
10	1	1.5	10	0	0
Totals	65	99.9	Totals	65	100.0

Table 11.2

Comparison by groupings of "easy" (E), "neither-easy-nor-difficult" (N) and "difficult" (D)

	Before			After	
Group	Frequency	Percentage	Group	Frequency	Percentage
E	1	1.5	E	14	21.5
N	50	76.9	N	49	75.4
D	14	21.5	D	2	3.1
Totals	65	100.0	Totals	65	100.0

Table 11.3

Change in perceptions of difficulty

Students finding the exercise to be:	Number	Percentage
Easier	53	81.5
The same	9	13.8
More difficult	3	4.6
Totals	65	100.0

11.2.2 RESULTS RELATING TO THE EFFECT OF IKR ON PERCEPTIONS OF QUESTION DIFFICULTY

The Before and After difficulty perceptions for each question for each student in each of the three groups (adult education, civil engineering and chemistry) are shown in **Tables A.32, A.33** and **A.34**, in **Appendix XXXV**. **Table 11.4**, shows the net change in perception of question difficulty for each student.

Table 11.4

Net change in the perception of question difficulty for each student

Adult education		Civil engineering[4]		Chemistry	
Students' initials	percentage change	Students' initials	percentage change	Students' initials	percentage initials
Students' initials	net shift	Students' initials	net shift	Students'	net shift
SF	0	SB	-3	AH	-2
SL	-19	LO	-1	SF	0
PB	-7	CS	+3	AD	-1
KL	0	GR	+8	SN	-4
JA	-1	GD	+4	CG	-2
AP	-4	DJ	+2	HM	-1
HS	0	CB	-9	IG	-4
CB	+1	FM	-8	BM	-9
LB	-11	JM	+3		
JR	-10	AP	-8		
SH	-4	WS	-4		
SR	+4	FB	-3		
		PF	-4		
		MG	+2		

11.2.3 RESULTS RELATING TO THE EFFECT OF IKR ON TIME TAKEN TO COMPLETE INTERPRETATION EXERCISES

a) Set One

The range of times taken by undergraduate civil engineers to complete a fifty one page questionnaire is shown in **Appendix XXXVI**. **Table 11.5** on the following page illustrates the distribution of individual times analysed by five groupings.

b) Set Two

The times taken Before and After, together with any changes for each student, in each of the three groups, are shown in **Tables A.35, A.36** and **A.37** in **Appendix XXXVII**. **Table 11.6** on the following page, summarises the percentage changes for each student.

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4   Not all the civil engineers recorded the time taken and their difficulty assessments.

Table 11.5

Summary comparison of time taken (in minutes) by sixty five civil engineering students, to complete the questionnaires

	Before			After	
Time Taken	Frequency	Percent	Time Taken	Frequency	Percent
Less than 60	5	7.8	Less than 60	38	58.5
61 to 120	41	63.1	61 to 120	26	40.0
121 to 180	14	21.5	121 to 180	1	1.5
181 to 240	3	4.6	181 to 240	0	0
Greater than 241	1	1.5	Greater than 241	0	0
Totals	64[5]	100.00	Totals	65	100.0

Table 11.6

Change in time taken by each student

(Key: - = decrease in time taken + = increase in time taken)

Adult education		Civil engineering		Chemistry	
Students' initials	change	Students' initials	change	Students' initials	change
SF	-105	DM	-50	AH	-5
SL	-120	LO	-15	SF	+5
PB	+25	CS	-20	AD	-30
KL	+50	GR	-15	SN	-15
JA	+40	GD	+60	CG	-5
AP	-60	DJ	+15	HM	-10
HS	-75	CB	-15	IG	-10
CB	0	GU	-15	BM	-15
LB	-25	PJ	+75		
JR	0	AP	+60		
SH	-25				
SR	0				

11.3 DISCUSSION

The discussion to follow is presented in three parts consistent with the presentation of the results, namely the effect of IKR on: **experiences of difficulty in interpretation; perceptions of question difficulty;** and **time taken.**

11.3.1 DISCUSSION RELATING TO THE EFFECT OF IKR ON EXPERIENCES OF DIFFICULTY IN INTERPRETATION

Even without statistical analysis, the data in **Table 11.1** show that students found the exercises **easier** After IKR. Before IKR, 73.8% of students assessed the difficulty they experienced at "6" or more. After IKR this figure dropped to 30.8%. **Table 11.2** gives another perspective: Before IKR only 1.5% of students found the exercise easy whereas After, 21.5% found it easy. In addition, while 21.5% of students found the exercise difficult, this percentage drops to 3.1%, After IKR. As the data in **Table**

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5 One student did not provide this information.

11.3 show, 81.5% of students found the exercises easier After IKR. Some individual differences for some students were extensive as the data in **Table 11.7** show.

Table 11.7

Individual student's changes in experience of difficulty

Change	Frequency	Percentage
-5	5	7.7
-4	3	4.6
-3	11	16.9
-2	19	29.2
-1	15	23.1
0	9	13.8
+1	3	4.6
Totals	65	100.0

Five students' experiences of difficulty **decreased by five points** on the scale and only three experienced more difficulty, and that by only one. Almost **30% of students experienced less difficulty by three or more points** on the scale.

11.3.2 DISCUSSION RELATING TO THE EFFECT OF IKR ON PERCEPTIONS OF QUESTION DIFFICULTY

The data in **Tables A.32, A.33** and **A.34, (Appendix XXXV)** show that overall, After IKR, the adult education students perceived their questions to be **11% easier;** the civil engineering students **4% easier;** and the chemistry students **12% easier.** Of the adult education students, **seven of the twelve** perceived the questions to be easier; of the civil engineers, **seven of the fourteen;** and of the chemistry students, **seven of the eight.** Some changes were relatively large with SL, LB and JR (adult education) finding the interpretation task easier to the extent of -19, -11 and -10, respectively. In the civil engineering group, GR experienced an **increase** in difficulty of 8, but CB and FM experienced decreases of 9 and 8, respectively. In the chemistry group, IG and BM experienced decreases of 4 and 9, respectively.

It cannot be doubted that, overall, IKR alters students' perceptions of difficulty in interpreting what a number of questions require. Taking all three groups together, **twenty one of the thirty four** students experienced decreases, **six** of whom experienced decreases of 8 or more. These large decreases in difficulty perception indicate that some students seemed to have **benefitted considerably from even limited exposure to IKR.** However, it must not be forgotten that **four of the thirty four** students showed no change and that **eight** perceived increases in difficulty. While the researcher considers these results as evidence that IKR did alter students' perceptions towards less difficulty, some caution is necessary.

It will be remembered that students were asked to give their difficulty assessment on several questions and the overall picture could hide other insights. Consequently, the

researcher wondered what the **net number of decreases in perception of difficulty** would be for each student. IKR is expected to enhance students' ability to understand what is required, and it is reasonable to assume that if it does, then questions should be perceived as less difficult to answer. If students show no change or an increase in difficulty perception, then IKR did not assist. By subtracting the sum of the **number of increases** and **number of no-changes** from the **number of decreases**, for each student, one obtains the **net number of decreases**. These calculations are shown in **Tables A.38, A.39**, and **A.40** in **Appendix XXXVIII**, and the results are summarised in **Table 11.8**.

Table 11.8

Net change in experiences of difficulty for each student, by group
(Key: NC = net number of decreases/increases   + = net decrease   - = net increase)

Adult education		Civil engineering		Chemistry	
Students' initials	NC	Students' initials	NC	Students' initials	NC
SL	+6	SB	0	AH	-4
PB	+2	FB	0	SF	-4
KL	-6	LO	-8	AD	-2
JA	-6	CS	-10	SN	0
AP	-4	GR	-6	CG	-4
HS	-8	MG	-4	HM	-6
CB	-8	GD	-2	IG	-0
LB	+8	DJ	-4	BM	+8
JR	+6	WS	-4		
SH	-4	CB	+4		
SR	-6	FM	-4		
SF	-6	JM	-4		
		AP	+2		
		PF	-4		

Table 11.8 shows that of the thirty four students who responded, **only seven experienced a net decrease in the number of perceptions of difficulty.** These findings do not contradict the overall findings that perceptions of difficulty decreased, but do illustrate that students found some questions easier than others. Some increase in difficulty is likely with some students because they will not adapt quickly to IKR and will require more practice than others. This result indicates, as might be expected, that for some students, IKR at first makes questions seem more difficult, but those who grasp it quickly gain marked shifts in perceptions of easiness.

11.3.3 DISCUSSION RELATING TO THE EFFECT OF IKR ON TIME TAKEN TO COMPLETE INTERPRETATION EXERCISES

a) Set One

Even without statistical manipulation it is safe to find that After IKR, the sixty four civil engineering students took less time to complete exercises in question interpretation. As **Table 11.5** shows, Before IKR, **four students took more than three hours to**

complete the exercises, while After IKR, none took this long. After IKR, 58.5% of students took less than an hour whereas Before, this figure was only 7.8%. Indeed, After IKR, 98.5 % of students took two hours or less. Again, there were some surprising individual results. The data in **Table 11.9** show that although 10.9% of students took longer by up to forty five minutes, **23.5% saved more than an hour**. One student each saved 240, 165 and 150 minutes.

Table 11.9

Number of students who saved time, took more time or showed no change

Time change	Number	Percentage
Saved between 181 - 241	1	1.6
Saved between 121 - 180	3	4.7
Saved between 61 - 120	11	17.2
Saved between 1 - 60	39	60.9
No change	3	4.7
Gained between 1 to 45	7	10.9
Totals	64	100.0

It could be that the lack of difficulty experienced and the extensive savings in time, are explained by **students becoming bored or annoyed by being asked to complete the same exercises twice** - once Before and again After. However, this is not borne out by the extensive improvements in students' performances reported in Chapter Four[6] nor by the students' own statements of the effort they expended on the After questionnaire as reported in Chapter Three[7].

Less easy to defend is the claim that students took less time to complete the exercise because they had seen the questions in the Before questionnaire and would have had time to think about them. One could argue that being given a "second chance" at the same question may assist a student to understand it and to take less time interpreting it. However, it is unlikely that the "second chance" effect would have had a major influence on the results. The students were under no time constraint - they could have taken as long as they wished. Consequently, spending additional time on the interpretation task would have been unlikely to have led to further improvement.

It is unlikely that merely seeing the same questions for a second time, would have resulted in improved performance. Nonetheless, to be certain that it was IKR that contributed to time reductions and not the "second chance" effect, the researcher could have built a control group into the experimental design. Alternatively, and more desirable from the ethics of research perspective, would have been to change the questions and question pairs in the After questionnaire. However, the researcher was

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[6]   Paragraph 4.1.2.
[7]   Paragraph 3.1.

worried that the latter would have changed the wording to such an extent that the comparisons Before and After would not have been possible.

b) Set Two

The data in **Tables A.35, A.36** and **A.37 (Appendix XXXVII)** show that, overall, time taken After IKR was **295 minutes less** in the adult education group and **85 less** in the chemistry group. However, in the civil engineering group time taken **increased by 70 minutes** overall. Taking all thirty responses together, an analysis of the distribution of times taken Before and After is shown in **Table 11.10.**

Table 11.10
Summary comparison of time taken in minutes

	Before			After	
Time Taken	Frequency	Percentage	Time Taken	Frequency	Percentage
Less than or 60	16	53.3	Less than or 60	20	66.7
61 to 120	10	33.3	61 to 120	7	23.3
121 to 180	4	13.3	121 to 180	2	6.7
181 to 240	0	0	181 to 240	1	3.3
Greater than 241	0	0	Greater than 241	0	0
Totals	30[8]	99.9	Totals	30	100.0

Just as for Set One, **the distribution shifts towards less time taken** with the number of students taking sixty minutes or less increasing from **53.3% to 66.7%.** As **Table 11.6** shows, there were some considerable time savings with seven of the thirty students saving an hour or more. Nineteen of the thirty students (63.3%) saved some time. However, most striking was the fact that students KL, JA, PJ and GD **increased** the time they took by **50, 40, 75 and 60 minutes,** respectively.

The fact that eight students took more time After IKR to complete their questionnaires, with four of these taking more than double the time they took Before IKR, can be explained by information processing theory. If students already have a heuristic which they use without being aware that they use it, applying a new technique which is made explicit to them, may lead to difficulty, initially. For some students, IKR may suddenly reveal that the questions are a lot more difficult than first realised and this may prompt students to take more care and more time. In addition, as with any new technique, some students will understand quickly how to apply it and others will require more practice.

It is difficult to explain why the civil engineering group overall recorded an increase in time taken. Certainly the extensive increases by PJ (+75) and GD (+60) would

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[8]   Some students did not provide this information.

have contributed to this, but one could ask why the reductions in time taken were not as extensive as those for adult education students. Since the civil engineering students had been out of university for some years, their approach to essay-writing could have been one of apprehension. The researcher's experience of teaching this group is that they do not enjoy essay-writing: they and regard the task with trepidation because it is well known that those who fail the professional examination, usually fail on the essay paper.

Another possibility cannot be ignored. It has already been explained how some students are field dependent, that is, they find it difficult to identify the essentials (the signal) in any communication. It could be that the day-to-day work of some professions, such as civil engineering does not provide opportunities for the mental practice or experience that would predispose one to interpretive thinking. If junior civil engineers are involved, on a day-to-day basis, mainly on complex mathematical calculations, design drawing and completing questionnaire-type reports, they will have little opportunity to interpret complex written questions. The researcher considers that testing the effect of IKR on different occupational groups could be another future research project.

As pointed out in discussing the results for Set One, time-savings could have been due to the repetition of describing answers to the same questions and to boredom, resulting in a slapdash approach to the After questionnaire. However, this possibility cannot be upheld since the quality of descriptions increased overall. For reasons already explained[9], a control group was not used in this experiment.

One might expect that where there is **a large decrease in the perception of difficulty, there would be a large decrease in time taken.** In other words, time taken would be less because students found the questions to be easier. No such relationship was found. For example, in the adult education group, although SF and HS found no change in difficulty, they cut the time taken by 105 and 75 minutes respectively. In contrast to this, KL also recorded no change in difficulty but took 50 minutes longer to complete the After questionnaire. It cannot be stated that a large decrease in perceived difficulty leads to a large reduction in time taken.

The researcher also wondered about the possibility of a relationship between the quality of descriptions, and the perceived difficulty of the questions and the time taken. On the one hand, if students found the questions to be slightly easier, it would be reasonable to expect this to result in increased quality of descriptions. On the other hand, it could be that if students hurried the After questionnaire, time saving could have resulted in

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[9]   Paragraph 2.1.

decreased quality of description. To test this, the percentage change in perception of difficulty and time taken for each student was compared to the percentage change in description quality. These comparisons are shown in **Appendix XXXIX.**

There is no relation between **change in perception of difficulty** and **change in quality of description.** For example, in the adult education group, although KL, HS and SF perceived no change in difficulty, they still achieved increases in quality of description of 7, 14 and 8, respectively. Even, CB and SR who perceived the questions to be 1 and 4 more difficult After IKR, increased the quality of their descriptions by 9 and 1, respectively. Similar instances of quality increasing while perceptions of difficulty increase and of quality decreasing while perceptions of difficulty decrease, can be found in the civil engineering and chemistry groups.

There is also no obvious relationship between the change in time taken and the change in quality of description. In most instances, even though times taken were considerably reduced, the quality of description increased. **It is interesting to note that in no instance did quality decline where time taken was reduced.** This indicates that reductions in time taken were due to students' enhanced interpretation skills.

11.4 CONCLUSIONS

The results revealed in these experiments make it possible to support the hypothesis that **after workshops on IKR, students experienced the tasks of question interpretation to be easier.** It is safe to find that this experiencing of less difficulty is not merely due to repeating the exercises again in the After questionnaire. Almost 82% of a group of sixty five civil engineering undergraduate students found it easier to work through a fifty one page questionnaire after workshops on IKR.

It is also possible to support the hypothesis that after workshops on IKR, **students perceived a number of questions to be less difficult to answer,** but only with regard to adult education and chemistry students. For graduate civil engineers in general, IKR increased the perception of difficulty. Further research is required to test the effect of IKR on different professional groups and also to compare results on university students as against professionals who have been working for a some years.

There is clear evidence that **IKR assists students to reduce the time they take** to interpret a number of questions, and to **simultaneously maintain or increase the quality of their interpretations.** It is therefore possible to support the hypothesis that after workshops on IKR, a group of students will take less time to complete question interpretation tasks.

The researcher acknowledges that taking less time to interpret questions, perceiving questions to be easier to answer, and finding the interpretation task easier, do not necessarily mean that students' essays will improve in quality. An attempt to find out whether or not there is a relationship between, for example, a decrease in difficulty perception and the quality of students' interpretations was inconclusive. While it would be possible to test whether a decrease in difficulty perception contributes to better essays, this would be a rather indirect test. The researcher would rather see experiments to test the effect of IKR directly on the quality of essays in examinations. Clearly, as also indicated in Chapter One[10], such experiments are essential. The effect of IKR on the quality of essays in examinations requires further testing.

The fact that many students saved considerable amounts of time doing the exercises in these experiments, while maintaining or increasing interpretation quality, is an indication **that IKR can assist students to reduce the time they take to adequately interpret questions.** It is likely that some students will, initially, require more time than others to use IKR to obtain increases in description quality. The substantial decreases in perceptions of difficulty are an indication that **IKR can assist students to feel more confident about answering questions,** and it is reasonable to expect that this confidence should be reflected in essay quality. It is likely that if some of the extensive changes recorded by some students in these experiments could be reproduced for more students, perhaps with longer workshops on IKR, it would have a considerable impact on improving essay-writing ability.

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[10] Paragraph 2.3.

CHAPTER TWELVE

CONCLUSION.
ASSISTING STUDENTS TO WRITE MORE EFFECTIVE ESSAYS:
RECOMMENDATIONS FOR LECTURERS AND EXAMINERS

12.0 INTRODUCTION

In this thesis, the results of fourteen experiments concerning the effect of the IKR technique on students' abilities to interpret essay questions and on their perceptions of question and instruction key word difficulty, have been reported and discussed.

Although nineteen experiments in all were conducted from February 1990 till December 1992, five have not been reported in this thesis because the contribution of their results to finding out more about how students interpret questions would have been minimal. In addition, it was necessary to keep this thesis to a manageable length.

Almost all work on information processing research reported in the literature surveyed by the researcher, has examined individual operations in a given context. In the experiments reported in this thesis, the researcher has attempted an integrated test of information processing theory in a real functional, non-clinical situation. This research has been directed by information processing theory, but has also been an outworking and probing of the theory itself. It is safe to state that the theory has been found to stand up well and predict well, but there are instances where it has not. Later in this chapter, recommendations are given for further research.

Some writers on the theme of improving essay-writing refer to **direction words, instruction words, key structural words** or **key topic words**. However, the researcher has not encountered as yet, the systematic search for instruction key words (I), knowledge key words (K) and relevance key words (R) in a question, and the attempt to relate them to each other, that the IKR technique (IKR) involves. Just how IKR is applied in interpreting questions has been explained in **Chapter One.**

In the same chapter, an extensive illustration is provided of how the potential advantages of using IKR can be explained in terms of information processing theory. It was explained how all students are involved in some mode of information processing when interpreting questions, whether they are aware of it or not, and that IKR is a mechanism for making this explicit. Becoming aware of the process one uses to interpret questions enables an assessment of its effectiveness.

The description of current information processing theory in Chapter One makes it easy to understand why question interpretation is a difficult task with ample opportunity for misinterpretation. Firstly, working space is limited, and students without an adequate chunking device will find long questions difficult to interpret. Secondly, all students have a unique experience of essay-writing (and communicating in general) which gives rise to perceptual filters which in turn, influence the way they approach question interpretation. If some of these perceptual filters are erroneous (and this research has shown that many are), students could be misled, resulting in an inadequate interpretation of the question and in turn, an ineffective essay.

Thirdly, information processing theory indicates that some students are more field dependent than others, that is, they are easily distracted by irrelevant information (noise). In addition, some students although unaware of it, attempt to understand the meaning of a question before having read it in full. Clearly, there is considerable scope for hindering students' reconstruction of what the examiner asks for in a question. This is corroborated by other researchers. Galbraith found (1980) that a doctoral student's poor writing stemmed from inability to reconcile her conception of what others demanded of her, with her private conception of the research topic. Hounsell (1988 p164) had a similar experience where a student's writing was inhibited by an inappropriate understanding of tutors' expectations.

In this research, insights have been gained into, for example, the effect of IKR on students':
• essay examination results;
• abilities to identify correctly the number of parts required in the answers to questions;
• criteria for deciding on the number of parts;
• perceptions of question difficulty when questions contain statements and when questions vary in length;
• understandings of what different instruction key words (IKWs) entail and the relative difficulty in terms of mental effort that different IKWs imply;
• criteria for deciding that one question entails a more difficult answer than another;
• perceptions of the difficulty experienced in undertaking question interpretation exercises;
• times taken to complete various interpretation exercises;
• quality of descriptions when asked to describe how they would answer a question if asked to do so; and
• time taken to complete interpretation exercises.

Rather than merely providing a summary repetition of the findings from each experiment, it was decided that a more effective conclusion to this research would be to offer recommendations to lecturers and examiners[1], and to offer suggestions for further research. This approach would, of itself, necessitate stating the relevant results giving rise to the recommendations.

12.1 RECOMMENDATIONS FOR LECTURERS

The researcher considers that there is sufficient evidence in the results of this research to recommend that lecturers, from most disciplines, teach IKR to their students. Strictly speaking, because of the experimental design, it has not been established beyond any doubt that any of the observed changes in students' perceptions are due **only** to IKR. The researcher is aware that a control group of matched ability, who were not exposed to IKR would have been the ideal (perfect) way to conduct many of the experiments in this study. However, it has been explained in the thesis why the controlled experimental approach could not and was not applied.

The fact that the experimental design was not ideal, does not detract in a major way from the findings. In several experiments it was the same group of students which were given the After exercises. Extensive precautions were taken to minimise the effect of other variables and the researcher in many instances points out cases where other variables could have influenced results. In this light and also since IKR was the major change in Before and After workshops, the researcher considers it safe to attribute changes in students' responses (both improvements and declines) to IKR.

For example, it has been found that IKR alters students' perceptions so that they are better able to recognise that:
* long questions and questions with statements before the actual question, are not necessarily more difficult or easier to answer, than short questions and that some of the information is irrelevant[2];
* very short questions are not necessarily more difficult or easier to answer, than long questions;
* the number of parts required in an answer to a question[3] can be identified by counting the IKWs;
* the difficulty perceived in some IKWs and that their fears or aversions to some IKWs, are unfounded[4].

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[1] It is likely that some lecturers will also be examiners. However, because the tasks of examining and the tasks of lecturing are somewhat different, it was considered that separate lists of recommendations would be more helpful.

[2] Paragraph 4.3.

[3] Paragraph 5.1.2.

[4] Paragraph 8.4.1, Paragraph 9.5 and Paragraph 10.4.

It has also been found that IKR:

- enables many students to describe more adequately how they would answer a question if actually asked to do so[5];
- alters the perceptions used by many students to decide the difficulty of, and number of parts in a question, away from from "homespun" criteria which frequently lead to erroneous perceptions, to more adequate criteria based on information processing[6];
- alters the erroneous perceptions many students have of some IKWs, such as not allowing "waffle" and use of personal views, for example, towards more rational perceptions based on the extent of decision-type thinking required in the answer[7];
- encourages students to think more intensely about the meanings of IKWs[8].

Some lecturers may consider that teaching students how to interpret questions is not a university-level activity. It may be considered a deviation from teaching their discipline and an intrusion into more legitimate uses of lecture time in an already overloaded curriculum. However, the fact that many students do arrive at university without the necessary essay-writing skills, is a university-level problem[9]. It has been shown in this research that many students' existing perceptual filters and "homespun" interpretation techniques, make misunderstanding of what is being asked of them in essay questions, a strong possibility. Consequently, while some students may have studied extensively and know their history, geography or anatomy, for example, they may still fail or perform poorly in an examination. Unless students are taught how to apply the knowledge they have, it is reasonable to expect that they will not perform well in essays that require such application.

The researcher, like most fellow-educators, does not consider that assisting students to perform well in essay examinations is a primary duty: the purpose of education is not to teach students how to pass examinations. However, since most students are assessed to a large extent by an essay examination, the researcher considers it to be at least part of the lecturer's duty to provide students with the skills to answer essay-type examination questions adequately.

This research has shown that IKR can enhance interpretation abilities of many students to a substantial degree even after only a one-hour workshop and two to three hours of self-study in the form of practising interpretation. However, it has also been found[10]

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5   Paragraph 6.4.
6   As indicated by the conclusions reported in Paragraph 5.3 and 7.4.
7   Paragraph 9.5.
8   Paragraph 9.5.
9   Paragraph 1.0.
10   See for example, Paragraphs 4.3, 5.3, 6.3 and 7.5j.

that, in general 20%-30% of students did not improve after an IKR workshop of an hour. The researcher would recommend that at least two sessions of one hour, with practice in between, would seem to be the minimum exposure if those students who are field dependent are also to be assisted. It is likely that two one-hour workshops would be required to change traditional, deep-seated and perhaps misleading perceptions. Depending on the time alotted to a lecturer, using two hours for IKR (for example, in a ten-hour lecture series) will be impractical and therefore, innovative ways would have to be found to include teaching of IKR.

It may be possible to teach IKR on a departmental level to all first year students, with refresher workshops for second and third year students at the beginning of each year. A more ambitious plan would be to initiate a **communications skills unit** in the university with specialist staff, part of whose duties would include teaching IKR across departments[11].

If individual lecturers or a departmental group of lecturers decide to teach IKR in some form or other, it should include:

* having to write one or two essays to be marked in detail by the lecturer before the teaching of IKR begins. This should bring home to students that their traditional ways of answering questions might not be adequate;

* showing students that most of what is called **"writing"** is in fact **"thinking"**: that once one has thought out what is required, choosing the correct expression ("scribing") is relatively straightforward. As Wilkinson (1986 p37-38) finds: "Analytical competence is fundamental in education. In the last resort the argument for reading and writing are not in terms of communication [but] the quality of thinking and feeling they bestow". Spenser (1983 p13) illustrates the point in a similar way when he reports that many Scottish teachers regard essay-writing as important for developing pupils' clarity and logic as thinkers. The researcher considers that Murray (1981 p178) has arrived at the same finding: "The prewriting process is largely invisible; it takes place within the writer's head. ... But we must understand that such a process takes place, that it is significant, and that it can be made clear to our students";

* pointing out that questions contain IKWs and knowledge key words, and in many cases, relevance key words;

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[11]   The researcher is aware that some Enterprise in Higher Education (EHE) units in some universities in the United Kingdom fulfil this role. However, it is uncertain whether or not these units will survive once funding runs out.

- showing students how IKWs can indicate where the **actual question** in an examination question begins, **how many parts** the answer should contain and the **level of complexity of thinking** required;

- an explanation of the meanings (requirements) of the most frequently used IKWs. This could be partly done by discussions in tutorials, specifically designed to investigate the ways students interpret IKWs. It seems as if Jones and Grant (1991 p9) have recognised the benefit of doing this. They quote a another researcher[12] who finds that: "The best teachers attempt to teach the skills denoted by words like 'analyse', 'assess', and 'evaluate' ... Being able to understand, quite untutored, the distinction between analyse and assess come naturally, I suggest, to few students.";

- explanation that questions with statements, long questions and less specific/vague questions, are not necessarily easier than questions which are short, do not contain statements and are direct and specific;

- extensive practice in using the IKR formula to interpret the requirements of questions, as opposed to writing out essays in full. The researcher considers that Hounsell and Murray (1992 p8) recognised this intuitively: "It is difficult to see how repeated practice in writing essays will of itself bring about a significant improvement in the quality of written work. " ;

- extensive practice in writing very brief explanations of how one would answer a question if asked to do so. It seems as if Ellington (1987 p6) has recognised the value of this. He suggests that students should be encouraged to write introductions which clearly explain how one has interpreted the question and how one intends tackling it.

If a lecturer who attempts to assist students by teaching IKR, is also the examiner, then there is less likelihood that the way questions are designed will mislead. If the lecturer is not also the examiner, then it would seem advisable to inform the examiner about the meanings of various IKWs conveyed to students. Even if a group of students has not been introduced to IKR, this research shows that there is much examiners can do to assist students in adequately interpreting the questions they design.

12.2 RECOMMENDATIONS FOR EXAMINERS ON DESIGNING ESSAY-TYPE QUESTIONS

There is considerable recognition that the way examiners design questions plays a crucial part in determining students' success in answering them. For example, Ellington (1987 p4) finds that: "The construction of clear, unambiguous essay

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[12] In the Times Educational Supplement, 18th June 1976, p2.

questions that effectively assess what they are intended to assess is a much more difficult task than is commonly supposed." Nightingale (1986 p5) finds that: "As designers of questions, we must try to anticipate where our questions might lead our students".

Lees (1992 p33) describes how possible differences in interpretation by student and examiner, of the requirements of an essay title can lead to a student failing unjustly. Johnstone (1988 p3) finds that the setting of examination papers is a very hazardous task: one not to be taken lightly, and requiring considerable thought. From the research results reported in this thesis the reader will understand why examiners need to take such care. In this light, the reader will understand why the word **"designing"** and not merely **"wording"** has been used in the heading of this paragraph. Examining effectively, whether students know about something and whether they can apply this knowledge, requires more than just selecting words. The examiner is involved in constructing or designing meaning which conveys the general area of knowledge required, the specific knowledge required, how the knowledge is to be manipulated, the amount of mental effort required, and even how the answer should be presented.

Although there is some advice in the literature on how examiners should design questions, the researcher finds it inadequate. For example, Ellington (1987 p4-5) advises examiners to match the question to the specific outcomes being assessed and to formulate questions so that students are presented with clearly-defined tasks and know exactly what is expected of them. But how is the examiner supposed to do this? The researcher considers that the results of this research can provide some guidelines.

a) Make explicit why even everyday, non-technical words are used in a question

There is considerable evidence that many students pay unjustified attention to words which the examiner may regard as insignificant[13]. For example, while some students consider that discussing the **effect** of something is more difficult than discussing the **role** of the same thing, others find the opposite. One would think that explaining the advantages and disadvantages of a career in civil engineering would involve the same content no matter who the audience is. However, some students think that such an explanation to **friends** would be more difficult than to an **'A' Level student**. Other students find the opposite.

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[13] Paragraph 7.3.2.

In chosing words for a question, it might be helpful for examiners to ask: "**Why do I want to use this word and not other similar words?**". For example, perhaps the examiner wishes to test something very specific by using **effect** rather than **role**. Once examiners have made explicit for themselves why a certain word has been used, this should be made explicit in the question. If there is something at "the back of the examiners mind", that the word **effect** rather than **role** expresses, then the only way for students to know this (and to respond to it), is for them to be told.

A slightly different example of the requirement to take care with apparently unambiguous everyday words is shown in the following question.

Are there advantages to be gained from designing civil engineering works for a limited life or is it better to construct for future generations?[14]

The researcher has found that students use considerable effort (and time) deciding whether there is any significance (requirements of the examiner) in the distinctions between **designing** and **construct** and between **limited life** and **future generations**. A more helpful wording would have been:

Are there advantages to be gained from designing civil engineering works for a limited life or an extended life?

As Elliot finds (1968 p67): "The wording of questions should be clear and unambiguous ... Be thorough in formulating questions, and have them checked by a colleague ... Do not use words with which your pupils are not familiar".

b) Attempt to use IKWs which are familiar to students and which do not cause apprehension

This research has shown that many students hold irrational and unjustifiable perceptions about the requirements of some IKWs[15]. A few students even used language such as "I hate" or "I find frightening", to express their reaction to some IKWs[16]. It is reasonable to assume that misconceptions about IKWs will influence students' performances in essay-writing. Cockburn and Ross (no date p 26) also point out the difficulties that can arise when IKWs not familiar to students are used.

This research has shown[17] that the five IKWs (of sixteen) perceived as indicating most difficulty are **analyse, assess, evaluate, justify** and **compare & contrast**. There is evidence that **analyse** is perceived as being particularly difficult. Another finding is

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[14] For an IKR interpretation of this question see Paragraph, 1.2.2d, Example Sixteen.
[15] Paragraph 8.4.1c and Paragraphs 9.5c, d, e.
[16] Paragraph 8.4.1c.
[17] Paragraph 10.4.

that IKWs such as **illustrate, explain**, and **assess** are perceived as more difficult than the very similar IKWs **give example, describe** and **weigh-up**, respectively[18]. In addition, IKWs such as **write, outline** and **illustrate** are perceived by many students as not giving a clear indication of what is required and are therefore an invitation to "waffle"[19].

Consequently, if students are not tutored in IKR, it would seem reasonable to suggest that examiners avoid those IKWs which are perceived (erroneously) as more difficult, which are unfamiliar or which cause apprehension. This does not mean making a question less demanding in terms of thinking, but using a familiar IKW with the same meaning (can test the same skills) as the unfamiliar one. For example, instead of **assess** or **evaluate**, use **weigh-up** and instead of **illustrate** use **give examples**. Similarly, instead of using the vague, "**Write** an essay on ..." one could be more specific and specify what mental task is required by using, say, **describe** or **discuss**.

The researcher realises that this recommendation seems to be limiting students' educational development: not expanding their horizons and vocabulary. This is not the case because if IKR lectures are not offered, and care is not taken in choosing IKWs, the examiner may end up examining the students' understanding of the requirements of IKWs rather than knowledge of history, geography or anatomy, for example. Clearly this would be ineffective question-design and also ineffective and invalid examining.

c) If possible, avoid using statements in questions
The researcher makes this recommendation despite it being found[20] that many students preferred questions with statements and some expressed a preference for statements to come before the actual question rather than after it. Many students who perceived in this way were operating on the erroneous assumption that the information in statements contains helpful information and guidelines to assist them with the answer. Information processing theory suggests, and this research confirms it, that students confronted with a statement will employ working space in an attempt to understand what the statement means, whether or not it bears relevance to the question, and whether the examiner requires it to be used in the answer. It will be noticed that all this mental activity does not address the actual question.

d) If possible, keep question length to between four and six lines
This research has shown[21] that questions with a line length of three or fewer are more frequently considered more difficult than questions with a line length of nine, despite

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18 Paragraph 9.4.2.
19 Paragraph 7.3.2 and Paragraph 9.5f.
20 Paragraph 7.5.1d.
21 Paragraph 4.2.2.

both questions requiring the same mental effort in answering[22]. There is extensive evidence[23] that many students think that very short questions do not contain helpful information, or guidelines to help structure the answer. However, questions with a line-length of nine are more frequently regarded as being more difficult than questions with a line-length of six, again, despite both questions requiring the same mental effort in answering. It cannot be doubted that the longer the question the more complex is the information processing required to interpret the question, and the chance that misinterpretation will occur.

e) Ensure that necessary statements and additional length do contain relevant information.

This research has shown[24] that many students consider questions with statements and longer questions to be easier to answer than questions without statements and shorter questions. The reason for this is that the statement and the length are perceived to contain information and guidelines to help with an answer. As this research has shown, students perceive this even when the statements and additional length are not helpful, that is, when they are merely "padding" for experimental purposes.

Consequently, if students are not taught IKR, examiners should ensure that the statement or length **does contain information which is relevant**. Better still, it could be explained to students why the extra information is given. Take the following question, for example:

The public inquiry procedure regarding large civil engineering works is intended to bring into consideration the views of any person or group likely to be affected by a proposal. Many such inquiries are time consuming and costly and often create long periods of uncertainty before a decision is given. However it is often stated that this procedure is a necessary evil to ensure the best interests of the community. List the safeguards used to ensure the best interests of the community during this procedure and describe the role of the independent observer[25].

The actual question only begins with the IKW **List**, and it seems as if the statement is largely irrelevant. The results of this research make it safe to predict that many students will consider that their discussion of the best interests of the community must include the issues of **time, cost** and **uncertainty**. However, one cannot tell if this is what the examiner intended. If the examiner did intend this, then a more effective wording of this question would be:

List the safeguards used to ensure the best interests of the community during public inquiry procedures regarding large civil engineering works. Describe the role of the independent observer and pay particular attention to matters of time, cost and

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22 Paragraph 7.5.1f.
23 Paragraph 7.3.2b.
24 Paragraph 7.3.2a and 7.3.2b.
25 For an IKR interpretation of this question see Example Five, Paragraph 1.1.1a.

uncertainty.

f) Be aware of the number of parts being asked for and the level of effort being required in each part.

The evidence from this research[26] was inconclusive regarding the effect of the number of parts in a question on students' ability to identify accurately those parts. However, an understanding of information processing theory together with an understanding of the requirements of IKWs, make it safe to expect that questions requiring three parts in an answer, all of which involve extensive reasoning implied by, say, **discuss**, **weigh-up** or **compare**, will confront students with a difficult task.

Consequently, increased awareness on the part of examiners of just how many parts their questions contain and the level of information processing required in each, is likely to increase the appropriateness of question difficulty. The phrase "the appropriateness of question difficulty" has been used to emphasise that this recommendation does not necessarily mean that easier questions should be designed. Question difficulty should be appropriate to the level of attainment of the students and the time available in the examination. For some students (honours and postgraduate) a complex, multi-part question may be appropriate.

12.3 RECOMMENDATIONS FOR FURTHER RESEARCH

As is usual with pioneering research, numerous questions arose in this research, each of which could become a point of departure for further research. Some suggestions are now offered which might yield even more understanding about how students interpret essay questions and how examiners design them.

a) Does IKR improve students' essay examination marks?

Although the results of one experiment reported in this thesis show that workshops in IKR did not significantly improve students' examination essay marks[27], there were numerous reasons other than failure of IKR, which could have accounted for this. Consequently, further experiments are necessary, perhaps under more stringently controlled conditions. For example, the researcher would now attempt to incorporate a "mock examination" and use of a control group. After the experiment, the control group would be given the same tuition in IKR as the experimental group received, so as not to prejudice their performance in an actual examination.

In addition, to ensure students practised IKR, an attempt would be made to make the written exercises compulsory. While there is evidence[28] that many students whose

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[26] Paragraph 5.1.2.
[27] Paragraph 2.4.
[28] Paragraph 6.2.

disciplines were adult education and civil engineering benefitted from IKR in terms of enhanced information processing skills, many of those studying chemistry did not benefit. It would be revealing to conduct this further research with student groups from different disciplines. It might be found for example, that students from the physical sciences require more tuition than those from the social and applied sciences.

b) Does enhanced information processing skills gained through IKR result in students writing better essays?

At several places in this thesis, the researcher has conveyed the understanding that IKR is an information processing technique. The grounding for this understanding is provided in Chapter One, where an attempt is made to explain IKR in terms of information processing. This does not mean that IKR is the whole of information processing but only a part of it - just one technique among many to assist students to deal more effectively with information. From the researcher's understanding of some of the current literature on information processing, IKR is a precursor to other stages of information processing, assisting with their operation. Again, it must be stated that further work is necessary to find out more about the relationship between IKR and other stages of information processing.

As already mentioned, some of the results reported in this thesis show that IKR alters students' perceptions so that they are less likely to be misled by irrelevant length and statements in a question. It has also been shown that after tutoring in IKR students are able to identify more accurately the number of parts in a question, and to recognise that certain IKWs indicate more difficulty (work) than others. However, while it is reasonable to expect that enhanced information processing skills will result in better essays, this should be tested empirically.

c) Can a more comprehensive classification of criteria for students' identification of number of parts and for deciding on question difficulty, be devised?

As a result of this research, the researcher has devised two general classifications: one for the criteria used by students to identify the number of parts[29] in a question, and another for the criteria used to identify difficult questions[30]. It is likely that with face-to-face interviews with students to probe some of the vague responses given, even more accurate classifications could be obtained. It might be considered unnecessary to conduct such further research because the criteria offered by students are mostly

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[29] See Appendix XIII.
[30] See Appendix XXIX.

erroneous and IKR is helpful in altering these erroneous perceptions[31]. However, gaining an even more accurate picture of how students perceive question difficulty and the number of parts required in an answer before tutoring in IKR, can further enable lecturers and examiners to assist students. A list of such criteria could be issued to students explaining that only those few criteria relating to the IKWs will lead to accurate assessment of the number of parts, and of difficulty.

d) What do students understand to be the requirements of some IKWs?

In asking students why they think one IKW is more difficult than another, the researcher was able to gain preliminary insights into what some students consider some IKWs require them to do[32]. Parts of this research have shown that some students hold unjustified views as to what some IKWs require and that there is considerable contradiction on whether a mental task involves difficulty or does not. Face-to-face interviews with students could probe in detail, perceptions of what tasks various IKWs require. In addition, finding out why some students are "afraid" of, or "hate", some IKWs could reveal more about the misconceptions and might contribute to further enhancing students' essay-writing performances.

e) Given the same questions, do students and examiners give the same IKR interpretations?

It would be reasonable to assume that different people using the same technique (IKR) would arrive at the same IKR interpretation of the same question. It would be relevant to test whether this happens first, with students from different disciplines and second, with students and their examiners. Any differences in interpretation would provide additional valuable opportunities to learn: it would require making explicit the thinking behind various decisions.

f) Are the enhanced information processing skills gained from IKR, still present after one year?

While it is evident from this research that IKR enhances the information processing skills of many students in the short-term, its effect in the long term has not been tested. This further research would be relevant because it might be that students forget how to apply IKR, and an indication of the extent or otherwise of forgetfulness would give guidance on how frequently refresher tutorials would be required. In addition, if IKR does have longer term effects, it will become more attractive as a technique, because it would be preparing students for more effective thinking in their careers.

g) Is it possible to use IKR to devise a question difficulty index?

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[31] Paragraph 5.2.1 and Paragraph 7.5b.
[32] Paragraph 8.3.2 and Paragraph 9.4.2.

Using the theory of information processing and the results of this research, the researcher considers it possible to devise an index of question difficulty. Such an index could be used by examiners in a check-list fashion to score the difficulty of any question they designed. This could also lead to departmental policy of setting upper and lower difficulty score limits for different groups of students, and any draft questions exceeding these would require to be re-designed.

h) Why do examiners use statements?

Bearing in mind the results of this research that statements in questions mislead many students as to what is required, and that statements temporarily use up working space, it would be revealing to find out why examiners use statements. This research might reveal that in many instances statements are unnecessary, or that examiners wish to achieve some specific goal, by inclusion of statements.

12.4 CONCLUSION

The researcher would stress that the recommendations in this chapter are not criticisms of existing lecturing and examining practice. Some of the recommendations may already be in operation. However, if lecturers decide to help their students to perform better in examination essays, the recommendations should assist.

The researcher predicts that a major tension surrounding essay-writing will arise in the not too distant future. On the one hand, the complex problems of contemporary society make it inevitable that graduates in all disciplines will require extensive thinking skills. This requirement is likely to increase as they become more senior in a career or profession. In order to avoid making serious errors which might harm others as well as themselves, and more positively, to progress complex but beneficial projects, they will need to understand thoroughly what is required of them. Most educators would claim that it is to develop these thinking skills that essay-writing is so prominent in university teaching. Some reflection will reveal that interpreting essay questions is a solid foundation for interpreting report briefs, items on the agendas of meetings, titles for speeches, and clients briefings, to name just a few.

On the other hand, the current funding arrangements for universities in the United Kingdom which require them to accept more and more students, is likely to discourage lecturers from setting essays because of the volume of marking involved. This could mean that a major method for developing students' thinking skills is neglected, to the detriment of the students, their future employers and society. Perhaps IKR could contribute to alleviating this dilemma.

IKR has the potential to develop thinking skills without the accompanying laborious

scribing-out that is so frequently and erroneously referred to as 'essay-writing'. This does not mean that students should never practice scribing out essay answers in full, merely that thinking skills can be more effectively developed by asking students to describe how they would answer a question if asked to do so.

One can understand how this training would assist students later in professional life. The most difficult aspect of problem solving, it could be argued, is clarifying exactly what the problem is and then specifying steps to be taken to overcome it. The routine tasks of actioning each of the solutions could be delegated to others. The researcher considers that initiating students into using IKR, not only prepares them more adequately for passing examinations, but more importantly for being more effective thinkers in their personal lives and professional roles. In this light, it is difficult to find reasons for not introducing students to IKR.

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APPENDICES

APPENDIX I

SOME INSTRUCTION KEY WORDS (IKWs) WITH THEIR DEMANDS (MEANINGS)

The original objective in compiling (from several dictionaries) this list of IKWs and their meanings was to assist students to understand what each IKW required. The intention was not to give exhaustive meanings, and it is expected that ways to improve the expression of what some IKWs require will continue to be found.

a) Explicit IKWs

analyse	describe, examine and criticise in great detail
appraise	see **evaluate**
assess	weigh-up or judge the extent to which conditions are fulfilled
compare	examine the similarities and differences between
contrast	point out the differences between
comment	brief expression of opinion
consider	think over; ponder on; reflect on
criticise	point out defects; pass judgement; show errors
categorise	group phenomena together using some criteria
define	show clearly the outlines of; give the precise meaning of
discuss	argue the case for and against
describe	a detailed account
distinguish	make clear the differences
differentiate	recognise differences between
enumerate	see **list**
evaluate	appraise or find value of
examine	scrutinise; investigate or inspect carefully
explain	make clear or intelligible; illustrate the meaning of; account for
give	see **state**
indicate	show; point out; make known; reveal
illustrate	make clear; explain by means of examples
interpret	using your experience explain the meaning of or assign significance to
judge	give an opinion or decision
justify	show to be true, right or reasonable; give reasons for
list	make a list
name	see **list**
outline	brief, general description without detail
present	see **state**
relate	tell story, describe
show	reveal, disclose; reveal in logical sequence
state	declare plainly or in detail
suggest	propose ideas, solutions or reasons
summarise	make a brief statement of the main points
trace	explain stage by stage
verify	show to be true; confirm

b) Hidden IKWs with the researcher's revisions to show clarification by inserting an explicit IKW

to what extent	**describe** to what extent
in your opinion	in your opinion **evaluate**
how far does	**discuss** how far
do you agree that	**state** whether or not you agree
what are	**describe** what are
should/could/would	**weigh-up** whether or not one should/could/would
is/are	**discuss** whether or not engineer(s) is (are)

DATA COLLECTED FROM CHEMISTRY DEPARTMENTAL RECORDS TO TEST FOR EQUAL ABILITY OF ATTENDEE AND NON-ATTENDEE GROUPS, AND TO SHOW CONFORMATION TO A NORMAL DISTRIBUTION

Table A.1

Data relating to attendees

Candidates' reference numbers	Final examination mark	3rd year year mark	Essay paper mark	First question and mark		Second question and mark	
3	45.4	40.0	28	Q_7	18	Q_9	16
5	53.8	61.3	34	Q_2	14	Q_5	17
6	41.4	62.3	28	Q_6	14	Q_{10}	16
7	41.2	39.3	38	Q_5	11	Q_9	18
10	69.0	70.7	23	Q_2	20	Q_3	17
11	45.2	52.3	32	Q_5	16	Q_7	13
12	43.0	49.0	31	Q_5	17	Q_9	16
14	55.4	50.0	33	Q_1	14	Q_2	14
15	63.0	57.0	31	Q_2	10	Q_5	16
16	76.4	79.7	45	Q_5	15	Q_{10}	25
18	51.0	41.3	40	Q_9	22	Q_{10}	23
25	62.0	46.0	30	$Q5$	15	Q_9	23
26	66.8	64.0	33	Q_1	13	Q_2	10
29	71.8	72.7	30	Q_2	8	Q_9	20
31	58.2	64.0	33	Q_7	15	Q_{10}	15
33	62.0	46.7	29	Q_1	14	Q_5	18
37	51.8	58.3	28	Q_8	10	Q_9	18
38	51.0	31.3	29	Q_5	15	Q_{10}	10
40	59.8	55.7	29	Q_5	15	Q_3	16
41	54.4	54.7	25	Q_5	15	Q_9	18
43	53.0	59.3	26	Q_2	23	Q_7	10
44	57.6	64.0	37	Q_2	14	Q_3	15

Total number of attendees = 22

Table A.2

Data relating to non-attendees

Candidates' reference numbers	Final examination mark	3rd year year mark	Essay paper (final)	First question and mark (3rd year)		Second question and mark	
1	53.0	59.3	26	Q_5	14	Q_{10}	12
2	57.0	55.3	30	Q_2	16	Q_5	14
4	55.8	61.0	24	Q_7	12	Q_8	12
8	45.0	38.7	34	Q_2	16	Q_9	18
9	53.2	54.7	29	Q_3	17	Q_8	12
13	48.0	48.7	26	Q_5	14	Q_8	12
17	69.6	58.3	35	Q_2	20	Q_5	15
19	75.4	78.3	37	Q_5	19	Q_{10}	18
20	76.2	70.0	45	Q_7	20	Q_8	25
21	53.8	55.7	27	Q_1	14	Q_2	13
22	49.6	56.0	30	Q_2	13	Q_9	17
23	41.6	50.3	34	Q_1	18	Q_5	16
24	50.0	39.0	34	Q_5	15	Q_9	19
27	66.6	65.0	35	Q_1	15	Q_8	20
28	40.8	42.7	27	Q_5	15	Q_6	12
32	52.6	56.3	30	Q_8	15	Q_9	15
34	72.0	61.3	32	Q_2	16	Q_5	16
35	52.2	49.3	29	Q_2	14	Q_8	15
36	61.0	59.0	34	Q_2	16	Q_3	18

Total number of non- attendees = 19

Table A.3

Frequency distribution of marks of attendees and non-attendees to show confirmation to a normal distribution and to a normal population

Mark bands	Frequency: attendees	Frequency: non-attendees[1]
40 - 44.9	3	2
45 - 49.9	2	3
50 - 54.9	6	6
55 - 59.9	4	2
60 - 64.9	3	1
65 - 69.9	2	2
70+	2	3

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[1] Although the analysis of gender distribution of both groups compared to the total population did not reflect the total population, it was decided that this was of minor importance since the experiment was not comparing performance by gender.

COVERING DIRECTIONS ISSUED WITH THE BEFORE AND AFTER
QUESTIONNAIRES

a) Before

Name:

CIVIL ENGINEERING YEAR I

COMMUNICATION SKILLS: EXERCISE ONE

To be handed in at the next lecture.

This is not a test!

Please enjoy the quiz-type exercise but do also treat it seriously. As you will see from lectures what you will learn from doing the exercise carefully will assist you greatly in improving your communication skills - especially examination essay-writing.

Please answer the questions to the best of your ability because your answers will also become some of the data in a major research project to help students answer questions more effectively.

There are five parts to this exercise and although you will have to do some thinking in each part it should be fun. If you undertake the whole exercise seriously it should take about two hours. But why not spread the work load - do an hour one night and another hour the following night.

REMEMBER! PLEASE READ THE INSTRUCTIONS BEFORE EACH PART AND PLEASE DO NOT CONSULT WITH YOUR FRIENDS - I REALLY DO WANT YOUR OWN HONEST ANSWERS.

W. Robb. October 1990

Name:

CIVIL ENGINEERING YEAR I

COMMUNICATION SKILLS: EXERCISE TWO
To be handed in at the next lecture.

In this lecture you have learned the KIR technique for analysing essay questions. You have seen that:

* even though you do not have all the knowledge you need you can still ANALYSE questions. This means that you can tell how a question should be answered even though you know nothing of the subject;

* the INSTRUCTION(S) can tell you how many parts there are in a question;

* the INSTRUCTION can also tell you when a statement or quotation in a question is useful or irrelevant;

* the INSTRUCTION, in addition, gives you an indication of the difficulty involved in the parts of the question.

This exercise is a repeat of Exercise One, but this time PLEASE USE THE **KIR METHOD** OF QUESTION ANALYSIS: refer to your lecture handouts if you need to.

Please enjoy the quiz-type exercise but do also treat it seriously: please answer the questions to the best of your ability. Not only are you practising your thinking, but when you hand in this exercise it will supply data that will assist other students and university staff in the future.

REMEMBER! PLEASE READ THE INSTRUCTIONS BEFORE EACH PART AND PLEASE DO NOT CONSULT WITH YOUR FRIENDS - I REALLY DO WANT YOUR OWN HONEST ANSWERS.

W. Robb. October 1990

THE FEEDBACK FORM USED TO DETERMINE STUDENTS' EFFORT IN COMPLETING BEFORE AND AFTER QUESTIONNAIRES, AND AN ANALYSIS OF THIS FEEDBACK

a) The feedback form

TO ALL FIRST YEAR CIVIL ENGINEERING STUDENTS WHO SUBMITTED EXERCISES ONE AND TWO DURING THE COMMUNICATION SKILLS LECTURES

PLEASE HELP!

Thank you for the enthusiastic way in which you worked through both exercises on interpreting essay questions.

The information you supplied will be used in a major research project to assist other students. It is therefore very important that you treated both exercises seriously.

Please would you help!

I need to know how seriously you actually did treat Exercises One and Two. Please answer the following questions **honestly**: I will be the only person that sees the answers and I will use them only to make sure that the data you provided is valid. I will destroy the answers you give after I have checked the validity of the data.

Please ring the statement which best describes how you treated **Exercise One**

I put in:

considerable effort	*some effort*	*little effort*	*very little effort*

Please ring the statement which best describes how you treated **Exercise Two**

I put in:

considerable effort	*some effort*	*little effort*	*very little effort*

Name: (please print)_____

W. M. Robb
Guest Lecturer: Department of Civil Engineering

b) Table A.4

The extent of effort students employed on completing the Before and After questionnaires

(Key: 4= considerable effort 3 = some effort 2 = little effort 1 = very little effort)

	Before			After	
Effort Indicator	Frequency	Percent	Effort Indicator	Frequency	Percent
1	0	0	1	1	1.8
2	2	3.6	2	14	25.0
3	25	44.6	3	36	64.3
4	29	51.8	4	5	8.9
Totals	56[2]	100.0	Totals	56	100.0

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[2] Only fifty six of the sixty five students responded.

DIRECTIONS FOR COMPLETION OF, AND A LIST OF THE EIGHT PAIRS OF
QUESTIONS USED IN, PART A

a) Directions for completion

1. In this part you will find eight (8) pairs of questions, each pair on a separate page.

2. Try and decide if one question of the pair is more difficult than the other or, if both questions have the same degree of difficulty.

3. If you think one question of the pair is more difficult than the other please try to explain why you think so. Be as brief as you wish but please write neatly.

4. Remember - it is not the knowledge content of the question which is important but the structure of the question itself. Assume that you have swotted hard and that you have all the knowledge you need!

5. You will find some questions on the subjects of adult education and chemistry. This is intentional so please use commonsense to assess whether one question is more difficult or if both questions in the pair are of the same difficulty.

b) The questions used in the eight pairs in Part A

A 1

1   Describe the effects of computer applications on the education and training of an engineer.

2   Describe the role of computer applications on the education and training of an engineer.

A 2

1   Discuss the influence of industrial relations on site activities with particular reference to flexibility in working practice.

2   Discuss the role of industrial relations on site activities with particular reference to flexibility in working practice.

A 3

1   Sociologists are not really scientists but academics attempting to give a scientific format to their views. Do you agree?

2   Do you agree with the view that sociologists are not really scientists but academics attempting to give a scientific format to their views?

A 4

1   List at least ten principles that adult educators should follow when teaching adults.

2   List at least ten principles that adult educators should attempt to follow when teaching adults.

A 5

1   Discuss, giving examples, the particular obligations that the common law duty of care for neighbours imposes on an engineer.

2   An individual has a duty of care to his neighbours under common law. Discuss, giving examples, the particular obligations that this duty imposes on an engineer.

A 6

1   As the richer nations of the world develop their technologies the gap between them and the poorer countries widens. Are engineers playing their proper role to stem this drift apart?

2   Are engineers playing their proper role to stem the richer and poorer nations drifting apart because of the technology gap?

A 7

1   Are there advantages to be gained from designing civil engineering works for a limited life or is it better to construct for future generations?

2   Are there advantages in designing civil engineering works for a limited life or is it better to construct for future generations?

A 8

1   Should environmental impact assessments (EIAs) be required by legislation on the grounds that they are valuable for guiding engineers in their care of the environment?

2   It is agreed that environmental impact assessments (EIAs) are valuable for guiding engineers in their care of the environment. Should EIAs be required by legislation?

A LIST OF QUESTIONS USED IN THE NINE PAIRS OF PART B

B1

1   A career as a civil engineer would be enjoyable, rewarding
and an opportunity to contribute to the wealth of society. How
would you attempt to convince an 'A Level' student of this?

2   A career as a civil engineer has many enjoyable moments
and enables one to serve the well-being of one's nation. How
would you attempt to convince your friends of this?

B2

1   It is suggested that the efficiency of any organisation is
largely dependent on the degree of self-motivation of the
people working for it. This motivation depends on how
managers treat staff, how they themselves act towards their
work and organisation and how well they manage the
resources of the organisation. What steps do you think
managers in the construction industry should take to motivate
non-professional staff who are poorly paid and based mainly
on sites far from large centres of population?

2   An organisation's efficiency is largely dependent on the degree
of employees' self-motivation and, in turn, how managers treat
staff, manage themselves and act towards their organisation.
How might managers in the construction industry motivate non-
professional site workers who are poorly paid and based mainly
on sites far from large centres of population?

B3

1   Adults are more experienced than children and may be
offended by another person telling them what is worthwhile.
Explain how an adult educator should teach adults.

2   Adult educators, like educators of children, are concerned
with doing that which is worthwhile. However, this poses a
problem because most adults think they know what is
worthwhile and would take exception to another person
telling then what is and is not worthwhile. Using the
principles of adult education, explain how an adult educator
must select a) teaching aids, b) teaching methods and c) a
personal teaching style so as to achieve the learning
objectives without offending experienced adult learners.

B4

1   A professional civil engineer is usually held responsible
for the durability, serviceability, design, cost -
effectiveness, safety, and eye-pleasing aspects of his
structures. For each of these aspects indicate whether or
not laws, regulations, standards and codes of practice
exempt the engineer from his responsibilities.

2   Professional engineers are usually held responsible for all
aspects of their structures. Do laws, regulations, standards
and codes of practice exempt them from their responsibilities?

B 5

1   The construction industry improves the fabric and facilities
        of society as well as providing employment for many people.
        The industry can also be used as an economic regulator or its
        resources can be kept fully employed. Discuss the advantages
        and disadvantages of the industry as an economic regulator
        and as a stimulator of full employment.

2   The fabric and facilities of society are improved by the
        construction industry. The industry is also used by
        politicians and others as an economic regulator or its
        resources can be kept fully employed. Discuss the
        advantages and disadvantages of the industry as a stimulator
        of full employment and as an economic regulator.

B 6

1   The public inquiry procedure regarding large civil
        engineering works is intended to bring into consideration
        the views of any person or group likely to be affected by
        the proposal under discussion. Many such inquiries are time
        consuming and costly and often create long periods of
        uncertainty before a decision is given. However, it is
        claimed that this procedure is a necessary evil and contains
        safeguards to prevent abuse. What are these safeguards
        used to ensure the best interest of the community?

2   The public inquiry procedure, although costly, allows many
        views to be taken into account. What safeguards are
        used to ensure the best interest of the community?

B 7

1   Chemistry is a subject which has done so much good yet can
        do so much harm. We can all appreciate that the well being
        of human beings has been enhanced by synthetically
        produced drugs and antibiotics. However, equally we can
        think of the horrors caused by nuclear war, use of nerve
        gases and the abuse of insecticides and detergents. The
        chemist has to take considerable responsibility for this state
        of affairs and make explicit his/her code of ethics and to
        ensure colleagues adhere to this code. Do you agree?

2   The benefits of chemistry include new medical drugs,
        advances in nutrition and many synthetic and cheaper
        industrial raw materials. These have made life better for
        most people. But there are also disbenefits of chemistry
        such as production of nuclear weapons, artificial additives
        to foods, illegal production of substitutes for hard drugs and
        abuse of nerve gases and insecticides. Chemists are
        responsible for this state of affairs and must introduce a
        code of ethics and make sure all adhere to it. Do you agree?

B8

1 It is agreed that waste products emitted from burning hydrocarbons such as wood, coal and peat cause greater pollution and environmental damage than does waste from nuclear power stations. Using your knowledge of the chemicals involved describe which effects of these two groups of waste products is likely to be the most damaging.

2 There is growing concern among scientists, politicians and the general public that our use of energy is inefficient and gives more disadvantages than advantages. It is agreed that waste products from both nuclear power stations and from burning hydrocarbons of all kinds endanger the environment and consequently mankind. Use your knowledge of chemistry and of the likely waste products from both sources to decide which of these two groups of waste products is likely to be the most damaging.

B9

1 Clients are now offered a variety of management services by engineers, architects and quantity surveyors. Compare management contracting with the conventional system.

2 The management services that can be offered by engineers, architects, quantity surveyors and other professionals has grown rapidly in recent years. It has become difficult for some clients to chose the service that best suits them and whether or not they should contract out. Compare management contracting with the conventional system.

a) The directions

PART D

1. In this part you will find seventeen (17) questions, each on a separate page.

2. Try and decide how many parts in each of the questions.

3. Once you have decided on the number of parts please try to explain how you arrived at your answer. Be a brief as you wish but please write neatly.

4. Remember - it is not the knowledge content of the question which is important but the structure of the question itself. Assume that you have swotted hard and that you have all the knowledge you need!

5. You will find some questions on the subjects of adult education and chemistry. This is intentional so please use commonsense to assess how many parts there are in the question.

b) The seventeen questions used in Part D

D 1

The needs of people should be at the forefront of educators'
thinking and planning when they design courses of study for
adults. But there are many kinds of needs from the
physiological to self-actualisation. Describe, briefly,
Maslow's hierarchy of needs theory? How does this theory
relate to the real life situation of adults' needs?

D 2

The public inquiry procedure regarding large civil engineering
works is intended to bring into consideration the views of any
person or group likely to be affected by a proposal. Many such
inquiries are time consuming and costly and often create long
periods of uncertainty before a decision is given. However, it is
often stated that this procedure is a necessary evil to ensure the
best interests of the community. List the safeguards used to
ensure the best interest of the community during this procedure
and describe the role of the independent observer.

D 3

Describe what you regard to be the main disadvantages in a civil
engineering career. Would you recommend civil engineering as
a career to an A level student? What arguments would you put to
that student?

D 4

Describe how UK engineers should prepare for entering
European markets in 1992 and discuss the merits of a
Community wide statutory registration of engineers. What do
you think the barriers to such a scheme would be?

D 5

Describe the effects of computer applications on the education
and training of an engineer.

D 6

Why do sodium and potassium react so violently with water and
what safety precautions would you take when using these
metals?

D 7

It is suggested that the efficiency of any organisation is largely
dependent on the degree of self-motivation of the people
working for it. This motivation depends on how managers treat
staff and how well they manage the resources of the
organisation. What steps do you think managers in the
construction industry should take to motivate staff who are poorly
paid and based mainly on sites far from large centres of
population? Is it possible to undertake systematic management
on construction sites, especially when weather conditions can set
back the best laid plans?

D 8

Today, computer applications are found in almost every
engineering office. Describe their effects on the work of
engineers. How do these applications save time and money?

D9
Describe the responsibilities of the engineer in connection with
works designed and constructed by the contractor. Discuss how
the engineer should discharge those responsibilities. List the
standards that can assist the engineer in this task.

D10
Environmental impact assessments (EIAs) are essential in civil
engineering. Should EIAs be required by legislation and should
engineers be given compulsory training in their formulation?

D11
Adult educators, like educators of children, are concerned with
doing that which is worthwhile. However, this poses a problem
because most adults think they know what is worthwhile and
would take exception to another person telling them what is and
is not worthwhile. Using the principles of adult education,
explain how an adult educator must select a) teaching aids and
b) teaching methods so as to achieve the learning objectives
without offending experienced adult learners. Describe the
teaching style most likely to be suitable for adults.

D12
Describe what personality traits are needed to be an
effective adult educator. Discuss the best way for an adult
educator to gain these traits.

D13
It is claimed that the gases emitted from burning hydrocarbons
such as coal, cause greater pollution and environmental damage
than does waste from nuclear power stations. In your opinion
(using your knowledge of the chemicals involved), which effects of
these two groups of waste products are likely to be the most
damaging? What right have chemists to voice opinions on these
matters?

D14
As the richer nations develop, the gap between them and the
poorer countries widens. List what engineers can do to stem
this drift apart. Describe why this gap will continue to widen.

D15
Compare quality assurance with quality control. What are the
benefits of quality control to the Client, Designer and the
Contractor?

D16
How, and to what extent, do you believe that engineering designs
should be influenced by the types of operatives and plant
available for construction? What can the engineer do when
operatives and plant are limited?

D17
A professional civil engineer is usually held responsible for
the durability, serviceability, design, cost - effectiveness,
safety, and eye-pleasing aspects of his structures. Describe for
each of these aspects indicated whether or not laws exempt the
engineer from his responsibilities. Explain the difference
between laws, regulations, standards and codes of practice.

APPENDIX VIII

THE QUESTIONS USED IN THE TEN PAIRS IN PART C

C 1

1   Describe the effects of computer applications on the education and training of an engineer.

2   Compare the role of computer applications on the education and training of an engineer.

C 2

1   Describe the effects of computer applications on the education and training of an engineer.

2   Describe the role of computer applications on the education and training of an engineer.

C 3

1   List the advantages to be gained from designing for a limited life and from designing for future generations.

2   Compare the advantages to be gained from designing for a limited life and from designing for future generations.

C 4

1   Evaluate the different teaching techniques of a teacher of adults and a teacher of children.

2   List the different teaching techniques of a teacher of adults and a teacher of children.

C 5

1   Discuss from the viewpoints of the Client, the Engineer and the Contractor, the advantages and disadvantages of awarding contracts before designs have been "frozen".

2   Contrast from the viewpoints of the Client, the Engineer and the Contractor, the advantages and disadvantages of awarding contracts before designs have been "frozen".

C 6

1   Compare and contrast the possible dangers of the two main methods for producing hydrogen gas from water.

2   Describe the possible dangers of the two main methods for producing hydrogen gas from water.

C 7

1   Write an essay about the different approaches to preventing deaths and injuries on construction sites.

2   Evaluate the different approaches to preventing deaths and injuries on construction sites.

C 8

1   Explain how the Engineering Council is likely to be an "engine for change" in the next decade.

2   Weigh up whether the Engineering Council is likely to be an "engine for change" in the next decade.

C 9

1   Describe the advantages of the flip chart, overhead projector and side projector as teaching aids in adult education.

2   List the advantages of the flip chart, overhead projector and side projector as teaching aids in adult education.

C 10

1   Debate this motion: "Women are well-suited to a career in civil engineering".

2   Describe why women are well-suited to a career in civil engineering.

APPENDIX IX

TABLES TO SHOW THE FREQUENCY OF MENTIONS IN PART A AND PART B FOR Q₁ OR Q₂ IN A PAIR BEING MORE DIFFICULT, OR OF BOTH QUESTIONS BEING OF EQUAL DIFFICULTY

Table A.5

Frequency of mentions in Part A, for Q_1 or Q_2 in a pair being more difficult, or of both questions being of equal difficulty

	Before							After					
Pair	Q_1	%	Q_2	%	Same	%	Pair	Q_1	%	Q_2	%	Same	%
A_1	32	50	16	25	16	25	A_1	16	25	11	17	37	58
A_2	36	56	8	13	20	31	A_2	15	23	5	8	45	69
A_3	10	15	11	17	44	68	A_3	4	6	4	6	57	88
A_4	23	36[3]	15	23	26	41	A_4	11	17	4	6	50	77
A_5	23	35	5	8	37	57	A_5	9	14	7	11	49	75
A_6	4	6	40	62	21	32	A_6	10	16	15	23	39	61
A_7	19	29	7	11	39	60	A_7	6	9	3	5	56	86
A_8	34	53	16	25	14	22	A_8	15	23	6	9	44	68

Table A.6

Frequency of mentions in Part B, for Q_1 or Q_2 being more difficult, or of both being of equal difficulty

	Before							After					
Pair	Q_1	%[4]	Q_2	%	Same	%	Pair	Q_1	%	Q_2	%	Same	%
B_1	28	43	15	23	22	34	B_1	17	27	11	17	36	56
B_2	27	42	14	22	23	36	B_2	16	25	13	20	36	55
B_3	46	71	14	22	5	8	B_3	34	52	22	34	9	14
B_4	18	28	37	58	9	14	B_4	22	34	24	37	19	29
B_5	2	3	6	10	55	87	B_5	0	0	4	6	60	94
B_6	22	34	22	34	20	31	B_6	12	18	13	20	40	62
B_7	12	19	12	19	40	62	B_7	5	8	2	3	56	89
B_8	11	18	29	47	22	35	B_8	11	17	24	37	30	46
B_9	23	36	15	23	26	41	B_9	7	11	7	11	49	78

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[3] Some percentages are based on sixty five responses and others on sixty four: some students did not respond to all pairs.

[4] Because some students did not give a response to every question some percentages are based on sixty two, sixty three and sixty four.

TABLES TO SHOW THE NUMBER OF REASONS RECORDED FOR EACH
QUESTION ANALYSED BY NUMBER OF PARTS PERCEIVED (PART D), AND
THE FREQUENCY OF MENTIONS OF NUMBER OF PERCEIVED PARTS FOR
EACH QUESTION (WITH PERCENTAGES)

Table A.7

**The number of reasons recorded for each question (Before and After) analysed by
number of parts perceived (Part D)**

No. of parts	1		2		3		3+		
Question number	B	A	B	A	B	A	B	A	TOTALS
1	0	0	50	56	9	4	3	0	122
2	0	8	48	48	11	5	3	1	124
3	4	0	1	3	55	59	2	0	124
4	2	2	4	7	53	53	4	0	125
5	24	47	36	15	1	0	2	0	125
6	1	0	50	58	7	1	4	3	124
7	1	0	36	52	17	7	8	1	122
8	4	0	23	41	33	18	2	1	122
9	2	0	2	2	45	55	13	5	124
10	1	4	51	57	9	1	2	0	125
11	2	0	5	13	45	42	11	5	123
12	2	0	57	60	2	0	1	1	123
13	0	0	40	52	18	9	4	1	124
14	1	0	49	55	11	5	0	0	121
15	3	0	16	31	10	4	34	25	123
16	1	0	18	17	32	39	11	3	121
17	0	0	12	26	6	4	40	30	118
TOTALS	48	61	498	593	364	306	144	76	2090

Total (Before)   1054
Total (After)   1036

Frequency of mentions (Before and After) of number of perceived parts for each question (with percentages)
(Note: Bold type indicates the correct response for each question)

Before

Parts identified and percentage of total responses

Q	1	%	2	%	3	%	4	%
1	0	0	**50**	81	9	15	3	4
2	0	0	**48**	77	11	18	3	5
3	4	6	1	2	**55**	89	2	3
4	2	3	4	6	**53**	84	4	6
5	**24**	38	36	57	1	2	2	3
6	1	2	**50**	80	7	11	4	7
7	1	2	**36**	58	17	27	8	13
8	4	6	**23**	37	33	54	2	3
9	2	3	2	3	**45**	73	13	21
10	1	2	**51**	81	9	14	2	3
11	2	3	5	8	45	72	11	17
12	2	3	**57**	92	2	3	1	2
13	0	0	**40**	64	18	30	4	6
14	1	2	**49**	80	11	18	0	0
15	3	5	16	25	10	16	34	54
16	1	2	18	29	**32**	52	11	17
17	0	0	12	20	6	10	**40**	70

After

Q	1	%	2	%	3	%	4	%
1	0	0	**56**	93	4	7	0	0
2	8	13	**48**	77	5	8	1	2
3	0	0	3	5	**59**	95	0	0
4	2	3	7	12	**53**	85	0	0
5	**47**	76	15	24	0	0	0	0
6	0	0	**58**	94	1	2	3	4
7	0	0	**52**	87	7	12	1	1
8	0	0	**41**	68	18	30	1	2
9	0	0	2	3	**55**	89	5	8
10	4	6	**57**	92	1	2	0	0
11	0	0	13	22	42	70	5	8
12	0	0	**60**	98	0	0	1	2
13	0	0	**52**	84	9	15	1	1
14	0	0	**55**	92	5	8	0	0
15	0	0	31	52	4	7	25	41
16	0	0	17	29	**39**	67	3	4
17	0	0	26	43	4	7	**30**	50

PERCENTAGE OF ALL RESPONSES FOR EACH QUESTION ANALYSED BY NUMBER OF PARTS PERCEIVED, QUESTION LINE-LENGTH, NUMBER OF HIDDEN IKWS AND NUMBER OF PARTS: TO SHOW DEGREES OF INCORRECTNESS

(Key: "(one)", "(two)" or "(three)" indicates the actual number of parts as indicated by IKR)

Table A.9: question line-length

	Before				After			
Parts Perceived:	1	2	3	3+	1	2	3	3+
Two-line questions								
5 (one)	38	57(57)	2(2)	3(6)	77	23(23)	0	0
6 (two)	2(2)	78	2(2)	8(16)	0	92	2(2)	6(12)
15 (two)	5(5)	27	2(2)	56(112)	3(3)	49	8(8)	40(80)
Degree of incorrectness: 204 /3 = 68					128/3 = 43			
Three-line questions								
3 (three)	6(12)	2(2)	89	3(3)	0	6(6)	94	0
8 (two)	6(6)	40	51(51)	3(6)	0	75	25(25)	0
10 (two)	2(2)	83	12(12)	3(6)	6(6)	91	3(3)	0
12 (two)	3(3)	92	3(3)	2(4)	0	98	0	2(4)
14 (two)	0	83	17(17)	0	0	92	8(8)	0
Degree of incorrectness: 127/5 = 25					52/5 = 10			
Four-line questions								
4 (three)	3(6)	6(6)	85	6(6)	3(6)	9(9)	86	2(2)
9 (three)	3(6)	5(5)	72	20(20)	0	5(5)	89	6(6)
16 (three)	2(4)	30(30)	51	17(17)	0	27(27)	64	9(9)
Degree of incorrectness: 100 /3 = 33					64/3 = 21			
Six-line questions								
1 (two)	0	80	14(14)	6(12)	0	92	6(6)	2(4)
13 (two)	0	64	30(30)	6(12)	0	86	12(12)	2(4)
17 (two)	0	22	1(1)	67(134)	2(2)	45	8(8)	45(90)
Degree of incorrectness: 203/3 = 68					126/3 = 42			
Nine-line questions								
2 (two)	0	78	17(17)	5(10)	12(12)	78	8(8)	2(4)
7 (two)	2(2)	55	30(30)	13(26)	0	85	14(14)	2(4)
11 (two)	5(5)	6	71(71)	18(36)	0	25	66(66)	9(18)
Degree of incorrectness: 197/3 = 66					126/3 = 42			

Table A.10: number of hidden IKWs

Parts Perceived:	Before 1	2	3	3+	After 1	2	3	3+
No hidden IKWs								
2 (two)	0	78	17(17)	5(10)	12(12)	78	8(8)	2(4)
5 (one)	38	57(57)	2(2)	3(6)	77	23(23)	0	0
9 (three)	3(6)	5(5)	72	20(20)	0	5(5)	89	6(6)
12 (two)	3(3)	92	3(3)	2(4)	0	98	0	2(4)
14 (two)	0	83	17(17)	0	0	92	8(8)	0
17 (two)	0	22	1(1)	67(134)	2(2)	45	8(8)	45(90)
Degree of incorrectness: 285/6 = 48					170/6 = 28			
One hidden IKW								
1 (two)	0	80	14(14)	6(12)	0	92	6(6)	2(4)
4 (three)	3(6)	6(6)	85	6(6)	3(6)	9(9)	86	2(2)
8 (two)	6(6)	40	51(51)	3(6)	0	75	25(25)	0
11 (two)	5(5)	6	71(71)	18(36)	0	25	66(66)	9(18)
15 (two)	5(5)	27	2(2)	56(112)	3(3)	49	8(8)	40(80)
Degree of incorrectness: 338/5 = 68					227/5 = 45			
Two hidden IKWs								
3 (three)	6(12)	2(2)	89	3(3)	0	6(6)	94	0
6 (two)	2(2)	78	2(2)	8(16)	0	92	2(2)	6(12)
7 (two)	2(2)	55	30(30)	13(26)	0	85	14(14)	2(4)
10 (two)	2(2)	83	12(12)	3(6)	6(6)	91	3(3)	0
13 (two)	0	64	30(30)	6(12)	0	86	12(12)	2(4)
Degree of incorrectness: 157/5 = 31					63/5 = 13			
Three hidden IKWs								
16 (three)	2(4)	30(30)	51	17(17)	0	27(27)	64	9(9)
Degree of incorrectness: 34/1 = 34					36/1 = 36			

Table A.11: number of actual parts

Parts Perceived:	Before 1	2	3	3+	After 1	2	3	3+
One part								
5 (one)	38	57(57)	2(2)	3(6)	77	23(23)	0	0
Degree of incorrectness: **65 /1 = 65**						**23/1 = 23**		
Two parts								
1 (two)	0	80	14(14)	6(12)	0	92	6(6)	2(4)
2 (two)	0	78	17(17)	5(10)	12(12)	78	8(8)	2(4)
6 (two)	2(2)	78	2(2)	8(16)	0	92	2(2)	6(12)
7 (two)	2(2)	55	30(30)	13(26)	0	85	14(14)	2(4)
8 (two)	6(6)	40	51(51)	3(6)	0	75	25(25)	0
10 (two)	2(2)	83	12(12)	3(6)	6(6)	91	3(3)	0
11 (two)	5(5)	6	71(71)	18(36)	0	25	66(66)	9(18)
12 (two)	3(3)	92	3(3)	2(4)	0	98	0	2(4)
13 (two)	0	64	30(30)	6(12)	0	86	12(12)	2(4)
14 (two)	0	83	17(17)	0	0	92	8(8)	0
15 (two)	5(5)	27	2(2)	56(112)	3(3)	49	8(8)	40(80)
17 (two)	0	22	1(1)	67(134)	2(2)	45	8(8)	45(90)
Degree of incorrectness: **649/12 = 51**						**403/12 = 34**		
Three parts								
3 (three)	6(12)	2(2)	89	3(3)	0	6(6)	94	0
4 (three)	˙3(6)	6(6)	85	6(6)	3(6)	9(9)	86	2(2)
9 (three)	3(6)	5(5)	72	20(20)	0	5(5)	89	6(6)
16 (three)	2(4)	30(30)	51	17(17)	0	27(27)	64	9(9)
Degree of incorrectness: **117 /4 = 29**						**67/4 = 17**		

A BRIEF EXPLANATION OF THE METHODOLOGY FOR TRANSCRIBING AND CLASSIFYING REASONS GIVEN FOR IDENTIFYING THE NUMBER OF PARTS IN A QUESTION

Collecting data in an open-ended fashion, involves both advantages and disadvantages. Allowing students to express reasons in their own words provides the potential for discovering something previously unknown about how they perceive the number of parts in a question. A pre-programmed response sheet always holds the danger that none of the choices offered by the researcher conveys adequately what students think. However, the potentially large number of responses makes for difficulties of presentation and analysis.

TRANSCRIBING
It would have been an unnecessary and cumbersome task to transcribe reasons word-for-word from the Before and After questionnaires, onto the preliminary analysis sheets. Consequently, each reason was shortened to the minimum words possible. Several examples will illustrate how this was done.
- "The description and theory are the two things you're asked for", became: "**Description + theory**".
- "You are asked for a list and for the description of the role", became: "**List + describe**".
- "Two questions in the first sentence and one in the last" became: "**Three sentences**".
- "It asks for the effects on two things - education and training", became: "**Education + training**".
- "The reason why sodium and potassium react is the same. Thus the safety precautions will be the same for each one", became: "**Reaction + safety precautions**".
- "You have to describe the effects and then why it saves money and time (two different points)", became: "**Describe + time + money**".
- "The a) and b) in one sentence then the description in teaching style", became: "**a) + b) + describe**".
- "One part in each of the two sentences", became: "**Two sentences**".

CONTRADICTION BETWEEN NUMBER OF PARTS INDICATED AND REASONS GIVEN
In a very few instances students gave the number of parts as, say "1", but then gave a reason which indicated two parts. In these instances the numerical result is given precedence and the two reasons recorded under "reasons given for one part".

CLASSIFICATION OF REASONS
At this stage there was considerable danger of bias. The reader will remember that it was expected that reasons would change in nature from **number of content items** (topics or knowledge areas) Before, to the **number of IKWs** After. In many instances great care was required to ensure that a reason was transcribed accurately. Take the following example.

One student identified (Before) three parts in question D_{13} and gave the following reason: "When it asks for **your opinion** it is on two things **coal** and **nuclear**. Then one more part when you give **your opinion** on chemists."

The researcher transcribed this as "**coal + nuclear + your opinion**", which indicates that this student has used both the number of contents and an IKW (in you opinion) to decide on the number of parts. It could have been that the student was using only content items (coal + nuclear + chemists) but because "in your opinion" was noticed and so as to err on the side of caution this reason was included under the general classification of "**Topics + IKW**".

THE SIXTY ONE GENERAL CLASSIFICATIONS UNDER WHICH ALL REASONS GIVEN FOR PART D WERE CLASSIFIED WITH THE NUMBER OF MENTIONS FOR EACH CLASSIFICATION EXPRESSED AS A PERCENTAGE OF ALL REASONS

(Key: No. = number   IKWs = instruction key words   + = and)

(Percentages have been calculated for only the most frequently mentioned classifications)

		Before	%	After	%
1	No. of questions	66	6.3	31	
2	No. of question marks	14		2	
3	No. of sentences	42	4.0	0	
4	No. of sentences containing a question mark	3		0	
5	No. of named IKWs	216	20.5	466	45.0
6	No. of IKWs + No. of content items	202	19.2	123	11.9
7	Miscellaneous	13		1	
8	No. of content items	112	10.6	90	8.7
9	Introduction + No. of questions	41	3.9	1	
10	Introduction + knowledge	7		0	
11	No reasons given	77	7.3	59	5.7
12	No. of parts/things	52	4.9	10	
13	No. of IKWs + No. of questions	14		3	
14	"No. of instructions"/"instructions"	12		114	11.0
15	"No. of instructions"/"instructions" + No. of question marks	1		1	
16	No. of paragraphs	1		0	
17	Introduction + No. of links + No. of questions	1		0	
18	No. of content items + No. of parts/things	6		0	
19	No. of content items + No. of IKWs + No. of questions	9		0	
20	No. of IKWs + No. of parts/things	24		35	3.4
21	Introduction + No. of guidelines + No. of questions	0		1	
22	Introduction + No. of IKWs	7		22	3.2
23	No. of content items + No. of questions	6		2	
24	Punctuation	4		0	
25	No. of sentences + No. of parts	18		7	
26	"No. of instructions"/"instructions" + No. of parts/things	2		7	
27	No. of questions + No. of parts/things	13		1	
28	No. of IKWs + the word "and"	4		2	
29	Introduction + No. of content items + No. of questions	1		0	
30	Introduction + No. of content items + No. of IKWs	7		3	
31	No. of questions + No. of links	2		0	
32	Introduction + No. of sentences + No. of parts	2		1	
33	Introduction + No. of questions + No. of parts/things	5		0	
34	"No. of instructions"/"instructions" + No. of questions + introduction	1		2	
35	"No. of instructions"/"instructions" + No. of questions	7		0	
36	No. of questions + No. of question marks	3		0	
37	No. of sentences + No. of questions + No. of parts	1		1	
38	No. of IKWs + No. of parts/things + No. of questions	4		0	
39	No. of IKWs + No. of sentences	6		1	
40	Parts/things + the word "and"	3		0	
41	No. of content items + No. of links	1		0	
42	Introduction + No. of parts/things + No. of content items	3		1	
43	Introduction + No. of IKWs + No. of questions	1		0	

44	No. of content items + No. of IKWs + No. of parts/things	6	3
45	No. of IKWs + knowledge	0	3
46	No. of questions + No. of content items	4	1
47	No. of questions + the word "and"	2	0
48	No. of sentences + and No. of parts + the word "and"	1	0
49	No. of question marks + the word "and"	1	0
50	Introduction + No. of content items	2	0
51	No. of sentences + No. of content items	4	0
52	No. of paragraphs + No. of content items	1	1
53	"No. of instructions"/"instructions" + introduction	1	0
54	Introductions	2	0
55	Introduction + No. of parts/things	2	0
56	Introduction + knowledge + No. of questions	0	1
57	No. of IKWs + No. of parts/things + No. of sentences	1	2
58	"No. of instructions"/"instructions" + No. of IKWs + No. of parts/things	0	2
59	Introduction + No. of IKWs + No. of parts/things	1	0
60	"No. of instructions"/"instructions" + No. of content items	0	1
61	No. of sentences containing a question	12	13
	Totals	1054	1036

The top eight reasons Before accounted for 76.7% of reasons Before
The top five reasons After accounted for 82.2% of reasons After

A SAMPLE OF HOW REASONS GIVEN IN PART D WERE RECORDED AND CLASSIFIED

D 1   The needs of people should be at the forefront of educators' thinking and planning when they design courses of study for adults. But there are many kinds of needs from the physiological to self-actualisation. Describe, briefly, Maslow's hierarchy of needs theory? How does this theory relate to the real life situation of adults' needs? [**Two parts**]

a) Reasons given by those who thought the question contained one part

Before	After
0	0

b) Reasons given by those who thought the question contained two parts

Before	After
1 Two questions (11)	5 Describe + how (32)
4 Two sentences with question marks	6 Maslow's theory + how
6 Describe + relate (5)	14 Two instructions (4)
8 Theory + relation to needs	14 Key words in sentence
2 Two question marks (5)	11 No reason given (2)
8 Maslow's theory + relation to human need/life (2)	12 Two tasks
11 No reason given (2)	1 Two questions (3)
9 Statement + two questions	9 Description + a question
7 I found out what examiner wanted	15 Two instructions + two question marks
10 Intro + test knowledge of the subject	2 Two question marks (2)
5 Describe + how (5)	13 Describe + question at the end
3 Last two sentences (2)	6 Describe + explain (2)
6 Describe + relationship (2)	6 Describe + theory
8 Needs of people + kind of needs	6 Discuss + how
9 Two statements followed by two questions	6 Describe + relating
3 Two sentences	6 Describe + what
12 Counting the things you have to do	61 Last two sentences contain two questions
13 Describe + a question	
12 Two parts/points (2)	
9 Two direct questions at the end of some info	
14 Describe + describe	
16 Two paragraphs	
6 Describe + relate theory	
50	**56**

c) Reasons given by those who thought the question contained three parts

Before	After
8 Maslow's theory + thinking about designing + planning when designing	20 Describe has two parts + how
9 Intro + two questions (3)	21 Info + guidelines + question
9 One statement + two questions	22 Statement + describe + how
17 There are infor + links + questions	22 Info + describe + how
18 Explanation + two parts with connected answers	
19 Maslow's theory + describe + second question	
23 Theory + fact + question	
9	**4**

d) Reasons given by those who thought the question contained more than three parts

Before   After
1 Two questions at the end + first two questions
24 Punctuation is a good guide
6 Describe + how + think + how plan + how diversify
                        3   **0**

THE FREQUENCY OF MENTION OF EACH OF THE SIXTY ONE CLASSIFICATIONS, BY NUMBER OF PARTS PERCEIVED
(Key: No. = number   IKWs = instruction key words + = and)

	Number of mentions	Percentage of all reasons for that number of parts
One part: Before		
1 No. of questions	4	8.0
27 No. of questions + No. of parts/things	2	4.2
3 No. of sentences	2	4.2
5 No. of named Instruction Key words (IKWs)	11	23.0
8 No. of content items	12	25.0
55 Introduction + No. of parts/things	1	2.1
14 "No. of instructions"/"instructions"	2	4.2
7 Miscellaneous	6	12.5
11 No reasons given	3	6.3
12 No. of parts/things	5	10.4
Totals	48	99.9
One part: After		
1 No. of questions	6	9.8
27 No. of questions + No. of parts/things	1	1.6
5 No. of named IKWs	33	54.1
8 No. of content items	3	4.9
14 "No. of instructions"/"instructions"	11	18.0
11 No reasons given	5	8.2
12 No. of parts/things	2	3.3
Totals	61	99.9
Two parts: Before		
1 No. of questions	44	8.8
27 No. of questions + No. of parts/things	3	0.6
36 No. of questions + No. of question marks	1	0.2
47 No. of questions + the word "and"	2	0.4
2 No. of question marks	13	2.6
49 No. of question marks + the word "and"	1	0.2
3 No. of sentences +	15	3.0
4 No. of sentences containing a question mark	3	0.6
61 No. of sentences containing a question	6	1.2
25 No. of sentences + No. of parts	6	1.2
48 No. of sentences + and No. of parts + the word "and"	1	0.2
40 Parts/things + the word "and"	3	0.6
16 No. of paragraphs	1	0.2
5 No. of named IKWs	148	29.7
6 No. of IKWs + No. of content items	73	14.7
13 No. of IKWs + No. of questions	8	1.6
20 No. of IKWs + No. of parts/things	2	0.4
28 No. of IKWs + the word "and"	3	0.6
39 No. of IKWs + No. of sentences	2	0.4
8 No. of content items	68	13.7
9 Introduction + No. of questions	10	2.0
10 Introduction + knowledge	7	1.4
32 Introduction + No. of sentences + No. of parts	2	0.4
54 Introductions	2	0.4
14 "No. of instructions"/"instructions"	6	1.2
26 "No. of instructions"/"instructions" + No. of parts/things	1	0.2
35 "No. of instructions"/"instructions" + No. of questions	1	0.2
7 Miscellaneous	6	1.2
11 No reasons given	43	8.6
12 No. of parts/things	17	3.4
Totals	498	99.9

Two parts:After

1 No. of questions	17	2.9
2 No. of question marks	2	0.3
61 No. of sentences containing a question	7	1.2
25 No. of sentences + No. of parts	4	0.7
37 No. of sentences + No. of questions + No. of parts	1	0.2
5 No. of named IKWs	331	55.8
6 No. of IKWs + No. of content items	50	8.4
13 No. of IKWs + No. of questions	2	0.3
20 No. of IKWs + No. of parts/things	2	0.3
28 No. of IKWs + the word "and"	1	0.2
8 No. of content items	49	8.3
23 No. of content items + No. of questions	2	0.3
9 Introduction + No. of questions	1	0.2
22 Introduction + No. of IKWs	1	0.2
14 "No. of instructions"/"instructions"	72	12.1
15 "No. of instructions"/"instructions" + No. of question marks	1	0.2
7 Miscellaneous	1	0.2
11 No reasons given	44	7.4
12 No. of parts/things	5	0.8
Totals	593	100.0

Three parts: Before

1 No. of questions	16	4.4
27 No. of questions + No. of parts/things	5	1.4
31 No. of questions + No. of links	1	0.3
36 No. of questions + No. of question marks	2	0.5
46 No. of questions + No. of content items	2	0.5
2 No. of question marks	1	0.3
3 No. of sentences +	17	4.7
61 No. of sentences containing a question	5	1.4
25 No. of sentences + No. of parts	8	2.2
37 No. of sentences + No. of questions + No. of parts	1	0.3
51 No. of sentences + No. of content items	3	0.8
24 Punctuation	3	0.8
52 No. of paragraphs + No. of content items	1	0.3
5 No. of named IKWs	56	15.4
6 No. of IKWs + No. of content items	88	24.2
13 No. of IKWs + No. of questions	6	1.6
20 No. of IKWs + No. of parts/things	2	0.5
28 No. of IKWs + the word "and"	1	0.3
38 No. of IKWs + No. of parts/things + No. of questions	4	1.1
39 No. of IKWs + No. of sentences	4	1.1
8 No. of content items	22	6.0
18 No. of content items + No. of parts/things	5	1.4
19 No. of content items + No. of IKWs + No. of questions	6	1.6
23 No. of content items + No. of questions	4	1.1
41 No. of content items + No. of links	1	0.3
50 Introduction + No. of content items	2	0.5
9 Introduction + No. of questions	27	7.4
17 Introduction + No. of links + No. of questions	1	0.3
22 Introduction + No. of IKWs	7	1.9
30 Introduction + No. of content items + No. of IKWs	5	1.4
29 Introduction + No. of content items + No. of questions	1	0.3
33 Introduction + No. of questions + No. of parts/things	2	0.5
42 Introduction + No. of parts/things + No. of content items	1	0.3
43 Introduction + No. of IKWs + No. of questions	1	0.3
14 "No. of instructions"/"instructions"	4	1.1
34 "No. of instructions"/"instructions" + No. of questions + introduction	1	0.3
35 "No. of instructions"/"instructions" + No. of questions	5	1.4
11 No reasons given	21	5.8
12 No. of parts/things	22	6.0
Totals	364	100.8

Three parts: After

1 No. of questions	8	2.6
46 No. of questions + No. of content items	1	0.3
61 No. of sentences containing a question	5	1.6
25 No. of sentences + No. of parts	2	0.7
52 No. of paragraphs + No. of content items	1	0.3
5 No. of named IKWs	100	32.7
6 No. of IKWs + No. of content items	56	18.3
13 No. of IKWs + No. of questions	1	0.3
20 No. of IKWs + No. of parts/things	9	2.9
28 No. of IKWs + the word "and"	1	0.3
39 No. of IKWs + No. of sentences	1	0.3
57 No. of IKWs + No. of parts/things + No. of sentences	1	0.3
8 No. of content items	35	11.4
44 No. of content items + No. of IKWs + No. of parts/things	1	0.3
21 Introduction + No. of guidelines + No. of questions	1	0.3
22 Introduction + No. of IKWs	20	6.5
30 Introduction + No. of content items + No. of IKWs	3	1.0
32 Introduction + No. of sentences + No. of parts	1	0.3
56 Introduction + knowledge + No. of questions	1	0.3
14 "No. of instructions"/"instructions"	31	10.1
26 "No. of instructions"/"instructions" + No. of parts/things	3	1.0
11 No reasons given	22	7.2
12 No. of parts/things	2	0.7
Totals	306	99.7

More than three parts: Before

1 No. of questions	2	1.4
27 No. of questions + No. of parts/things	3	2.1
31 No. of questions + No. of links	1	0.7
46 No. of questions + No. of content items	2	1.4
3 No. of sentences	8	5.6
61 No. of sentences containing a question	1	0.7
25 No. of sentences + No. of parts	4	2.8
51 No. of sentences + No. of content items	1	0.7
24 Punctuation	1	0.7
5 No. of named IKWs	1	0.7
6 No. of IKWs + No. of content items	41	28.5
20 No. of IKWs + No. of parts/things	20	13.9
57 No. of IKWs + No. of parts/things + No. of sentences	1	0.7
8 No. of content items	10	6.9
18 No. of content items + No. of parts/things	1	0.7
19 No. of content items + No. of IKWs + No. of questions	3	2.1
23 No. of content items + No. of questions	2	1.4
44 No. of content items + No. of IKWs + No. of parts/things	6	4.2
9 Introduction + No. of questions	4	2.8
30 Introduction + No. of content items + No. of IKWs	2	1.4
33 Introduction + No. of questions + No. of parts/things	3	2.1
42 Introduction + No. of parts/things + No. of content items	2	1.4
55 Introduction + No. of parts/things	1	0.7
59 Introduction + No. of IKWs + No. of parts/things	1	0.7
15 "No. of instructions"/"instructions" + No. of question marks	1	0.7
26 "No. of instructions"/"instructions" + No. of parts/things	1	0.7
35 "No. of instructions"/"instructions" + No. of questions	1	0.7
53 "No. of instructions"/"instructions" + introduction	1	0.7
7 Miscellaneous	1	0.7
11 No reasons given	10	6.9
12 No. of parts/things	8	5.6
Totals	144	100.3

More than three parts: After

61 No. of sentences containing a question	1	1.3
25 No. of sentences + No. of parts	1	1.3
5 No. of named IKWs	2	2.6
6 No. of IKWs + No. of content items	17	22.4
20 No. of IKWs + No. of parts/things	24	31.6
45 No. of IKWs + knowledge	3	3.9
57 No. of IKWs + No. of parts/things + No. of sentences	1	1.3
8 No. of content items	3	3.9
44 No. of content items + No. of IKWs + No. of parts/things	2	2.6
22 Introduction + No. of IKWs	1	1.3
42 Introduction + No. of parts/things + No. of content items	1	1.3
26 "No. of instructions"/"instructions" + No. of parts/things	4	5.3
34 "No. of instructions"/"instructions" + No. of questions + introduction	2	2.6
58 "No. of instructions"/"instructions" + No. of IKWs + No. of parts/things	2	2.6
60 "No. of instructions"/"instructions" + No. of content items	1	1.3
11 No reasons given	10	13.1
12 No. of parts/things	1	1.3
Totals	76	99.7

234

THE NUMBER OF MENTIONS IN EACH CLASSIFICATION BEFORE IKR, AND THE NUMBER OF MENTIONS GIVING RISE TO THE CORRECT IDENTIFICATION OF THE NUMBER OF PARTS

(Key: No. = number   IKWs = instruction key words   + = and)
Those classifications which gave rise to no correct responses are omitted from this list which is extracted from **Appendix XIII**

Classification	Number of mentions	Number of mentions giving correct number of parts
1 No. of questions	66	58
2 No. of question marks	14	12
3 No. of sentences	42	25
4 No. of sentences containing a question mark	3	2
5 No. of named IKWs	216	193
6 No. of IKWs + No. of content items	202	93
7 Miscellaneous	13	6
8 No. of content items	112	58
9 Introduction + No. of questions	41	10
10 Introduction + knowledge	7	7
11 No reasons given	77	50
12 No. of parts/things	52	30
13 No. of IKWs + No. of questions	14	10
14 "No. of instructions"/"instructions"	12	11
16 No. of paragraphs	1	1
18 No. of content items + No. of parts/things	6	1
19 No. of content items + No. of IKWs + No. of questions	9	3
20 No. of IKWs + No. of parts/things	24	1
23 No. of content items + No. of questions	6	1
24 Punctuation	4	2
25 No. of sentences + No. of parts	18	12
26 "No. of instructions"/"instructions" + No. of parts/things	2	1
27 No. of questions + No. of parts/things	13	4
28 No. of IKWs + the word "and"	4	2
33 Introduction + No. of questions + No. of parts/things	5	2
35 "No. of instructions"/"instructions" + No. of questions	7	6
36 No. of questions + No. of question marks	3	3
37 No. of sentences + No. of questions + No. of parts	1	1
38 No. of IKWs + No. of parts/things + No. of questions	4	1
39 No. of IKWs + No. of sentences	6	6
40 Parts/things + the word "and"	3	2
47 No. of questions + the word "and"	2	2
48 No. of sentences + and No. of parts + the word "and"	1	1
49 No. of question marks + the word "and"	1	1
54 Introductions	2	2
61 No. of sentences containing a question	12	8
Totals	**1054**	**627**

THE MOST MENTIONED FIVE CRITERIA FOR PERCEPTIONS OF "ONE PART", "TWO PARTS", "THREE PARTS", AND "MORE THAN THREE PARTS"

(Key: No. = number   IKWs = instruction key words   + = and)
This data has been extracted from Appendix XV.

Classification	Number	%
One part: Before		
8 No. of content items	12	25.0
5 No. of named IKWs	11	23.0
7 Miscellaneous	6	12.5
12 No. of parts/things	5	10.4
1 No. of questions	4	8.0

These top five reasons represent 79.2% of reasons in this section

	Number	%
One part: After		
5 No. of named IKWs	33	54.1
14 "Number of instructions"/"instructions"	11	18.0
1 No. of questions	6	9.8
11 No reasons given	5	8.2
8 No. of content items	3	4.9

These top five reasons represent 95% of reasons in this section

	Number	%
Two parts: Before		
5 No. of named IKWs	148	29.7
6 No. of IKWs + No. of content items	73	14.7
8 No. of content items	68	13.7
1 No. of questions	44	8.8
11 No reasons given	43	8.6

These top five reasons represent 75.5% of reasons in this section

	Number	%
Two parts: After		
5 No. of named IKWs	331	55.8
14 "Number of instructions"/"instructions"	72	12.1
6 No. of IKWs + No. of content items	50	8.4
8 No. of content items	49	8.3
11 No reasons given	44	7.4

These top five reasons represent 92.1% of reasons in this section

	Number	%
Three parts: Before		
6 No. of IKWs + No. of content items	88	24.2
5 No. of named IKWs	56	15.4
9 Introduction + No. of questions	27	7.4
12 No. of parts/things	22	6.0
8 No. of content items	22	6.0

These top five reasons represent 59.0% of reasons in this section

	Number	%
Three Parts: After		
5 No. of named IKWs	100	32.7
6 No. of IKWs + No. of content items	56	18.3
8 No. of content items	35	11.4
14 "Number of instructions"/"instructions"	31	10.1
11 No reasons given	22	7.2

These top five reasons represent 79.7% of reasons in this section

More than three parts: Before

6 No. of IKWs + No. of content items	41	28.5
20 No. of IKWs + No. of parts/things	20	13.9
8 No. of content items	10	6.9
11 No reasons given	10	6.9
12 No. of parts/things	8	5.6

These top five reasons represent 62.0% of reasons in this section

More than three parts:After

20 No. of IKWs + No. of parts/things	24	31.6
6 No. of IKWs + No. of content items	17	22.4
11 No reasons given	10	13.1
26 "Number of instructions"/"instructions" + No. of parts/things	4	5.3
45 No. of IKWs + knowledge	3	3.9
8 No. of content items	3	3.9

These top six reasons represent 80.2% of reasons in this section

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APPENDIX XVIII

BRIEF DETAILS ON EACH OF THE THREE STUDENT GROUPS AND HOW THE EXPERIMENT WAS CONDUCTED WITH EACH OF THEM

a) Postgraduate adult education students

Nature of the group

These students were studying during the evenings for a two-year, part-time diploma in adult education at the University of Glasgow. Amongst other courses, the researcher offered a five-session course on communication skills at the beginning of the first year[1]. It was straightforward to conduct the experiment with this group because the exercises were introduced and practised as an integral part of the first two sessions. The Class of 1990 agreed to allow two of the regular course exercises involving IKR to be used in an experiment. The researcher was interested in the results this group would produce because of the wide range of students' ages and their academic experience. For example, most students already had a first degree and the age range was approximately twenty five to fifty two years of age.

Conduct of the experiment

On 1st October 1990 as part of their regular course work for the week, sixteen students were asked to complete the questionnaire. They were not given any tutoring on question interpretation and were asked neither to read books[2] on this topic nor to consult with colleagues. Twelve of the sixteen students completed the questionnaire satisfactorily and these were taken in on the following Monday. A 90-minute IKR workshop was conducted, after which the same questionnaire was issued with a request to complete as before, but this time applying IKR. Some students expressed unease about what appeared to them to be duplication of effort, but after reminding them of the purpose of the exercise, the researcher was convinced that most students were still enthusiastic. All twelve students who completed the Before questionnaire, also completed the After questionnaire, and these were collected on Monday 15th October. Consequently, at the end of the experiment the researcher was in receipt of twelve matching pairs of completed questionnaires.

b) Graduate civil engineering students

Nature of the group

Since 1986 the researcher has given essay-writing courses to graduated civil engineers preparing for the essay part of their professional examinations. IKR has been an integral part of these courses usually held at the University of Glasgow or on the premises of a local engineering firm[3]. The age-range of this group was approximately twenty one to thirty two years of age. Throughout 1990 and 1991 the researcher obtained permission from the students on three courses to use IKR exercises as experiments.

Conduct of the experiment

The experiment was conducted in a similar way as to that explained for the post graduate adult education group. However, it was necessary to involve three separate courses because of the poor completion rate of the After questionnaire. Approximately forty Before questionnaires were issued, but in the end only sixteen matching pairs were achieved. This was surprising since these young engineers were anxious to pass their professional examination.

c) Fourth year chemistry honours students

Nature of the group

Expressing the wish to test the effects of IKR on students in the physical sciences, the researcher's supervisor arranged two workshops with this group who have to sit an essay paper as part of their final examination. The age range of this group was approximately nineteen to twenty three years of age, and consisted of about eighty members.

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[1] The researcher also taught the following courses: Philosophy of Adult Education, Management of Adult Education and Teaching Methods for Adult Education.

[2] This request was necessary since the researcher's book (Robb: 1976) was on sale in the university book shop and students might have been tempted to refer to it and other similar publications.

[3] The University courses were offered from the Department of Civil Engineering and ran over seven evenings, of which two were devoted to IKR question interpretation. Similar courses were offered by the West of Scotland Young Members' Branch of the Institution of Civil Engineers at Babtie, Shaw and Morton, a large consultancy at 85 Bothwell Street, Glasgow. Although IKR was also used in a similar one-day course, it was not possible to involve these groups in the experiment because of the difficulty of issuing and collecting a Before and After questionnaire.

Conduct of the experiment

The experiment was conducted in a similar way as to that explained for the post graduate adult education group. However, when the experiment was first attempted with this group in 1991 it was decided to allow the students to complete the After questionnaire during the second workshop. This proved unsatisfactory: many of the After questions remained unanswered and completed answers were illegible, presumably owing to time pressure. Although under these conditions twenty matched pairs of questionnaires were obtained, the quality of the After questionnaires was so poor that they had to be scrapped. The same experiment was conducted with the same group in November 1992 with students being asked to complete both questionnaires at home as described for the adult education group. At the end of the experiment eight matching pairs of questionnaires were achieved.

THREE LISTS OF QUESTIONS USED IN THE QUESTIONNAIRES FOR THE ADULT EDUCATION, CIVIL ENGINEERING AND CHEMISTRY GROUPS

a) Adult education[4]

1 The success of adult education depends on effective marketing as much as successful teaching. Discuss this statement.

2 Describe the procedures which the Contractor and Engineer should follow in submitting a claim under the ICE Conditions of Contract (5th Edition). Discuss whether or not these conditions are adequate for the construction industry in the 1990s.

3 What would be the result of treating $C_{12} H_{22} O_{11}$ with $H_2 S_{O4}$? From your own laboratory experience, how would you distinguish between glucose and fructose in an aqueous solution?

4 Why is the Training Agency so severely criticised for its involvement in adult education? Is this criticism fair and what do you think could be done to avoid some of the criticism?

5 Describe the evidence which suggests that the exercise of power and the control of policy in Scottish education has become more and more centralised.

6 Describe briefly the philosophical position you have in relation to your own professional practice as an adult educator. Discuss whether one's philosophy can or should be affected by professional training and assess the benefits or otherwise of including a study of philosophy of education in a diploma programme.

7 "I have attempted to make the survey as comprehensive as possible by treating the field in its entirety and by considering all the ways in which adults may be educated. In other words, I have equated adult education with the education of adults for any purpose whatsoever, not excluding aspects of industrial training." Is this an acceptable definition of adult education in 1984?

Do you think education and training are synonymous, and describe how an industrial training programme you have observed applies some of the principles of adult education.

8 You are currently manager of an adult education unit and you have been asked to prepare an Urban Programme application for a proposed community development project in a deprived city housing estate. In the current economic climate funds are scarce and you know that the funders will be looking for proposals which contain a clear element of evaluation.

How can one introduce evaluation into the project?

9 Adult education can have several meanings and because these meanings are not made explicit at the beginning of a discussion, paper or research project, much confusion arises. List at least four meanings of "adult education". Discuss which meaning is fundamental in the sense that it gives rise to the other meanings and weigh-up whether the term should be scrapped and another one found to replace it.

10 An individual has a duty of care to his neighbours under common law. Describe the particular obligations that this duty imposes on a civil engineer. Are regulations, standards and laws sufficient to ensure that this duty of care is acknowledged?

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4 To improve expression, the phrases "Postgraduate adult education students", "Graduate civil engineering students", and "Fourth year chemistry honours students" are indicated in this report as "adult education", "civil engineering" and "chemistry".

11 Chemists have considerable responsibility in the modern world. The materials they work with and the waste products arising from chemical processes can be very toxic. Not only that, supposed benefits to society arising from advances in chemical knowledge such as plastic and nuclear fission can result in disadvantages such as an increase in litter and the continual threat of nuclear war.

Describe at least five examples where a chemical benefit can lead to social disaster if abused. Discuss whether chemists should attend courses in environmental ethics as a part of their university course.

12 Is there a Scottish tradition in the philosophy of adult education?

b) Civil engineering

1 An individual has a duty of care to his neighbours under common law. Discuss the particular obligations that this duty imposes on a civil engineer.

2 List the main criticisms directed at the Training Agency regarding its involvement in adult education and discuss what could be done to avoid these criticisms.

3 What would be the result of treating sucrose (table sugar) with sulphuric acid? From your own laboratory experience, how would you distinguish between glucose and fructose in an aqueous solution?

4 Are engineers playing their part in reducing the technology gap between poor and rich countries? What more could engineers do to reduce the gap and are your suggestions practical in modern economic conditions?

5 Describe the effects of computer applications on the education and training of an engineer.

6 Describe what you would regard to be the main disadvantages in a civil engineering career. Would you recommend civil engineering as a career to an A level student? What arguments would you put to the student?

7 Professional civil engineers are usually held accountable for the durability, serviceability and safety of their structures. Discuss how this accountability put into practice?

Do laws, regulations and standards exempt engineers from their responsibilities and in what ways can the engineers' awareness of their responsibilities be heightened?

8 It is suggested that the efficiency of any organisation is largely dependent on the degree of self-motivation of the people working for it. This motivation depends on how managers treat staff, how they themselves act towards their work and organisation and how well they manage the resources of the organisation.

What steps do you think managing civil engineers should take to motivate non-professional staff who are poorly paid and based mainly on site?

9 The public inquiry procedure regarding large civil engineering works is intended to bring into consideration the views of all those affected by the proposal. Describe how the procedure works. Discuss the disadvantages of the procedure and assess whether or not existing legislation makes the procedure superfluous.

10 Adult education can have several meanings and because these meanings are not made explicit at the beginning of a discussion, much confusion arises. List at least four meanings of "adult education". Should the term "adult education" be scrapped and another one found to replace it?

11 Chemists have considerable responsibility in the modern world. The materials they work with and the waste products arising from chemical processes can be very toxic. Not only that, supposed benefits to society arising from advances in chemical knowledge such as plastic and nuclear fission can result in disadvantages such as an increase in litter and the continual threat of nuclear war.

Describe at least five examples where a chemical benefit can lead to social disaster if abused. Discuss whether chemists should attend courses in environmental ethics as a part of their university course.

12 Should environmental impact assessments be required by legislation?

c) Chemistry

1 Fluxionality (stereochemically non-rigid behaviour) is important in the chemistry of many inorganic and organometallic compounds. Give a full description of what fluxionality is and discuss whether or not you agree? What are the particular advantages of using fluxionality in analysing organometallic compounds

2 Adult education can have several meanings and because these meanings are not made explicit at the beginning of a discussion, much confusion arises. List at least four meanings of "adult education".

Should the term "adult education" be scrapped and another one found to replace it?

3 Waste products from nuclear fission and hydrocarbon combustion endanger the environment. Using your knowledge of chemistry, show how waste products arise in each case and decide which are most damaging.

4 The public inquiry procedure regarding large civil engineering works airs the views of any person or group likely to be affected by the proposal under discussion. Explain what this procedure is and describe how it works.

Bearing in mind existing legislation and regulations, do you think this procedure is necessary to protect the public. What are the safeguards which are used to ensure the best interest of the community?

5 Compare and contrast the possible dangers of the two main methods for producing hydrogen gas from water.

6 Explain why the excited states of molecules have, in many cases, different geometries from that of the ground state.

7 An organisation's efficiency is largely dependent on the degree of employees' self-motivation and, in turn, how managers treat staff, manage themselves and act towards their organisation. How might managers in the construction industry motivate non-professional site workers?

To what extent do pay-levels affect motivation and offer suggestions for other aspects of increasing remuneration packages without giving more cash?

8 Describe with relevant equations what happens when sucrose is treated with sulphuric acid under room temperature and normal pressure. How would you distinguish between glucose and fructose in aqueous solution?

PROCEDURE FOLLOWED AND PRECAUTIONS TAKEN IN TRANSCRIBING STUDENTS' DESCRIPTIONS

Before

The researcher had to find a balance between giving a complete word-for-word transcript which would have been time consuming and unnecessarily increase the length of this thesis, and giving an accurate and full account. Consequently, some editing of responses was undertaken according to the following rules.

- Words such as **"introduction"** and **"conclusion"** were deleted.
- Where possible, paraphrasing has been used. For example, "I think I would first describe ...", becomes "Describe ...". Similarly, "The knowledge I would need is ..." becomes "K =."
- Where words have been added to make grammatical sense, these are placed in square brackets [ ].
- At least three students used point form in all or some of their descriptions, that is, they numbered each step of the answer "1", "2", "3" and so on, or "a)", "b)", "c)" and so on. While this illustrates a logical way of thinking it had little relevance as to the adequacy of a description of how a question would be answered. Consequently for consistency, these numbers are omitted.
- Where no response at all is given this is counted as being unable to describe how to answer the question and takes a SS of 0.
- With the Before descriptions, **a great deal of latitude** was allowed and if the student indicated even vaguely that they were to do something, it is given a point. However, with the After descriptions, **very little latitude** was allowed. This caution is necessary to control any subconscious desire by the researcher to make the After descriptions appear more adequate than the Before descriptions.
- Each relevant point in the researcher's best descriptions and the students' descriptions is indicated by an asterisk and BSs and SSs are obtained by summing these.

After

On initial sight of the returned questionnaires it looked, from the quantity written, that the response had been poor and that there would be a dramatic decline in quality. However, the analysis was undertaken in the same way as Before, but with the following additional rules.

- Where, in addition to a full description, students included a "I", "K", and "R" break-down, duplication is avoided. However, if the fuller description does not contain sufficient description, the IKR break-down is examined and if one or more aspects of it correspond to the best description, then appropriate points are awarded. For example, in the adult education group, in Q_2CB^1, the student states, "Detail conditions" but he/she earlier in the IKR analysis mentions "contractor and engineer". Consequently, the two points are awarded.

- When a student states: "The knowledge I need is ...", this is taken to mean "Describe" or "Show", for example. In other words this is taken as a part of the description as to how they would answer.

- Points have been awarded only when the researcher is sure that the student intended to offer a mention as part of the description of how to answer the question. For example, Q_1HS simply states "effective marketing/teaching", and this could be indicating that this student wanted to discuss the interrelationship between effective marketing and successful teaching. However, because the meaning is not specific enough the researcher has not awarded a point for this.

- Unlike in the Before analysis, the phrases **"with particular reference to"**, **"in relation to"** and **"compared to"** occurred in a number of instances This gave some difficult in awarding points towards the SS. For example, consider the following statement: "Argue for and against adequacy of conditions for construction industry with particular reference to 1990s". (Q_2CB) To gain the two points, the student would have to indicate that to answer this question adequately, a description of the conditions facing the construction industry in the 1990s would be necessary before assessing whether or not the conditions are relevant. In Q_2CB, the three phrases listed do not make it explicit enough that this prior description will be done and points are not awarded for the second part after "in relation to". However, in this particular example notice how the student does indicate the necessary step-wise answer in the IKR analysis - a point was awarded.

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[1] As already explained, shorthand is used to improve expression. Q_2CB indicates Question Two of student CB.

A SAMPLE OF IKR DESCRIPTIONS AND OF STUDENTS' DESCRIPTIONS

(In the IKR description each asterisk indicates a point that should appear in the students' descriptions. In the students' descriptions each asterisk indicates a point of match).

Adult education[2]

A sample of a best score calculation (BS)

Q7: BS = 10
Re-state the definition*. Expand briefly on its meaning*. Describe the state of society in 1984*. Assess whether the definition is acceptable*. Define education*. Define training*. Decide whether or not they are synonymous*. Describe briefly an observed industrial training programme*. State what principles of adult education are*. Show how an industrial training programme applies some principles of adult education*.

A sample of two students' descriptions Before and After

Before

S H Definition of education* and training* - distinguish between them. Weight on training to relate with industrial training programme. SS = 2

JR Discuss merits of definition* against an up-to-date definition. Discuss education/training** by giving meanings or definitions. Describe a programme* with examples of principles*. SS = 5

After

S H I = describe. R = 1984, adult education. K = adult education - definition*, education* and training* and industrial training programme* SS = 4

JR I = is this. K = an acceptable definitions of adult education*. R = 1984*. I = do you think. K = education* and training*. R = synonymous*. I = describe. K = principles of adult education*. Applied in industrial training*. R = programme you have observed* SS = 8

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[2] Since the transcription and analysis for the civil engineering and chemistry groups were undertaken in an identical way to that for the adult education group, it is not necessary to display samples from these two groups. As already explained, a full record is presented in the Robb (1993).

APPENDIX XXII

INDIVIDUAL BEFORE (B) AND AFTER (A) STUDENTS' SCORES (SSs) FOR EACH QUESTION, AND THE NET GAIN OR LOSS IN ADEQUACY (C) FOR EACH STUDENT AND EACH QUESTION

Table A.12: Adult education

		SL	PB	KL	JA	AP	HS	CB	LB	JR	SH	SR	SF	Net
	B	3	1	3	1	2	3	4	2	1	1	4	1	26
1	A	3	1	3	3	4	4	5	4	5	2	3	5	42
	C	0	0	0	+2	+2	+1	+1	+2	+4	+1	-1	+4	+16
	B	3	4	2	5	4	2	3	3	1	0	5	3	35
2	A	3	2	2	3	3	4	5	3	4	4	5	4	42
	C	0	-2	0	-2	-1	+2	+2	0	+3	+4	0	+1	+7
	B	2	3	3	3	1	2	3	4	3	2	5	4	35
3	A	3	2	3	3	2	3	3	4	3	2	4	3	35
	C	+1	-1	0	0	+1	+1	0	0	0	0	-1	-1	0
	B	3	3	4	3	4	2	5	5	1	2	4	4	40
4	A	3	3	4	5	4	3	4	4	4	2	4	3	43
	C	0	0	0	+2	0	+1	-1	-1	+3	0	0	-1	+3
	B	2	1	2	5	2	3	2	2	1	0	2	2	24
5	A	1	2	3	3	4	3	2	2	3	3	3	3	32
	C	-1	+1	+1	-2	+2	0	0	0	+2	+3	+1	+1	+8
	B	3	3	2	3	3	2	4	0	1	0	5	3	29
6	A	3	3	6	4	6	3	6	3	4	3	6	3	50
	C	0	0	+4	+1	+3	+1	+2	+3	+3	+3	+1	0	+21
	B	5	7	4	6	4	3	6	2	5	2	7	1	52
7	A	3	2	5	7	6	5	6	5	8	4	5	5	61
	C	-2	-5	+1	+1	+2	+2	0	+3	+3	+2	-2	+4	+9
	B	0	0	2	1	2	2	1	1	1	0	1	1	12
8	A	1	1	2	2	3	1	3	1	2	2	2	2	22
	C	+1	+1	0	+1	+1	-1	+2	0	+1	+2	+1	+1	+10
	B	2	2	4	3	4	2	2	3	2	1	4	3	32
9	A	3	3	3	1	3	3	4	4	4	2	4	3	37
	C	+1	+1	-1	-2	-1	+1	+2	+1	+2	+1	0	0	+5
	B	1	2	2	4	3	0	2	2	1	0	4	3	24
10	A	3	2	3	3	3	4	2	3	3	1	3	2	32
	C	+2	0	+1	-1	0	+4	0	+1	+2	+1	-1	-1	+8
	B	1	2	2	2	2	2	3	2	2	1	1	2	22
11	A	2	2	3	5	4	3	3	2	4	3	5	3	39
	C	+1	0	+1	+3	+2	+1	0	0	+2	+2	+4	+1	+17
	B	3	1	2	1	3	2	2	3	1	0	3	3	24
12	A	1	1	2	2	2	3	3	3	2	1	2	2	24
	C	-2	0	0	+1	-1	+1	+1	0	+1	+1	-1	-1	0
		28	29	32	37	34	25	37	29	20	9	45	30	355
		29	24	39	41	44	39	46	38	46	29	46	38	459
Net		+1	-5	+7	+4	+10	+14	+9	+9	+26	+20	+1	+8	+104

245

Table A.13: Civil engineering

		SB	PJ	LO	CS	GR	GU	GD	DJ	DM	CB	FM	JM	AP	WS	FB	MG	Net
	B	1	1	2	2	2	1	1	1	2	1	2	0	2	2	2	1	23
1	A	2	2	1	1	1	1	2	1	1	2	2	2	2	2	2	1	25
	C	1	1	-1	-1	-1	0	1	0	-1	1	0	2	0	0	0	0	+2
	B	4	1	3	2	3	2	2	2	2	4	4	2	3	2	3	3	41
2	A	2	2	2	2	2	2	2	2	2	3	2	3	3	2	2	2	35
	C	-2	1	-1	0	-1	0	0	0	0	-1	-2	1	0	0	-1	0	-6
	B	2	2	2	3	3	3	1	3	3	1	5	2	2	1	1	1	35
3	A	2	2	1	3	3	3	2	3	3	3	3	3	3	2	3	2	41
	C	0	0	-1	0	0	0	1	0	0	2	-2	1	1	1	2	1	+6
	B	2	4	3	4	4	0	0	4	3	5	4	3	1	3	3	1	44
4	A	3	4	3	3	3	1	3	4	3	2	4	4	4	4	3	3	51
	C	1	0	0	-1	-1	1	3	0	0	-3	0	1	3	1	0	2	+7
	B	2	1	1	3	3	1	1	3	1	1	3	1	1	3	3	0	28
5	A	3	2	1	1	1	0	2	1	1	1	2	3	2	2	1	2	25
	C	1	1	0	-2	-2	-1	1	-2	0	0	-1	2	1	-1	-2	2	-3
	B	2	3	3	2	3	1	3	3	3	2	3	2	2	3	3	3	41
6	A	3	2	3	3	3	3	3	2	1	3	3	3	4	3	3	3	45
	C	1	-1	0	1	0	2	0	-1	-2	1	0	1	2	0	0	0	+4
	B	3	3	1	5	3	1	1	4	3	2	5	2	3	4	3	1	44
7	A	3	3	3	5	3	3	3	3	3	2	3	3	4	4	4	4	52
	C	0	0	2	0	0	2	2	-1	0	0	-2	1	1	0	1	2	+8
	B	2	2	1	2	1	1	2	2	1	2	4	2	2	1	1	3	29
8	A	3	2	1	2	2	1	3	3	3	3	2	2	3	3	2	2	37
	C	-1	0	0	0	1	0	1	1	2	1	-2	0	1	2	1	-1	+6
	B	4	1	3	4	1	0	3	4	2	3	3	3	4	4	3	3	45
9	A	3	3	3	3	3	0	3	3	2	3	3	4	5	4	3	2	47
	C	-1	2	0	-1	2	0	0	-1	0	0	0	1	1	0	0	-1	-2
	B	3	0	4	4	2	0	2	3	4	3	3	2	2	1	2	3	38
10A	A	3	3	3	3	3	0	2	3	3	4	3	2	3	2	2	1	40
	C	0	3	-1	-1	1	0	0	0	-1	1	0	0	1	1	0	-2	+2
	B	3	0	2	2	2	2	1	2	2	2	2	2	2	2	1	1	28
11A	A	2	2	2	2	2	0	2	2	2	2	2	0	2	2	2	2	28
	C	-1	2	0	0	0	-2	1	0	0	0	0	-2	0	0	1	1	0
	B	2	0	1	2	2	0	1	2	1	2	2	1	2	2	1	1	22
12A	A	2	2	1	1	1	0	2	1	1	2	1	2	2	2	2	2	24
	C	0	2	0	-1	-1	0	1	-1	0	0	-1	1	0	0	1	1	+2
		30	18	26	35	29	12	18	33	27	28	40	22	26	28	26	20	418
		31	29	24	29	27	14	29	28	25	30	30	31	37	32	29	25	450
Net		+1	+11	-2	-6	-2	+2	+11	-5	-2	+2	-10	+9	+11	+4	+3	+5	

Table A.14: Chemistry

		AH	SF	AD	SN	CG	HM	IG	BM	Net
	B	1	2	3	2	3	3	3	1	18
1	A	3	3	3	2	3	3	3	3	23
	C	2	1	0	0	0	0	0	2	+5
	B	2	3	3	2	3	2	2	3	20
2	A	3	3	3	3	3	2	2	2	21
	C	1	0	0	1	0	0	0	-1	+1
	B	5	3	5	5	6	4	3	3	34
3	A	5	5	3	6	4	3	3	2	31
	C	0	0	-2	1	-2	-1	0	-1	-3
	B	6	6	6	5	5	4	4	5	41
4	A	4	5	5	6	4	4	2	4	34
	C	-2	-1	-1	1	-1	0	-2	-1	-7
	B	3	1	3	3	4	4	1	4	23
5	A	3	5	4	4	5	4	1	1	27
	C	0	4	1	1	1	0	0	-3	+4
	B	2	4	2	3	2	3	1	3	20
6	A	2	3	5	4	2	2	1	1	20
	C	0	-1	3	1	0	-1	0	-2	0
	B	3	3	3	3	3	3	3	3	24
7	A	3	3	3	3	3	3	2	3	23
	C	0	0	0	0	0	0	-1	0	-1
	B	2	2	4	4	4	4	2	2	24
8	A	3	3	4	3	3	2	2	2	22
	C	1	1	0	-1	-1	-2	0	0	-2
		24	24	29	27	30	27	19	24	204
		26	30	30	31	27	23	16	18	201
Net			+2	+6	+1	+4	-3	-4	-3	-6 -3

247

THE NUMBER OF IMPROVEMENTS (+), NON-IMPROVEMENTS (0) AND
DECLINES (-) FOR EACH STUDENT AND EACH QUESTION, AND THE
DIFFERENCE BETWEEN THE IMPROVEMENTS AND THE SUM OF NON-
IMPROVEMENTS AND DECLINES [(+)-(0+-)]

Table A.15: Adult education

	+	0	-	(0+-)	(+)-(0+-)		+	0	-	(0+-)	(+)-(0+-)
SL	5	4	3	7	-2	Q_1	10	1	1	2	+8
PB	2	7	3	10	-8	Q_2	3	6	3	9	-6
KL	5	6	1	7	-2	Q_3	2	6	4	10	-8
JA	7	1	4	5	+2	Q_4	3	6	3	9	-6
AP	7	2	3	5	+2	Q_5	7	3	2	5	+2
HS	9	1	2	3	+6	Q_6	9	3	0	3	+6
CB	6	5	1	6	0	Q_7	8	1	3	4	+4
LB	5	6	1	7	-2	Q_8	9	2	1	3	+6
JR	11	1	0	1	+10	Q_9	7	2	3	5	+2
SH	10	2	0	2	+8	Q_{10}	6	3	3	6	0
SR	4	3	5	8	-4	Q_{11}	9	3	0	3	+6
SF	6	2	4	6	0	Q_{12}	5	3	4	7	-2
Totals	77	40	27	67	+10	Totals		80	38	26	

% of total possible responses (12 x 12 =144)
    53   28   19   47

STUDENTS		QUESTIONS	
Number improving (net)	five	Number improving (net)	seven
Number neither improving nor declining	two	Number neither improving nor declining	one
Number declining	five	Number declining	four

Table A.16: Civil engineering

	+	0	-	(0+-)	(+)-(0+-)		+	0	-	(0+-)	(+)-(0+-)
S B	4	4	4	8	-4	Q_1	6	7	3	10	-4
P J	7	4	1	5	+2	Q_2	2	8	6	14	-12
L O	1	7	4	11	-10	Q_3	7	7	2	9	-2
C S	1	5	6	11	-10	Q_4	7	6	3	9	-2
G R	3	4	5	9	-6	Q_5	6	3	7	10	-4
G U	3	7	2	9	-6	Q_6	6	7	3	10	-4
G D	8	4	0	4	+4	Q_7	7	7	2	9	-2
D J	1	6	5	11	-10	Q_8	8	5	3	8	0
D M	1	8	3	11	-10	Q_9	4	8	4	12	-8
C B	5	5	2	7	-2	Q_{10}	5	7	4	11	-6
F M	0	6	6	12 .	-12	Q_{11}	4	9	3	12	-8
J M	9	2	1	3	+6	Q_{12}	5	7	4	11	-6
A P	8	4	0	4	+4						
W S	4	7	1	8	-4						
F B	5	5	2	7	-2						
M G	6	3	3	6	0						
Totals	66	81	45	126	-60	Totals	67	81	44		

% of total possible responses (16 x 12 = 192)
       35   42   23   65

STUDENTS		QUESTIONS	
Number improving (net)	four	Number improving (net)	nil
Number neither improving nor declining	one	Number neither improving nor declining	one
Number declining	eleven	Number declining	eleven

Table A.17: Chemistry

	+	0	-	(0+-)	(+)-(0+-)		+	0	-	(0+-)	(+)-(0+-)
AH	3	4	1	5	-2	Q_1	3	5	0	5	-2
SF	3	3	2	5	-2	Q_2	2	5	1	6	-4
AD	2	4	2	6	-4	Q_3	1	3	4	7	-6
SN	5	2	1	3	+2	Q_4	1	1	6	7	-6
CG	1	4	3	7	-6	Q_5	4	3	1	4	0
HM	0	5	3	8	-8	Q_6	6	3	3	6	0
IG	0	6	2	8	-8	Q_7	0	7	1	8	-8
BM	1	2	5	7	-6	Q_8	2	3	3	6	-4
Totals	15	30	19	49	-34	Totals	15	30	19		

% of total possible responses (8 x 8 = 64)
23   47   30

STUDENTS

Number improving (net)	one
Number neither improving nor declining	nil
Number declining	seven

QUESTIONS

Number improving (net)	nil
Number neither improving nor declining	two
Number declining	six

QUESTIONS USED IN THE BEFORE AND AFTER QUESTIONNAIRES FOR A MODIFIED EXPERIMENT WITH CIVIL ENGINEERING STUDENTS

Before

5   Describe the effects of computer applications on the education and training of an engineer.

2   List the main criticisms directed at the Training Agency regarding its involvement in adult education and discuss what could be done to avoid these criticisms.

7   Professional civil engineers are usually held accountable for the durability, serviceability and safety of their structures. Discuss how is this accountability put into practice.

   Do laws, regulations and standards exempt engineers from their responsibilities and in what ways can the engineer's awareness of their responsibilities be heightened?

6   Describe what you would regard to be the main disadvantages in a civil engineering career. Would you recommend civil engineering as a career to an 'A Level' student? What arguments would you put to the student?

10   Adult education can have several meanings and because these meanings are not made explicit at the beginning of a discussion, much confusion arises. List at least four meanings of "adult education". Should the term "adult education" be scrapped and another one found to replace it?

11   Chemists have considerable responsibility in the modern world. The materials they work with and the waste products arising from chemical processes can be very toxic. Not only that, supposed benefits to society arising from advances in chemical knowledge such as plastic and nuclear fission can result in disadvantages such as an increase in litter and the continual threat of nuclear war.

   Describe at least five examples where a chemical benefit can lead to social disaster if abused. Discuss whether chemists should attend courses in environmental ethics as a part of their university course.

8   It is suggested that the efficiency of any organisation is largely dependent on the degree of self-motivation of the people working for it. This motivation depends on how managers treat staff, how they themselves act towards their work and organisation, and how well they manage the resources of the organisation. What steps do you think managing civil engineers should take to motivate non-professional staff?

   What part do you think increasing pay could contribute to this motivation and what influence does living on site have on morale?

9   The public inquiry procedure regarding large civil engineering works is intended to bring into consideration the views of all those affected by the proposal, and result in a final solution which meets high engineering standards yet is also pleasing to the public.

   Describe how the procedure works and show with a diagram the main information flows.

   What are the disadvantages of the procedure and assess whether or not existing legislation makes the procedure superfluous.

After

5   Discuss the various factors which must be taken into account when assessing the price of an element of civil engineering work.

2   List the results of treating sucrose with sulphuric acid. How would you distinguish between glucose and fructose in aqueous solution?

7   Discuss the measures which you think should be taken to reduce injury and death on sites.

    Is the construction industry as safety conscious as other industries and if not, why not?

6   Describe the extent to which engineering designs should be influenced by types of operatives and plant available. In what practical ways would operatives and plant available influence design? Describe two projects you have been involved in that illustrate this influence.

10 History can have several meanings and because these meanings are not made explicit at the beginning of a discussion, much confusion arises. Indeed, much of the discussion regarding the purpose and nature of history is wasteful because of this lack of attention to meaning. List at least four meanings of "history". Should the term "history" be scrapped? If so give reasons for the term you would use to replace it.

11 Doctors have considerable responsibility in the modern world. The techniques they work with decide life and death and some medical processes can be very dangerous. Not only that, supposed benefits to society arising from advances in medical knowledge such as advanced heart surgery and genetic engineering can result in disadvantages such as an increase in the elderly population and manipulation of the foetus.

    Describe at least five examples where a medical benefit can lead to social disaster if abused and discuss whether doctors should attend courses in medical ethics as a part of their university course.

8   The Institution's rules for professional conduct require among other items that a member shall discharge his professional responsibilities with integrity and his duties to his employer with complete fidelity. Of course there is great controversy as to what the terms "responsibility" and "integrity" mean. In general terms, what do you understand by "responsibility" and "integrity"? What is the difference between these two and "fidelity"?

    How do you interpret these requirements for engineers employed by clients, and is there any difference in the way responsibility and integrity should be applied when relating to contracting organisations?

9   The conservation of old buildings and structures is an increasing activity and many people wish to preserve existing appearances often at considerable cost. Others however, prefer to rebuild in an entirely modern manner.

    Describe the advantages and disadvantages of the conservation approach and show in a list the main advantages only of the modern approach.

    At what stage should the engineer become involved in this debate in a project and assess whether or not becoming involve would damage relationship between the engineer and client.

**THE STUDENTS SCORES (SSs) FOR EACH QUESTION FOR EACH STUDENT
IN A MODIFIED EXPERIMENT WITH CIVIL ENGINEERING STUDENTS**
(Key: Q = question number   ST = student totals   QT = question totals)

Table A.18: Before

Ques	SH	NS	SC	AW	JM	SD	SB	DT	FP	CM	SL	CL	PK	JG	GG	AB	QT
2	2	3	0	3	3	2	3	2	3	1	4	4	3	3	3	2	41
5	1	2	1	3	2	1	1	2	0	1	2	2	2	3	3	1	27
6	3	3	3	3	4	3	4	3	4	1	2	2	2	4	4	3	48
7	4	3	4	3	3	2	1	3	3	2	5	4	4	6	6	2	55
8	3	2	4	4	4	3	1	1	3	2	3	5	3	6	6	3	53
9	5	4	4	4	3	4	3	1	5	3	4	4	2	5	4	4	59
10	3	3	2	1	1	2	3	2	1	2	2	2	3	4	3	1	35
11	2	2	3	1	2	2	1	2	2	1	2	2	3	3	0	2	30
ST	23	22	21	22	22	19	17	16	22	13	24	25	22	34	29	18	

Table A.19: After

	SH	NS	SC	AW	JM	SD	SB	DT	FP	CM	SL	CL	PK	JG	GG	AB	QT
2	2	2	2	2	2	2	2	1	2	1	2	2	3	2	2	1	30
5	1	1	1	2	1	1	2	1	1	2	1	0	0	2	2	1	19
6	3	3	3	3	3	3	3	3	2	2	3	3	4	4	2	2	46
7	4	3	3	4	4	3	5	3	3	3	3	1	4	4	4	2	53
8	6	4	5	4	5	5	5	5	3	5	5	5	5	5	4	3	74
9	7	4	5	5	5	5	5	5	5	5	5	3	4	4	5	5	77
10	4	2	4	2	4	4	2	4	4	3	4	0	2	3	3	4	49
11	2	2	2	2	2	1	2	2	2	2	2	2	1	2	4	1	31
ST	29	21	25	24	26	24	26	24	22	23	25	16	23	26	26	19	

REVISED CALCULATIONS FOR THE ADULT EDUCATION GROUP, TAKING INTO ACCOUNT ADDITIONAL POINTS FOR RELATIONAL TERMS IN THE AFTER DESCRIPTIONS

Table A.20: A revision of data in Table A.12 in Appendix XXII

		SL	PB	KL	JA	AP	HS	CB	LB	JR	SH	SR	SF	Net
	B	3	1	3	1	2	3	4	2	1	1	4	1	26
1	A	3	2	4	3	4	4	5	4	5	2	3	5	44
	C	0	+1	+1	+2	+2	+1	+1	+2	+4	+1	-1	+4	+18
	B	3	4	2	5	4	2	3	3	1	0	5	3	35
2	A	3	3	3	3	3	4	5	3	4	4	5	4	44
	C	0	-1	+1	-2	-1	+2	+2	0	+3	+4	0	+1	+9
	B	2	3	3	3	1	2	3	4	3	2	5	4	35
3	A	3	3	3	3	2	3	3	4	3	2	4	3	36
	C	+1	0	0	0	+1	+1	0	0	0	0	-1	-1	+1
	B	3	3	4	3	4	2	5	5	1	2	4	4	40
4	A	3	4	4	5	4	3	4	4	4	2	4	3	44
	C	0	+1	0	+2	0	+1	-1	-1	+3	0	0	-1	+4
	B	2	1	2	5	2	3	2	2	1	0	2	2	24
5	A	1	3	3	3	4	3	2	2	3	3	3	3	33
	C	-1	+2	+1	-2	+2	0	0	0	+2	+3	+1	+1	+9
	B	3	3	2	3	3	2	4	0	1	0	5	3	29
6	A	3	5	6	4	6	3	6	3	4	3	6	3	52
	C	0	+2	+4	+1	+3	+1	+2	+3	+3	+3	+1	0	+23
	B	5	7	4	6	4	3	6	2	5	2	7	1	52
7	A	3	3	5	7	6	5	6	5	8	4	5	5	62
	C	-2	-4	+1	+1	+2	+2	0	+3	+3	+2	-2	+4	+10
	B	0	0	2	1	2	2	1	1	1	0	1	1	12
8	A	1	2	2	2	3	1	3	1	2	2	2	2	23
	C	+1	+2	0	+1	+1	-1	+2	0	+1	+2	+1	+1	+11
	B	2	2	4	3	4	2	2	3	2	1	4	3	32
9	A	3	3	3	1	3	3	4	4	4	2	4	3	37
	C	+1	+1	-1	-2	-1	+1	+2	+1	+2	+1	0	0	+5
	B	1	2	2	4	3	0	2	2	1	0	4	3	24
10	A	3	3	3	3	3	4	2	3	3	1	3	2	33
	C	+2	+1	+1	-1	0	+4	0	+1	+2	+1	-1	-1	+9
	B	1	2	2	2	2	2	3	2	2	1	1	2	22
11	A	2	2	3	5	4	3	3	2	4	3	5	3	39
	C	+1	0	+1	+3	+2	+1	0	0	+2	+2	+4	+1	+17
	B	3	1	2	1	3	2	2	3	1	0	3	3	24
12	A	1	2	2	2	2	3	3	3	2	1	2	2	25
	C	-2	+1	0	+1	-1	+1	+1	0	+1	+1	-1	-1	+1
		28	29	32	37	34	25	37	29	20	9	45	30	355
		29	35	41	41	44	39	46	38	46	29	46	38	472
Net		+1	+6	+9	+4	+10	+14	+9	+9	+26	+20	+1	+8	+117

Table A.21: A revision of data in Table A.15 in Appendix XXIII

	+	0	-	(0+-)	(+)-(0+-)		+	0	-	(0+-)	(+)-(0+-)
S L	5	4	3	7	**-2**	Q_1	10	1	1	2	**+8**
PB	8	2	2	4	**+4**	Q_2	6	3	3	6	**0**
KL	7	4	1	5	**+2**	Q_3	3	7	2	9	**-6**
JA	7	1	4	5	**+2**	Q_4	3	6	3	9	**-6**
AP	7	2	3	5	**+2**	Q_5	7	3	2	5	**+2**
HS	9	1	2	3	**+6**	Q_6	9	3	0	3	**+6**
CB	6	5	1	6	**0**	Q_7	8	1	3	4	**+4**
LB	5	6	1	7	**-2**	Q_8	9	2	1	3	**+6**
JR	11	1	0	1	**+10**	Q_9	7	2	3	5	**+2**
SH	10	2	0	2	**+8**	Q_{10}	6	3	3	6	**0**
SR	4	3	5	8	**-4**	Q_{11}	9	3	0	3	**+6**
SF	6	2	4	6	**0**	Q_{12}	5	3	4	7	**-2**
Totals	85	33	26	59	+26	Totals	85	33	26		

Percentages of total possible responses (144)
	59	23	18	41	+18[3]

RESPONDENTS
Number improving	six
Number not improving	two
Number declining	three

QUESTIONS
Number improving	seven
Number not improving	two
Number declining	three

---

[3]   Owing to rounding up, the differences in percentages (53 - 47 = 6) do not match the true figure of 7%.

APPENDIX XXVII

A DESCRIPTION OF HOW REASONS FOR ONE QUESTION BEING CHOSEN AS MORE DIFFICULT, WERE TRANSCRIBED AND ANALYSED

WHEN DO SIMILAR STATEMENTS REPRESENT THE SAME REASON?

As is to be expected, some students will express the same reason in different words. However, in some instances it was difficult to tell whether a similar statement was indeed, expressing the same reason or a different one. For example, does the expression "Less specific" represent the same as "requires wider discussion"? To overcome this difficulty, considerable attention was paid to detecting similarities of meaning. Where there is little doubt that several different expressions express the same reason, only the one expression is listed and a number in brackets placed after it for the number of times it occurred. For example, In A_1 "Effect is more difficult than role" was given as a reason in some form or other, twenty eight times. So that valuable addition insights were not lost as to why students think "effects" indicates more difficulty than "role", additional comments given by students were also recorded.

DEALING WITH NEGATIVE EXPRESSION OF REASONS

Many reasons for a question being perceived as more difficult are given in the negative, that is, in a form which explains why the other question was perceived as being easier. For example, one student for A_5 found Q_1 to be more difficult because " In Q_2 the first two sentences present the facts and then the question, making it more understandable". Similarly, one student selected Q_2 as being more difficult because less knowledge was required to answer Q_1. In these negative reasons were transcribed as the mirror image: "Q_1 does not present the first two sentences present the facts and then the question" and "more knowledge needed", respectively. It was not practical to keep a record of every reversal of this kind.

VAGUE AND INCORRECT REASONS

In many instances reasons were unhelpful because they were too vague. For example, to state that a question is more difficult because "it is not straightforward", "the wording is poor", "it is not clear what is asked" or "asked in a confusing way", does not explain why the question is not straightforward, why the wording is poor, and so on. Consequently, an attempt was made, by surveying other reasons for that question, what "not being straightforward", for example, meant.

There were also many incorrect reasons. For example, a student might find a question more difficult because "it has more parts", when clearly both questions have only one part each. Unless the student gave additional comment on why he/she perceived more than one part, these kinds of reasons were unhelpful. The researcher is aware that these instances of vagueness and incorrectness could have been clarified by including in the design of the experiment, face-to-face interviews with students, but this was not undertaken owing to the already extensive scope of this study.

CONTRADICTIONS

The researcher noticed two levels of contradiction. The first was within the reasons for the same question. For example, in A_2Q_1 Before, one reason is given as "less specific" and another as "too specific". The second level occurs between two questions in the same pair. For example, in A_2, the requirement for more knowledge is mentioned as being the cause of difficulty for both questions. While these contradictions can be easily explained by the fact that individuals perceive difficulty in different ways, they do not help in reaching a conclusion about what makes one question more difficult than another. To overcome this difficulty, it was decided to provide in addition to an analysis for each question in each pair, an analysis of all reasons given for all questions in parts A, B, and C. It was hoped that this wider analysis would provide an overall picture of why some questions are perceived as more difficult.

A SAMPLE OF HOW REASONS WERE RECORDED AND CLASSIFIED
(ACCORDING TO THE CLASSIFICATIONS WITHIN EACH SET)

(Note: The number at the beginning of a reason indicates its classification under one of the classifications listed in **Appendix XXIX**. The number in brackets at the end of each reason indicates the number of times it was mentioned. As will be seen in Robb (1993 pp205-218) many footnotes were necessary to clarify certain issues - these have been omitted in this sample).

Set One

A₁

1   Describe the effects of computer applications on the education and training of an engineer.

2   Describe the role of computer applications on the education and training of an engineer.

Before

QUESTION ONE

1 Less straightforward
2 "Effect" more difficult than "role" (28)
1 Not clear what is asked
3 Poor flow
4 Must give both ads and disads- not just a specific function
5 More discussion needed
5 Must discuss not only why computer is used but the result on the training of an engineer
6 Asks what happens due to computers not only what the computer does
6 Must know both role and effect

36

QUESTION TWO

7 Asks for a less personal view
2 "Role" is more difficult than "effects" (10)
1 Not as direct
9 You are asked the purpose, whereas in Q₁ it has already happened
8 More specific to an engineer
5 More indepth answer needed
7 Not general cannot be applied to any course with computer studies in the syllabus

17

After

QUESTION ONE

2 "Effects" more difficult than "role" (13)
6 Requires knowledge of engineers' training before computers
6 Needs more information
6 Must write about computers and engineers not just about computers

16

QUESTION TWO

2 "Role" more difficult than "effect" (5)
5 Needs more thought
9 Information is not given in the first sentence
8 Lesser spectrum of relevance
3 Vague
10 Must give own opinion
9 Must describe something not already known
11 More parts

12

Set Two

(Almost identical to that for Set One, so not displayed)

a) Adult education

Before

Q1

SL   No reason given[22]

JR   [So many] choices[32] - how best to chose my point and then organise the presentation[1] so that I could develop the point.

Q2

SL   No reason given[22]

SH   Not knowing enough about it[6]

SF   Scared by the language[17] - lots of technical terms which I do not understand[17]

Q3

SL   No reason given[22]

HS   Do not know chemistry[6] - would need to do a course in chemistry

CB   [It is a] factual answer[25] - used to the arts - discussion, weighing up hard to write about pure facts - nothing to get your teeth into - like doing a quick crossword

SR   Wording confusing[3]. Distinguish between glucose and fructose in an aqueous solution or between both fructose and fructose both in an aqueous solution

After

Q1

SR   [Difficult] to distinguish knowledge and relevance[28]

Q2

SR   [Difficult] to distinguish knowledge and relevance[28]

THE CRITERIA WITHIN EACH SET AND THEIR FREQUENCY OF MENTION
(Percentages are calculated only for the largest number of mentions)

Set One

	Classifications (criteria)	Before		After	
		Number of mentions	%	Number of mentions	%
1	Less/not straightforward/clear/direct/understandable	21	6.1	17	10.8
2	One word/phrase in the question indicates difficulty	93	26.8	47	29.7
3	Poor/complex wording/flow/expression/phrasing: too long/long-winded, confusing, vague	44	12.7	16	10.1
4	Must give both sides/advantages and disadvantages/pros and cons/	1		1	
5	More discussion/argument/thinking/precision/deciding/ comment/application of knowledge needed[1]	29	8.4	5	3.2
6	More knowledge/detail/indepth required	20	5.8	10	6.3
7	Personal views are not allowed/required. Own opinion not/less possible	6		1	
8	Scope much narrower/less general/less vague/ambiguous/ definite/varied. More specific	22	6.3	12	7.6
9	One is not given part of the answer/information/knowledge in the question	17	4.9	8	5.1
10	Must give personal/own views/opinions	9		2	
11	More parts/work. Longer/intricate/detailed answer required	5		4	
12	Scope much wider/less specific/expansive/less definite/ wide-ranging	16	4.6	2	
13	Does not put question first/statement interferes	11		4	
14	Does not give helpful background/ideas/information/guidelines /hints/clues	7		4	
15	Must defend a statement given as true or an answered hinted at as preferred	12		3	
16	Questioner does not sound friendly/gentle. Sounds forceful	2		-	
17	More formal/clinical/academic	1		-	
18	Not split into question and statement/two questions	23		9	5.7
19	Irrelevant/unhelpful information/statement/background first	0		3	
20	Does not put information/background/statement first	8		2	
21	Does not give information in a single sentence. Question split	0		1	
22	No reason given	1		7	
Totals		348		158	

CLASSIFICATION BY QUESTION

Pair	A1		A2		A3		A4		A5		A6		A7		A8		TOT
Question	Q1	Q2	Q1	Q2	Q1	Q2	Q1	Q2	Q1	Q2	Q1	Q2	Q1	Q2	Q1	Q2	
F (Before)	36	16	43	8	16	11	25	14	27	6	5	51	23	7	38	22	348
F (After)	16	12	18	6	4	5	12	4	10	9	10	19	5	5	16	7	158

---

[1] Also expressed as "not just a yes/no or textbook answer".

Set Two

(For presentation purposes, where there are no mentions of a classification both Before and After, it is deleted from the list)

	Classifications (criteria)	Before Number of mentions	%	After Number of mentions	%
1	Less/not straightforward/clear/direct/understandable	40	9.1	23	8.7
2	One word/phrase in the question indicates difficulty	27	6.1	31	11.7
3	Poor/complex wording/flow/expression/phrasing: too long/long-winded, confusing, vague	88	20.1	33	12.5
4	Must give both sides/advantages and disadvantages/pros and cons/	1		4	
5	More discussion/argument/thinking/precision/deciding/ comment/application of knowledge needed[2]	19	4.3	10	
6	More knowledge/detail/indepth required	13		11	
7	Personal views are not allowed/required. Own opinion not/less possible	1		0	
8	Scope much narrower/less general/less vague/ambiguous/ definite/varied. More specific	13		4	
9	One is not given part of the answer/information/knowledge in the question	57	13.0	26	9.8
10	Must give personal/own views/opinions	3		2	
11	More parts/work. Longer/intricate/detailed answer required	33	7.5	43	16.3
12	Scope much wider/less specific/expansive/less definite/ wide-ranging	16		4	
14	Does not give helpful background/ideas/information/guidelines /hints/clues	74	16.8	43	16.3
15	Must defend a statement given as true or an answer hinted at as preferred	6		0	
16	Questioner does not sound friendly/gentle. Sounds forceful	3		0	
17	More formal/clinical/academic	6		1	
18	Not split into question and statement/two questions	14		4	
19	Irrelevant/unhelpful information/statement/background first	9		12	4.5
20	Does not put information/background/statement first	2		1	
22	No reasons given	4		8	
23	Question structure causes problems	3	0.7	0	
24	More direction/info given	2		0	
25	Does not allow discussion/simplistic/deals with facts	3		0	
26	More direct	1		0	
27	Statement/too much wording/first before question	0		4	
28	Does not motivate or inspire to give a good answer	2		0	
	Totals	440		264	

CLASSIFICATION BY QUESTION

																			TOT
Pair	B1		B2		B3		B4		B5		B6		B7		B8		B9		
Question	Q1	Q2	Q1	Q2	Q1	Q2	Q1	Q2	Q1	Q2	Q1	Q2	Q1	Q2	Q1	Q2	Q1	Q2	
F (Before)	35	19	34	20	70	25	25	43	2	7	25	26	15	15	12	33	22	12	
		440																	
F (After)	18	16	13	14	34	24	25	28	0	5	14	12	6	3	8	27	8	8	
		264																	

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[2] Also expressed as "not just a yes/no or textbook answer".

(The data in this set was collected in an experiment involving three student groups, and it was decided to record the reasons separately for each group. For presentation purposes, where there are no mentions in a classification both Before and After, it is deleted from the list)

(Key: AE = adult education, CE = civil engineering, CH = chemistry)

Before

Classifications (criteria)	AE[3]	CE	CH	Totals	
1 More difficult to describe rather than answer/not knowing where to begin	5	5	2	12	7.8
3 Ambiguous/confusing/vague wording	8	9	4	21	13.6
5 Requires a lot of thought/work/discussion is difficult	0	11	0	11	7.1
6 Don't know enough/lack of knowledge	11	10	0	21	13.6
10 Subjective/personal: cannot give balanced view	4	1	1	6	
opinion is needed	0	1	0	1	
11 Long answer needed	0	2	2	4	
12 Too general/wide-ranging/many ways to answer	0	4	0	4	
14 No relevance words/guidance on how to answer	0	8	6	14	9.1
15 Depends on answer to first part	0	1	0	1	
17 Complex/technical language	2	0	0	2	
19 Side-tracked/irrelevant/waffle/introduction misleads	0	2	5	7	
22 No reason ·	13	4	0	17	11.0
23 Number of parts/structure	2	10	0	12	7.8
25 Factual answer (nothing to get your teeth into)	1	6	3	10	6.5
29 Difficult to distinguish K and R and I	0	1	0	1	
30 No conclusion sought	0	0	1	1	
31 Don't know how much time to spend on it	0	1	0	1	
32 Overwhelmed by choice/ complexity/"bitty"/fragmented	6	0	2	8	5.2
TOTAL REASONS	52	76	26	154	

After

Classifications (criteria)	AE	CE	CH	Totals	%
1 More difficult to describe rather than answer/not knowing where to begin	1	3	0	4	3.3
3 Ambiguous/confusing/vague wording	3	8	1	12	10.0
5 Requires a lot of thought/work/discussion is ..difficult	0	16	0	16	13.3
6 Don't know enough/lack of knowledge	4	4	0	8	6.6
11 Long answer needed	0	4	0	4	
12 Too general/wide-ranging/many ways to answer	0	5	0	5	
14 No relevance words/guidance on how to answer	0	2	2	4	
19 Possibility of being side-tracked/irrelevant/introduction .. hides/misleads	0	3	2	5	
22 No reason	4	1	0	5	4.2
23 Number of parts/structure	7	26	0	33	27.5
25 Factual answer (nothing to get your teeth into)	0	4	2	6	5.0
28 The exercise itself leads to boredom	2	0	2	4	
29 Difficult to distinguish K and R and I	9	0	0	9	7.5
32 Overwhelmed by choice/ complexity/"bitty"/fragmented	0	4	1	5	
TOTAL REASONS	30	80	10	120	

---

[3] Some students offered more than one reason for a question being difficult. All reasons were recorded and analysed to gain as many perceptions as possible.

THE FREQUENCY OF MENTION OF THIRTY NINE CRITERIA GIVEN FOR PERCEIVING ONE QUESTION AS MORE DIFFICULT THAN THE OTHER IN A PAIR

	Classifications (criteria)	Number of mentions	%	Number of mentions	%
1	Less/not straightforward/clear/direct/understandable	18	3.6	3	0.6
2	One word/phrase in the question indicates difficulty	34	6.3	16	3.1
3	Poor/complex wording/flow/expression/phrasing too long/long-winded, confusing, vague	22	4.1	2	0.4
4	Must give both sides/advantages and disadvantages/ pros and cons/	45	8.4	22	4.2
5	More discussion/argument/thinking/precision/deciding/ comment/application of knowledge needed[4]	34	6.3	31	6.0
6	More knowledge/detail/indepth required	16	3.0	13	2.5
7	Personal views are not allowed/required. Own opinion not/less possible	4	0.7	2	0.4
8	Scope much narrower/less general/less vague/ambiguous/ definite/varied. More specific	17	3.2	0	0.0
9	One is not given part of the answer/information in the question	7	1.3	2	0.4
10	Must give personal/own views/opinions	17	3.2	8	1.5
11	More parts/work. Longer/intricate/detailed answered required	85	15.9	107	20.5
12	Scope much wider/less specific/expansive/less definite/ wide-ranging	10	1.9	3	0.6
14	Does not give helpful background/ideas/information/ guidelines /clues	3	0.6	0	0.0
15	Must defend a statement given as true or a preferred answer	10	1.9	2	0.4
17	More formal/clinical/academic	1	0.2	0	0.0
23	Question structure causes problems	15	2.8	6	1.2
26	More direct	0	0.0	1	0.2
34	IKW (by relevant name)	178	33.2	211	40.5
35	IKW (by non-relevant name)	15	2.8	33	6.3
36	"Level I Vs Level II"	0	0.0	56	10.7
37	Unable to explain why	1	0.2	0	0.0
38	Miscellaneous	2	0.4	3	0.6
39	Does not need/allow both sides	2	0.4	0	0.0
	Totals	536	100.4	521	100.1

CLASSIFICATION BY QUESTION

Pair	C1		C2		C3		C4		C5		C6		C7		C8		C9		C10		TOTALS
Question	Q1	Q2	Q1	Q2	Q1	Q2	Q1	Q2	Q1	Q2	Q1	Q2	Q1	Q2	Q1	Q2	Q1	Q2	Q1	Q2	
F (Before)	13	42	25	14	9	54	47	5	12	20	85	8	9	36	8	40	46	4	40	19	536
F (After)	11	46	17	7	0	59	56	2	19	7	54	4	14	25	7	35	64	0	94	0	521

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[4] Also expressed as "not just a yes/no or textbook answer".

PERCENTAGE OF RESPONSES FOR EACH IKW IN A PAIR AS BEING MORE
DIFFICULT AND FOR BOTH IKWS IN A PAIR BEING PERCEIVED AS
EQUALLY DIFFICULT

(Key: B = Before IKR   A = After IKR   Dif = Percentage change)

	Describe			List			(Or)	
B	A	Dif	B	A	Dif	B	A	Dif
81.1	79.4	-1.7	4.1	10.3	+6.2	14.8	10.3	-4.5

	Write			Explain			(Or)	
B	A	Dif	B	A	Dif	B	A	Dif
16.2	17.2	+1.0	56.8	62.1	+5.3	27.0	20.7	-6.3

	Discuss			Evaluate			(Or)	
B	A	Dif	B	A	Dif	B	A	Dif
12.1	24.1	+12.0	56.8	44.9	-11.9	31.1	31.0	-0.1

	Define			Outline			(Or)	
B	A	Dif	B	A	Dif	B	A	Dif
54.1	44.9	-9.2	5.4	10.3	+4.9	40.5	44.9	+4.4

	Analyse			Justify			(Or)	
B	A	Dif	B	A	Dif	B	A	Dif
33.8	34.5	+0.7	39.2	24.1	-15.1	27.0	41.4	+14.4

	Weigh-up			Assess			(Or)	
B	A	Dif	B	A	Dif	B	A	Dif
5.4	3.4	-2.0	17.6	17.2	-0.4	77.0	79.4	+2.4

	Explain			Describe			(Or)	
B	A	Dif	B	A	Dif	B	A	Dif
36.5	41.4	+4.9	6.8	6.9	+0.1	56.7	51.7	-5.0

	Illustrate			Give examples			(Or)	
B	A	Dif	B	A	Dif	B	A	Dif
40.5	55.1	+14.6	6.8	0	-6.8	52.7	44.9	-7.8

	Debate			Justify			(Or)	
B	A	Dif	B	A	Dif	B	A	Dif
40.5	44.9	+4.4	25.7	20.6	-5.1	33.8	34.5	+0.7

APPENDIX XXXII

TABLES SHOWING THE DISTRIBUTION OF MENTIONS OF THE SIXTY CRITERIA BY IKWs

(KEY: In **Tables A.24** and **A.25** on the following four pages, each IKW is represented by a number as follows:)

IKW	Number in tables A.24 and A.25
Describe	1
List	2
Write	3
Explain	4
Discuss	5
Evaluate	6
Define	7
Outline	8
Analyse	9
Justify	10
Weigh-up	11
Assess	12
Explain	13
Describe	14
Illustrate	15
Give examples	16
Debate	17
Justify	18

Table A.24
Before

IKW NUMBER	REASON/CRITERIA	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	TOT	RANK
3	Does not give clear indication of what is required/what examiner wants/Not specific/vague/Long-winded approach	1		6			1	1	4	1	3	1	2	3						22	4
4	Needs more than one viewpoint					2	6		1	3		2	1				23			38	2
5	More thorough case needed/ More thinking/thought needed				9		4		1	2	2	1	1	2		2				24	3
6	Requires more knowledge/understanding Needs search for more evidence			2	2		1	2	1	1		1	1	2		1	4	2		20	
7	Does not allow personal viewpoint					1														1	
10	Must give own view/own words		2							3				3						8	
11	Requires more detail/work/depth	30		2	15		4	12	1	7	2		4	10	3	7		3	1	101	1
12	Wide ranging/all encompassing question Danger of being side-tracked by too many arguments			1			2			2	2		1			2				10	
15	One side of the argument is already decided; you must support it										3							7		10	
17	More formal approach needed Could involve much technical background				3						3		3		2				1	12	
25	Cannot be formatted into sentences		2																	2	
26	More factual/specific/direct						3	15			3									21	5
40	Requires listing and describing				1															1	
41	Must give reasons for list/conclusions				6						11			4					2	24	3
42	Must link paragraphs																		1	1	

IKW NUMBER	REASON/CRITERION	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	TOT	RANK
43	More care with layout needed				1															1	
44	Must show or explain				1	3		2						1						7	
45	More accuracy needed/cannot waffle			2	3			2								2		3		12	
46	Must instruct someone				1															1	
47	Examples needed				3															3	
48	Must show how thoughts interlock				1													1		2	
49	Must not be boring				1															1	
50	Definite answer/conclusion needed						11				8						2			21	5
51	Must first solve then explain						1													1	
52	Must give meaning						2													2	
53	Cannot use input from others						1												1	2	
54	Not a moral question																		1	1	
55	Must take problem to pieces and work on each piece									2			1							3	
56	Must answer why										1									1	
57	More than adding up pros and cons												1							1	
58	Cannot use pictorial method															1				1	
59	Needs more than examples, ie how something is done															3				3	
60	Requires an argument with someone else Difficult to bring out the problem without going one to one [debate]																	2	1	3	
TOTALS		54	2	9	42	5	29	34	5	18	36	4	13	24	3	26	4	33	20	361	

Table A.25

After

IKW NUMBER	REASON/CRITERION	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	TOT	RANK
1	I don't know what this means										1									1	
3	Does not tell you what to do exactly/ Vague/very broad/not specific				4		3								1					8	6
4	Must give pros and cons/both sides/ Needs two separate arguments						1	1							1			8		12	4
5	More thinking/thought needed				1	1		2			1		3							8	6
6	Requires more knowledge/understanding/ Needs more than just facts				1				2					2	3					8	6
7	Cannot use own opinions								2											2	
9	It does not lead on from something previous								1											1	
10	Must give own thoughts/opinions				2															2	
11	Requires more detail/work/depth	16			6	3			2	6			3	3			1			40	1
12	More open and more discussion																	1		1	
15	Inflexible answer - already set/ Requires argument only for/ Must show that a person, statement or act is reasonable/proper/ Must show something to be true							1			1								3	5	
17	More formal approach needed						2													2	

267

Table A.25 continued

REASON/CRITERION	IKW NUMBER																		TOT	RANK
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18		
18 Needs examples/picture description Requires a picture in words	1														9				**10**	**5**
40 More writing involved/ Needs argument and examination/ Involves description, investigation and criticism/Needs weighing-up and description	3				1				1			1							**6**	
26 More specific/accuracy				2		2	8						2		1				**15**	**2**
41 Must give reasons for list/conclusions/ Conclusion/decision needed/ Must argue about reasons not just give them	1				2	4				3			1				1	1	**13**	**3**
49 Difficult to write down without being boring					1														**1**	
44 Must make plain or clear							2						1						**3**	
43 Requires logical setting out							1												**1**	
63 Sounds complex																	2		**2**	
62 May entail a complex list of reasons												1							**1**	
61 Longer															1				**1**	
TOTALS	24	2	4	16	4	11	13	2	10	6	1	5	12	1	15	0	13	4	**143**	

268

TABLES SHOWING THE DISTRIBUTION OF RESPONSES ON THE
DIFFICULTY SCALE OF 1-6 FOR EACH IKW, AND   CATEGORISATION OF
EACH IKW INTO E, N OR D ACCORDING TO WHICH CATEGORY GAINED
THE HIGHEST NUMBER OF MENTIONS EXPRESSED AS A PERCENTAGE OF
TOTAL RESPONSES

Table A.26

Distribution of responses on the difficulty scale of 1-6 for each IKW, Before (B) and After (A)

	1 A	1 B	2 A	2 B	3 A	3 B	4 A	4 B	5 A	5 B	6 A	6 B	Totals A	Totals B
Analyse	0	2	2	7	6	10	8	14	7	17	7	16	30	66[5]
Assess	0	1	4	10	7	15	8	14	9	16	2	8	30	64
Compare	1	9	12	30	9	16	4	8	4	0	0	1	30	64
Contrast	2	4	7	15	10	29	6	9	3	6	2	0	30	63
Compare & contrast	1	2	5	4	7	17	9	21	4	10	4	11	30	65
Discuss	2	7	6	21	9	17	6	11	4	7	3	1	30	64
Describe	10	24	8	21	9	12	3	5	0	3	0	0	30	65
Evaluate	0	1	5	8	4	12	13	20	7	16	1	8	30	65
Explain	4	10	5	20	12	20	6	14	3	2	0	1	30	67
Illustrate	2	3	6	7	9	18	9	26	3	7	1	4	30	65
Justify	0	2	3	5	9	14	9	20	8	14	1	11	30	66
Show	5	21	14	22	8	16	3	8	0	0	0	0	30	67
Comment	3	16	9	19	11	17	5	10	2	4	0	0	30	66
Suggest	2	11	12	16	10	28	5	9	1	2	0	1	30	67
Write	11	30	8	19	6	10	1	4	4	1	0	2	30	66
List	20	51	8	9	2	7	0	0	0	0	0	0	30	67
TOTALS	63	194	114	233	128	258	95	193	59	105	21	64	480	1047

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[5]   While sixty seven students completed both exercises some omitted to score one of more of the IKWs.
Consequently, in some instances the percentages had to be calculated on a number of mentions less than
sixty seven.

**Categorisation of each IKW into E, N or D according to which category gained the
highest number of mentions expressed as a percentage of total responses**
(Key: E = easy   N = neither-easy-nor-difficult   D = difficult)

			Before							
			E			N			D	
SCORE	1	2	[1+2]	3	4	[3+4]	5	6	[5+6]
IKW									
Analyse	3	11	**14**	15	21	**36**	26	24	**50**
Assess	2	15	**17**	23	22	**45**	25	13	**38**
Compare	14	47	**61**	25	13	**38**	0	1	**1**
Contrast	6	24	**30**	46	14	**60**	10	0	**10**
Compare & contrast	3	6	**9**	26	32	**58**	16	17	**33**
Discuss	11	33	**44**	27	17	**44**	11	1	**12**
Describe	37	32	**69**	18	8	**26**	5	0	**5**
Evaluate	1	13	**14**	19	30	**49**	25	12	**37**
Explain	15	30	**45**	30	21	**51**	3	1	**4**
Illustrate	4	11	**15**	28	40	**68**	11	6	**17**
Justify	3	8	**11**	21	30	**51**	21	17	**38**
Show	31	33	**64**	24	12	**36**	0	0	**0**
Comment	24	29	**53**	26	15	**41**	6	0	**6**
Suggest	16	24	**40**	41	13	**55**	3	1	**5**
Write	46	29	**75**	15	6	**21**	1	3	**4**
List	76	13	**89**	11	0	**11**	0	0	**0**

Table A.28

Categorisation of each IKW into E, N or D according to which category gained the highest number of mentions expressed as a percentage of total responses
(Key: E = easy   N = neither-easy-nor-difficult   D = difficult)

After

SCORE	1	2	E [1&2]	3	4	N [3&4]	5	6	D [5&6]
IKW									
Analyse	0	7	7	20	27	47	23	23	46
Assess	0	13	13	23	27	50	30	7	37
Compare	4	40	44	30	13	43	13	0	13
Contrast	7	23	30	33	20	53	10	7	17
Compare & contrast	4	17	21	23	30	53	13	13	26
Discuss	7	20	27	30	20	50	13	10	23
Describe	33	27	60	30	10	40	0	0	0
Evaluate	0	17	17	13	44	57	23	3	26
Explain	13	17	30	40	20	60	10	0	10
Illustrate	7	20	27	30	30	60	10	3	13
Justify	0	10	10	30	30	60	27	3	30
Show	16	47	63	27	10	37	0	0	0
Comment	10	30	40	37	16	53	7	0	7
Suggest	7	40	47	33	17	50	3	0	3
Write	37	27	64	20	3	23	13	0	13
List	66	27	93	7	0	7	0	0	0

TABLES SHOWING THE CALCULATION FOR EACH IKW, OF THE
Σ[MENTIONS OF A SCORE X VALUE OF THE SCORE]; THE
CATEGORISATION OF EACH IKW INTO E, N OR D ACCORDING TO WHICH
CATEGORY GAINS THE HIGHEST Σ[MENTIONS OF A SCORE X VALUE OF
THE SCORE], AND CALCULATIONS OF THE DIFFERENCE FOR EACH
CATEGORY   (E, N AND D) FOR EACH IKW BASED ON THE NUMBER OF
RESPONSES FOR EACH CATEGORY, EXPRESSED AS A PERCENTAGE OF
ALL RESPONSES

Table A.29

Using data in Table A.26, the calculation, for each IKW, of the Σ[mentions of a
score x value of the score] (Before and After)
(Key: A = After   B = Before   Tots = totals)

IKW	1 A	1 B	2 A	2 B	3 A	3 B	4 A	4 B	5 A	5 B	6 A	6 B	TOTS A	TOTS B
Analyse	0	2	4	14	18	30	32	56	35	85	42	96	131	283
Assess	0	1	8	20	21	45	32	56	45	80	12	48	118	178
Compare	1	9	24	60	27	48	16	32	20	0	0	6	88	155
Contrast	2	4	14	30	30	87	24	36	15	30	12	0	97	187
Compare & contrast	1	2	10	8	21	51	36	84	20	50	24	66	112	261
Discuss	2	7	12	42	27	51	24	44	20	35	18	6	103	185
Describe	10	24	16	42	27	36	12	20	0	15	0	0	65	137
Evaluate	0	1	10	16	12	36	52	80	35	80	6	48	115	261
Explain	4	10	10	40	36	60	24	56	15	10	0	6	89	182
Illustrate	2	3	12	14	27	54	36	104	15	35	6	24	98	234
Justify	0	2	6	10	27	42	36	80	40	70	6	66	115	270
Show	5	21	28	44	24	48	12	32	0	0	0	0	69	145
Comment	3	16	18	38	33	51	20	40	10	20	0	0	84	165
Suggest	2	11	24	32	30	84	20	36	5	10	0	6	81	179
Write	11	30	16	38	18	30	4	16	20	5	0	12	69	131
List	20	51	16	18	6	21	0	0	0	0	0	0	42	90
TOTALS	63	194	228	466	384	774	380	772	295	525	126	384	1476	3115

Table A.30

Categorisation of each IKW into E, N or D according to which category gains the highest Σ[mentions of a score x value of the score]

(Based on data in Table A.29 in Appendix XXIV)

(Key: E = easy, N = neither easy nor difficult, D = difficult)

| | | E | | Before | N | | | D | | |
IKW	1	2	[1&2]	3	4	[3&4]	5	6	[5&6]	TOTALS
Analyse	2	14	16	30	56	86	85	96	181	283
Assess	1	20	21	45	56	101	80	48	128	250
Compare	9	60	69	48	32	80	0	6	6	155
Contrast	4	30	34	87	36	123	30	0	30	187
Compare & contrast	2	8	10	51	84	135	50	66	116	261
Discuss	7	42	49	51	44	95	35	6	41	185
Describe	24	42	66	36	20	56	15	0	15	137
Evaluate	1	16	17	36	80	116	80	48	128	261
Explain	10	40	50	60	56	116	10	6	16	182
Illustrate	3	14	17	54	104	158	35	24	59	234
Justify	2	10	12	42	80	122	70	66	136	270
Show	21	44	65	48	32	80	0	0	0	145
Comment	16	38	54	51	40	91	20	0	20	165
Suggest	11	32	43	84	36	120	10	6	16	179
Write	30	38	68	30	16	46	5	12	17	131
List	51	18	69	21	0	21	0	0	0	90
TOTALS	194	466	660	774	772	1546	525	384	909	3115

273

	E			N			D			
	1	**2**	**[1&2]**	**3**	**4**	**[3&4]**	**5**	**6**	**[5&6]**	**TOTALS**
IKW										
Analyse	0	4	**4**	18	32	**50**	35	42	**77**	131
Assess	0	8	**8**	21	32	**53**	45	12	**57**	118
Compare	1	24	**25**	27	16	**43**	20	0	**20**	88
Contrast	2	14	**16**	30	24	**54**	15	12	**27**	97
Compare & contrast	1	10	**11**	21	36	**57**	20	24	**44**	112
Discuss	2	12	**14**	27	24	**51**	20	18	**38**	103
Describe	10	16	**26**	27	12	**39**	0	0	**0**	65
Evaluate	0	10	**10**	12	52	**64**	35	6	**41**	115
Explain	4	10	**14**	36	24	**60**	15	0	**15**	89
Illustrate	2	12	**14**	27	36	**63**	15	6	**21**	98
Justify	0	6	**6**	27	36	**63**	40	6	**46**	115
Show	5	28	**33**	24	12	**36**	0	0	**0**	69
Comment	3	18	**21**	33	20	**53**	10	0	**10**	84
Suggest	2	24	**26**	30	20	**50**	5	0	**5**	81
Write	11	16	**27**	18	4	**22**	20	0	**20**	69
List	20	16	**36**	6	0	**6**	0	0	**0**	42
TOTALS	63	228	291	384	380	764	295	126	421	1476

Calculations of the difference for each category (E, N and D) for each IKW based on the number of responses for each of the E, N and D categories expressed as a percentage of all responses

(Using data from **Tables A.27** and **A.28**)

SCORE	1	2	[1+2]		3	4	[3+4]		5	6	[5+6]	
IKW												
Analyse (B)	3	11	14		15	21	36		26	24	50	
Analyse (A)	0	7	7	-7	20	27	47	+11	23	23	46	-4
Assess (B)	2	15	17		23	22	45		25	13	38	
Assess (A)	0	13	13	-4	23	27	50	+5	30	7	37	-1
Compare (B)	14	47	61		25	13	38		0	1	1	
Compare (A)	4	40	44	-17	30	13	43	+5	13	0	13	+12
Contrast (B)	6	24	30		46	14	60		10	0	10	
Contrast (A)	7	23	30	0	33	20	53	-7	10	7	17	+7
Compare & contrast (B)	3	6	9		26	32	58		16	17	33	
Compare & contrast (A)	4	17	21	+12	23	30	53	-5	13	13	26	-7
Discuss (B)	11	33	44		27	17	44		11	1	12	
Discuss (A)	7	20	27	-17	30	20	50	+6	13	10	23	+11
Describe (B)	37	32	69		18	8	26		5	0	5	
Describe (A)	33	27	60	-9	30	10	40	+14	0	0	0	-5
Evaluate (B)	1	13	14		19	30	49		25	12	37	
Evaluate (A)	0	17	17	+3	13	44	57	+8	23	3	26	-11
Explain (B)	15	30	45		30	21	51		3	1	4	
Explain (A)	13	17	30	-15	40	20	60	+9	10	0	10	+6
Illustrate (B)	4	11	15		28	40	68		11	6	17	
Illustrate (A)	7	20	27	+12	30	30	60	-8	10	3	13	-4
Justify (B)	3	8	11		21	30	51		21	17	38	
Justify (A)	0	10	10	-1	30	30	60	+9	27	3	30	-8
Show (B)	31	33	64		24	12	36		0	0	0	
Show (A)	16	47	63	-1	27	10	37	+1	0	0	0	0
Comment (B)	24	29	53		26	15	41		6	0	6	
Comment (A)	10	30	40	-13	37	16	53	+12	7	0	7	+1
Suggest (B)	16	24	40		41	14	55		3	2	5	

SCORE [5+6] IKW	1	2	[1+2]		3	4	[3+4]		5	6		
Suggest (A)	7	40	47	+7	33	17	50	-5	3	0	3	-2
Write (B)	46	29	75		15	6	21		1	3	4	
Write (A)	37	27	64	-11	20	3	23	+2	13	0	13	+9
List (B)	76	13	89		11	0	11		0	0	0	
List (A)	66	27	93	+4	7	0	7	-4	0	0	0	0

SCORE [5+6]	1	2	[1+2]	3	4	[3+4]	5	6

BEFORE AND AFTER SCORES, TOGETHER WITH CHANGES IN PERCEIVED DIFFICULTY FOR EACH STUDENT AND EACH QUESTION, FOR THREE GROUPS

(Key: B = Before A = After   C = change   Tot = totals)

Table A.32: Adult education

		1	2	3	4	5	6	7	8	9	10	11	12	Net Shift
	B	3	4	3	2	4	4	3	3	2	5	3	2	
SF	A	3	3	2	3	3	4	3	3	4	5	3	2	
	C	0	-1	-1	+1	-1	0	0	0	+2	0	0	0	**0**
	B	4	5	5	3	5	4	5	4	4	5	5	4	
SL	A	3	2	3	3	2	3	3	2	4	3	2	4	
	C	-1	-3	-2	0	-3	-1	-2	-2	0	-2	-3	0	**-19**
	B	3	3	3	3	3	3	3	3	3	4	3	5	
PB	A	1	2	2	4	2	3	4	4	2	3	3	2	
	C	-2	-1	-1	+1	-1	0	+1	+1	-1	-1	0	-3	**-7**
	B	2	2	2	3	3	4	3	2	4	3	2	3	
KL	A	2	2	2	4	3	3	4	2	3	3	3	2	
	C	0	0	0	+1	0	-1	+1	0	-1	0	+1	-1	**0**
	B	2	2	2	3	2	3	3	5	4	5	3	3	
JA	A	3	3	3	3	2	3	4	3	3	3	3	3	
	C	+1	+1	+1	0	0	0	+1	-2	-1	-2	0	0	**-1**
	B	3	1	1	3	3	3	3	3	4	3	2	3	
AP	A	3	1	1	2	2	3	3	2	3	3	2	3	
	C	0	0	0	-1	-1	0	0	-1	-1	0	0	0	**-4**
	B	3	3	4	3	3	3	3	2	3	3	4	1	
HS	A	3	3	3	3	3	3	3	2	3	3	3	3	
	C	0	0	-1	0	0	0	0	0	0	0	-1	+2	**0**
	B	2	2	2	2	2	4	2	4	2	2	2	2	
CB	A	2	2	2	2	3	3	3	2	2	3	3	2	
	C	0	0	0	0	+1	-1	+1	-2	0	+1	+1	0	**+1**
	B	2	3	3	3	3	2	3	4	3	3	3	3	
LB	A	2	2	2	2	2	2	2	2	2	2	2	2	
	C	0	-1	-1	-1	-1	0	-1	-2	-1	-1	-1	-1	**-11**
	B	4	3	3	3	3	4	4	3	4	3	3	5	
JR	A	2	2	2	4	4	3	4	2	2	2	2	3	
	C	-2	-1	-1	+1	+1	-1	0	-1	-2	-1	-1	-2	**-10**
	B	3	5	2	3	4	4	3	4	3	4	3	3	
SH	A	3	3	4	2	3	4	3	4	3	2	3	3	
	C	0	-2	+2	-1	-1	0	0	0	0	-2	0	0	**-4**
	B	3	3	4	2	3	4	3	5	3	3	4	4	
SR	A	4	4	3	5	2	5	3	2	4	4	4	5	
	C	+1	+1	-1	+3	-1	+1	0	-3	+1	+1	0	+1	**+4**
Net		-3	-7	-5	+4	-7	-3	+1	-12	-4	-7	-4	-4	**-51**

Table A.33: Civil engineering

		1	2	3	4	5	6	7	8	9	10	11	12	Net Shift
SB	B	3	3	3	3	4	1	2	2	4	3	3	4	
	A	3	2	2	2	3	3	2	3	3	3	2	4	
	C	0	-1	-1	-1	-1	+2	0	+1	-1	0	-1	0	-3
LO	B	3	3	2	3	3	3	4	3	4	3	3	3	
	A	3	2	2	4	2	3	4	3	4	3	3	3	
	C	0	-1	0	+1	-1	0	0	0	0	0	0	0	-1
CS	B	3	5	2	4	4	3	4	4	3	3	3	4	
	A	3	3	2	4	4	4	4	4	5	5	3	4	
	C	0	-2	0	0	0	+1	0	0	+2	+2	0	0	+3
GR	B	4	2	3	2	2	3	3	2	1	1	1	3	
	A	4	3	2	3	2	2	4	1	3	3	3	5	
	C	0	+1	-1	+1	0	-1	+1	-1	+2	+2	+2	+2	+8
GD	B	4	2	2	2	3	3	2	4	2	2	3	3	
	A	2	4	3	5	2	5	4	2	3	2	2	2	
	C	-2	+2	+1	+3	-1	+2	+2	-2	+1	0	-1	-1	+4
DJ	B	2	1	1	3	3	2	3	5	4	4	2	5	
	A	1	3	2	4	1	3	5	4	5	4	3	2	
	C	-1	+2	+1	+1	-2	+1	+2	-1	+1	0	+1	-3	+2
CB	B	3	2	2	4	3	4	5	5	3	4	3	3	
	A	2	1	1	4	2	4	3	4	4	4	2	1	
	C	-1	-1	-1	0	-1	0	-2	-1	+1	0	-1	-2	-9
FM	B	2	2	4	2	4	2	2	4	2	4	2	4	
	A	2	2	2	2	2	2	2	2	2	2	2	4	
	C	0	0	-2	0	-2	0	0	-2	0	-2	0	0	-8
JM	B	5	2	3	2	1	4	3	3	2	2	3	4	
	A	3	2	2	4	3	3	4	4	4	3	4	1	
	C	-2	0	-1	+2	+2	-1	+1	+1	+2	+1	+1	-3	+3
AP	B	4	3	1	4	4	5	2	3	4	5	4	4	
	A	2	3	1	3	4	4	4	2	2	4	2	4	
	C	-2	0	0	-1	0	-1	+2	-1	-2	-1	-2	0	-8
WS	B	5	3	2	4	2	4	4	2	2	5	3	4	
	A	2	3	1	4	2	4	5	3	5	2	3	2	
	C	-3	0	-1	0	0	0	+1	+1	+3	-3	0	-2	-4
FB	B	4	2	2	3	5	2	3	5	2	4	2	3	
	A	5	3	2	2	3	4	2	4	2	3	2	2	
	C	+1	+1	0	-1	-2	+2	-1	-1	0	-1	0	-1	-3
PJ	B	2	3	4	4	2	4	4	1	5	2	3	1	
	A	1	2	3	4	1	4	4	1	5	2	3	1	
	C	-1	-1	-1	0	-1	0	0	0	0	0	0	0	-4
MG	B	3	3	2	4	2	2	4	4	3	3	1	2	
	A	3	3	2	3	1	2	3	2	4	5	3	4	
	C	0	0	0	-1	-1	0	-1	-2	+1	+2	+2	+2	+2
Net:		-11	0	-6	+4	-10	+5	+5	-8	+10	0	+1	-8	-18

Table A.34: Chemistry

		1	2	3	4	5	6	7	8	Net Shift
	B	4	3	2	3	2	3	3	4	
AH	A	3	3	2	3	2	3	3	3	
	C	-1	0	0	0	0	0	0	-1	-2
	B	2	4	3	3	4	1	3	1	
SF	A	4	2	3	4	1	2	3	2	
	C	+2	-2	0	+1	-3	+1	0	+1	0
	B	2	4	2	2	4	5	2	2	
AD	A	2	3	2	4	2	3	3	3	
	C	0	-1	0	+2	-2	-2	+1	+1	-1
	B	2	2	4	4	4	3	5	5	
SN	A	2	2	3	2	4	4	4	4	
	C	0	0	-1	-2	0	+1	-1	-1	-4
	B	2	3	3	3	4	3	4	3	
CG	A	2	2	3	3	3	3	4	3	
	C	0	-1	0	0	-1	0	0	0	-2
	B	2	3	3	3	3	3	3	3	
HM	A	2	3	3	3	3	3	3	2	
	C	0	0	. 0	0	0	0	0	-1	-1
	B	3	4	3	3	2	3	3	2	
IG	A	2	3	3	3	2	2	2	2	
	C	-1	-1	0	0	0	-1	-1	0	-4
	B	3	3	2	3	3	2	3	2	
BM	A	2	2	1	2	1	2	1	1	
	C	-1	-1	-1	-1	-2	0	-2	-1	-9
Net:		-1	-6	-2	0	-8	-1	-3	-2	-23

DISTRIBUTION OF TIMES TAKEN BY SIXTY FIVE UNDERGRADUATE CIVIL ENGINEERING STUDENTS TO COMPLETE THE BEFORE AND AFTER QUESTIONNAIRES

Before				**After**		
Time in minutes	Frequency	Percentage		Time in minutes	Frequency	Percentage
35	1	1.5		5	1	1.5
45	1	1.5		25	1	1.5
50	1	1.5		30	4	6.2
60	2	3.1		40	3	4.6
64	1	1.5		45	6	9.2
75	2	3.1		50	5	7.7
90	21	32.3		58	1	1.5
100	1	1.5		60	17	26.2
105	8	12.3		75	4	6.2
120	8	12.3		80	2	3.1
135	2	3.1		90	14	21.5
150	9	13.8		105	2	3.1
180	3	4.6		120	4	6.2
210	1	1.5		150	1	1.5
230	1	1.5				
240	1	1.5				
300	1	1.5				
Totals	65	100.0		Totals	65	100.0

APPENDIX XXXVII

THE CHANGES IN TIME TAKEN (MINUTES) TO COMPLETE DESCRIPTIONS OF HOW ONE WOULD ANSWER SEVERAL QUESTIONS

Table A.35: Adult education

	Tine taken Before	Time taken After	Change
SF	150	45	-105
SL	180	60	-120
PB	50	75	+25
KL	40	90	+50
JA	20	60	+40
AP	100	40	-60
HS	120	45	-75
CB	60	60	0
LB	45	20	-25
JR	120	120	0
SH	60	35	-25
SR	180	180	0

Table A.36: Civil engineering

	Time taken Before	Time taken After	Change
PJ	45	120	+75
LO	45	30	-15
CS	110	90	-20
GR	75	60	-15
GU	40	15	-25
GD	45	105	+60
DJ	110	125	+15
DM	80	30	-50
CB	105	90	-15
AP	180	240	+60

Table A.37: Chemistry

	Time taken Before	Time taken After	Change
AH	35	30	-5
SF	25	30	+5
AD	90	60	-30
SN	45	30	-15
CG	35	30	-5
HM	30	20	-10
IG	25	15	-10
BM	30	15	-15

Note: The shorter times taken by chemistry students can be explained by the fact that their exercise comprised eight questions whereas that for the adult education and civil engineering groups comprised twelve questions.

THE NUMBER OF INCREASES (+), NO-CHANGES (0) AND DECREASES (-) IN DIFFICULTY EXPERIENCES FOR EACH STUDENT AND EACH QUESTION AND THE DIFFERENCE BETWEEN THE DECREASES AND THE SUM OF NO-CHANGES AND INCREASES [(+)-(0+-)]

Table A.38: Adult education

	+	0	-	(0++)	(-)-(0++)		+	0	-	(0++)	(-)-(0++)
SL	0	3	9	3	+6	Q_1	2	7	3	9	-6
PB	3	2	7	5	+2	Q_2	2	4	6	6	0
KL	3	6	3	9	-6	Q_3	2	3	7	5	+2
JA	4	5	3	9	-6	Q_4	5	4	3	9	-6
AP	0	8	4	8	-4	Q_5	2	3	7	5	+2
HS	1	9	2	10	-8	Q_6	1	7	4	8	-4
CB	4	6	2	10	-8	Q_7	4	6	2	10	-8
LB	0	2	10	2	+8	Q_8	1	4	7	5	+2
JR	2	1	9	3	+6	Q_9	2	4	6	6	0
SH	1	7	4	8	-4	Q_{10}	2	4	6	6	0
SR	7	2	3	9	-6	Q_{11}	2	6	4	8	-4
SF	2	7	3	9	-6	Q_{12}	2	6	4	8	-4
Totals	27	58	59	85	-26	Totals	27	58	59		

% of total possible responses (144)
19 40 41   59

STUDENTS		QUESTIONS	
No experiencing net decrease in difficulty	Four	No experiencing net decrease in difficulty	Three
No experiencing net increase in difficulty	Eight	No experiencing net increase in difficulty	Six
No experiencing no change in difficulty	Nil	No experiencing no change in difficulty	Three

	+	0	-	(0++)	(-)-(0++)		+	0	-	(0++)	(-)-(0++)
SB	2	4	6	6	0	Q_1	1	6	7	7	0
LO	1	9	2	10	-8	Q_2	4	5	5	9	-4
CS	3	8	1	11	-10	Q_3	2	5	7	7	0
GR	7	2	3	9	-6	Q_4	5	5	4	10	-6
GD	6	1	5	7	-2	Q_5	1	4	9	5	+4
DJ	7	1	4	8	-4	Q_6	5	6	3	11	-8
CB	1	3	8	4	+4	Q_7	6	5	3	11	-8
FM	0	8	4	8	-4	Q_8	3	3	8	6	+2
JM	7	1	4	8	-4	Q_9	8	4	2	12	-10
AP	1	4	7	5	+2	Q_{10}	4	6	4	10	-6
WS	3	5	4	8	-4	Q_{11}	4	6	4	10	-6
FB	3	3	6	6	0	Q_{12}	2	6	6	8	-2
PF	0	8	4	8	-4	Totals	45	61	62		
MG	4	4	4	8	-4						
Totals	45	61	62	106	-44						

% of total possible responses (168)
    27 36 37   63

STUDENTS

No experiencing net decrease in difficulty	Two
No experiencing net increase in difficulty	Ten
No experiencing no change in difficulty	Two

QUESTIONS

No experiencing net decrease in difficulty	Two
No experiencing net increase in difficulty	Eight
No experiencing no change in difficulty	Two

Table A.40 Chemistry

	+	0	-	(0++)	(-)-(0++)		+	0	-	(0++)	(-)-(0++)
AH	0	6	2	6	-4	Q_1	1	4	3	5	-2
SF	4	2	2	6	-4	Q_2	0	3	5	3	+2
AD	3	2	3	5	-2	Q_3	0	6	2	6	-4
SN	1	3	4	4	0	Q_4	2	4	2	6	-4
CG	0	6	2	6	-4	Q_5	0	4	4	4	0
HM	0	7	1	7	-6	Q_6	2	4	2	6	-4
IG	0	4	4	4	0	Q_7	1	4	3	5	-2
BM	0	1	7	1	+8	Q_8	2	2	4	4	0
Totals	8	31	25	39	-14	Totals	8	31	25		

% of total possible responses (64)
    13 48 39   61

STUDENTS		QUESTIONS	
No experiencing net decrease in difficulty	One	No experiencing net decrease in difficulty	One
No experiencing net increase in difficulty	Five	No experiencing net increase in difficulty	Five
No experiencing no change in difficulty	Two	No experiencing no change in difficulty	Two

285

COMPARISON OF CHANGE IN PERCEPTION OF DIFFICULTY; CHANGE IN TIME TAKEN, AND THE CHANGE IN DESCRIPTION QUALITY

Key:

1 = Respondents' initials
2 = % change in difficulty perception from Tables **A.32**, **A.33** and **A.34** (Appendix XXXV)
3 = % change in time taken, from Tables **A.34**, **A.35**, **A.36**, and **A.37** (Appendix XXXVII)
4 = % change in description quality Tables **A.12**, **A.13** and **A.14** (Appendix XXII).

Adult education				Civil engineering				Chemistry			
1	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**
SF	0	-105	+8	SB	-3	-	+3	AH	-2	-5	+2
SL	-19	-120	+1	PJ	-4	+75	+61	SF	0	+5	+6
PB	-7	+25	-5	LO	-1	-15	-8	AD	-1	-30	+1
KL	0	+50	+7	CS	+3	-20	-17	SN	-4	-15	+4
JA	-1	+40	+4	GR	+8	-15	-7	CG	-2	-5	-3
AP	-4	-60	+10	GU	-	-25	+17	HM	-1	-10	-4
HS	0	-75	+14	GD	+4	+60	+61	IG	-4	-10	-3
CB	+1	0	+9	DJ	+2	+15	-7	BM	-9	-15	-6
LB	-11	-25	+9	DM	-	-50	-7				
JR	-10	0	+26	CB	-9	-15	+7				
SH	-4	-25	+20	FM	-8	-	-25				
SR	+4	0	+1	JM	+3	-	+41				
				AP	-8	+60	+42				
				WS	-4	-	+14				
				FB	+3	-	+11				
				MG	+2	-	+25				