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ABSTRACT

The Institute of Educational Technology of the British Open University evaluated an Open University broadcast course in the chemistry of carbon compounds. Industrial chemistry was a separate but parallel component of the course which was presented by television and radio broadcast. Questionnaires, telephone interviews, and group discussions were used to evaluate the television and radio presentation of the industrial chemistry component. By the end of the course, students recognized the unit as worthwhile. The television program was viewed by most of the students, and they praised the production as clear and informative. The radio talk broadcast received some criticism and only about one-third of the students listened to it. Students who missed both the television and radio programs were twice as likely to fail or to withdraw from the course as students who missed neither. (CH)

Broadcast Evaluation Report No. 4

INDUSTRIAL CHEMISTRY COMPONENT

S24 : TV7

R3

Audio-Visual Media Research Group
INSTITUTE OF EDUCATIONAL TECHNOLOGY
Open University

Broadcast Evaluation Report

No. 4

Television Programme 7	"Industrial Preparation of Acetic Acid".
Radio Programme 3	"Economics in the Chemical Industry".
Related Text	"Industrial Chemistry: a Parallel Reading Text".
Open University course S24-	"Introduction to the Chemistry of Carbon Compounds".

Evaluator	Margaret Gallagher, Research Officer, Institute of Educational Technology.
Producer	Barrie Whatley, BBC.
Academics	Roger Hill, Senior Lecturer, Science. Len Haynes, Professor, Science.

Audio-Visual Media Research Group,
Institute of Educational Technology,
Open University.

April 1975.

CONTENTS

Appendices are not included with the Main Report but are bound separately and are available, on request, from the Audio-Visual Media Research Group. They contain:

THE 1974 BROADCAST EVALUATION PROGRAMME

Aims

This report is one of a series of 18, based on evaluations of 35 Open University programmes carried out during 1974, by the Audio-Visual Media Research Group of the Institute of Educational Technology, in conjunction with the BBC.

What we are trying to do in these studies can be summarised as follows:

1. to discover typical or potential uses of broadcasting within a faculty area, to see whether these succeed, and whether improvements are needed, with the idea of generating information useful for decision-making in new courses likely to use broadcasting in a similar way.

2. to provide producers with information about certain issues which arose during the making of a specific programme - for example, did students find a particular technique helpful or not?

3. to discover practical difficulties encountered by students in using broadcast material (e.g. awkward transmission times, late mailing of related printed material, etc.), and possible ways of overcoming these difficulties.

4. to produce information which will generate and test some assumptions made by the Audio-Visual Media Research Group about the uses of broadcasting in the Open University, and how students use or learn from broadcasts. Some of the questions to which we are seeking answers are:

   (i) to what extent do students benefit or suffer as a result of the position of a broadcast in a course?

   (ii) do students require more help in identifying the function of broadcasts and how to use them in their studies than is currently accepted in course production?

   (iii) do course teams make the fullest use of the potential of broadcasting in the Open University situation?

5. to involve producers and academics in a detailed evaluation study, with the aim of demonstrating some of the evaluation methods available, and how to select and use these methods, so that producers are more aware of what they might do themselves, and of the limitations and difficulties of certain approaches to evaluation.

Criteria

It can be seen that the emphasis in the studies is on the improvement of broadcasting as a teaching device. We are more concerned with learning how to make future programmes more helpful for students, than with passing summary judgements on individual programmes, or on broadcasting as a whole. On the

other hand, it would be misleading for us to pretend that the evaluation reports were totally objective, and unsullied by the values held by the evaluators themselves, or by the producers and academics involved in the studies. For improvements to be suggested, some model, however vague, is necessary of what broadcasting ought to be doing in the Open University. For this reason, we will try to make explicit what criteria we have had in mind when we have been studying programmes.

First of all, we have been concerned to examine whether the broadcasts have been made with a clear educational intent, in the sense of providing the student with knowledge or experience relevant to the course he or she is pursuing. This is an important point, and it is crucial to the likely acceptance of the evaluation reports that our intentions here are fully understood. Certainly we have in general tried to avoid judging whether the educational aims of the programme were the right ones, at this stage of our enquiries. Whether a particular way of using television or radio is appropriate in the Open University situation cannot be determined by evaluation of a single programme. A programme may fail for many reasons, none of which may be connected with the educational intentions underlying the programme, or with the way it was made. It is hoped, though, that as we increase the number of programmes evaluated, it will become clear that certain kinds of intention behind a programme will be very difficult to achieve, that others require certain pre-requisites or conditions, while yet more can usually be achieved with ease in the Open University situation. In other words, we have tried to avoid commenting on whether a programme should or should not have chosen, as a matter of principle, for example a case study approach, or a particular topic as a case-study, at a certain point in time. What we have been concerned with, though, is whether there was at least some kind of educational purpose behind the choice of the material or approach, and whether in fact the students were able to discern this purpose, and use the material provided in a relevant way (even if the way the material was used was unanticipated).

The question of whether a programme is relevant or not is much more complex. This is a judgement that we would prefer to leave to the course team. Nevertheless, the students' perception - rightly or wrongly - of a programme's relevance is of course crucial to the likelihood of the programme succeeding in its intentions, and this has been an important part of our enquiries. In general, though, we have proceeded on the assumptions that the course team at least believes the programme has relevance to a course.

Another criterion generally present in our evaluation of particular television programmes has been whether the programme has been able to provide students with knowledge or experience which it would be difficult to provide as cheaply or conveniently in any other way in the Open University situation. It is not a criterion we would wish to apply mechanically, without other considerations being taken into account. There is considerable virtue in providing students with a variety of programme formats, and under certain circumstances we recognise it will be more convenient or appropriate to use

television, when radio or print could well have been used instead. Nevertheless, television is a scarce resource within the University, and therefore we believe that our evaluation should concern itself to some extent with the potential of broadcasting for uniquely bringing certain knowledge and experiences to the student.

A third criterion we have borne in mind is the extent to which the intended relationship between broadcast and text has been achieved, and the extent to which students have been able to integrate broadcasts with the rest of their activities. Occasionally, of course, programmes are deliberately designed to stand alone, but nevertheless there is usually some assumed relationship between broadcasts and texts, and so we have been concerned to discover whether students themselves have been able to make this integration.

When preparing these evaluation reports, we have tried to avoid incorporating in the reports our own judgements on the artistic or aesthetic quality of a programme. This is not because we have been uninfluenced by such factors, nor because we believe them to be unimportant. However, although we have very clear preferences for some programmes over others, which may well show through in some of the evaluation reports, our views on this aspect of a programme are not likely to be better based than anyone else's. Furthermore, we believe that it would be very difficult to draw conclusions for future programme-making as a result of an interpretation of the aesthetic quality of a programme. There are, as will become apparent from the evaluation reports, enough mundane matters which need to be altered or improved, without our having to enter this difficult area. Similarly, we have not generally been too concerned with techniques of programme-making, except where we have been asked specifically by a producer or academic to investigate whether certain techniques have enhanced or impeded the educational aims of a programme, or where it has become clear from student responses that problems have arisen as a result of techniques used in the programme. The emphasis of the evaluation therefore is intended to be very much directed towards the educational aspects of the broadcasts.

Evidence

Besides trying to make explicit the criteria which have guided us in these studies, we ought also to clarify the relative importance we have given to various kinds of evidence. For instance, although obviously a programme stands a much better chance of achieving its objectives if it is rated highly by students, in terms of usefulness, interest, enjoyment, etc., we have not been content to accept this as a main criterion, for a number of reasons. It will become clear on reading our studies that students or even tutors are not always the best judges of the relevance or even the intellectual weight of a programme. Furthermore, students vary in their reaction to different programmes, and frankly we are more interested in discovering why a programme helps one group of students and not another.

Nor have we put heavy reliance on the more classical type of evaluation evidence, that derived from performance tests. The main aim of a programme is seldom to introduce important and fresh cognitive content. If the ideas are that important, they are nearly always dealt with in the correspondence texts as well. Therefore it is often impossible to deduce from performance tests alone what a student has learned from the broadcast, and what he has learned through the correspondence text. In addition, performance tests rarely indicate what corrective action is necessary to improve a programme. There are often other important aims behind a programme which are not strictly content-based, and many of the reasons why programmes do not succeed as well as they might have nothing to do with the actual content of the programmes. Performance testing therefore is, on its own, too narrow a base for evaluation, but nevertheless it still has a useful role in our studies, used in conjunction with other evidence.

Group discussions can be extremely useful for generating ideas about why programmes have succeeded or failed, and what kind of improvements could be made. However, a group discussion can also be very untypical of the general student reaction to a programme. The initial reaction of the first student to respond to the programme tends to set the tone for the rest of the group. Furthermore, students usually watch in isolation, rather than in groups, and the group situation stimulates students to think about a programme in a difrerent way to that of the isolated student.

Evidence from the standard University feedback sources, such as CURF (the Course Unit Report Form), CT4 (Course Tutor Reports), and Staff Tutor reports, is sometimes lacking for a specific programme, and when it does exist, is usually not detailed enough. Furthermore, both CURF and CT4 suffer from low response rates, and so one is never sure whether the information is representative.

Finally, even specially designed questionnaires, based on a representative sample, and with high response rates, suffer from the superficiality of response to the questions set. Telephone interviewing can sometimes overcome this, but 40% of our students do not have telephones.

It can be seen therefore that every source of evidence, taken alone, has its drawbacks. We have therefore tried to create a situation where information from a wide variety of sources has been collected, so that with the relevant producer and academic we can build up a coherent picture of the way a programme has been used by students, the relationship of the programme to the rest of the course, the consequences for different kinds of student, and ways in which the programme could be made of more benefit to students.

Method

To do this, we have developed a method which we have used fairly consistently in nearly all the 18 studies, and which we hope to continue to use in 1975.

We invited in late 1973 senior producers in each of the six faculty areas to suggest between three and five programmes each, which were examples of typical or potential uses of broadcasting within a faculty area. Each senior producer

responded, and when the offers were examined in detail, it became clear that in some cases two or more programmes were linked together, and could be examined within one study. In effect, we were offered altogether 21 television programmes and six radio programmes. One television programme was not evaluated, as we were given the wrong programme number, and another programme was not evaluated because of pressure of work. In addition, we were also involved in a separate study of M231 (Analysis) which includes an evaluation of a further six television and four radio programmes (Ahrens, Burt and Gallagher, 1974). Thus the following programmes were included in the 1974 evaluation programme:

TABLE 1. Programmes evaluated in 1974

Evaluation Report No.	Faculty	Course	Television programmes	Radio programmes	Evaluators
15	Arts	A302	TV9	-	Gallagher
18		AMST283	TV8	-	Bates
6	Social	DS261	TV4	-	Gallagher
7	Sciences	DS201	TV6	Radio 9	Bates/Roberts
11		DT201	TV7	-	Gallagher
2	Educational	E221	TV3	Radio 6	Gallagher
8	Studies	E221	-	Radio 15	Gallagher
17		E283	TV6/7/8	-	Gallagher
10		E351	TV4/5/6	Radio 7	Bates
1	Mathematics	M231	TV1/2/3/4/5/6	Radio 1/2/3/4	Gallagher
12		MDT241	-	Radio 4	Gallagher
4	Science	S24-	TV7	Radio 3	Gallagher
9		S323	TV9	-	Gallagher
16		SM351	TV7	-	Gallagher
5	Technology	T100	TV26	-	Gallagher/Roberts
13		T241	TV11	-	Bates
14		T241	TV12	-	Bates
3		T291	TV6	-	Bates
18		15	25	10	

The way the sample of programmes was drawn requires justification. This was the first time that a detailed evaluation of a series of programmes had been attempted. (Two previous studies in 1972, one on E283, TV4/5 and Radio 9, and one on MST282, TV1-4 had been attempted, but at the express request of the producers involved). It was therefore necessary to ensure co-operation from the BBC. It was considered that the study would be more welcomed if the BBC itself was allowed to suggest the programmes to be evaluated. In any case, with over 800 television programmes and a similar number of radio programmes current in 1974, it was impossible either to choose a sample large enough to be representative of the whole BBC/OU output within the resources available, or for us ourselves to have a broad overview of the total production of programmes. We believe that the Senior Producer is in the best position to know the full range of output within his faculty area. Indeed, a major interest for us was to see what kind of programmes would be offered. In any case, it must be remembered that the aim of the evaluation is not to evaluate broadcasting as a whole, but to try to improve the use of broadcasting. If the programmes offered were therefore indeed representative of even just the future thinking of the producers in a given faculty area, this would be sufficient for our purpose. The danger of course is that programmes which are considered to be especially outstanding, or programmes where there is profound disagreement between producers and academics about their value, might be offered instead. Even should this have happened, though, there would be value in this. In effect, we were offered a very wide range of programme. Many without doubt were typical, while one or two were pointers to possible new developments in the use of broadcasting. The main weakness was the small number of radio programmes offered. Only two of the ten radio programmes were specifically offered, the remainder being dragged in through being linked to television programmes. This pattern in fact is being repeated in 1975. It is very difficult to obtain recommendations for radio programmes for evaluation, and this - together with some of the evaluation results - does suggest a serious undervaluing of radio, even in the BBC.

Once the sample had been settled, a work-plan for the year was worked out, to ensure a spread of work-load across the year. This led to programmes being allocated to each of us, six studies to Bates, and twelve to Gallagher. Between two and four weeks before the repeat transmission of a programme we would view the programmes on video tape, skim-read the text, supplementary material, and course guide, looking at the relationship between the text and programme, and then go and see the producer, and where possible the academic responsible. This interview was informal and unstructured, but the aim of it was to determine what the producer and academic were trying to do in the programme, what they would like us to find out, and any special difficulties which were encountered in getting the programme made, or difficulties anticipated when the programme was transmitted. Producer and academic were interviewed separately. These interviews and our examination of the broadcast and relevant printed material provided us with the basis for a questionnaire. Occasionally, where the subject matter was particularly difficult, the educational technologist attached

to the course team would provide help in explaining or suggesting difficulties, and in the wording of certain "test-type" questions. The draft of the questionnaire was then circulated to the producer and academic, for their further suggestions and approval, and to the University's Survey Research Department, for an independent view on the wording of questions. At the same time, the University Data Processing Division was asked to produce a random sample of generally about 200 students, with three sets of address labels, for postal questionnaires, and an independent random list of 50-100 students with telephones. This sample was drawn to avoid students on other studies (e.g. CURF). It was considered the minimum number necessary to give a reliable sample on each course (see the report itself for its error factor, as this varied from study to study.)

The questionnaires varied from study to study, but most contained questions about if or when the students watched or listened, reasons for missing the broadcast, (if they had missed it), whether they had read the unit and broadcast notes before or after seeing the programme, and where they were in the course, how useful, enjoyable, and difficult they found the programme, what they thought the purpose of the programme was, usually some questions about the content of the programme, sufficient to assess whether they had understood what the programme was about, and then questions specific to the programme being studied. Students were also usually asked how they were finding the course. A feature of all the questionnaires was the combination of pre-coded and open-ended questions. Students were asked, for instance, not only to rate the programme on a fixed scale of usefulness, but also to give reasons for their answer. The questionnaires were posted to arrive within five days of the second transmission of a programme. (Where two or more programmes were involved in a single study, the procedure varied, according to circumstances). A reminder was sent within 10 days, and a second reminder within another 10 days. These reminders boosted response rates considerably, most averaging over 70%.

On some studies (9 in all), the postal questionnaires were backed up by about 50 telephone interviews. These were used where there were doubts about whether a postal questionnaire would provide the information required in sufficient depth. The telephone interviews also proved useful as a general cross-check with questionnaire information. The interviews would be carried out over a period of five days in the evenings, by the whole evaluation team, sometimes supplemented by part-time - but trained - interviewers, and sometimes the producer was also used as an interviewer. In one instance, a group discussion was held with six students by telephone, using conference-call facilities. The decision whether to use telephone interviewing was also governed by the work-load in a particular week. Thus, on some enquries, although it was desirable, it was not practical.

Again on some studies (6 in all), group discussions were arranged, where the programme was shown to a group of students. The procedure was to contact a staff tutor and find out whether any classes or day-schools were arranged within a week of the transmissions. Sometimes a discussion could be specially

arranged. We would copy the programme from 1" Ampex on to ½" cassette, and take a VCR machine to the study centre, and show the programme to about 10-30 students. (Staff tutors had usually written to students to tell them we were coming, or even to invite them specially.) The discussion would be deliberately loosely-structured, led by the evaluator. Sometimes the producer attended, but was not always announced. The first question was usually: "What did you think of the programme?" The evaluator would normally have a range of questions prepared. In most cases, it was not necessary to put these questions, since they tended to be covered spontaneously in the discussion, but if the discussion began to drift away from the programme, one of these questions would be asked, in order to bring the discussion back to the programme. The discussion was sound recorded, and later transcribed. The aim of these discussions was to obtain ideas about the programme and what it meant to students, which we could not anticipate. Ideally, we would like to have based the postal questionnaire on the discussions, but these discussions had to be held after the transmission, and there was insufficient time to incorporate points from the discussions in the questionnaires. Used in conjunction with questionnaire, and other data, however, the discussions are useful for providing insight into student's ideas about broadcasting and how they use it. There is considerable evidence though from the evaluation reports that such discussions can give a very misleading impression of general student reaction, particularly if the producer is present. We also tried to hold group discussions at summer school for three of the studies, but these turned out to be either impossible to carry out (no-one turned up for two) or of no value for our purposes.

Finally, we have made use of other feedback information available, particularly course unit report form data, course tutor feedback from the CT4, and CMA feedback.

Pre-coded data from postal questionnaires and telephone interviews are hand-counted, and the open-ended comments are typed for each question. The quantitative and qualitative data are then sifted, and with manual cross-checks, a general picture is built up in the form of a full report. This report draws not only on information from this specific enquiry, but also on information from the other studies. This cumulative build-up of information is extremely important. For instance, a finding which looks none too solid in a single study - because, for example, it may be based on small numbers - becomes much more significant when the finding is repeated in several different independent studies. Similarly, a finding which has a number of possible explanations in one study can be more confidently explained in the light of similar findings in other studies. We have in fact waited until data from all 35 programmes have been collected before the first evaluation study has been written (with the exception of the M231 study.)

Nevertheless, it would be wrong to stress too heavily the level of certainty of our findings. We do not wish to give a pseudo-scientific gloss to our enquiries. It must be remembered that these 18 studies were carried out over a period of just six months (April to September 1974). The entire team

consisted of two evaluators, a research assistant (Carrie Roberts) a secretary shared with other IET staff, and a "spending" budget of £1500 for the whole year. In addition, the Group was involved in other major studies (e.g. piloting a VCR system in study centres) and heavy committee work. Nevertheless, a new study was being started almost every week during the six-month period. The actual combination of methods used was often just as much due to matters of expediency as to carefully designed research method. Nevertheless, we believe we were right to go for as many programmes as possible, and a wide variety of sources of information even if this has meant obtaining "quick and dirty" information. Table 2 summarises the sources of information available and used in each enquiry.

TABLE 2. Sources of Information Used on Each Enquiry

Evaluation Report No.	Programmes	Specially designed postal questionnaire	Telephone interviews	Group discussions	CURF	CMA (feedback)	CT4
15	A302/TV9	X	-	X	X	-	-
18	AMST283/TV8	X	-	-	X	-	X
6	DS261/TV4	X	X	-	X	-	X
7	DS261/TV6	X	X	X	X	-	X
11	DT201/TV7	X	X	X	X	-	-
2	E221/TV3/ Radio 6	X*	-	-	-	X	X
8	E221/Radio 15	X	-	X	-	X	X
17	E283/TV6 8	X	-	-	X	X	X
10	E351/TV4 6/ Radio 7	X	X	-	X	-	-
1	M231/TV1 6/ Radio 1 4	X	X	-	X	X	-
12	MDT241/Radio 4	X	X	-	X	-	X
4	S24-/TV7/ Radio 3	X	X	-	-	X	X
9	S323/TV9	X	-	X	-	X	-
16	SM351/TV7	X	X	-	-	-	-
5	T100/TV26	X	-	-	X	-	X
13	T241/TV11	X	-	-**	-	X	-
14	T241/TV12	X	-	-**	-	X	-
3	T291/TV6	X	-	X	-	X	X
18	18	18	8	6	10	9	10

* = questionnaire also sent to tutors

** = tried, but failed

At the same time, because we have been in a unique position of having studied a number of programmes across all faculty areas, we have risked interpretation and occasionally speculation. This explains why we have prepared such a full report, with as much information as possible available. We hope that the report is presented in such a way that the reader can draw his or her own conclusions about the validity of the results, and our interpretation of the results. In the long run, we believe that the real value, if any, of these reports will be in the stimulus and thought they provoke amongst those concerned with using broadcasting, rather than with the specific recommendations and conclusions. However, for those too busy to work through the full report, we have made recommendations and conclusions, and produced these in the summary.

Finally, just as important for us as the results themselves has been the co-operation that has resulted between producers, academics, students and ourselves. These evaluation studies have been, without exception, supported in every possible way by BBC producers, students and OU academics. Frankly, we underestimated both the amount of work involved for ourselves, and the willingness of producers and academics to engage in the actual process of evaluation, and we hope to involve both groups more fully in 1975. The evaluation studies are due just as much to the efforts of students and the academic and production staff, as to ourselves. At the same time, just as the producer has to take the final responsibility for a programme, so we must take final responsibility for these evaluation reports. They do represent in the main our own views, and we must take responsibility for any errors or offence caused by the report.

Industrial Chemistry Component

in

S24- "An Introduction to the Chemistry of Carbon Compounds"

The Course

S24- is a ½-credit Second Level course in chemistry: it is a "theoretical" - as opposed to a "practical" or "applied" - course, providing an intensive study of one chemical element - carbon. The study of carbon compounds, or organic chemistry, is justified on two main grounds. Firstly, since the chemistry of carbon compounds has been explored more deeply than the chemistry of the compounds of any other element, "information is available for a very deep study of structure and bonding theories."[1] Secondly, a knowledge of carbon chemistry "is a necessary prerequisite for undertaking in-depth study in the life sciences."[1] Both of these factors underline the essentially theoretical orientation of the course.

However, one of the course objectives is that students should have an understanding of some of the applications of the theory studied. Students are expected to demonstrate their understanding "of the interrelationships of chemistry, technology and society by:

(a) indicating the scientific basis of a given technological development"[2] and by

"(b) indicating social consequences of a given application of science or technology."[2]

The "applications of the theory" are dealt with in one major mode - an almost entirely free-standing "industrial chemistry component", made up of one television and one radio programme and a "Parallel Reading Text" entitled "Industrial Chemistry." No reference is made in the course's introductory booklet to this industrial component and its place in relation to the rest of the course, apart from one brief footnote on the back cover of the booklet: beneath a list of Unit titles for S24-, it reads "From Unit 7 onwards, students should also read 'Industrial Chemistry - A Parallel Reading Text.'"[3] This is the sole mention, in the introductory material to the course, of the existence of a Parallel Reading Text.

The course contains eleven printed Units, each with a corresponding television programme. This "correspondence" is best interpreted in terms of "scheduling": while generally the programmes are integrated with the printed material, they occasionally deal with a separate topic. The television programmes are transmitted at fortnightly intervals. There are three radio programmes transmitted at five and six-weekly intervals. Since S24- is a ½ credit course, it must be combined with a $\frac{1}{6}$ credit (6 units) course to make up a half-credit course of 17 units. Students are expected to have finished the main bulk of their work on S24- before attending Summer School in July or August, after which they continue with work on

1. S24- "An Introduction to the Chemistry of Carbon Compounds - Introduction and Guide to the Course", Milton Keynes: Open University, p.7.

2. Op. cit., p.15.

3. Op. cit., p.24.

their one-sixth credit components.

The Industrial Chemistry Component As a Whole

The industrial component as a whole is designed to give "an appreciation of the place of chemistry in the chemical industry."[4] It consists of (i) the Parallel Reading Text, a 20-page booklet meant to be read in parallel with Units 7 to 11 of the course. The Text has particular connections with Units 9 and 11. (ii) a Television Programme, broadcast when students, if on schedule, will have just started work on Unit 7. (iii) a Radio Programme broadcast when, again if on schedule, students will have just finished work on Unit 7. A question testing the objectives of the industrial component forms part of the tutor-marked assignment covering Unit 11 at the very end of the course.

Apart from the already mentioned footnote reference to the Parallel Reading Text in the course's introductory booklet, students' first encounter with the industrial component is likely to be just before the first transmission of TV7. If they are in the habit of referring to broadcast notes before watching or listening to programmes (and they are strongly advised to do so[5]) students will find that there are, in fact, no broadcast notes for TV7: instead they are advised to refer to the Parallel Reading Text. Here they will find both pre- and post-broadcast material for the television and radio programmes which form part of the industrial component.

The pre-broadcast material consists of a 3-page introduction to both programmes, giving details of various processes which have been, or are, used for the manufacture of acetic acid (the chemical whose preparation is discussed in the programmes), and some background information to the petrochemicals industry. It also lists five questions which, it is suggested, should be borne in mind while watching the television programme, and contains a two-page display sheet setting out the structure of the radio programme. The post-broadcast material in the Parallel Reading Text consists of a more detailed discussion of some of the major points made in the programmes and of their implications, photographs of the chemical plant seen in the television programme, and a diagrammatic representation of the chemical process described in the programme. Students are advised to skim-read the post-broadcast material immediately after viewing TV7 and then to re-read the text more carefully after reading Unit 11. The text contains several references to Units 9 and 11, and a concluding Self Assessment Question designed to test all the objectives of the Parallel Reading Text.

These objectives may be taken as those of the Industrial Chemistry Component as a whole: they thus subsume those of the broadcasts, with which we are more directly concerned and which will be dealt with in detail. Briefly, the objectives of the text require that students should be able to: define and use the terms, concepts and principles covered in the industrial component; categorize a given piece of information about a chemical process as relevant to the topics covered;

4. S24- "Industrial Chemistry - A Parallel Reading Text", p.4. (Appendix A)

5. S24- "Introduction and Guide to the Course", p.10.

recognize the implications of the existence of certain reactions and conditions in a chemical process; identify factors related to the economic viability of a chemical process.[6]

The Programmes: Context and Purpose

TV7: "The Industrial Preparation of Acetic Acid"

The television programme is a filmed location visit - a field trip, in which students are taken by a member of the course team, Len Haynes, into industry to see at first-hand a process for the production of acetic acid. Len Haynes introduces the programme on location explaining that this will be rather different from the previous, laboratory-based, programmes in the course, and will attempt to show the difference between laboratory preparation of chemicals and their preparation on an industrial scale. During the programme, the actual production process is broken up by discussion between Len Haynes and key research and production workers at the factory (B.P. Chemicals at Hull). The discussion covers the research history, and significant points in the development of this particular chemical process. The links between research and development are pointed out, and the function of the various stages in the developmental process is explained. Graphics and animated diagrams are used (a) to hold on the screen factual information - the composition of chemical components (b) to illustrate diagrammatically the production process and the function of the various parts of the plant. The programme is in colour.

Radio 3: Economics in the Chemical Industry

This is a programme in which two members of the course team, Roger Hill and David Jackson, talk about the role of economics in industrial chemistry. The pervasiveness of economic viability in industry is considered in terms of those factors which an industrialist would have to consider when deciding whether to develop a particular process.

Discussion with the producer of the programmes, Barrie Whatley, and with one of the other course team members who contributed to the Industrial Chemistry Component Roger Hill, revealed no major differences in their individual views of what the component as a whole, or the specific programmes, had set out to achieve.

The two programmes were made to contribute to the same purpose: they therefore share the same objectives, although the radio programme placed more emphasis on the cost factor, while the television emphasised the developmental stages in the acetic acid process and the technical constraints common in industrial chemistry. The aims of both programmes were identified on two levels:

General

(1) To give an appreciation of the place of chemistry in the chemical industry.

(2) To provide insights into the industrial chemical environment.

6. S24- "Industrial Chemistry - A Parallel Reading Text", p.3.

(3) To give an understanding of some of the similiarities and differences between the industrial manufacture of chemicals and the preparation of chemicals in the laboratory.

Specific

(1) To give an appreciation of the phases involved in achieving a commercially viable industrial process.

(2) To give an appreciation of the central role of such 'simple' factors as:-
Corrosion
Fabrication Technology
Separation and Purification Techniques
in determining whether a process will be commercially viable.

(3) To show that on an industrial scale energy use, i.e. steam, cooling capacity, power demand, must be considered on an equal footing with product yield.

(4) To show why the above factors, coupled with availability of raw materials and possible product markets, often lead to a very different process for obtaining the product than would normally be used in the laboratory.

The purpose, then, was to give not only specific data or information (General aim 3) and an awareness of particular applications of chemistry (General aim 1), but to convey a certain experience or sense of involvement in an environmental sense (General aim 2).

These aims are not, in fact, explicitly made known to students in the pre-broadcast material, although the first is referred to in the Parallel Reading Text as an aim of the industrial chemistry component as a whole, and the third is mentioned at the beginning of both the television and the radio programmes. Although the purpose of the programmes is not spelt out to students in terms of specifically stated aims and objectives, the evaluation of the programmes on the basis of the above aims is justified since these were undoubtedly real aims for the producer at the time of programme production: this can be verified by reference to early course preparation documents.

Method of Evaluation

Because of the considerable time-lapse between the transmission of the programmes and the scheduled finishing date for work on the industrial chemistry component (a period of about three months) it was decided that a two-stage evaluation would be appropriate. Moreover, it was decided that the evaluation should not simply concentrate on a study of the programmes, but should investigate the general feasibility of using separate, parallel material.

The print material related to the industrial component was read and both programmes viewed and listened to several times. After discussion with Barrie Whatley and Roger Hill in early April, a questionnaire (see Appendix C), designed to elicit basic attitudes and immediate reactions to the programmes, was mailed to a sample of 330 students registered for S24-. The sample was selected by computer as representative of all students taking that course, and in fact consisted of 44% of students registered for S24- at that time.

Since there was a delay of a fortnight between the first transmission of the television programme and the last transmission of the radio programme, this initial questionnaire was mailed to arrive after the television broadcasts, but before the radio broadcasts. Two reminder letters were sent out to those students who had not replied 10 days and 20 days after the second radio transmission. Another copy of the questionnaire was included with the second reminder letter. A total of 170 students (74%) returned usable questionnaires.

After a preliminary analysis of these responses and further discussion with Barrie Whatley, a second questionnaire (Appendix C) was designed. This aimed to discover students' retrospective reactions to the programmes and the industrial chemistry component at a time when they should have been able to place this part of the course in perspective. Those students in the original sample of 230 who were still registered for S24- in July were contacted again: accordingly 217 students received the second questionnaire at the end of July, when they should have been completing work on the last assignment for the course. The same system of reminder letters was used, and a total of 110 students (51%) returned usable questionnaires. Among these were 12 students who had not returned the initial questionnaire. We received a response, then, from 79% of our original sample of 230, or from 93% of those students sampled who sat the final examination for the course.

It was assumed that the response rate to the second part of the study would not be high, since students had already completed one questionnaire and since many would be caught up in preparations for Summer School. We were also anxious to gain detailed information about aspects of the television programme which students remembered three months after having seen it. Consequently, it was decided to carry out a small number of telephone interviews so that more detailed and specific reactions could be probed. A sample of 75 students, representative of the total student population, was selected by computer. These students were written to and asked if they would be willing to co-operate in being interviewed. Of these, 12 refused and a number of others could not be contacted. Eventually, 44 (59%) were telephoned and interviewed using a schedule base directly on the second questionnaire.

A survey carried out in 1972 with about 60 students, gathered general reactions to S24-. Relevant aspects are included in Appendix G. In 1973, the CT4 (see page 4) was sent to all 27 course tutors on S24-. Relevant data is included in Appendix H. In neither case was the information collected of much help in our 1974 evaluation: both previous studies - particularly the CT4 - suffered from low response rates. However, the data is included so that the full range of existing feedback can be examined in the context of this study.

Respondents and Non-Respondents

A calculation of two standard errors indicates a sampling error of between $\pm$ 2% and $\pm$ 6%. The data can be regarded as representative of the total student population within those limits. However, our respondents were significantly more successful in terms of course completion than those who did not return the questionnaires.

Table 3. Respondents' and Non-Respondents' Success or Failure in Course Completion

	Completed course successfully		Unsuccessful in completing course		Total Sample	
	Nos.	%	Nos.	%	Nos.	%
Respondents	136	75	46	25	182	79
Non-respondents	18	37	30	62	48	21
Total sample	154	67	76	33	230	100

χ^2 = 23.7 at 95% level of confidence.

As the table shows, those 182 students who returned at least one of the questionnaires were significantly more successful in completing the course than the students who did not respond at all. Moreover, of those students who did respond, there was a significantly higher success rate among those who returned both of our questionnaires than among those who returned only one of the two.

Table 4. Respondents' Success or Failure in Course Completion

	Completed course successfully		Unsuccessful in completing course		Total respondents	
	Nos.	%	Nos.	%	Nos.	%
Respondents to only one questionnaire	46	55	38	45	84	46
Respondents to both questionnaires	90	92	8	8	98	54
Total respondents	136	75	46	25	182	100

χ^2 = 32.9 at 95% level of confidence.

It is likely, in fact, that many of those who returned only the first questionnaire, although still officially registered for S24- at the end of July, had effectively dropped out of the course by that date.

The reactions reported by our respondents, therefore, particularly in the second part of the study, must be regarded as presenting a picture of the Industrial Component in the course as it appeared to the most able, or successful, students registered for S24- in 1974.

Results

Viewing and Listening Pattern

A striking contrast emerges between the large number of students who watched the television programme and the very low numbers listening to the radio programme. Tables 5 and 6 are based on responses to our first questionnaire (mailed close to the programme transmission dates). Our telephone interview sample confirmed that while over 80% watched the television, only about a third of the students listened to the radio programme.

Table 5. TV7 - Students' Viewing Pattern

Viewed at least once		Viewed Sun.0920 only		Viewed Tues.17.25 only		Viewed both transmissions		Viewed cassette		Didn't view		All students		Taped sound	
Nos.	%	Nos.	%	Nos.	%	Nos.	%	Nos.	%	Nos.	%	Nos.	%	Nos.	%
142	84	87	51	22	13	29	17	2	1	28	16	170	100	4	2

Table 6. Radio 3 - Students' Listening Pattern

Listened least once		Listened Thurs.18.05 only		Listened Sat.10.10 only		Listened both transmissions		Listened to cassette		Didn't listen		All students		Taped sound	
Nos.	%	Nos.	%	Nos.	%	Nos.	%	Nos.	%	Nos.	%	Nos.	%	Nos.	%
62	36	35	21	17	10	5	3	1	1	108	64	170	100	20	12

While very few students overall listened to the radio programme, a strikingly high proportion - a third - of those who did listen recorded it on tape, presumably to enable them to listen again later. Combining this group with students who listened to both transmissions, we can say that up to 40% of those who listened to the programme heard it more than once: in comparison, about a fifth of the student viewers saw the television programme twice.

Just under a quarter of the students in our sample were, or had previously been, employed in the chemical industry: these were no more or less likely to watch or listen to the programmes than students not employed in the industry. However, there were marked differences in the proportion in each of these two groups who watched or listened twice. In the case of both the radio and the television programme, only one-tenth of those who viewed or listened twice (we have included those who taped the radio programme) were, or had been, employed in the chemical industry. Not surprisingly, then, the vast majority of students already fairly familiar with at least some of the material presented in the programmes did not watch or listen more than once.

In the case of the television programme, the week-end morning viewing time was by far the more popular - Thursday evening at 5.25 p.m. probably being an impossible time for many students other than teachers, or perhaps off-duty shift workers. It is interesting that although the transmission times of the radio

programme appear to be rather more convenient than those of the television, this factor does not seem to have encouraged students to listen. Indeed, in this case twice as many listeners chose the week-day evening broadcast as those who listened to the Saturday morning transmission. While Saturday at 10.10 a.m. may be an inconvenient time for some - general household hubbub, shopping - it is not a sufficiently 'bad' time to have been a major reason for the very disappointing listening figures for this programme.

A more important deterrent is likely to have been the transmission pattern of the course's three radio programmes.

Table 7. Radio Transmission Pattern

Study Week	Dates	Transmission	Time Interval
1	26/29 Jan	Introductory TV Programme	
5	28 Feb/2 March	Radio 1	4 weeks
10	4/6 April	Radio 2	5 weeks
16	16/18 May	Radio 3	6 weeks

With such a sparse and irregular schedule many students were bound to forget to listen. In fact, "forgetfulness" was one of the main reasons given for having missed the radio programme: fourteen students mentioned this, while only one student gave it as a reason for having missed the television programme.

A wide range of other reasons was given for having missed both programmes but two were mentioned more frequently than others: many students said they were "at work" when the programmes were transmitted (15 in the case of the radio programme and 6 for the television). The transmission times (particularly the very early evening slots which each programme had) were probably not entirely satisfactory for those students working in industry. The other principal reason given was "lack of time": 19 students said they missed the radio, and 4 the television programme for this reason. As we shall show later, there was a general feeling among students that the work-load for the course was extremely heavy; there is evidence[7] that where students are feeling the pressure of work and are behind schedule, the broadcasts - particularly radio - will be omitted in favour of concentration on the printed material. This is supported by the fact that students who missed both the television and the radio programmes for the Industrial Component were less likely to complete the course successfully than students who missed only the radio programme, while students who heard both television and radio programmes did best of all.

7. AHRENS, S., BURT, G., and GALLAGHER, M. (1975). Broadcast evaluation report, No. 1: M231 'Analysis', Milton Keynes: Open University.

Table 8. Performance of Viewers/Listeners vs. those who missed Programmes

	Failed/ withdrew		Pass (Grade 3 or 4)		Good Pass (Grade 1 or 2)		All students	
	Nos.	%	Nos.	%	Nos.	%	Nos.	%
Saw TV/ heard radio	10	16	15	24	37	60	62	36
Saw TV/ missed radio	23	28	24	30	34	42	81	48
Missed both programmes	9	33	7	26	11	41	27	16
All students	42	25	46	27	82	48	170	100

A number of interesting points emerge from Table 8. Students who missed both programmes were twice as likely to fail or withdraw as students who missed neither. While there are no great differences in the results of those who saw the television programme and those who didn't, there are marked differences in the performances of those who heard the radio programme and those who did not - the former were less likely to fail or withdraw from the course, and more likely to obtain a "good" pass in the final examination. This is not, of course, to imply that listening to this particular radio programme determined the students' final result - rather that students who heard the programme were, on the whole, more able to cope with the course than those who did not.

Another factor relevant both to listening and performance (though not to viewing) was the number of years spent in the system. 'A' students were less likely to listen than either 'B' or 'C' students: only 20% of the 'A's listened, while over 40% of the 'C's did, and about a third of the 'B' students heard the programme. Moreover, 'A' students were less likely to be successful than the others - a third of the 'A's in our sample failed or withdrew, compared with just under a quarter of both of the other groups. It is possible that many students who in their fourth year of study at the Open University are still taking second-level courses are having to struggle to make progress. However, the tendency for 'A' students not to listen was more marked than their tendency to fail - suggesting that students may find radio programmes increasingly expendable in their later years of study.

A further interesting feature with regard to radio (but again, not television) was that some students seemed to have difficulty, later in the year, in remembering whether they had, or had not, heard the radio programme. Ten students who, in response to the first questionnaire said that they had heard the programme, said later (in the second questionnaire) that they had not - these represented 16% of all those who originally said that they heard the radio programme. A further seven students said in July/August that they had heard the programme, though earlier they had said that they had missed it. While some

of these seven could, perhaps, have listened to a recording of the programme some time after it was broadcast, only one of them actually said that this had been the case and this was the sole student of the seven who, in reply to other questions, revealed any real knowledge of the radio programme. Since there was no problem of this kind with regard to the television programme, this lapse of memory is an interesting indication of the difficulty some students appear to have with radio as a learning medium: this problem emerged from other aspects of the study, and will be dealt with more fully later.

Early Reactions to the Programmes

Enjoyment and Usefulness

In response to our first questionnaire, the overwhelming majority of those who watched and listened found the programmes enjoyable and interesting. As Table 9 shows, listeners to the radio programme were more inclined to be non-commital: the largest single group said it was "all right".

Table 9. Extent to which Viewers/Listeners Enjoyed the Programmes

	Very much		Quite a lot		It was all right		Not very much		Not at all		Don't know		No answer		Total viewers/ listeners	
	Nos.	%	Nos.	%	Nos.	%	Nos.	%	Nos.	%	Nos.	%	Nos.	%	Nos.	%
Television	30	21	63	44	41	29	6	4	2	1	-	-	-	-	142	100
Radio	7	11	20	32	28	45	5	8	-	-	1	2	1	2	62	100

The radio programme, then, was the rather less popular, but was still found enjoyable by a high proportion of those who listened. A similar pattern emerges for the extent to which the programmes were found interesting: only 10% and 20% respectively said the television and radio programmes were not interesting, the rest being split fairly evenly between those who found it "very" and "fairly interesting". The programmes were found enjoyable because they gave "valuable insight" into the production of chemicals, and for the "reality" which they added to the abstract theoretical material presented in the written texts. "Emphasises the fact that chemistry is not only a theoretical subject but that the practical aspects can be translated from laboratory to industrial plant using essentially the same concepts." The majority of students welcomed the opportunity to see something of which they had little or no previous knowledge but which was "readily understandable". Others said they found the television programme "a welcome change": "it made a break from the test tube and blackboard chemistry we have been watching in previous programmes". About a tenth of those who viewed (14 students) saw this programme in colour, and three of them mentioned this spontaneously as an aspect which had enhanced this particular programme. Many students - about 20 - referred to the "clear and informative" presentation of the television programme: one comment summarises well the reactions of most of these students: "It seemed to me to be a well made, well-balanced programme which

covered most aspects in an interesting way without going into too much confusing detail."

Those who did not enjoy the programmes were, for the most part, just not interested in industrial chemistry, preferring laboratory chemistry and micro-analysis. Several said that they were "well behind at this part of the course" and a few others could not see the relevance of the material to the rest of the course. In the case of the radio programme, students were more critical of the programme content and presentation, finding it "monotonous" and "repetitive", "obvious" or just "common sense". Finally, four students - a fifth of all who commented on their lack of enjoyment of the radio programme - specified difficulties in concentrating on and learning from radio: "I have great difficulty in following most of the radio lectures. This is not due to lack of initial interest on my part but, I think, because it is a much more remote medium than television." We have already noted (Table 8) that students who listened to the radio programme were more likely to complete the course successfully and to do well in the final examination than students who did not listen: in those terms, then, such students were the most able group in our sample, and this should be borne in mind when examining reactions to the radio programme.

The difference in the extent to which students enjoyed the two programmes - television and radio - was less marked than was the extent to which they found the programmes useful.

Table 10. Extent to which viewers/Listeners found the Programmes Useful

	Very		Fairly		Not very		Not at all		Don't know		No answer		Total viewers listeners	
	Nos.	%	Nos.	%	Nos.	%	Nos.	%	Nos.	%	Nos.	%	Nos.	%
Television	23	16	78	55	31	22	2	1	6	4	2	1	142	100
Radio	4	6	30	48	20	32	2	3	5	8	1	2	62	100

Again, the majority did find both programmes useful, although in the case of the radio programme this was only just over half of those who listened.

The television programme was found useful for two major, related, reasons. Students either mentioned the insights which the programme gave into the workings of a production plant: "the relationship between laboratory testing and the practicalities of the actual plant became vividly apparent"; "a good insight to problems of industry"; "a good idea of how the chemist works"; "shows what chemical works look like, how chemiatry is used industrially." Clearly, then, students appreciated the "experiential" aspect of the programme (General Aim 2, p.13), using it as a "substitute visit". Six students spoke specifically of the appropriateness of the programme format to its subject-matter: "to see a chemical plant helps to give a scale that can't always be imagined from reading"; "visual description of an industrial process helps clearer understanding". At a more general level, students found it useful to see some of the applications of theory

which they had already studied (General Aim 1, p.13): "brought into focus the practical applications of chemistry"; "stimulated thoughts about chemistry beyond laboratory level"; "made the course more realistic - up to then it had been just formulae on paper"; "broadened my view of the subject which readily is seen merely as a collection of theoretical facts backed up by laboratory demonstrations"; "showed the practical and industrial importance of the principles in the units".

However, while most students welcomed the opportunity to encounter the practical applications of certain of the theoretical aspects covered in the units, most of those who did not find the television programme useful were unable - at least at the time of questionnaire completion - to relate the programme to the material presented in the printed units: "not particularly pertinent to the course so far"; "no help with Unit 7 directly"; "no relation to text". Moreover, the six students who "didn't know" how useful the programme was, all raised this question of "relevance". Several students specified irrelevance to assignment or examination material: "not very relevant to exam in Oct./Nov."; "not really relevant to the course assignments". Six students said that they were behind in their studies and a few mentioned lack of interest in or familiarity with industrial chemistry as reasons for their not having found the programme useful.

As for the radio programme, this was valued as a "back-up" to the television in that it "clarified" or "highlighted" certain points made in the latter. The analysis of the economic factors influencing industrial chemical production was specifically cited as a useful aspect of the radio programme. However, a third of those who listened did not find the programme useful. The criticisms of these students sprang from three main sources: firstly, the question of "relevance" - or irrelevance - to the rest of the course; secondly the matter of individual lack of interest in, or familiarity with, this material; and thirdly, the problem caused by radio as a learning medium.

Students who had studied, or were concurrently studying, T100, the Foundation Course in Technology would already have covered material on the chemical industry, including economics, and it was thought that this might influence their reactions to the Industrial Component of S24-. However, the 35 respondents with experience of T100 did not differ from the total sample either in the extent to which they found the programmes useful or in their reported enjoyment of the programmes. On the other hand, there was a notable difference in the response of those 37 students who had direct experience of the chemical industry: they tended to find the programme both more enjoyable and more useful than was so for the sample as a whole. For instance, while two-thirds of those who had never been employed in the chemical industry found the television programme useful, four-fifths of those who had worked, or were working, in the industry found it useful. Moreover, the latter group tended to find it more useful and enjoyable than the former: just under one-third said the programme was "very useful" as opposed to one tenth of those with no experience of chemical industrial employment. So while, as we have seen, for a few students familiarity with the material detracted from its usefulness, the opposite was more likely to be true.

Answers to the question which asked students what they thought the "point"

of the programme was, were difficult to interpret in isolation because of the different levels at which comments were made by students.[8] The groupings which have been made (Table 11) have drawn not simply on responses to this particular question but are based on an analysis of each individual complete questionnaire, in an attempt to pull together all of the information given by the student. Nevertheless, a problem remains, of course, in knowing whether students' comments reflect considered and complete reactions, or are simply an indication of the sorts of issues which came immediately to mind when answering the questions. It is quite possible, for instance, that on further reflection students would have extended and perhaps even amended their initial comments. For this reason, we refer to the 'expressed' understanding of the programmes' purpose.

Table 11. Students' Expressed Understanding of the Purpose of the Programmes

	Expressed full understanding		Expressed some understanding		Expressed no understanding		Total viewers/listeners	
	Nos.	%	Nos.	%	Nos.	%	Nos.	%
Television	75	53	41	29	26	18	142	100
Radio	26	42	15	24	21	34	62	100

The television programme, then, was more readily understood than was the radio which, on the basis of our analysis, presented problems - in terms of students' general recognition of what the programme had set out to do - for about a third of those who listened - despite the evidence, already cited, that listeners were among the most able students in our sample.

Taking the television programme on its own, it is worth noting that professed enjoyment or usefulness of the programme is no real indication of the extent to which its purpose has actually been understood.[9] Of the 75 students who fully understood the programme, almost a quarter did not enjoy it and/or did not find it useful. While these students clearly grasped the main aims of the programme: "to give one an idea of the scale and complexity of a chemical plant and the problems of transferring a reaction from the laboratory to a greater scale" or "to outline the financial and operational differences between laboratory and large scale production of chemicals", most of them were unable to see the relationship of the programme to the rest of the course, and the rest were already familiar with the material presented. On the other hand, of the 26 who did not understand the programme's purpose at all, two-thirds nevertheless said that they enjoyed it and/or found it useful, for instance in that it "gave a good insight into some of the many technological problems." However, when asked about the purpose of the

8. See: GALLAGHER, M. (1975). Broadcast evaluation report, No. 2: E221 'Cumbria Case Study', Milton Keynes: Open University, for a more detailed discussion of this point.

9. See: BATES, A.W. (1975). Broadcast evaluation report, No. 3: T291 'Instrumentation', Milton Keynes: Open University, for

programme, half of these students did not reply at all, and most of the others commented vaguely that the point of the programme was "to illustrate the text". And there were one or two who just got things wrong: "to show how acetic acid could be manufactured in a one-stage process from acetylene".

The small number of students - 8 - who neither understood the purpose of the programmes nor enjoyed/found it useful consisted of 6 who found no relevance in the televised material to that presented in the rest of the course, and 2 who were unsympathetic towards the style of the programme: "Not enough detail. Model apparatus should have been used"; "Felt that this was presented as an 'arts type' programme and contained few points of hard information." Of these 8, a couple said flatly that they didn't know what the purpose of the programme was; there were one or two specious comments: "public relations promotion for B.P.".

Finally, there were those students - 30% of those who viewed - who only partly understood the purpose of the programme. Again, three quarters of these had enjoyed and/or found the programme useful, while a quarter had not. The answers given by this group to the question concerning the "point" of the programme generally touched on just one aspect of what the programme had set out to achieve: "to show one the uses of organic chemistry", "to familiarize students with industrial chemical plants", "to promote interest in applied chemistry", "to show the complexity of the plant", "to show how research in the laboratory could save time and money when used in the actual plant." So while these comments revealed an awareness of particular aspects of the programme's intentions, they are not sufficiently full to indicate that any more than the stated points have been understood.

Turning to the radio programme, the 26 students - over two-fifths of listeners - who fully understood its purpose recognised the emphasis which the programme placed on economics and commercial viability, in that it was seen "to illustrate the many factors which have to be considered in setting up the commercial production of a chemical and how they are weighed against each other to achieve a viable industry" or "to illustrate the conflicting needs in achieving commercial success in the chemical industry." Some expressed the purpose in more general terms: "to emphasize the economic aspects of the process" or "to reinforce the TV programme from a different aspect", while others centred on the programme's emphasis on development by steps: "the various stages involved in order to decide if a chemical process is commercially viable."

About a quarter of those who listened, while not understanding the full purpose of the programme, nevertheless grasped certain aspects of it: "the contrast between the step-to-step science and the 'crossed fingers' executive decisions based on 'guesstimates'" or "the planning difficulties of industrial chemists". Many students did not see the radio programme as having a purpose distinct from that of the television programme: answers such as "to highlight factors influencing chemistry in industry", "to show the role of theory in a practical context" or even "to complement TV programme", while fair enough in a broad sense are certainly not accurate responses to the question asked and could be called to mind by 'general impressions' of the programme rather than as the result of truly critical listening.

Finally, there were those students - a third of all who listened - who appeared to have no clear idea of the purpose of the radio programme. Some did attempt to express what they thought this purpose was: "A good explanation of how process works", "To give commercial information", "To show that it is not necessary to have yields in an economical process". Others were facetious: "to fill up one radio slot", or defeated: "I'm still wondering". And 11 of these 21 students just refrained from any comment at all.

Again, as with the television programme, rating of the radio programme as enjoyable or useful was not related to students' understanding of its purpose. Each of the three groups, described as having fully, partially or not understood the aims of the programme, was divided fairly equally between those who did and those who did not find the radio programme enjoyable and/or useful.

Background, either in terms of course taken at the Open University, or work experience in the chemical industry and number of times that the programmes were seen or heard, had no significant effect on the extent to which students understood the purpose of the programmes, though those currently or previously employed in the industry did tend to express a fuller understanding. This was particularly so in the case of the radio programme: while just over a third of those without industrial experience fully understood the programme's purpose, well over half of the students with this experience did so.

Radio Programme: Relation to Television Programme

Students were divided fairly evenly on the question of the extent to which the radio programme had added to their understanding of the material presented in the television programme, though students with experience in the chemical industry were more likely to say that the radio had been helpful here.

Table 12. Extent to which Radio Aided Understanding of Television

Great deal		Quite a lot		Not very much		Not at all		Don't know		No response		All listeners	
Nos.	%	Nos.	%	Nos.	%	Nos.	%	Nos.	%	Nos.	%	Nos.	%
3	5	23	37	26	42	5	8	2	3	3	5	62	100

The extent to which the radio programme was said to have aided understanding of the televised material was not related to the usefulness rating of the radio programme itself; nor was it, as might have been expected, related to the expressed understanding of the television programme. However, there was, not surprisingly, a significant relationship between the degree of expressed understanding of one programme and that of the other.

Table 13. Expressed Understanding of the Purpose of the Two Programmes

	Radio fully/ partly understood	Radio not understood	Total viewing and listening
TV fully/ partly understood	38	13	51
TV not understood	2	8	10
Total viewing and listening	40	21	61

χ^2 = 11.00 at 95% level of confidence.

Those students who both saw the television programme and heard the radio programme, did not differ from those who only saw the television in the extent to which they expressed understanding of the television programme. However, as the table shows, few students - only 2 - who even partly understood the purpose of the radio programme did not understand the television programme, whereas over a quarter of those who grasped the television programme, even partially, still did not get to grips with the radio programme.

Less than a third of those who listened said that they had learnt anything new from the radio programme. But, again, not surprisingly, those who felt that they had learnt something new were more likely to rate the programme as useful than those who felt that they hadn't.

Table 14. Usefulness of Radio Programme and Whether Anything New was Learnt

	Something new learnt Nos.	Nothing new learnt Nos.	Total respondents to both questions
Very/ Fairly useful	16	14	30
Not very/Not at all useful/ Don't know	1	24	25
Total	17	38	55

χ^2 = 15.54 at 95% level of confidence.

Those students who felt that they had learnt something new from the radio programme made comments covering a very wide range of items. Most mentioned only one point, but several listed a number of new areas covered by the programme, and

while a few students ventured only general comments: "costing procedure to produce the chemical plant" or "difficulties of having to plan ahead", most were much more specific: "the possibility of isolating some of the partial products rather than re-cycle these into the reaction", "relation of volume and surface area of product and cost", "the importance of the rate constant rather than the equilibrium constant", "predetermination of fixed cost and variable charges", "recycling of unused starting materials", "outlet for by-products is almost as important as the main product". Comments centred on issues related to the economics of the chemical industry, and the complete range did cover almost all of the "new" points made in the radio programme. One important point which might have been mentioned, but which none of our respondents raised, was the question of the advantages of continuous rather than batch process. This may be partly explained by the fact that in the radio programme this issue is covered in relation to recycling - a topic mentioned by several students and one which is treated not only in the television programme, but which both introduces and concludes the radio discussion of the related, but more general, question of continuous/batch process.

Of those who felt that the radio programme had given them something new, twice as many had taped it as those who had heard it only once, while a few more had heard both transmissions. In the sample as a whole, on the other hand, only a third of those who listened, taped the programme. It could be, then, that in order to fully appreciate the programme, more than one hearing was necessary, and indeed there is some support for this from other studies in the series.[10] On the other hand, it must be borne in mind that radio listeners were the most successful, in terms of course completion and examination results amongst our sample of students (see above). Those who felt that they had the time to listen to the radio programme more than once could then be said to be the most able group within the sample, and therefore the group most likely, a priori, to appreciate the finer points made by the programme.

Finally, several students who felt that they had not learnt anything new from the radio programme, nevertheless said that it had given them a "clearer gestalt or overview" or that it had "put economics and industrial organic chemistry into perspective." However, it should be noted that the radio programme did have a distinct function, though one which was subsumed by the aims of the Industrial Component as a whole. While the television programme had centred on the technical aspects of chemical production, the radio programme concentrated entirely on issue of economic forecasting and viability in industrial chemistry. This point was not always fully appreciated: about a third of those who listened failed to see that the radio programme had any function distinct from that filled by other elements of the Industrial Component.

10. See, for example: GALLAGHER, M. (1975). Broadcast evaluation report, No. 8: E221 'Radio Plays', Milton Keynes: Open University.

Print Material

The material in the Parallel Reading Text was divided into two sections, one of which was to be read before the broadcasts (pre-broadcast material), and the other to be skimmed through immediately after the television programme and reread more carefully after the final course unit (post-broadcast material).

Table 15. Use of Pre- and Post-Broadcast Material With Television Programme

	Read in detail		Read briefly		Didn't read		No answer		All viewers	
	Nos.	%	Nos.	%	Nos.	%	Nos.	%	Nos.	%
Pre-broadcast material	25	18	68	48	46	32	3	2	142	100
Post-broadcast material	42	30	70	49	26	18	4	3	142	100

Just over a tenth of those who watched the programme didn't use either the pre- or post-broadcast written material, and these students tended to enjoy the programme less, and to find it less useful, than those who used the Parallel Text. However, they were just as likely to understand the purpose of the programme as those who had read the text.

There was a delay of two weeks between the first transmission of the television programme and the second transmission of the radio programme. It was felt, then, that some re-reading of the associated print material might be needed before the radio programme. In fact, over a quarter of those who listened did not read through the notes before the broadcast. The 43 listeners who did use the pre-broadcast material, did so at varying time-intervals before listening.

Table 16. Time-interval Between Reading Pre-Broadcast Material and Listening to Radio Programme

More than 1 week	More than 1 day	More than 1 hour	Just before	More than 1 week/Just before	Didn't read	No answer	Total
10	12	7	7	7	17	2	62

About three-quarters of those who used the material did so specifically in preparation for the radio programme, and it is worth noting that only two of the students who listened to the radio programme did so without having read any of the related print material. Nevertheless, the Display Sheet (Appendix B) in the Parallel Reading Text - a flow diagram setting out the structure of the radio programme, which students were advised to have before them while listening, - was actually used by only half of those who listened to the programme. Moreover, only one of those students who expressed difficulty in concentrating on radio programmes in general, and who therefore might have been expected to make use of aids such as the Display Sheet, did in fact use the Sheet. At the same time, almost all of those who did use the Display Sheet said that it was useful in helping them to follow the points covered in the radio programme.

Table 17. Usefulness of Display Sheet in helping Follow Points Covered in Radio Programme

Very useful		Fairly useful		Not very useful		Not at all useful		Didn't use it		No answer		All listeners	
Nos.	%	Nos.	%	Nos.	%	Nos.	%	Nos.	%	Nos.	%	Nos.	%
15	24	12	20	4	6	1	2	26	42	4	6	62	100

Use or non-use of the Display Sheet did not affect students' rating of the "usefulness" of the radio programme. However, use of the Sheet was significantly related to understanding of the programme's purpose: while very few who used the Display Sheet did not understand the purpose - at least partially - the majority of students who did not use the Sheet failed to express even partial understanding of the programme's purpose.

Table 18. Use of Display Sheet and Understanding of Purpose of Radio Programme

	Display Sheet used	Display Sheet not used	All listeners
Radio fully/ partly understood	27	12	39
Radio not understood	3	16	19
All listeners	30	28	58

χ^2 = 14.61 at 95% level of confidence.

*4 "no answers" to question on use of Display Sheet not included in total.

Of course, the students who used the Display Sheet while listening may well have turned back to it when answering the question about the purpose of the programme, which might to some extent explain their apparently more complete understanding

of the programme.

The Industrial Chemistry Component as a Whole: Early Reactions

The most important specified aim of the Industrial Chemistry Component was to give students insight into the differences between the industrial manufacture of chemicals and the preparation of chemicals in the laboratory. Of the students who had either seen the television programme or heard the radio programme, almost four-fifths thought the programmes had been successful in this respect.

Table 19. Extent to which Programmes gave insight into Differences between Industry and Laboratory

A great deal		Quite a lot		Not very much		Not at all		Don't know		Total viewing or listening	
Nos.	%	Nos.	%	Nos.	%	Nos.	%	Nos.	%	Nos.	%
26	18	86	60	30	21	-	-	1	1	143	100

Respondents who had both heard the radio programme and seen the television, were significantly more positive than those who had only seen the television programme, (nine-tenths as opposed to two-thirds saying "a great deal" or "quite a lot": $\chi^2 = 6.95$ at 95% level).

Answers to the open-ended question in which students were asked to comment on what they had learnt from the programmes about why differences exist between industrial manufacture and laboratory preparation, raise the question as to whether radio listeners are simply a more articulate and able group, or whether the radio programme itself contributed to the greater ability, among students who listened to list such factors. Although the majority (65%) of those who either watched or listened answered this question, proportionately fewer of the "TV only" respondents did so (60%, as opposed to 73% of those who heard the radio programme). Moreover, the range of issues and sub-issues mentioned by those who listened to the radio broadcast was much wider than that covered by those who only watched the television programme (33 as against 16). The five major points concerning laboratory and industrial differences which it was expected that students would mention, were cost/economic factors, scale, energy, process, materials.

Table 20. Points mentioned concerning Laboratory and Industrial Differences

Base. Ss students mentioning any difference *Students could mention more than one point	Students mentioning*		Expected % students mentioning
	Nos.	%	%
Cost/economic factors	60	68	70
Scale	44	50	70
Materials	20	23	20
Energy	7	8	40
Process	7	8	40
Purification	8	9	
By-products	7	8	
Output/yield	6	7	

In addition, a very wide range of minor points was raised, for example, demand/market, waste, reaction routes, re-cycling. Strictly, a number of these relate not so much to why differences exist (the question actually asked), as to what differences exist and there was clearly some misreading of the question here. It is for this reason that the gap between the expected and the actual frequency of mentions of the two major factors "energy" and "process" is perhaps not so disturbing, since mention many of the sub-issues - for example, purification, by-products, yield, re-cycling - carries an implicit acceptance of the "energy" and "process" differences. Moreover, it is possible that many of the students who mentioned only scale and/or cost, may have assumed that these factors subsumed factors such as "energy" and "process".

Students' own assessment of the extent to which the programme(s) had given insight into the differences between industrial manufacture and laboratory preparation of chemicals (Table 19) was not strictly related to their ability or willingness to say what they had learnt from the programme(s) about why such differences exist. Thus, while, as one might expect, almost two-thirds of those who felt that the programmes had given "not very much" insight into the differences failed to comment on reasons for the differences, one-third of students who said they had gained "quite a lot" and a tenth of those who gained "a great deal" of insight also failed to comment.

Questions which asked for an assessment of two further aims of the Industrial Component, firstly to explain how one particular chemical process - the acetic acid process in use at B.P. - works, and secondly to stimulate interest in industrial chemistry were answered in a way which throws some further light on the problem of weighing any contribution made by the radio programme itself, against

the possibly overriding importance of the characteristics of the students' who listened.

Table 21. Extent to which Programmes Added to Understanding of Chemical Process, and Stimulated Interest in Industrial Chemistry

	Great deal		Quite a lot		Not very much		Not at all		Don't know		No answer		Total viewing or listening	
	Nos.	%	Nos.	%	Nos.	%	Nos.	%	Nos.	%	Nos.	%	Nos.	%
Understanding chemical process	11	8	63	44	60	42	6	4	-	-	3	2	143	100
Stimulate interest	21	15	37	26	62	43	17	12	2	1	4	3	143	100

While there is no difference between our two groups (i.e. those who saw only the television programme, and those who also heard the radio broadcast) in their assessment of the extent to which the programme(s) added to understanding of how a chemical process works, there is a difference in the extent to which they felt the programme(s) had stimulated interest in industrial chemistry: while half of those who did hear the radio programme said that their interest had been stimulated "a great deal" or "quite a lot", only a third of those who did not hear the radio said this. Responses to these two questions lend weight to the likelihood that the significantly more positive response of radio listeners to the earlier question on laboratory/industrial differences may be a measure of the success of the radio programme rather than a feature of the sort of students who listen to radio programmes. Students were asked the extent to which the programmes (i.e. radio and television, if they had viewed/heard both) had added to their understanding of how a chemical process works. Hypothesising that radio listeners are a more highly motivated and generally more enthusiastic group than others, one might have expected them to be more positive in response to this question. However, they were not. Indeed the radio programme would have made little or no contribution to this particular aim, which was covered almost exclusively by the television programme. Consequently, we may be fairly confident that the responses to these various questions are valid reactions to the programmes themselves rather than expressions of motivational or attitudinal differences in the two groups of students. This leads to the conclusion that the radio programme did contribute significantly to the major aim of indicating differences between industrial manufacture and laboratory preparation of chemical (General Aim 3, p.13) and that students who did not hear the programme were accordingly disadvantaged.

The final part of our initial questionnaire asked for students' further comments on the programmes, or more generally on the industrial chemistry section of the course. Of the 57 students who commented, half simply affirmed their general enthusiasm for the Industrial section, reiterating points made earlier

such as the "visual impression" given, and the "clear presentation" of the material: "a great deal was conveyed very briefly and economically". On the other hand, about a sixth of those who commented felt that more depth was needed in the treatment of the topic, and that throughout the course there should be "more emphasis on the industrial uses of the reactions we learn about." A further group - again about a sixth of those who commented - was having difficulty with the course generally and had fallen behind the recommended study schedule. This group was split evenly between those who felt that the Industrial Component was misplaced and would be more appropriate if left until nearer the end of the course, and those who said that this section should be scrapped altogether and more help given with the difficult theoretical aspects of the course content.

Table 22. Further Comments on the Industrial Chemistry Section of the Course

	Students commenting
I.C. Section generally interesting/useful	29
More depth/coverage needed	9
Not interested in I.C. section	6
Behind schedule: move I.C. section to end of course	4
Behind schedule: omit I.C. section	4
Follow-up with actual visit to plant as tutorial/day-school	3
Other comments	2

Later Reactions: The Industrial Chemistry Component in Perspective

As we have shown, the sudden appearance of the Industrial Component while students were expected to be working on Unit 7 of the course was, to a proportion of students, inexplicable and irrelevant. Our intention, in the second stage of the study, was to discover whether attitudes to and appreciation of the Industrial Component had changed in the three months which elapsed between the first encounter with this material and the final stages of the course, when all of the course materials should have been assimilated and placed in perspective. We were moreover, concerned to discover the extent to which the Parallel Text had, as intended, been used as "parallel reading" to Units 7-11, or whether its study had been concentrated towards the end of the course.

It should be borne in mind that respondents to the second questionnaire were significantly more successful, in terms of course completion, than those students who returned only the first questionnaire (Table 4). Analysis of the two sets of data shows that those replying to the second enquiry differed from those responding only to the first with respect to radio listening figures (they were twice as likely to have heard the programme as students who failed to return the second

questionnaire). However, there were no attitudinal differences between the two groups - even in relation to the radio programme. Nevertheless, it should be remembered that the response to this part of the study is biassed towards the most able students registered for the course, and this must be taken into account in interpreting the data. The "high-points" for starting study of the Parallel Text (Table 23) reflect its points of connection with the rest of the course material - its introduction (via the television programme) during Unit 7, references to it in Units 9 and 11, and the TMA due after Unit 11. By Unit 9 half had not begun their study of the Text, while more than a third did not start their study until Unit 11 or after, (see Figure 1, over.)

It is not surprising, then, that half of the ninety respondents to the later enquiry who had seen or heard one or other of the two programmes would have preferred them to have been broadcast later in the year.

Table 23. Preferred Transmission Times of Programmes on Industrial Chemistry (actually broadcast early/mid-May)

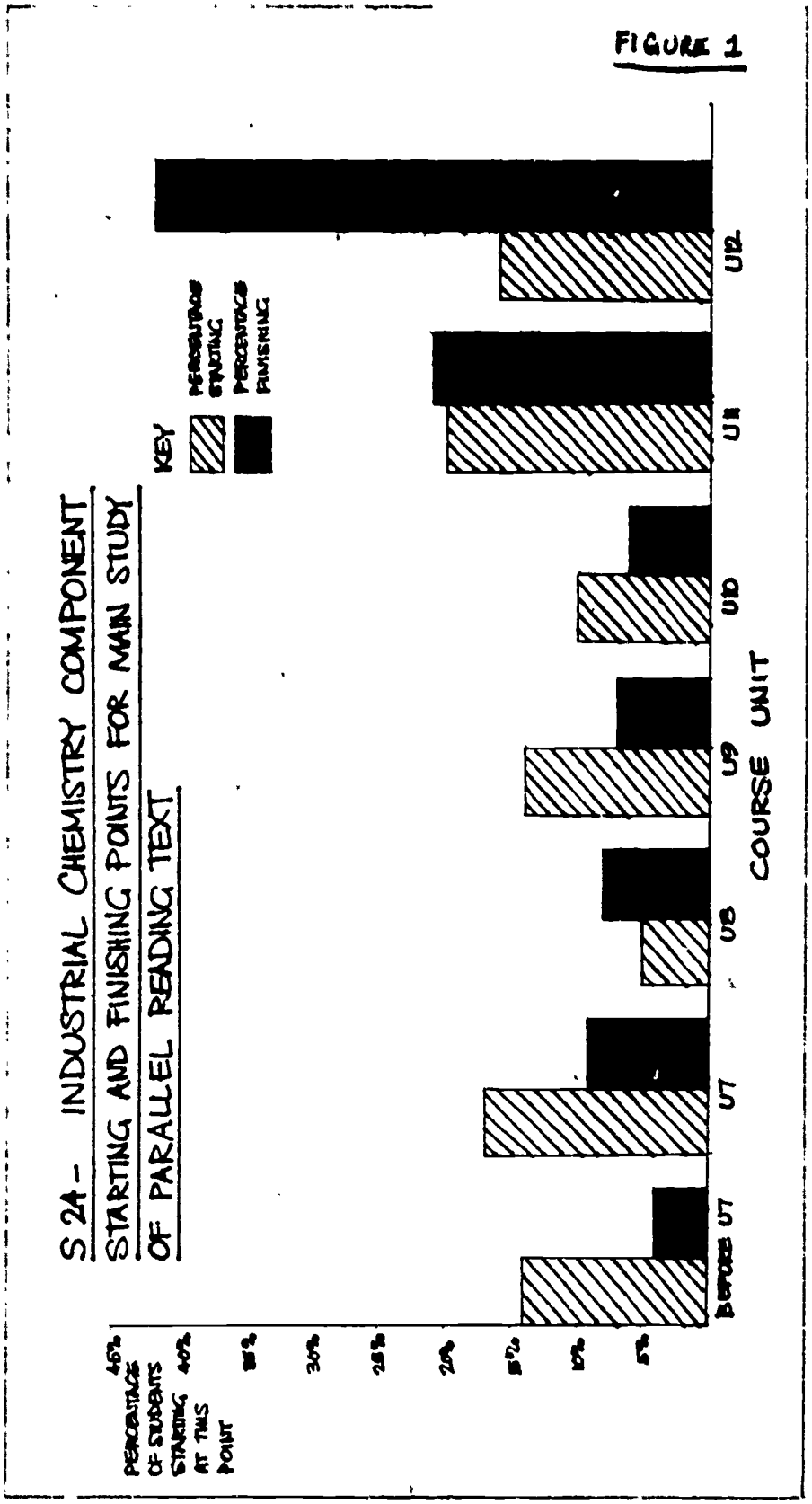
Preferred earlier transmission		Preferred later transmission		Suitable as they were		No answer		Total viewing or listening	
Nos.	%	Nos.	%	Nos.	%	Nos.	%	Nos.	%
2	2	45	50	33	37	10	11	90	100

The fact that the TMA concerned with the Industrial Component was linked with Unit 11, the last unit in the course, was almost certainly an important determinant of the way in which students organised and timed their study of the Parallel Text on Industrial chemistry.[11] Several students had, in fact, raised this point spontaneously in response to the first questionnaire: "In my short experience of the courses, I find most students work to the deadlines fixed for CMAs and TMAs. I am invariably one or two units behind the current TV programme and am not usually prepared for it." And another requested that "research should be done into the timing of all the programmes" because his "study of units is 'concentrated' when the relevant CMA or TMA is due in."

Significantly more of the students who would have preferred the programmes transmitted later in the course began their main study of the Parallel Text during or after Unit 11 (half said "later" compared with a fifth of the others: $\chi^2 = 10.84$ at 95% level). Not surprisingly, then, it was the students who concentrated their study of the Industrial Section towards the end of the course who, in general, found the programmes misplaced. On the other hand, it is worth noting that almost a quarter of those who would have liked the broadcasts later in the course had, in fact, begun their main study of the Parallel Text before or during Unit 7, indicating that even for those willing and able to follow the

11. See: GALLAGHER, M. (1975). Broadcast evaluation report, No. 1; M231 'Analysis', Milton Keynes: Open University.

FIGURE 1


S 24- INDUSTRIAL CHEMISTRY COMPONENT
STARTING AND FINISHING POINTS FOR MAIN STUDY
OF PARALLEL READING TEXT
KEY
PERCENTAGE STARTING
PERCENTAGE FINISHING
PERCENTAGE OF STUDENTS STARTING AT THIS POINT
40%
30%
25%
20%
15%
5%
BEFORE U7
U7
U8
U9
U10
U11
U12
COURSE UNIT

recommended study dates, the scheduling of the programmes on industrial chemistry was not ideal.

Nevertheless, three quarters of those who saw or heard the programmes felt that they were valuable in helping appreciation of the material presented in the Parallel Text.

Table 24. Value of Programme(s) in Helping Appreciation of Material Presented in Parallel Reading Text

Great deal		Some value		Not much value		No value		No answer		Total viewing/ listening	
Nos.	%	Nos.	%	Nos.	%	Nos.	%	Nos.	%	Nos.	%
15	17	53	58	12	13	2	2	8	9	90	100

Again, students who heard the radio programme were significantly more positive in their response than those who saw the television programme only (nine-tenths of the former, as opposed to two-thirds of the latter, answered "great" or "some" value: χ^2 = 7.26 at 95% level). However, there was no relationship between the value attributed to the programmes and opinions as to the appropriateness of their transmission timing.

The overwhelming majority (over three-quarters) of those who felt that the programmes were of value in aiding appreciation or the Parallel Text, mentioned the usefulness of a visual presentation. Some cited its effect on ease of recall: "I can remember the TV programme much better than I can the text, although I spent considerably longer on the latter." Others appreciated the greater depth of understanding which visualization had allowed: "helped me to visualize the complexity of industrial production as outlined in the text"; "visual approach helps to give some idea of the size and scale of the process." Another important role of the programmes was to "orientate" students: "helped one to think in terms of industrial situation rather than that of a large laboratory" and "prepared the 'mental ground' for the subsequent reading." A small number of students (5) simply commented generally on the "summarising"/"reinforcing" function of the programmes.

The comments of those students who did not value the programmes tended to reflect a lack of interest in the Industrial Component as a whole, rather than any feeling that these particular programmes were deficient, although one student felt that the television programme added nothing to the textual explanation of the chemical process and another said that it was an inadequate substitute for an actual factory visit. A couple of others mentioned the scheduling of the programmes as having detracted from their usefulness.

It will be obvious at this point that when students were asked to comment on the television and radio programmes together, almost invariably it was the televisaion programme which was singled out for praise or criticism: only five students specifically mentioned the radio programme, although, as Table 25 shows, those who listened to the programme felt, in retrospect, in that its contribution to

to the Industrial Component had been as useful as that of the television programme.

Table 25. Usefulness of the Programmes as Contributions to the Industrial Chemistry Section of the Course

	Very useful		Fairly useful		Not very useful		Not at all useful		No answer		Total viewing/ listening	
	Nos.	%	Nos.	%	Nos.	%	Nos.	%	Nos.	%	Nos.	%
Television	24	27	44	50	13	15	3	3	4	4	88	100
Radio	8	18	24	54	9	20	2	4	1	2	44	100

A comparison of this data with earlier responses to the question on the general "usefulness" of the television and radio programmes shows no major shifts of opinion, though in the case of just under half of both radio listeners and television viewers, there was an opinion shift of one point on the four-point scale (e.g. a move from "very" to "fairly" or vice-versa). There were three times as many positive as negative shifts: most of the latter were due to students having difficulty in recalling the programme(s), whereas the majority of the positive shifts were the result of students having put into perspective the programme(s) which they had previously considered irrelevant. Thus by the end of the course, a rather more favourable reaction to the programmes had been established than that which was recorded earlier.

Students were asked to mention anything at all from the television programme which came to mind spontaneously, without reference to any notes. The intention was to discover which aspects of the programme had remained with students at a point three months after first viewing it and at a time when preparation for the TMA meant drawing on the programme content. Clearly, the programme impressed on students the size and scale of the chemical plant. This was the point most commonly made by both respondents to the questionnaire and students who were interviewed. Individual students did mention more specific visual points from the programme, e.g. "location of the plant in fields" "stainless steel vessel imported from Sweden" "the control room" "the age of the cars" "the diagrams showing which part was which"; and others cited non-visual points which were made in the programme: "cost constraints" "problems of waste disposal" "complexity of process" "importance of yield". However, the single consistent feature of the replies is their awareness of the "vast scale" of the industrial plant. The range and type of points mentioned was not affected by such factors as the number of times the programme had been seen, whether seen in colour or in monochrome, or ratings of the programme. However, the replies of our interview sample were of a more general, non-specific nature than those of our questionnaire sample: it is therefore possible that not all of the latter managed to avoid reference to their notes before replying.

Table 26. Most Frequently Mentioned Aspects of the Television Programme

Visual	Students commenting	
	(questionnaire)	(interview)
Size/scale of plant	35	7
General appearance of plant	17	8
Construction/transportation of stainless steel vessel from Sweden	10	1
Recycling process	8	3
Flow diagrams	5	2
Location of plant	4	-
Non-visual		
Economic/cost factors	11	-
Differing industrial/laboratory techniques	10	2
Industry/laboratory interaction	6	-
Plant design problems	5	-
Complexity of process	5	-
Stages of development	4	2

Three content-based questions asked all students - whether or not they had seen or heard the programmes - to list (a) the phases involved in achieving a commercially viable industrial process, (b) the factors determining the commercial viability of a process, and (c) the reasons for differences in laboratory and industrial preparation of chemicals. These questions evoked a full and articulate response from students and revealed no differences between students who had and those who had not seen/heard programmes in the extent to which they appeared to be aware of these various factors. Only a handful of students failed to recognise all of the "phases" involved, while the distribution of mentions of the factors determining commercial viability and of the reasons for laboratory/industrial differences reflected an understanding greater than that expected. (See Appendix E for details). There was a noticeable increase in the quality and range of answers to (c) - reasons for difference - when these were compared with answers to the same question as posed in the earlier questionnaire: the mean number of reasons given increased from 2.4 to 3.9, while, for example, the percentage of students mentioning "energy" and "process" increased from 8% to 30% and from 8% to 33% respectively. Two of the major limitations of content questions in a study of this kind is their ineffectiveness in pin-pointing "gains" in knowledge (as opposed to simply telling us what students already knew) and the uncertainty which remains as to how much "research" students have undertaken before

answering.[12] However, in this particular study, the inclusion of an identical question at each of the two evaluation stages helped overcome, to some extent, the first problem, at least with respect to one of the questions, and the interview sample, who were required to answer spontaneously the same questions as students responding to the questionnaire, acted as a sort of 'control' group with respect to the second. Analysis of the two sets of data shows that although the answers of the questionnaire respondents were generally more detailed, in that they tended to "fill out" the factors cited, and to mention a greater number of sub-issues, the interviewees were just as likely to cover the main issues involved. (See Appendix F). We are, therefore, confident that these questions have evoked a valid response and that the answers reflect, with reasonable accuracy, the extent to which the Industrial Component, as a whole has been successful in achieving its major aims.

At a more subjective level half of our respondents felt, retrospectively, that the Industrial Component had increased their knowledge of industrial chemistry to a considerable extent.

Table 27. Previous Knowledge of Industrial Chemistry and Extent to Which Industrial Component Increased This

	A great deal		Quite a lot		Not very much		Nothing		No answer		Total respondents	
	Nos.	%	Nos.	%	Nos.	%	Nos.	%	Nos.	%	Nos.	%
Previous Knowledge of I.C.	-	-	28	25	57	52	53	48	-	-	110	100
Extent increased by Component	5	4	51	46	53	48	-	-	1	1	110	100

Not surprisingly, students with little or no previous knowledge were twice as likely to say that the Industrial Component had increased their knowledge ($\chi^2 = 13.52$ at 95% level) as students who knew "quite a lot" about industrial chemistry before starting work on the course. On the other hand, the Industrial Component was rather less successful in increasing interest in industrial chemistry where little or none had existed before.

12. See: BATES, A.W. (1975). Broadcast evaluation report, No. 3: T291 'Instrumentation', Milton Keynes: Open University, for a fuller discussion of the general limitations of content questions.

Table 28. Previous Interest in Industrial Chemistry and Extent to Which Industrial Component Increased This

	Very	Fairly	Not very	Not at all	Total Respondents
	Nos. %	Nos. %	Nos. %	Nos. %	Nos. %
Previous interest in I.C.	13 12	45 41	36 33	16 14	110 100
	Great deal	Quite a lot	Not very much	Not at all	
	Nos. %	Nos. %	Nos. %	Nos. %	
Extent increased by Component	2 2	45 41	53 58	10	110 100

In this case, students who were already at least "fairly" interested in industrial chemistry were more likely - though not significantly so - to have that interest increased, than were students who started the course with little or no interest in this aspect of the subject.

Nevertheless, 83% of our respondents thought that the Industrial Chemistry section had made a worthwhile contribution to the course. The 19 students who did not, were split fairly evenly between those who were just not interested in industrial chemistry and felt that this section had been a waste of time, and those who were critical of the "shallow coverage" of the topic. The majority of students who felt that the Industrial section had been worthwhile, appreciated the "practical relevance" which it had introduced to the course: about a third of these went so far as to say that the course would have been incomplete without the inclusion of a study of the industrial applications of organic chemistry theory. Generally, students appreciated the opportunity afforded by this section to put into "practical perspective" the theoretical material presented in the course. At a more mundane level, some of those who were having difficulty with the course content found the Industrial Component "a welcome relief from theory": for these "it helped to make the whole subject of chemistry a little less abstract."

The difficulty and heavy work-load of the course was the aspect most frequently mentioned in response to a question in which students were invited to make general comments on the Industrial Chemistry section or on the course as a whole. Students felt that the amount of work required justified the award of more than a one-third credit, and it is worth remembering that these comments were made by students who were "staying the course" well. Our interview sample, who were less self-selected than the questionnaire respondents, - in fact a quarter of them, although still officially registered with the course, had effectively withdrawn by the end of July - were even more critical of the conceptual difficulties in the course. Particular problems were caused by Units 1 and 2 which were major stumbling blocks for many students: in addition to being intellectually demanding they were found difficult to relate to the rest of the course. Specific criticisms were also made of the set book, in terms of its

content difficulty, style and relationship to the printed units: the constant cross-referencing between unit text and set book was found "irritating, confusing and time-wasting".

Other general comments were made concerning the Industrial Chemistry component. While some students merely repeated their satisfaction with this section of the course, others went on to suggest that it might have been more carefully and clearly integrated with the rest of the course material, rather than, as it appeared to some, "added on as an afterthought". Some felt that its treatment had been "too broad and shallow" and that, while interesting, it "seemed out of context with the rest of the course". It was suggested that the section could usefully be expanded - perhaps to a $\frac{1}{6}$ credit course in its own right; or that even if no actual expansion was undertaken, an attempt should be made to relate it to the rest of the course in an on-going way: "the methods and reactions of industry should be mentioned at appropriate points in the text". A related suggestion was that the Parallel Text should become an actual unit, or part of one, since it was too easy to ignore a separate, free-standing text until compelled to study it for assignment purposes. Finally, it was suggested that the television and radio programmes associated with the Industrial Component should be moved to the end of the course to coincide with the main study of the text in preparation for the tutor-marked assignment.

Conclusions and General Recommendations

By the time they had completed work on the course, most of our responding students had clearly appreciated the Industrial Chemistry Component as having made a valuable and interesting contribution to the course as a whole. The major aims of the Component - to provide an awareness of particular applications of chemistry, to convey a certain experience or sense of involvement, and to give specific data or information on the similarities and differences between industrial and laboratory preparation of chemicals - were all recognised by and indeed achieved, in varying degrees, by the majority of students.

Nevertheless, there is no doubt that the very sudden appearance, in the course, of the Industrial Component - via the television programme - came on many students as something of an unexplained surprise. Consequently, some students, particularly those who were having difficulty with the course or were behind schedule, were inclined to dismiss the television programme as irrelevant, to avoid listening to the radio programme (although many students missed the programme for other reasons), and to disregard the Parallel Reading Text until the late realisation that this was required reading for the final tutor-marked assignment of the course forced them to make a hasty and concentrated reading of the text.

Nowhere in the Introduction and Guide to the Course, in the printed units, or in the Parallel Reading Text is the rationale behind the inclusion of the Industrial Chemistry Component made clear; indeed, it is not even hinted a . Moreover, despite the fact that the Introduction and Guide has been reprinted since the first year of the course's presentation, no mention is made of even the existence of a separate Industrial Component or of its place in the course. Given that a third of our respondents viewed the television programme without having

looked, even briefly, at the material in the Parallel Text, it is not unreasonable to assume that many of these would have made their first acquaintance with industrial chemistry in S24- through the programme: they would, however, have had no idea of the existence of an Industrial Component as such, and might be forgiven for dismissing the programme as an interesting but irrelevant "aside" to the main study of chemical reactions.

The inclusion of a free-standing, parallel component in any course can be a useful and simple means of providing students with a body of material which cannot be easily fitted in with the main content areas and approach of the course, but which the course team feels is sufficiently relevant and important as to merit coverage of some sort. Clearly, however, the presentation of material in this way poses problems both in terms of its acceptance by students as a valid and worthwhile area of the course proper, and the difficulty of linking the parallel component with a study schedule which will inevitably be largely dictated by the main body of the course. While the S24- solution to the latter problem - linkage to study schedule - was potentially likely to be successful (initial impetus to study text provided by broadcasts, reinforced by references in two intermediary printed units, finally culminating in assignment based on the material), it was badly undermined by an absolute lack of any initial guidance to help students overcome the first problem - acceptance of material as relevant. As a result of this, the "linkage" was, on the whole, disregarded by most students, and many had almost completed the course before studying the Parallel Text and consequently gaining a perspective on the Industrial Component as a whole.

The fact that students <u>did</u> eventually gain this perspective and recognised that the Component made a worthwhile contribution to the course underlines the interesting, clear and informative way in which the industrial section was presented. As we have already shown, the television programme particularly was very well received, and very few students remained totally uninterested in industrial chemistry by the time of finishing work on the course. Nevertheless, certain problems <u>were</u> caused by the inclusion of a free-standing Parallel Component, and what follows is intended mainly to direct attention towards the sorts of issues which <u>future</u> course teams might consider when planning the use of parallel material, so that its acceptance and use by students may be maximised.

1. There are disadvantages in using a separately bound Parallel Text, in that, unless it contains material to be drawn on in assignments, it is extremely easy for students to ignore it altogether, particularly if they are having difficulty in keeping up with the work schedule dictated by the main body of the course. If the parallel component does contain assignment material, inevitably the majority of students will concentrate their study of it towards the due and cut-off dates for the relevant assignment. This will mean that if other material - such as broadcasts - is to be drawn on for the assignment, the time-lapse between the presentation of this material and the assignment submission date should not be unrealistically lengthy - probably not more than about a month. If the gap is wider, as was the case in S24- where the related programmes were transmitted three months before the assignment cut-off date, there is little likelihood that more than a few students will be able

to use the broadcast material profitably, since they will be unlikely to consolidate the programme information by following it up with a reading of the relevant text.

2. Despite the considerable practical problems presented by the use of parallel material, the course team may nevertheless feel that these can be overcome and that the content and approach taken in the course makes the inclusion of a Parallel Component justifiable. The rationale behind this inclusion should be made clear to students in the Course Introduction. If this is done - both by outlining the conceptual relationship between the main content areas of the course and the content to be presented "in parallel," and by making clear why the course team has decided to present the parallel material in this way - students will be more likely to start by accepting the material as relevant, rather than, as was the case for many S24- students, initially rejecting it and eventually accepting its relevance mainly in terms of its relationship to a particular assignment.

3. The various elements of the Parallel Component should also be briefly introduced and described in the Course Introduction, and their main points of linkage with the core material of the course should be outlined, perhaps diagrammatically, so that students will be aware not only of when they should be making links, but what sort of links can be made.

4. The S24- idea of introducing the Parallel Component through the television programme, with only a little pre-broadcast reading which though it helped to set the programme in perspective was not strictly necessary to comprehension of the broadcast, appears a potentially effective way of encouraging students to begin the related reading. Nevertheless, there will always be a proportion of students choosing not, or unable, to precede or follow the programme with any reading of pre- or post-broadcast material. (A third of our S24- students watched the programme without having looked, even briefly, at the pre-broadcast notes, for instance). Given the rather special problem presented by the use of Parallel Material, it may be worth considering prefacing the broadcast by a station announcement reminding students of the status of the material they are about to see, and directing them to a reading of the relevant section of the Parallel Text as soon as possible after the programme. This will be particularly valuable if the Parallel Material is introduced - as was the case in S24- at a distance of several months after students have studied the Course Introduction.

5. Finally, it should be borne in mind that, if material is to be presented in parallel with the main body of the course, this should not become extra material in the sense of giving students more work than has been agreed as reasonable to expect in a course at this level. Unless care is taken to cut down the amount of work demanded by the core units to correspond with that needed for a study of the parallel material, the course team are in danger of arousing the antipathy of students towards the material: in fact, this was a problem in S24- where, in a course which almost all students felt was

difficult and over-loaded, many felt that the inclusion of a Parallel Component was simply a devious means of slipping even more work into the syllabus. In terms of work-load then, parallel material must be considered an integral part of the course structure.

Summary of Main Findings

1. The overall educational purpose of the programmes, and of the Industrial Component as a whole - to give students an appreciation of the place of chemistry in the chemical industry - was recognised and seen as a worthwhile contribution to the course by all but a sixth of our student respondents by the time they had finished work on the course. The general aims of the programmes - to give awareness of applications of chemistry in industry, convey a sense of experience, or involvement, provide information on laboratory/industrial differences - were all successfully realised, though not always fully, for the majority of those who watched and listened.

2. The television programme, in acting as a substitute field trip, gave students an experience which it would have been difficult, if not impossible, to provide in any other way in the Open University. Almost all students (nine-tenths) welcomed this opportunity and enjoyed the "experiential" aspect of the programme and the "reality" imparted to the theoretical material in the text. About a sixth of those who viewed spontaneously praised the presentation of this particular programme, which was found not only interesting, but clear, well-balanced and informative.

   The radio talk, though valued by more than half of those who listened as a useful "back-up" to the television programme in its clarification and extension of specific economic points, nevertheless came in for a certain amount of criticism in terms of its content and presentation. About a quarter of those who listened either found it "monotonous" and "boring and repetitive" or guilty of presenting information which was "obvious" or "common sense".

3. Although the educational purpose of the Industrial Component was related to one of the four main Course Objectives - that students should gain an understanding of the interrelationships of chemistry, technology and society - and although there were specific references to the Parallel Text in the printed Units 9 and 11, it was not intended that the Industrial Section should be integrated with the main body of the course. Indeed, the whole idea was that this should be a separate, free-standing component which would eventually be tied in with the other course materials by means of the final tutor-marked assignment.

   While the majority of our respondents did not comment adversely on the inclusion of a free-standing course component - indeed most approved it, at least implicitly, in stating that the course would have been incomplete without some study of the industrial applications of organic chemistry theory - clearly a notable minority of students (about a fifth) were unable to see the relevance of the broadcasts and Parallel Text to the course as a whole, at

least at the time of transmission of the programmes (May). And while the question of "relevance" was not a problem for students by the time they had finished work on the course, there remained a group (about a sixth) of students who felt that the course team had fallen between two stools in presenting a parallel, though obligatory section on industrial chemistry: that its treatment had been superficial though still - because of the related TMA - requiring expenditure of considerable time on the part of students in an already over-loaded course, and that the timing of the programme transmissions and presentation of the printed material as a separately bound, parallel text had not encouraged a balanced and fruitful study of the Component.

4. The television programme was watched by about five-sixths of our respondents, though only just over one-third listened to the radio programme. Of those who did hear the programme, one-third recorded it on tape.

5. Students who missed both the television and the radio programmes were twice as likely to fail or withdraw from the course as students who missed neither.

6. The majority of students (90% of television viewers, 80% of radio listeners) reacted favourably to the programmes at the time of their transmission in May, finding them both interesting and enjoyable.

7. Although the majority students found the programmes useful, over a quarter of those who watched the television programme and over a third of those who heard the radio broadcast were unable, at the time of programme transmission, to relate the programmes to the material presented in the printed units.

8. About a tenth of those who listened to the radio programme specified difficulties in concentrating on and learning from not only this particular radio programme but radio output in general.

9. About a fifth of the television viewers and a third of the radio listeners did not, on the basis of this analysis, understand the purpose of the programmes at the time of their transmission.

10. Those students who were, or had previously been, employed in the chemical industry were less likely to watch or listen to both transmissions of the programmes. However, they tended to rate the programmes as more enjoyable and useful than was true for the sample as a whole, although there was little evidence to suggest that they had achieved a fuller understanding of the purpose of the programmes.

11. A third of the television viewers watched the programme without having looked at the pre-broadcast material in the Parallel Text.

12. The Display Sheet in the Parallel Reading Text - a flow diagram setting out the structure of the radio programme, which students were advised to have before them while listening - was used by only half of those who listened. Of those who used it, almost all said that it was a useful device in helping them to follow the points covered in the radio programme.

13. Over three-quarters of those who watched and listened said that the programmes had been successful in giving insight into differences between the industrial manufacture of chemicals and the preparation of chemicals in the laboratory. However students' subjective rating of the programmes' success in pointing out these differences was not strictly related to their ability or willingness to state in answer to an open-ended question, just what they had learnt from the programmes about why such differences exist.

14. By Unit 9, half of the students had still not begun their study of the Parallel Reading Text while more than a third did not start their study of the Text until Unit 11 or after.

15. Half of those who had either seen the television programme or heard the radio broadcast, would have preferred the programmes to have been transmitted later in the year.

16. By the end of the course, a rather more favourable view of the programmes had been established than that which was recorded at the time of their transmission, largely as a result of some students having put into perspective the programmes which they had previously considered irrelevant.

17. Two-thirds of our respondents felt, retrospectively, that the programmes were of considerable value in aiding their appreciation of the material in the Parallel Text. Of these, the majority (over three-quarters) mentioned the usefulness of a specifically visual presentation, both in terms of the greater depth of understanding which visualization allowed and as an aid to recall.

18. Students who said that they had little or no previous knowledge of industrial chemistry were twice as likely to say that the Industrial Component had increased their knowledge as students who said they knew a fair amount about the subject before starting work on the course. On the other hand, students who at the outset had little or no interest in industrial chemistry were less likely to have that interest increased than were students who started the course with some interest in this aspect of the subject. The study confirmed some of the methodological problems indicated by earlier studies in this series: significant differences (in terms of successful course completion) between responders and non-responders emphasising the need to ensure high response rates; the unreliability of students' subjective ratings of programmes in indicating their awareness and understanding of the programmes' aims; the problems involved in the setting and interpretation of test-type questions.

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