

Chapter 2

The Effectiveness of Instructional Media

When considering the effectiveness of educational media and technologies it is essential to cast an eye over the research in order to discern patterns of success and failure. In this section I want to look at the general effects of traditional teaching methods independently of the methods used within the lesson or lecture, and then I want to look at a number of studies which deal with different methods of broadcasting and recording such lessons, and the effectiveness of these versions when compared with the live presentation.

Figure 2.1: Traditional Media

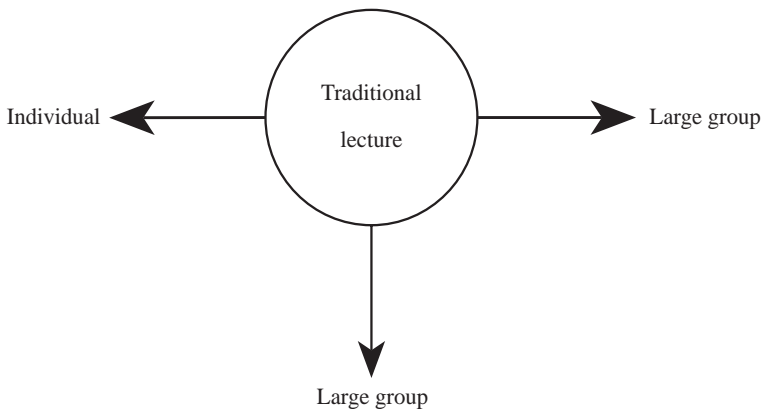
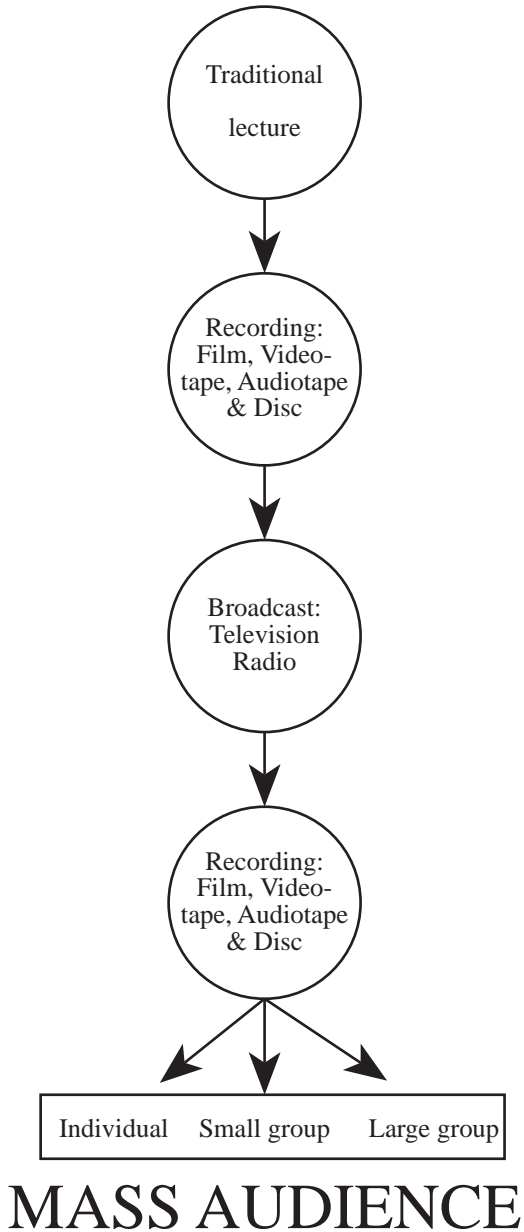


Figure 2.2: Broadcast Media



The traditional lecture or lesson is shown below as being suitable for a range of situations, from a single individual, through small groups, as found in most classrooms, to large groups in excess of several hundred students.

The audience size can be dramatically increased, as shown opposite, by the use of broadcast media such as radio and television. In this case, although the total audience may be several thousand or indeed hundreds of thousands, the lesson may be received by individuals, small groups or even large groups gathering at reception sites.

The audience can be greatly extended by recording the programme, for example on film or audio-tape, and then distributing it to other locations where the material is replayed, again either to individuals or small or large groups. The recorded material can offer a degree of flexibility which is not inherent in the traditional or broadcast form. The tape can be stopped and replayed if necessary, or it may be used on more than one occasion.

Of course, with modern technological approaches the lesson is recorded and edited; then the recording is broadcast and received at distant locations where it is again recorded for later use by individuals or groups. In order to understand some of the advantages of these systems, I will be considering first the research dealing with comparisons of traditional lessons with recorded versions of the same material, which will lead to conclusions concerning the relative effectiveness of new and old methods. I will then describe several projects which have attempted to extend educational media using the mass media.

EARLY FILM RESEARCH

With the advent of sound films for educational purposes in the early 1930s it was natural for researchers to consider the relative effectiveness of lectures and filmed recordings of such lectures. Hoban and Van Ormer's report, subtitled *Rapid Mass Learning*, summarized the research available during the period 1918 to 1950.

The earliest research investigating comparisons of sound films and lecture demonstrations was conducted by Clark in 1932. Three sound films, *Radioactive Substances*, *Liquid Air*, and *Characteristics of Sound*, were found to be as effective as the lecture demonstrations given by regular class instructors, in tests designed to measure thinking and reasoning ability.

A later study by Hall and Cushing in 1947 investigated the difference between a sound film presentation and a lecture with enlarged illustrations, dealing with 3 science topics: malaria, the diesel engine, and the micrometer. No differences were found. In this study the oral lecture was based on the film scripts and the illustrations were also taken from the film artwork.

In an experiment conducted by Vernon (1946) information test scores of seamen who witnessed two showings of a film demonstrating two methods of taking depth soundings, a total of 50 minutes of instructions, were only 6 per cent below those of groups which had usual instruction lasting 3 hours. Vernon concluded that an hour's film appears to be as effective as three hours weak oral instruction.

Hoban and Van Ormer summarize their review of the research, in which films are compared with demonstrations or lectures on science topics, and conclude that films reduce instruction time and are often equivalent to good instructors. They hasten to add that this should not be interpreted as meaning that films can eliminate the need for instructors but rather that the effectiveness of instructors of average or below-average ability can be improved (and instructional time can be saved). Also they suggest that because films can be projected on large screens, so the size of the group can be increased with no loss in instructional effectiveness. Finally, they conclude that films, used alone, can offset a shortage of instructors.

Films Reduce Instruction Time:

The conclusion which continually recurs in these studies is that films reduce instruction time with little or no sacrifice of instructional results. In some of the experiments in film presentation, from one-half to two-thirds of the instructional time was saved by the use of films in place of lecture or demonstration. There thus appears to be considerable support for the Navy slogan "More learning in less time", although this may not always be true for all films.

Films are Often Equivalent to Good Instructors:

A second conclusion that is recurrently supported by the research data is that, in communicating facts and demonstrating concepts, films (or filmstrips) are about equivalent, and sometimes better than superior instructors using the best non-filmic materials at their disposal.

.... this should not be interpreted to mean that films can eliminate the need for instructors, but as suggesting the following postulates: (1) the effectiveness of instructors of average and below

average ability can be improved (and instructional time can be saved) by the use of films; (2) because films can be projected onto a large screen, the size of the group can be increased substantially during film instruction with no loss, and possibly with significant gain, in instructional effectiveness of lesson presentation; (3) films, used alone, can offset a shortage of teachers.

Hoban, C.F. and Van Ormer, E.(1950) *Instructional Film Research, 1918-1950*. Port Washington, N.Y.: US Navy Special Devices Centre.

From the results of the first thirty years of research comparing the comparatively new educational media there is strong confirmation of their effectiveness when compared with traditional methods. Indeed, Hoban and Van Ormer suggest that by using film recordings of above average teachers there can be some compensation for poorer quality personnel.

Peggie Campeau's stringent review of the literature concerning audio-visual media, in 1966, cites nine studies conducted at university, senior high school, junior high school and elementary school levels in which no significant differences in achievement were found when students were taught by either motion pictures or conventional instruction. This is confirmed by Greenhill in his introduction to a volume of abstracts on film and tv research by MacLennan & Reid (1964).

EARLY TELEVISION RESEARCH

Just as research was indicating quite conclusively that there is no disadvantage in studying from filmed courses, a new technological innovation was entering the mass media market place. Television, although invented in the late 1920s, was only beginning to make headway in the early 1950s, and it was natural for researchers to turn their attention to a medium which offered all the potentialities of film, at a possible lower cost, for, as Lumsdaine and May concluded in 1965, film and tv can be considered substantially identical media for many purposes.

The first research effort used television as a means of expanding the total audience for a given lecture via closed circuit television, in which the transmission was carried from the lecture room, by cable, to several locations, enabling a single teacher to communicate with many hundreds of students. In fact, at one stage, audiences of 7,000 were taught via closed circuit tv in New York University. In Greenhill's report of the Pennsylvania experiment he acknowl-

edges that the major use of closed circuit tv is for the presentation of regular classroom instruction to students located in multiple classrooms. In this application television is used as a means of coping with mounting enrolments by making it possible for an instructor to teach larger numbers of students than would be possible by conventional means. Greenhill also argues that the standard of instruction would also be raised by:

- (1) extending the influence of its best professors to large numbers of students and
- (2) by making it possible for these professors to present demonstrations and other teaching materials that it would be impossible or impractical to use under normal classroom conditions.

This new medium, which is substantially the same as motion film, in that it presents moving pictures with sound accompaniments, should produce substantially the same results when compared with traditional teaching. The shift towards tv, which was viewed as a panacea for all the educational ills during the mid 1950s and early 1960s, resulted in a proliferation of research studies. Stickell, in 1963, reviewed 250 comparisons of educational television and conventional face-to-face instruction from 31 research reports. The results are given in Figure 2.3, which shows the number of studies classified as interpretable, partially interpretable or uninterpretable.

Overall, 75% of the studies showed no difference, with equal percentages favouring tv or face-to-face instruction. The 10 results which are fully interpretable are given in Figure 2.4, and, as you can see, they all come from Pennsylvania State University and were undertaken by Carpenter & Greenhill who were perhaps the most influential media researchers of the period.

The interpretable studies clearly indicate that, over a wide range of subjects, there is no difference between class lectures and tv instruction. In a review of teaching by television, Chu and Schramm found that, by 1967, of 421 separate comparisons taken from 207 published reports, 308 showed no difference, 63 showed tv to be superior and 50 found conventional instruction superior. These results confirm Stickell's earlier review of the literature.

Of the 421 comparisons Chu & Schramm also concluded that by and large tv can be used more effectively for primary and secondary school students than for college students.

The research reviewed was so wide-ranging that they were also able to conclude that tv can be used efficiently to teach any subject matter where one-way communication will contribute to learning.

Figure 2.3: Comparison of Television and Face-to-face Instruction. Stickell, D.W. (1963).

	Favoured Face-to-face	Shown no Difference	Favoured ETV	Total
Interpretable	0 (0%)	10 (100%)	0 (0%)	10
Partially interpretable	0 (0%)	20 (87%)	3 (13%)	23
Uninterpretable	28 (13%)	158 (73%)	31 (14%)	217
Total Sample	28 (13%)	188 (75%)	34 (14%)	250

Figure 2.4: Stickell's 10 *Interpretable* Studies of ETV.

Experimenter	Course	Result
Carpenter & Greenhill (1955)	Psychology	No Significant Difference (NSD)
Carpenter & Greenhill (1955)	Psychology	NSD
Carpenter & Greenhill (1958)	Chemistry	NSD
Carpenter & Greenhill (1958)	Chemistry	NSD
Carpenter & Greenhill (1958)	Business Law	NSD
Carpenter & Greenhill (1958)	Sociology	NSD
Carpenter & Greenhill (1958)	Meteorology	NSD
Carpenter & Greenhill (1958)	Psychology	NSD
Carpenter & Greenhill (1958)	Music Appreciation	NSD
Carpenter & Greenhill (1958)	Music Appreciation	NSD

Figure 2.5: Learning from television: What the research says. Chu, C.G. and Schramm, W. (1967). National Association of Broadcasters.

207 REPORTS

No Significant Difference	308	73%
Favour Television	63	15%
Favour Conventional	50	12%
TOTAL	421	100%

Figure 2.6: Results of 421 Comparisons between ETV and Conventional Teaching (Chu and Schramm, 1967, p.7)

	N.S.D.	Favoured Television	Favoured Conventional
Elementary	50	10	4
Secondary	82	24	16
College	152	22	28
Adults	24	7	2
TOTAL	308	63	50

These results lead to the inevitable conclusion that course enrolment can be greatly expanded by the use of educational television and that student performance will not suffer. However, the second point referred to by Carpenter, concerning the possible improvements in instruction, does not seem to be tenable. If this is the case, what are the advantages of using film or television? The answer is rather complex: when there is no difference in performance between the two modes the most obvious measure then to come under scrutiny is the relative cost of implementing either system.

An impression of the cost analysis can be gained from Greenhill's final report on tv teaching at Pennsylvania State University, during the period 1956-57. The system was in operation for 1,000 hours during the academic year with

Figure 2.7: Results of 421 Comparisons, by Subject Area.

Subject	No. of Comparisons	% in which TV equals or exceeds conventional
Mathematics	56	89%
Science	100	86%
Social Studies	77	90%
Humanities	45	96%
Languages	77	88%
Skills	26	96%
Miscellaneous	40	75%

four well-established courses in Psychology, Accounting, Sociology and Air Science. Comparisons were made between actual costs of televised instruction and the costs that would have been incurred in the courses had they been taught in the usual way in sections averaging 45 students. The analysis showed a total saving in favour of the tv service of \$40,000, which represented more than the total cost of running the service. However, it was necessary to have at least 200 students per course before any savings were made. Of course one can argue that it would be less expensive to teach such courses in classes of 200-400 students, and it is this argument which brought about the decline in closed circuit tv in many colleges. Essentially the system once installed required large recurrent finance to keep it in operation and, if the system was not fully operational for most of the academic year, it rapidly became less cost-effective.

Now let us move from what Schramm has recently called the “Big media” to the “small media” of radio and audio recordings.

RADIO AND AUDIO RECORDINGS

It is obvious that we should now consider the effectiveness of audio presentations when compared with traditional face-to-face instruction. Before continuing, however, it is necessary to mention one factor which is very important in such comparisons, and it is one which is often overlooked in experimental studies. If we wish to compare a radio broadcast and a traditional lecture the

audio-only version will show poorer performance if the traditional version includes many illustrations which form an integral part of the test used in the evaluation. This factor was demonstrated in the early days of film research by Nelson & Moll in a classic study, the results of which are given in Figure 2.8.

It is generally recognized that for teaching via radio or audio recordings essential graphic information, usually in the form of printed materials, must be provided in order to fully exploit the potential of the medium. This means that comparisons of radio and traditional teaching are really comparisons of audio plus print with traditional teaching.

Beginning in the 1920s instructional radio was widely used in the United States and Britain, but with the advent of television its use dwindled in the US, although it has continued to be widely employed by the BBC schools service. Developing countries, however, are making increasing use of radio, its principal attraction lying in its low cost when compared with television. It is also an effective instructional medium, as much of the research confirms. Carpenter, in 1937, prepared 15-minute radio lessons on science for pupils ranging from fourth grade to senior high school level. The results of the end-of-term examinations indicated that pupils taught by radio did as well as, or better than, those taught by conventional methods. Attitude reports from pupils showed a high degree of interest in radio lessons. An interesting experimental design for a comparison of radio and conventional teaching is reported by Heron & Ziebarth in 1946. 98 college students in general psychology were divided so that one half attended classroom lectures while the other half listened to the

Figure 2.8: Nelson, H.E. and Moll, K.R. (1950) Comparisons of the Audio and Video Elements of Instructional Films. Pennsylvania University, Instructional Film Research Programme.

Mean Scores of Groups instructed by Various Presentations of the film *Land and Live in the Desert*.

Control Group	29.1
Saw film picture only	45.6
Heard film sound only	47.4
Saw and heard film	57.3

same lectures over the radio. Halfway through the course, the two groups changed places. Mid-session and final examination results indicated that the radio was as effective as the face-to-face instruction. Another example of the effectiveness of radio as a teaching instrument, this time in a developing country, is reported by Chu & Schramm, concerning the work of Mathur & Neurath in 1959. A total of 145 villages in Bombay state, averaging about 850 people per village were chosen as the experimental group and were provided with radio sets. A similar number of villages without radio sets served as the control group. Twenty special farm programmes were broadcast twice a week for 30 minutes. Comparison of test results, both before and after the broadcast programmes, found a significant increase in knowledge in the radio villages, but only negligible increases in the non-radio groups. This and many other reports indicate the efficacy of instructional radio. Jamison and his colleagues considered the effectiveness of alternative instructional media, and report Forsythe's conclusion concerning studies of radio's effectiveness.

Research clearly indicates that radio is effective in instruction. Experimental studies comparing radio teaching with other means or media have found radio as effective as the so-called "conventional methods". Even though radio has been criticized for being only an audio medium, studies have shown that visual elements in learning are not uniformly important. In many educational situations visuals may be more harmful than helpful. Also, the efficiency of combined audio and visual media has been challenged by studies which show that multi-channel communications may not be inherently more effective than single channel presentations.

Forsythe, R.D. (1970) *Instructional Radio: a position paper*. Stanford University. ERIC ED 044 933

These conclusions can be extended to include the equivalent recorded form of instruction, such as discs or tapes. Popham, in 1961, divided an introductory graduate course into two sections. In one he taught in a lecture-discussion format; in the other, he played a tape-recorded version of the lecture and then led a brief discussion period. The two groups were carefully matched on scholastic aptitude and two achievement pre-tests. Following instruction several post-tests were administered and it was found that there were no

differences between the groups. Popham followed this experiment a year later with an investigation which attempted to assess the importance of the instructor-led discussion which had followed the taped presentation in the earlier experiment. During the second experiment the discussion was led by an untrained student, and again there were no differences between tape-taught and conventionally-taught students. Students, in both experiments, had generally favourable attitudes to the taped lectures. They felt that the lectures were better organised and they felt free from distractions during the taped presentation. However, they did miss the opportunity to question or disagree with the instructor. Popham concluded that his investigations suggested that there may well be a legitimate place for taped teaching at college level.

In view of this optimistic report it is surprising to learn that John Menne and his colleagues, in 1969, could find no mention of further taped lecture courses in the literature during the intervening 7 years. Popham's work had utilized the audio recordings for group presentation of the information. However, by 1969, the rapid expansion of cassette tapes was making the medium ideally suited to individualized learning and it was this aspect which was of interest to Menne. The course used was an introductory psychology course at Iowa State University. The lectures were recorded on tape and notes were taken from the blackboard material used by the instructor during the presentation of his lectures. The blackboard notes were then assembled to form a booklet. It was hypothesized that there would be no difference between the groups listening to the tapes and those who attended the lectures, although I suspect that the Iowa investigators had anticipated a superior performance from the individualized study group. The selection of students for the two types of instruction was not conducted on a random basis; the students were allowed to choose the method of instruction for the course.

A total of 290 chose the experimental audio tape presentations, with 408 going for the traditional lecture. However, the drop-out rate was much greater for the traditional group, representing 14% of the total, compared with only 2% of the tape-recorded lecture group. Each member of the experimental tape group was issued with a tape recorder, a complete set of lecture tapes, a booklet containing the transcribed blackboard material and a schedule of the lecture topics to be given to the lecture group. The audio-taped group was self-paced though they were required to take 3 objective tests during the course.

Information was available concerning student performance on several measures, which enabled a covariance analysis to be applied to the results for the regular exams, class points and a final grade. **There were no significant differences.** Incidentally, the experiment ran during the autumn of 1967, with

Figure 2.9: Ackers, G.W. and Oosthoek, J.K. (1972) The Evaluation of an Audiotape Mediated Course. *British Journal of Educational Technology*, 3, 136-147.

	Mean	SD	N	t-test	p
Lecture group	9.663	4.011	113	2.243	0.05
Tape group	10.838	3.777	99		

a replication in spring 1968, and the results were substantially the same for both periods. The conclusion drawn from the results was that Popham's findings were substantiated and it was predicted that, for most subjects, students given a recorder, set of tapes and notes, would learn about as much as students who attend regular lectures. Most of the students were appreciative of the freedom and flexibility which the method allowed them, though many of them admitted that procrastination frequently led to many hours of concentrated listening just prior to exams. Just over half the students reported that they listened to the tapes once only, a disappointing figure in view of the potential use of the medium, though the number of times a section of tape was reviewed, during a given session, was not reported. The noticeable difference in drop-out rate is clearly a benefit of this type of approach and the authors suggest that students tend to leave courses if they have fallen behind in their work and see little hope of recouping, a situation which does not as readily occur if the material is always available on tape. It is interesting to compare the results of the two experimental reports, from a cost perspective. Clearly the additional expense of providing tape recorders and sets of tapes would be vastly more expensive than for the group listening to a single tape-recorded copy of the lecture presented to a large group of students, but with little or no advantage in terms of effectiveness.

Ackers reports a similar experimental course to the one at Iowa, but with subjects randomly assigned to either a taped or live lecture condition. The subjects in the taped group again had individual access to recorders and tapes on the subject of micro-economics, and were able to follow the course at their own speed, within certain broad limits. Ackers does not elaborate on the broad limits and we can consider the taped course to be substantially student-paced. Both groups had ample opportunity to participate in test problems, which formed an integral feature of the instruction, and were encouraged to take part in fortnightly group discussions. The performance was assessed in a June

examination which, according to the authors, called for the sub-categories 'Application' and 'Analysis' of the category 'Comprehension' from Bloom's Taxonomy of Objectives. The results are given in Figure 2.9 and indicate a slight advantage in favour of the tape group.

The difference is statistically significant and amounts to a superior mean score of 6%. Ackers indicates that it had been anticipated that the well-programmed tape system would not only produce a higher mean score in the micro-economics examination, but, compared to the lecture group, also a significantly greater percentage of students passing the examination. This was not the case, approximately 50% of students passed the examination in both treatments. However, an analysis of the number of students actually failing to take the examination showed that the percentage failing because they did not sit the examination is only 22% for the taped lecture group, compared with 38% of the total lecture group. Thus when account is taken of failure by default the result is clearly in favour of the tape-slide group, with a 38% pass rate for the tape lectures and 27% pass rate for the conventional lectures.

CONCLUSIONS

The above is a brief presentation concerning the effects of film, tv, radio and taped lectures when compared with more traditional forms of teaching, in the early years of media research. The results lend support to Chu and Schramm's assertion that, given favourable conditions, pupils can learn from any instructional media that are now available. The apparent negativity of results in media research, which has tended over the years to confirm the preponderance of no significant difference results, has led to a certain disillusionment with the new media, particularly among administrators who feel that there are no advantages to be gained from the implementation of media projects.

This is not, however, the case. There is a positive side to the results in that, precisely because there are no differences, instructional radio and tv can be used in many situations, such as countries wishing to rapidly expand their training programmes, and the resulting learning will be the same as that produced in more traditional approaches. A case can also be made for recorded lectures, which certainly encourage students to persevere with courses which are largely student-paced. The choice of broadcast or recorded medium is a complex one, and increasingly cost factors are playing an important role. Indeed, cost will be the main factor in deciding whether or not media can deliver instruction at a more cost effective rate. My early research (Spencer, 1977) demonstrated that over a range of topics in applied physics, audio recordings

of lectures with simple printed diagrams were the most cost-effective method of teaching.

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