

A HANDBOOK OF EDUCATIONAL TECHNOLOGY

Second Edition

FRED PERCIVAL & HENRY ELLINGTON

First published in 1984, this book has become the essential basic 'primer' on the topic for students of education and educational technology and for practising teachers, trainers and lecturers.

The thoroughly revised second edition defines the nature of educational technology, examines the basic educational strategies and discusses the benefits and disadvantages of setting educational objectives. It considers mass, group and individualized instructional techniques and the media used to provide support in learning. The arguments for and against assessment procedures are reviewed and a useful guide to the methods of accurate and fair test-construction provided. The final chapters look at the organisation of resource centres and the numerous ways in which computers can be used to assist learning. 250 new terms have been added to the glossary in the reference section and the keyword index has also been updated.

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ISBN 1 85091 449 4 (UK)

ISBN 0 89397 300 9 (USA)



Kogan Page
120 Pentonville Road
London N1 9JN



Published in the USA by
Nichols Publishing Company
PO Box 96, New York,
NY 10024.

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42-62

429

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8864255

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**Kogan Page, London/Nichols Publishing
Company, New York**

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First published in Great Britain in 1984 by
Kogan Page Limited, 120 Pentonville Road, London N1 9JN
Second edition 1988

British Library Cataloguing in Publication Data

Percival, Fred

A handbook of educational technology: a
practical guide for teachers.—2nd ed.

1. Educational technology

I. Title II. Ellington, Henry

371.3'07'8 LB1028.3

ISBN 1-85091-547-4

ISBN 1-85091-449-4 Pbk

First published in the United States of America
in 1984 by Nichols Publishing, PO Box 96,
New York, NY 10024
Second edition 1988

Library of Congress Cataloging in Publication Data

Percival, Fred

Handbook of educational technology.—2nd ed.

Bibliography: P.

Includes Index.

1. Educational technology — Handbooks, manuals, etc.

I. Ellington, Henry. II. Title.

LB1028.3 1988 371.3'078 87-31381

ISBN 0-89397-297-5

0-89397-300-9 pbk

Printed and bound in Great Britain by
Richard Clay Ltd, Bungay, Suffolk

Contents

<i>Acknowledgements</i>	7
Introduction	9
Introduction to the Second Edition	11
Chapter 1 The Nature of Educational Technology	12
Introduction	12
Technology <i>in</i> Education	13
The Technology <i>of</i> Education	14
The Systems Approach	15
Definitions of Educational Technology	20
Development of the Main Concerns of Educational Technology: the Elton Model	21
Individualized Learning Techniques	23
Group Learning Techniques	28
Summary of the Main Features of Mass Instruction, Individualized Learning and Group Learning	30
Other Areas in which Educational Technology has Developed	31
Chapter 2 Basic Educational Strategies	33
Introduction	33
The Teacher/Institution-Centred Approach	33
The Student-Centred Approach	39
Chapter 3 Educational Objectives	48
Introduction	48
An Objectives-Based Approach to Course Design	48
Aims and Objectives	50
Writing Objectives	51
Skills Analysis	53
Types of Objectives	55
Some Advantages of Using Objectives	59
Some Weaknesses of the Objectives-Based Approach	61
Choosing Valid Objectives	62
Chapter 4 Mass Instruction Techniques	63
Introduction	63
The Main Mass Instruction Methods	63
Audiovisual Media used in Mass Instruction	71

Chapter 5 Individualized Learning Techniques	83
Introduction	83
Three Different Approaches to Individualized Learning	83
Media Used in Individualized Learning	89
Chapter 6 Group Learning Techniques	99
Introduction	99
General Features of Group Learning Methods	99
The Main Group Learning Techniques	105
Chapter 7 Student Assessment	116
Introduction	116
Desirable Characteristics of Student Assessment Procedures	117
Criterion-Referenced and Norm-Referenced Assessment	118
Test Construction	119
A Review of Student Assessment Methods	121
Self and Peer Assessment	128
Summary	129
Chapter 8 Evaluation	130
Introduction	130
Instructional Development by Error Elimination – A ‘Popperian’ Approach	131
Two Contrasting Paradigms of Evaluation	134
A Review of Evaluation Techniques	135
Evaluation of Cost-Effectiveness	139
Summary	140
Chapter 9 Resources Centres	141
Introduction	141
Resources, Resources Centres and Resource-Based Learning	141
The Role of Resources Centres in Different Educational Systems	144
The Planning, Organization and Operation of a Resources Centre	145
Chapter 10 Computers in Education	153
Introduction	153
Basic Concepts and Terminology	153
The Different Roles of the Computer in Education	156
Factors Affecting the Educational Use of Computers	163
Conclusion	168
Chapter 11 A Glimpse into the Future	169
Introduction	169
Current Trends in Educational Technology	169
Education in the Year 2000	174
Final Word	179
<i>Glossary</i>	180
<i>Bibliography</i>	241
<i>List of Organizations involved in the Educational Technology Field</i>	260
<i>Keyword Index</i>	264

Acknowledgements

We would like to acknowledge the help that we have received from the following people in producing this book:

- ☐ our colleagues Eric Addinall and Barry Murton, for advice and constructive criticism;
- ☐ the two (anonymous) readers to whom the original MS was sent by Kogan Page, whose constructive criticism was of considerable help in producing the final published version of the book;
- ☐ Una Baillie and Margaret Geddes, for typing the MS of this book and for all the other secretarial support they have given us in our work;
- ☐ Bill Black, for taking all the photographs;
- ☐ our Kogan Page editors Jane Wilkinson and Dolores Black.

The male pronoun has been used throughout the book for stylistic reasons only. Readers should interpret this as meaning a person of either sex. We hope that no one will be offended.

Introduction

Since educational technology emerged as a discipline in its own right in the years following the end of the Second World War, whole libraries of books have been written on virtually every aspect of the subject. Despite this wealth of material, however, there has been a noticeable lack of books that can be used as a basic 'primer' in the field, that is, books that give a simple overview of the main aspects of educational technology and explain how adopting an educational technology-based approach can help to improve the efficiency and effectiveness of the average teacher or lecturer.

This book has been written in an attempt to fill this gap, and we see it as having two main roles, namely, as a handbook for practising teachers and lecturers who want to learn something about the principles and practice of educational technology so that they can use it in their day-to-day work, and as a basic text for trainee teachers and students of education who are studying educational technology as part of their courses. The book should also prove useful as an introductory text for students of educational technology.

Since the book is not based on any particular educational system, and deals with the various topics covered in fairly general terms, we also hope that it will prove just as helpful to American, Australian and other English-speaking readers as it does to those in Britain.

The main text of the book consists of 11 chapters, each of which deals with a different aspect of educational technology.

Chapter 1 gives a broad introduction to educational technology, explaining what is meant by the term, introducing the 'systems approach' that underlies its thinking, and presenting a brief historical account of the way in which the field has developed since the late 1940s.

Chapter 2 then describes two fundamentally different approaches to education, within the context of which virtually all important developments in educational technology have taken place — the traditional 'teacher/institution-centred' approach and the more recent 'student-centred' approach.

Chapter 3 deals with the subject of educational objectives, the formulation of which should constitute the starting point of any systematic approach to course or curriculum design. It explains the

difference between 'aims' and 'objectives', offers guidance on how objectives should be written, and discusses the different types of objectives.

The next three chapters deal with the three main types of teaching methods that can be employed in implementing a course or programme of instruction, Chapter 4 dealing with 'mass instruction' techniques, Chapter 5 with 'individualized learning' techniques and Chapter 6 with 'group learning' techniques. In each case, a general discussion of the various methods that can be used and an analysis of their respective strengths and weaknesses is followed by a review of the different media and techniques that can be used to support them or put them into practice.

Chapters 7 and 8 then deal with the related topics of student assessment and course evaluation, explaining the overall role of each in the instructional process and describing the various techniques that can be used to carry them out.

Chapters 9 and 10 deal with two aspects of educational technology that have become progressively more important during the last 20 years and seem certain to become even more important during the next, looking at the role and organization of resources centres and at the various ways in which computers can be used in education.

Finally, Chapter 11 takes a glimpse into the future, trying to identify the main trends that underlie current educational technology and making informed guesses as to how these will have affected the overall educational scene by the year 2000.

The book also contains four reference sections, which have been included in order to increase its usefulness as a handbook.

The first is a comprehensive glossary of terms used in educational technology, defining over 800 words and phrases that teachers and lecturers are likely to come across in the course of their work; these not only cover the 'hardware' and 'software' aspects of educational technology, but also the highly important intangible aspects of the subject (sometimes described as the 'underware').

The second is a wide-ranging bibliography that lists over 350 books, papers and articles relating to the subjects covered in the individual chapters. This will enable readers to study in greater depth any topic or topics in which they are particularly interested. Full bibliographic details about all books, articles or other publications specifically referred to in the main text are given in the Bibliography under the appropriate chapter heading.

The third is a country-by-country list of some of the main professional bodies, associations and other organizations that are involved in the educational technology field and the various specific aspects thereof.

The fourth and final section is a detailed keyword index to the material covered in the main text.

Introduction to the Second Edition

A Handbook of Educational Technology was first published in 1984 and in light of the many changes that are occurring in the field the authors and publishers felt it was time to bring out a second edition. The authors have taken the opportunity to carry out a comprehensive revision of the book. This revision has taken four main forms.

First, all 11 chapters of the main text have been updated to take account of the various developments that have taken place since the first edition was written. A number of chapters have also had completely new material added to them (Chapters 1, 3, 4, 5, 6 and 7, for example).

Second, the visual impact of the book has been enhanced by introducing a large number of new illustrations, including 20 photographs (which were not used at all in the original version). This, it is hoped, will make the book even more useful to teachers and students.

Third, the glossary of terms used in educational technology that complements the main text has been thoroughly revised and updated. No less than 250 completely new terms have been added, room being made for most of these by removing any terms that had become dated or were judged to be of only peripheral importance.

Fourth, the chapter-by-chapter bibliography that constitutes the second major reference section has also been thoroughly revised and updated, with over 30 new references being added.

Needless to say, the keyword index has also been revised to take account of all the above changes.

CHAPTER 1

The Nature of Educational Technology

Introduction

To most people, the term 'educational technology' is, at best, confusing, and, at worst, downright off-putting. To some, the term is associated solely with the technical equipment and media of education — such as overhead projectors, television, tape-slide programmes, computers, etc. Others take the view that educational technology involves a clinical, systematic analysis of the entire teaching/learning process in an attempt to maximize its effectiveness. Indeed, extreme proponents of the latter view have sometimes been accused of treating learners more like 'impersonalized battery hens' than as 'people with inquiring minds who thrive on intellectual stimulation and human contact' — a view with which we have some sympathy.

Largely because of this confusion over its meaning, there can be little doubt that educational technology has now become a rather unhelpful jargon expression. Indeed, many practitioners working in the field are embarrassed by it, and, in some cases, have even made an attempt to disown it; several former 'educational technology units' in colleges and polytechnics have, for example, been re-named 'educational development units', 'learning units', or something similar. No one has so far managed to come up with an alternative, universally-acceptable name, however, so we appear to be stuck with it for the time being, and, for this reason, we will continue to use the term 'educational technology' throughout this book.

The perceptions of what constitutes 'educational technology' have evolved over a period of about 30 years, and its exact nature is not easily explained. Indeed Kenneth Richmond, in his excellent book *The Concept of Educational Technology* (1970), devotes the first 70 pages to a discussion of what educational technology is, and of the different connotations of the word 'technology'.

In this chapter, we will describe some of the general 'aspects' of educational technology, and trace its historical development. We will begin by discussing two quite different perceptions of educational technology, namely the idea of the 'technology *in* education' and the idea of a 'technology *of* education'.

Technology in Education

'Technology in education' embraces every possible means by which information can be presented. It is concerned with the 'gadgetry' of education and training, such as television, language laboratories and the various projected media, or, as someone once said, 'everything from computers to dinner ticket dispensers'. In other words, technology in education is basically the popular impression of what educational technology is all about, namely, *audiovisual aids*.

The general field of audiovisual aids is itself composed of two related but distinguishable areas, namely, *hardware* and *software*. The hardware side is concerned with the actual equipment — overhead projectors, slide projectors, tape recorders, videocassette recorders, television monitors, microcomputers, etc. The software side, on the other hand, is concerned with the various items that are used in conjunction with this equipment — such as overhead transparencies, slides, audiotapes, videorecordings and computer programs.

Technology in education is obviously one very important aspect of educational technology. Indeed, historically, many of the college-based 'educational technology units' evolved from units which were previously called 'audiovisual aids units'. By making appropriate use of hardware along with suitable software, it is often possible to improve the efficiency or quality of learning in a given situation, and this was the basis of the first developments in educational technology, as we shall see later.

One of the earliest phases in the evolution of educational technology was the 'hardware phase', in which a great deal of work was done in developing effective instructional equipment which was also reliable, serviceable and within the budgets of schools, colleges and training establishments. However, when such hardware eventually became generally available, it was found that there was a shortage of suitable software to use with it; this triggered off a subsequent 'software phase', in which particular attention was paid to the development of suitable learning materials, often based on the contemporary theories of learning and perception. Thus, even within this early development of educational technology, we can identify changes in the interpretation of the term 'technology'.

Initially, this had distinctly engineering connotations, since the main thrust of educational technology was concerned with the development of items of optical and electronic equipment for educational purposes; subsequently, it became much more associated with psychology and learning theory as the main thrust changed to the development of suitable software for use with this equipment.

However, at this stage in the development of educational technology, many people became aware that there was much in education and training which could be improved by thinking more carefully about *all* aspects of the design of teaching/learning situations. Such

considerations led to a new, broader interpretation of 'educational technology' as the entire technology *of* education rather than merely as the use of technology *in* education, with the latter being regarded as merely a part of the former rather than the whole field as had previously been the case. Let us now examine this new interpretation in more detail.

The Technology of Education

It could be argued that the principal role of educational technology is to help improve the overall efficiency of the teaching/learning process. In education and training, improved efficiency can manifest itself in many ways, for example:

- (a) increasing the quality of learning, or the degree of mastery;
- (b) decreasing the time taken for learners to attain desired goals;
- (c) increasing the efficiency of teachers in terms of numbers of learners taught, without reducing the quality of learning;
- (d) reducing costs, without affecting quality.

It is a value judgement as to which of the above interpretations are more important, and, indeed, such a judgement must be made in terms of the educational, financial and political aspects of individual situations. They are not necessarily mutually exclusive, but (to quote a hypothetical example) it might be found that certain measures that could well improve the quality of learning in a particular situation would also involve an increase in expenditure, so that a decision based on the likely cost-effectiveness of the measures would have to be made.

However, given well-defined criteria by which an improvement in the efficiency of an educational system, situation or process can be gauged, then decisions regarding the exact measures by which this can best be achieved can often be reached by applying a 'technology of education' approach. Recommendations for improvement are thus based on a study of the particular system *as a whole*, together with knowledge of appropriate educational research findings and theories of learning. In many cases, ideas and practices drawn from such diverse fields as psychology, sociology, business management and systems analysis are combined with developments in more technical fields such as optics, reprography, acoustics and microelectronics in order to produce the optimum learning or teaching system.

These aspects, which are all part of the technology *of* education, are sometimes called the 'intangible' aspects (or the 'underware', as opposed to the hardware and software already described). In this case, the emphasis is on the *techniques* of teaching and learning rather than on audiovisual aids *per se*. Although the 'intangible' aspects of educational technology are, by definition, less obvious than the 'hardware' and 'software' aspects, they are, nevertheless, just as

important (indeed, most educational technologists would say *more* important) when it comes to solving a particular problem.

A 'technology of education' approach to educational technology thus involves a systematic, scientific approach to a problem, together with the application of appropriate scientific research, both from 'hard' sciences such as physics and electronics and from social sciences such as psychology and sociology. In applying a technology of education approach, changes are not made to a system for their own sake, but only for good educational reasons that are generally based on research findings. Such changes may not always work as intended, but even unexpected outcomes may prove useful to the people involved (and to others) when future developments are being planned.

It is as a technology of education that most practitioners view educational technology today. Within this concept, technology in education is seen mainly as one of the possible means to an end, with appropriate hardware and software being selected or designed to back up the particular strategy that it is decided to adopt in order to achieve a given set of educational aims or objectives. In some cases, this may involve the use of sophisticated equipment such as video or computers; in others, duplicated worksheets may be all that are required. Here it is important that the educational development or innovation has been *systematically* and *scientifically* planned and executed. It is this 'systems approach' to educational technology which is at the heart of the technology of education.

The relationships between the various aspects of educational technology discussed so far are shown in schematic form in Figure 1.1.

The Systems Approach

The systems approach to the design and analysis of teaching/training situations is the basis of the great majority of modern educational technology-related developments. However, the terms 'system' (which we have already used in a number of contexts) and 'systems approach' are jargon terms and can have a variety of interpretations. Let us therefore first take a look at these terms in order to define the way in which we are to use them.

In an educational technology context, a *system* is any collection of interrelated parts that together constitute a larger whole. These component parts, or *elements*, of the system are intimately linked with one another, either directly or indirectly, and any change in one or more elements may affect the overall performance of the system, either beneficially or adversely. A simple system is illustrated schematically in Figure 1.2.

In Figure 1.2 the system consists of four distinct elements A, B, C, D which are related to or dependent upon each other as indicated. Note that some interrelationships may be two-way, while others may be one-way only. These elements may themselves be capable of further

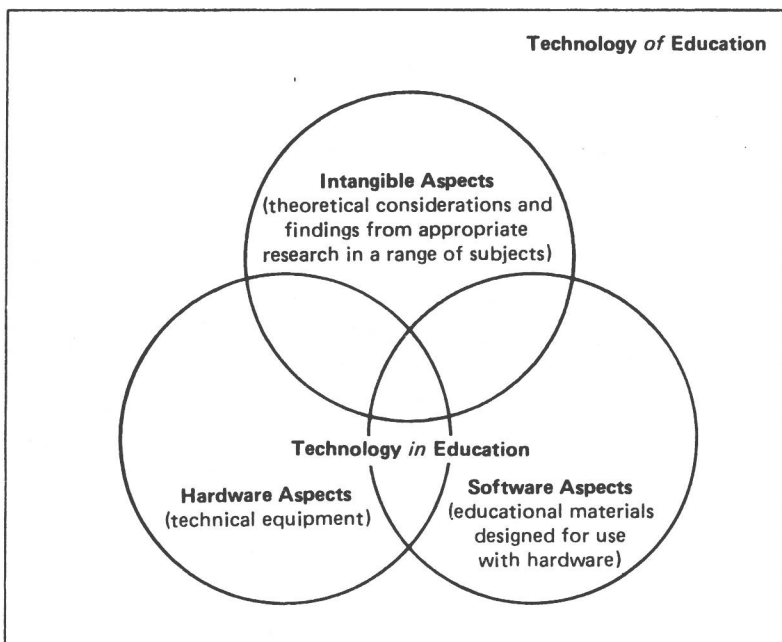


Figure 1.1 The relationships between the different aspects of educational technology

breakdown into other smaller components, and may thus be regarded as *sub-systems* of the overall system.

The processes of education and learning can be considered to be very complex systems indeed. The input to a given educational or learning system consists of people, resources and information, and the output consists of people whose performance has (it is to be hoped) improved in some desired way. A schematic representation of systems of this type is shown in Figure 1.3.

In such a system, the educational or learning process may be so complex that it can only be considered as a 'black box' whose mechanisms are not fully understood. However, research into the nature of the learning process has thrown *some* light on what happens inside the 'black box'. This has enabled educational technologists to structure the input to systems of this type in such a way as to try to improve the output through increasing the efficiency of the learning process, thus leading to a systems approach to course design based on existing knowledge of how people learn. Such a systems approach attempts to mould the input to a course in such a way as to enable the optimum assimilation of knowledge and skills to take place during the learning process and hence maximize the quality of the output. It is to the various elements of such a systems approach to the design of