COMMUNICATION

Pedagogical Analysis of Instructional Material in School Education

MADHU PARHAR
STRIDE, Indira Gandhi National Open University, India

Abstract : *Learning is facilitated by programmed and structured instructional material. The main focus of this study was the pedagogical analysis of printed instructional material at school level. The study was restricted to textbooks and learning material produced by the NCERT, theNOS and books from a private publisher. The books selected were of Grade 10 and the subjects were English, Hindi, Mathematics, Science and Social Science. A criteria was developed for evaluation. The components of the criteria were Objectives, Presentation, Evaluation, Layout and Production. The study reveals that NOS has utilized the fruits of educational technology in designing its material, whereas books from NCERT and private publisher are conventional. There is a need for capacity building among the textbook writers and courseware authors.*

Introduction

Teachers and textbooks are the two main academic inputs in school education in developing countries like India. The school quality, and hence, students' performance are directly influenced by the quality of teachers and instructional material. In fact, because of resource crunch, there is hardly any other learning material than textbooks in a school, with rare exceptions of workbooks and supplementary reading. Generally poor economic condition does not allow a student to access other forms of learning material. With large number of students coming from parents with no education or poor education, textbooks are the only learning support systems at home. Thus textbooks are of critical importance in Indian school education.

Textbooks have taken primarily two forms — conventional textbooks produced by the NCERT, State Textbook Boards and private publishers, and structured self-instructional material produced by researchers for their research and those by the National Open School for distance education students. There have been large number of studies on evaluation of textbooks and effectiveness of structured self-learning material, programmed learning material in particular. One set of studies focused on gender sensitivity and gender bias in textbooks. Another group of researchers studied the value orientation. There are other studies on programmed learning and other forms of structured learning material. However, the five sequential surveys of research in education by

Indian Journal of Open Learning, 1999, 8(1), 85-101.
ISSN 0971-2690. Printed in India.

Buch (1974, 1978, 1983, 1991) and NCERT (1997) do not record any research on analysis of textbooks and textual material from the angle of pedagogy. This study was an effort to examine textual material from pedagogical angle, application of educational technology in particular.

Educational Technology

Educational Technology has been described in many different ways. Some equate it with films, slides, television, computers, etc. i.e., gadgets and machines used in education and some others consider it as nothing else but programmed learning. The primary emphasis of educational technology is on 'learning' and not on 'teaching'. The UNESCO document "Learning to be" has also emphasised on this. The trend of professional definition is to equate educational technology with the goal of optimizing human learning Mukhopadhyay (1993) argues that:

> The major concern in education today is the widening gap between the learning potential and the learning outcome. In a conventional sense, this amounts to underachievement. Underachievement today is widespread and almost all pervasive at all levels of education and training. The non-correspondence between learning potential and outcome is universal; however far more acute in countries like ours, since educational processes and methods continue to remain unaltered on the face of changing techniques and technologies in the non-formal learning and learning of life skills outside the four walls of the schools and colleges. If educational technology has any quarrel with the conventional system it is on this ground. The birth of educational technology is for optimizing human learning through new unconventional learning techniques.

The above description indicate that the major concern of educational technology is optimizing human learning. Any one single methodology cannot achieve this goal. Hence educational technology prescribes a multi-channel learning to suit the learning needs of different learners at different times and of different subjects and skills.

Educational technology is considered as the interactive product of Technology of Education and Technology in Education (Percival and Ellington, 1984). Technology of Education implies a systemic approach to instructional design i.e., it provides the systemic frame for instruction. Technology in Education, on the other hand, implies audio-visual aids-slide projector, television, computer etc. This emphasis on 'technology of education' as a primary paradigm with technology in education providing the instrumentalities has led to the concept and practice of instructional design, the applied aspect of educational technology.

Instructional Design

The purpose of instruction is to help students learn. Instruction comprises a set of activities that facilitates the learners. These activities can be in the form of reading printed pages, listening to teacher talks, etc. For optimizing learning, instruction is designed in a systemic way. This systemic procedure to ensure learning is the basic spirit of Instructional Design. A typical systems approach to instruction is presented in figure 1.

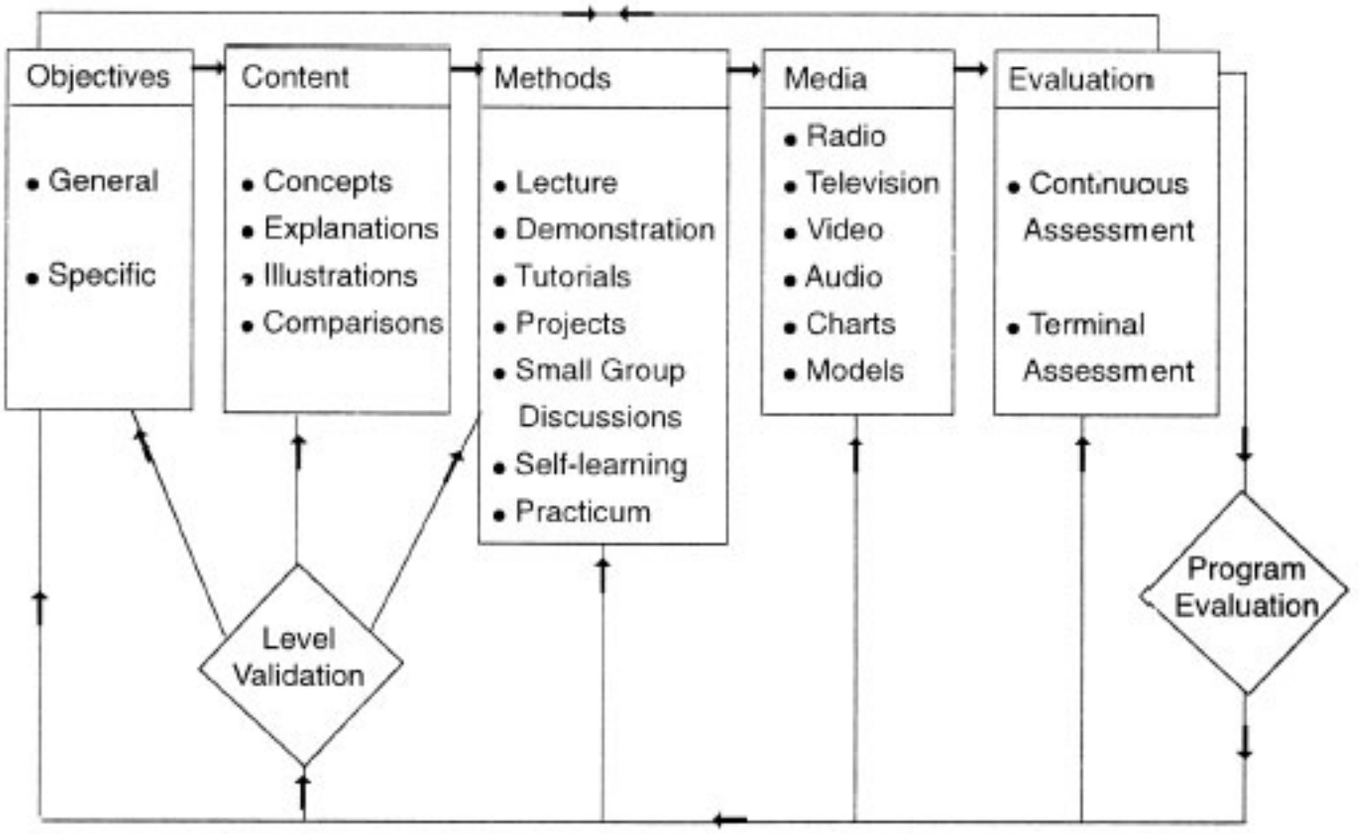

Fig. 1 : Systems approach to instruction instructional design model

The basic parameters of an instructional design are

- Objectives
- Content — with specification of level
- Methodology — means of transaction
- Aids and Media — instrumentalities and facilitators in transaction, and
- Evaluation — tools and techniques of formative and summative evaluation

These features of an instructional design can be built into a face to face transaction as well as in designing the instructional material. Instructional material refers to printed or electronic media software like, audio and video programmes. Some of the most common forms of printed material are textbooks, programmed and semi programmed material and learning modules.

In India, students have access only to the textbooks and the tutors. Tutors widely vary in their quality — knowledge of the content, communication and their overall attitude towards teaching, students, subjects, etc. The efficacy of a textbook as a facilitator of learning depends upon the quality of textbooks. The intrinsic quality in turn depends upon a large number of attributes, like

- content,
- social sensitivity,
- language,
- structuralization, and illustration,
- presentation, etc.

From learning point of view all these attributes are important. The last three attributes are directly related to learning process, particularly the structuralization and presentation since they determine the pedagogical efficiency of textbooks. Structuralization is the direct application of educational technology in instructional material development. There are very few, studies on the structures or pedagogical efficiency of textbooks as learning tools. The main focus of this study is pedagogical analysis of printed instructional material at the school level.

Previous Research

The programmed learning material and the textbooks, are the two major forms of instructional material.

The research studies on programmed learning have been reviewed by Dewal (1997), Kulkarni and Kapadia (1974), Mishra (1986), Mukhopadhyay (1989), Shah, Mehta and Kulkarni (1978) and Shukla (1991). They referred to studies by Sharma (1966), Desai (1966), Shah (1969), Shah (1964), Pandya (1974), Reddy (1975), Mehta (1973), Shah (1980), Seshadri (1980), Pandey (1980), Trivedi (1980), Sanguan (1984), Chaudhry (1985), Debi (1989), Desai (1986), Kalacherry (1987), Shah (1984), Rabindradas (1984) and others.

In most of the studies, development of material was one of the major objectives. Further, it was found that the group taught through programmed material achieved higher on the post test compared to the group taught through conventional lectures by teachers.

Few studies were reported on the comparison of various styles of programmed learning material such as linear, branching or mathetical. The branching style of PLM has been reported as more effective than linear style by Joseph (1983) and Kagathala (1982). Gautam (1986) found both linear and branching formats to be equally good in terms of performance of students. Kaur (1983) reported no difference between the linear and mathetical styles of programming. Khanam (1983) reported that PLM was better suited for learning concepts rather than rules. Ambli (1992) studied the effect of step to para, extrinsic to intrinsic reinforcements and overt and covert response transformation in learner reading material interaction on learner performance. Two major trends are indicated in one set of studies on programmed learning. These are:

Mukhopadhyay (1989) reviewed the researches on educational technology from the angle of planning and management implications. According to him "In India, textbook and teacher would remain the main media of education. On the one hand, programmed learning material has been found to be effective across the subjects and across the levels, on the other hand it has not found adequate reflection in the preparation and structuring of textbooks. First major implication is to consider whether the basic text for students at the school and the collegiate levels can have the elements of programming or semi-programming. Preparation of textbooks has not been professionalised yet, except to some extent in the NCERT's approach to textbook development at the school level. Even at that level, there is a scope of making textbooks far more self-learning."

Textbooks/Learning Material

There are quite a few studies on the evaluation of textbooks. The researches in this area have been reviewed by Desai and Roy (1975), Roy (1979), and Rao (1988) in the first Three Surveys of Research in Education — Buch (1974, 1978, 1983).

A few studies focused on gender sensitivity. The Maharashtra State Bureau of Textbook Production and Curriculum Research (MSBTPCR) studied the position of women in school textbooks for standards I to X and found a definite sex bias in these books. Dhan (1990), Gandhi(1991), Michael (1991), and Valliammai (1990), also studied the sexist bias in textbooks. Kher (1972), Lalithamma (1981), Pattabhiram (1973), and Ponkshe (1972) aimed at evaluation of school textbooks of history, mathematics and geography. Dharmadhikari (1973) evaluated teacher's handbooks for work experience. Manuel (1982) analysed the textbooks in environmental studies of NCERT. Gagneja (1974) evaluated social science, history and geography textbooks.

Another area where studies have been conducted are the value orientation in textbooks. (Anbarasu 1992, Chezhian 1988, Kariappa 1992, Khandekar 1991, Mohagaonkar 1990, and Vaidya 1991). Few other studies aimed at analysing the concepts in syllabus and textbooks. Gopalkrishnan (1977), and Karandikar (1973), did the content analysis of general science textbooks whereas Karim (1982) analysed the contents of history textbooks to assess the extent to which they promoted national integration. Mukhopadhyay (1983) studied the comprehensibility of language used in science and, social science textbooks at primary level. Lalu (1990) carried out a sociological analysis of home science textbooks. Sharma (1992) also made a sociological analysis of language and social science textbooks produced by NCERT. Narayanasamy (1992) analysed population concepts in primary school textbooks and developed strategies for teaching them.

Rastogi and others (1975) compared textbooks on vernacular prescribed for primary classes with reference to exercises, illustrations and physical aspect of textbooks. Vaghamare (1971) examined the extent of exercises in history textbook and weightage given to different types of exercises.

Recent studies indicate that children have difficulty reading their textbooks (The World Bank, 1997). Sharma (1993) on a study of readability found that the vocabulary in textbooks was too difficult. The textbooks also reflected poor instructional design, repeating only about five percent of words ten or more-times and using more than 350 words only once. School effectiveness studies in Uttar Pradesh found the grade II students had not acquired the reading competencies required to read the grade II textbooks in Arithmetic and Hindi. NCERT and Central Institute of Indian Languages (1995) on study of the "readability of primary textbooks" provide a comprehensive view of textbooks in six states. The results unfolded striking differences among the states in student comprehension of textbooks. The vocabulary and sentence structure of textbooks were too difficult for study at the primary level in many states. The study carried out as part of Andhra Pradesh Primary Education Project (APPEP) found out that professionally designed textbooks significantly improve learning achievement of grade I children in Andhra Pradesh (The World Bank, 1997).

Programmed learning as research indicates, provides a feasible alternative to improve learning by structuring learning material. The textbook related research, however, concentrated on gender sensitively content, value orientation, etc. There is no study, whatsoever, on structural analysis of textbook and textual material that could have indicated the pedagogical efficiency of textbooks and textual material. This is a major gap in Indian research. The present research is a modest effort in exploring in this otherwise unexplored area.

Objectives

The objectives of the present study were to:

- identify instructional material at school level,
- examine the use of educational technology in designing instructional material,
- evaluate the quality of material from the angle of pedagogical efficiency, and
- recommend necessary changes.

Methodology

The study was restricted to the national level textbooks and learning materials produced by the NCERT, the NOS and books from S.Chand & Co., a private publisher. The books selected were of the secondary level i.e. Grade 10. Students of 10th grade study five subjects for the CBSE examination. These are English, Hindi, Mathematics, Science and Social Science. The textbooks and materials in Science, Maths and Social Sciences are available from all three sources, NCERT, NOS and S.Chand & Co. However, English and Hindi textbook and materials were available only from the NCERT and NOS. The total number of lessons were too large for analysis for such a short term study. In consultation with the experts it was decided to select about 25 percent of the lessons from each textbook. The designing of evaluation instrument involved two steps. Evolving the Criteria and Developing the Information Blank on the basis of the criteria. Instructional design, mentioned earlier, provided the theoretical construct for the evaluation. The criteria were developed mainly on the basis of the instructional design. The main components were Objectives, Presentation of the content including structuring it into small bits of information, illustration, activities and summary. The issue of layout and quality of printing and production were also included in this analysis. The criteria thus developed was reviewed by experts in educational technology and modified. The modified version of the criteria was pilot tested on two textbooks/learning material.

On the basis of the criteria, thus developed, an Information Blank was developed for collection of data on objectives, introduction, presentation, evaluation exercises, layout, and production.

Each criteria was evaluated either on Yes/No or on a five point scale — 'Very Often (VO)', 'Often (O)', 'Some Times (ST)', 'Rarely (R)', and 'Never (N)'. Illustration and types of evaluation items were quantified.

For collecting data selected lessons from each textbook were evaluated against one criteria each. The criteria which involved five point rating had the risk of subjective judgement. To reduce subjectivity of assessment smaller sample of lessons were got evaluated by multiple evaluators. These evaluations were used for cross-validation.

Data were tabulated in tabular form for comparison. The main emphasis was on qualitative description and critical analysis of the textbooks with respect to each criteria developed in this study.

Findings

The findings of the study are presented under a few broad heads, namely, Objectives, Introduction, Presentation, Evaluation, Layout and Production.

Objectives

Objectives are the milestones in a learning endeavour. On this aspect, information was collected on whether the objectives are stated in the beginning of the lessons; if yes, whether the objectives are clear, measurable and stated in terms of learning outcomes. Whether there is a concept map in the beginning of each lesson was also studied.

None of the books produced by NCERT and the private publisher has stated objectives of the lessons, whereas in all the subjects and in all the lessons produced by NOS, there are stated objectives. The absence of stated objectives in the NCERT and privately published books deprives the learner of that important facility of 'knowledge of goals' which itself is a facilitator of learning. The stated objectives provide NOS material an edge ever the others in pedagogical soundness. Objectives in the NOS learning material are clearly stated and are measurable. In the NOS material, objectives are very often stated in terms of learning outcomes which makes objectives measurable.

Concept map in instructional material does not appear to be a common item. NCERT and the private publishers do not have concept map. NOS uses concept map only in the science learning material.

Introduction

The main purpose of an introduction is to orient the learner on what will be the main focus of the lesson/unit. It should link the lesson with the previous learning so that there is a continuity in the learning process. The introduction is also intended to create interest of the learner in the lesson. The effort was to assess whether each unit/lesson begins with an introduction, whether introduction refers to previous learning and leads to the content of the lesson and whether it is introduced in simple and interesting manner. Findings reveal that all the lessons in four subject textbooks produced by NCERT start with an introduction. English language textbook is the only exception. All lessons in all subjects in NOS material start with an introduction. None of the books of the three subjects from the private publisher had any introduction to the lessons.

Introduction in the NCERT's Science textbook lessons 'very often' referred to previous learning. Among the NOS material, introductions, 'very often' referred to previous learning in Science and Social Science textbooks. In Hindi textbooks only 'sometimes' introduction referred to previous learning; in English and Mathematics material introduction did not refer to previous learning. Textbooks published by the private publishers did not have an introduction, leave alone other qualitative aspects of introduction.

'Very often' the introduction leads to the content of the chapter in Hindi and Mathematics books of NCERT; it is 'often' found in Science and Social Science textbooks and 'never' in English books. In all the NOS learning material, the introduction 'very often' led to the content of the chapter.

Introduction to each lesson in the learning material of NOS in all subjects except in Hindi is 'very often' simple and interesting. In case of Hindi lessons, introduction is 'often' interesting and simple. Only in Hindi and Mathematics textbooks of NCERT, the introduction are 'very often' simple. In Science book, it is only 'sometimes' simple.

The above analysis reveals that the lessons of most of the NCERT and NOS material start with an introduction. In subtler qualities of introduction, there are variations between material produced by the NCERT and NOS. There are also internal variations in qualitative aspects of introduction among the lessons and subjects within the material produced by NCERT. Similar is the case with NOS. On this count NOS material satisfies larger number of pedagogical criteria.

Presentation

Presentation is the backbone of any textbook. It was tried to assess the presentation in terms of *small steps* illustrations, activities for the students, summary of the lesson, references for further reading, etc. The research on programmed instruction, referred earlier, indicates that content presented in small steps facilitate both immediate learning and long term retention. However, there are minor variations in this among the instructional material produced by NCERT, NOS and the private publisher.

Learning material produced by NOS and the private publisher are 'very often' presented in small steps. Out of the five subjects, lessons in the NCERT textbooks in English, Hindi and Mathematics are 'very often' presented in small steps whereas in Science and Social Science, these are often presented in small steps. This is one area where the textbooks from three sources share common attributes, and the attribute is pedagogically sound. In all the books from all three sources, the content is very often logically sequenced.

Just as introduction provides the set induction, orienting the learner to the learning task, *summary* at the end of lesson plays the role of closure as it is in live classrooms. The analysis of instructional material from NCERT, NOS and private publisher indicates two different trends (Table 1).

Table 1 : End of the unit summary

Subject	NCERT					NOS					PRIVATE				
	VO	O	ST	R	N	VO	O	ST	R	N	VO	O	ST	R	N
English					✓	✓									
Hindi					✓	✓									
Mathematics					✓	✓									✓
Science					✓	✓									✓
Social Science					✓	✓									✓

Table 1 reveals that none of the lessons of NCERT textbooks and material published by private publisher have a summary at the end of the lessons. On the other hand, all the units/lessons of NOS books have summarized the content of the unit, under the heading "what you have learnt", very effectively.

None of the textbooks published by NCERT, NOS or private publisher provide any list of additional reading at the end of the lesson or at the end of the book, with the exception of the English textbooks, from NCERT and NOS. The titles of few new stories which the author wants the students to read are listed at the end of the lesson.

Activities are important learning tool, for it helps in application of knowledge. The instructional material vary widely on this criteria (Table 2)

Table 2 : Use of activities in the textbooks

Subject	NCERT					NOS					PRIVATE				
	VO	O	ST	R	N	VO	O	ST	R	N	VO	O	ST	R	N
English				✓			✓								
Hindi				✓			✓								
Mathematics	✓					✓						✓			
Science		✓				✓									✓
Social Science		✓					✓								✓

Table 2 reveals that 'very often' the 'Activities' are used in NCERT Mathematics and the NOS Mathematics and Science material. The activities are often used in NCERT Science and Social Science textbooks and NOS English, Hindi and Social Science material. It is rarely used in English and Hindi textbooks of NCERT. There are no activities given in the Science and Social Science material produced by the private publisher. However, privately published books use activities 'often' in Mathematics textbook.

Illustration has a special role in textbooks. It clarifies concept; it also makes the material attractive and interesting. All the textbooks published by NCERT, NOS or private publisher use illustrations, though they vary widely in the quality and degree of usage (Table 3). The Science books from all the three sources and Social Science books of NOS and private publishers are 'very often' adequately illustrated. The Hindi books of both NOS and NCERT and English book of NCERT are not at all illustrated. Mathematics and Social Science books of NCERT are 'sometimes' illustrated. Mathematics material of NOS is 'often' illustrated.

Table 3 : Illustration of material

Subject	NCERT					NOS					PRIVATE				
	VO	O	ST	R	N	VO	O	ST	R	N	VO	O	ST	R	N
English					✓		✓								
Hindi					✓					✓					
Mathematics			✓				✓					✓			
Science	✓					✓					✓				
Social Science			✓			✓					✓				

It is useful to refer to illustrations in the text so that students can relate an illustration to the specific aspect of the text. The illustrations are very often referred to in the text of Mathematics and Science books of NCERT. But in Social Science, the illustrations are not referred to in the text.

Table also reveals that there were no illustrations in NCERT English and Hindi textbooks. In the NOS material on English, Mathematics and Science, the illustrations are very often referred to in the text. In the Social Science book, however, it is rarely done and in Hindi it is never done. Books on Mathematics and Science by private publisher very often refer the illustration in the text; and in Social Science it is not done at all.

Labeled illustrations are more effective and pedagogically sound than non-labeled illustrations, particularly in Science.

In the Mathematics and Science textbooks of NCERT, the illustrations are 'very often' labeled, and in the Social Science it is 'rarely' done. In the NOS material, illustrations are 'very often' labeled in English, Mathematics and Science books whereas in Social Science material, illustrations are 'rarely' labeled. Even in the books published by private publishers in Mathematics and Science, the illustrations are 'very often' labeled.

Presentation is the core of a textbook and textual material. Though there are lot of commonality in the approach among the three publishers, NOS attends to all the pedagogical aspects of textbook designing more meticulously than the NCERT and the private publisher. From the angle of pedagogical efficiency and application of educational technology, NOS material are superior to the material from the other two sources.

Evaluation Exercises

Evaluation exercises are an important aspect of any textbook/learning material. These exercises are provided so that the learners review their progress of learning, apply knowledge and feel motivated and challenged to continue further. Exercises are provided either at the end of the lesson or within the lesson after each section or both. The advantage of having exercises at the end of each section is that the learner can go back to the section and relearn before proceeding to the next section. Information was sought on

- whether there are self assessment questions (SAQ) within the text,
- what are the different types of questions,
- whether there are questions at the end of the lesson,
- whether these questions cover the whole text,
- whether these questions measure the achievement of the objectives, and
- whether model answer to the SAQs are provided in the text.

The textbooks produced by NCERT do not have SAQs or Intext Questions after each section, whereas all lessons in the NOS material, there are self assessment exercises. Out of the three books published by the private publisher, the books on Science and Mathematics have exercises after each section which is not the case in the Social Science book. It is interesting to note that the SAQs used by the private publisher are the questions from the Board examination.

In all the textbooks of NCERT and NOS, there are exercises at the end of each lesson. Mathematics and Social Science textbooks from private publisher had lesson end exercises. Science textbook from private publisher had exercises after each section, but no lesson end question.

Lesson end questions are meant for summative evaluation. Evaluation exercises at the end of each lesson of NOS material cover the whole text. Similar is the case with the NCERT textbooks in three subjects i.e., English, Hindi and Mathematics. In the Science and Social Science textbooks, the whole text is 'often' covered in the chapter end exercises. In the rest of the two subjects i.e., Mathematics and Social Science the whole text of the lesson is 'often' covered by the lesson end questions.

SAQs are supposed to evaluate achievement of learning goals or stated objectives of the lesson. It has been difficult to assess this aspect since NCERT and privately published books do not have any stated set of objectives. The assessment was possible only in case of the NOS material since all lessons have stated set of objectives. The evaluation exercises thus framed in the textbooks from the NCERT and the private publisher do not reflect whether objectives are achieved or not.

It is important that the text provides model answers so that the learner can compare his/her answer with that of the model answers to SAQs after each lesson. In NOS material the model answers are given at the end of each section. In the textbooks of NCERT, no model answers are given. In Mathematics book, only the answer is provided. Same is the case with the textbooks published by the private publisher (not the solution). The

rest two books did not give the answers to the evaluation exercise. This is a major weakness of the textbooks produced by the NCERT and the private publisher.

In all the subjects, the NOS modules contain different types of objective tests, very short answer and short answers type exercises. In the NCERT textbooks and books from private publisher, the short answer and essay type exercises are more in number.

Lay Out

Lay out of any textbook is an important aspect since it has significant role in learning. The different points that were considered in the layout are the

- provision of white space for student notes
- headings and sub-titles, and
- other layout parameters like page size, size of the margin, column size, type size, font, the location of the illustration, etc.

There are two different roles that white space can play. Firstly, adequate white space provides the relief, and reading becomes pleasant compared to the cramping of matter in tightly composed pages. Secondly, adequate white space can also be used for making margin notes, calculations and writing answers to the questions which is an important reading habit. The provision of white space in the material is given in Table 4.

Table 4 : Provision of adequate white space in the textbook

Subject	NCERT					NOS					PRIVATE				
	VO	O	ST	R	N	VO	O	ST	R	N	VO	O	ST	R	N
English					✓	✓									
Hindi					✓	✓									
Mathematics					✓	✓									✓
Science					✓	✓									✓
Social Science					✓	✓									✓

Above table reveals that all the modules of NOS have adequate white space in the text whereas none of the NCERT books or books from private publisher has white space in the text. On the contrary, books from the NCERT and the private publisher are too cramped for enjoyable reading.

In the material produced by the NOS, headings are 'very often' displayed boldly in all the lesson in all the subjects. Same is the case with the books published by the private publisher. But in the NCERT textbooks, the bold headings are not consistent across the subjects. In Mathematics, the headings are 'very often' bold; in Social Science it is 'often' bold; in English and Hindi it is 'rare', and in the Science book the headings are not at all bold. 'Very often' the subtitles are bold in the NOS modules and in the books published by the private publisher. The NCERT English, Hindi and Science textbooks

do not have bold subtitles but Mathematics and Social Science books 'very often' and 'often', respectively, have bold subtitles.

The language textbooks generally do not use illustrations except some diagrams in English material of NOS. In Mathematics, NOS uses three types of illustrations namely graphs, tables and diagrams; NCERT uses much more illustrations but only graphs and diagrams. All three publishers use almost all types of illustrations extensively in Science and Social Sciences books. Interestingly symbols and cartoons are not used in any of the subject by any of the publisher.

The NOS, books are printed in A-4 size 30 cm x 21 cm. The margin on the left and right side of the paper are in the proportion of 8 cm x 1.5 cm. The text is presented in single column except in Science which is produced in two columns. The material is printed in 12pt size. Compared to that, NCERT text books are produced in 24 cm x 17 cm in 10 point. Margin is 1.5 cm. on both sides. However, the margin becomes '0' (zero) due to side stitch binding. The margin in the privately published textbook is 1.5 cm on both sides printed on 24 cm x 17 cm size pages and in 10 point type. The smaller type size reduces the lead space making printing more cramped and reading more difficult.

Production

Production is an equally important aspect of textbook, because it provides the final get up that makes a book either attractive, dull or even repulsive. The main points under this aspect were

- printing of the material,
- relevance of the cover,
- thickness of the cover,
- durability,
- appearance of the book to the learners,
- thickness of paper, and
- readability of the book.

In all the learning material produced by NOS, 'very often' the printing is clear. The printing is 'very often' clear in the textbooks on Mathematics and Social Science produced by the private publisher. However, the printing of Science book was not as good as the NOS material. English, Hindi and Mathematics books of NCERT were 'often' clear in printing. The Science book was not clear. Printing on the reverse side was visible making reading difficult.

Cover is the first attraction of a book and also indicative of things covered in a book. All the books from NCERT, NOS and private publisher use subject related illustration on the cover. All the textbooks from all three sources, except Mathematics from NOS carry multicolour illustration; the covers are thick, and attractive.

Durability may not necessarily be a component of application of educational technology. Nevertheless, it is important since a book has to be used at least for a year. If it is not

durable, it gives way in between the year loosing the attractiveness. By durability, the quality of binding has mainly been emphasized. All the NCERT and NOS books are durable. Even the Science and Social Science books from private publisher are durable but not the Mathematics book.

All the modules published by NOS have thick papers. Therefore, the printing does not show on the other side of the paper. The printing in English, Hindi and Social Science books of NCERT does not show on the back side of the paper whereas in Mathematics and Science books the printing can be seen on the reverse side of the paper. Similarly printing is not seen in the Science and Social Science books published by the private publisher; but in Mathematics book the quality of the paper is thin. This would imply that NOS is consistent in using good quality thick papers for printing instructional material, whereas NCERT and the private publisher is inconsistent in choice of papers for printing of textbooks.

To conclude, the study highlights two major aspects of application of educational technology in instructional material preparation. There are core components like presentation of material and peripheral components like statement of objectives, introduction, layout and production. Within the core component, central theme is presentation of content in small steps; illustrations and summarization are the supporting items. It is important to recognize that the peripheral items directly influence the learning process; hence they need adequate attention and care. The study reveals that there are a lot of common ground among the textbooks from the various sources so far as the central core is concerned. Whereas, NOS takes the job of textual material design and development with the pedagogical seriousness to the last point, NCERT and the private publishers stop short at the minimum necessary items of a textbook. Thus, there are considerable scope for improvement of textbooks produced both by the NCERT and the private publisher. NOS material can work as exemplar material in this regard.

Implications

Studies have indicated that the learning is facilitated by programmed and structured instructional material. This study brings out that the NOS has utilized to a very large extent the fruits of educational technology in designing its material. Compared to that the books published by the NCERT and the private publisher continue to be largely conventional. Should we consider that one of the major aims of education is to develop skills of 'learning to learn', there are serious policy and planning implications in designing textbooks emerging out of this study.

Since the structured learning material is pedagogically more sound, it facilitates self learning and is feasible to be developed, it becomes obligatory on the part of the State to offer the child in the school the best it can. It requires a major policy shift with regard to textbook design, preparation and production, at the national level. Also it will be necessary to change the prevailing mechanism of textbook writing. NCERT as an apex organisation will have to take the lead, particularly since it has the most pervasive influence in school education in the country. Despite the non-statutory status, NCERT's curriculum and textbook are adopted and adapted by almost all the states of India. In

1995 a series of national workshops were held under the title "Textbook Renewal" (The World Bank, 1997). However, The World Bank document misses out on the role of educational technology in textbook renewal. One of the major implications of this study is to develop a national debate on use of educational technology in preparation of the textbook.

Textbooks have been defined as compendium of knowledge techniques, techniques of communication, 'teacher in print' etc. Textbooks are now written by trained teachers and 'trained headmasters' but not by trained writers. There is a need for capacity building among the textbook writers and courseware authors. Major planning implication will be with regard to the mechanism of textbook writing. There are two choice. One possibility is to train the textbook writers in the science and techniques of structuralisation, educational technology in other words. The second alternative is to develop learning material by a team comprising content specialists, language editors, educational technologists, instructional designers and illustrators, the way NOS develops its materials. In order to ensure pedagogical soundness both NCERT and the state level agencies will have to involve instructional designers, illustrators, textbook designers and production specialists along with the subject specialists. This will require in a major shift policy and planning of textbook preparation and production.

This study also raises certain cost implications for textbook production. NOS material offered large margin on each page. It can be construed that unit cost of NOS material is higher than that of the NCERT textbook. The cost analysis studies on NOS however indicates that cost of per set of learning material for all five subjects (5 x 6 booklets x 100 pages = 3000 pages) at the secondary level is about Rs.300.00. Compared to that subsidized cost of all the five books of NCERT (about 1800 pages) is Rs.181.00 — equivalent to Rs.301.00 for 300 pages material. For three subjects from private publishers a student has to pay Rs. 330/- which is more than all five subjects of NOS. If the subsidy provided by NCERT textbook and Govt. of India on paper is not considered for costing, the unit cost of NCERT textbook, NOS textbook is actually higher than. Hence if at the same or lesser cost a student can get better structured learning material than the conventional textbooks, there is no reason why they should be deprived of better material.

Much of the physical burden is not because of content but because of unimaginative production of textbooks. NOS material on any subject is produced in six or seven modules each of about 100 pages. Whereas the conventional textbook of about 300 to 350 pages are bound together. As a result a young student has to carry a lesson which is taught at the end of the year all through out the year whereas a student of NOS carries only 1/6th of the burden at any given time. Also thinker volume enhances durability. In order to reduce the burden of the students, textbooks could be modularised along with structuralization.

References

Buch, M.B. (ed), (1974) *A Survey of Research in Education*, Baroda: CASE.
Buch, M.B. (ed), (1978) *Second Survey of Research in Education*, Baroda: SERD.
Buch, M.B. (ed), (1983) *Third Survey of Research in Education*, New Delhi: NCERT.
Buch, M.B. (ed), (1991) *Fourth Survey of Research in Education*, New Delhi: NCERT.

Chaudhry, M. (1985) Preparation and Evaluation of a Programmed Learning Material in Geography for the Secondary Level, Unpublished Doctoral Dissertation in Education, Avadh University.

Debi, M. (1989) Developing and Testing the Effectiveness of the Programmed Learning Material in the Syllabus of Principles of Education in B.T. Course of Gauhati University, Unpublished Doctoral Dissertation in Education, Gauhati University.

Desai, R.M. (1986) A Study of Effectiveness of Programmed Learning Strategy in Teaching of Physics in the Eleventh Grade, Unpublished Doctoral Dissertation in Education, Bombay University.

Desai, U.R. (1966) Programmed Learning Versus Traditional Approach in the Teaching of Gujarati in Standard IX, Unpublished Doctoral Dissertation in Education, Gujarat University.

Dewal, O.S. (1997) Educational Technology. A Trend Report, in *Fifth Survey of Research in Education,* New Delhi: NCERT.

Kalacherry, K.A. (1987) Preparation and Experimental Try-out of Programmed Instructional Material in the Syllabus of Chemistry Prescribed for Class VIII in Maharashtra State, Unpublished Doctoral Dissertation in Education, Bombay University.

Kulkarni, S.S. and Kapadia, G.S. (1974) Programmed Learning : A Trend Report, in Buch, M.B. (ed), *A Survey of Research in Education,* Baroda, CASE.

Mehta, S.J. (1973) An Investigation into the Effectiveness of Programmed Material in English for Developing Reading Ability, Faculty of Education and Psychology, M.S. University.

Mishra, C.H.K. (1988) Educational Technology : A Trend Report, in *Third Survey of Research in Education,* New Delhi: NCERT.

Mohangaonkar, P. (1990) A Study of Human and Moral Values through the Marathi Textbooks of Standards VI, VII and VIII, Unpublished M.Phil. Dissertation in Education, Nagpur University.

Mukhopadhyay, B. (1983) The Relationship between Comprehensibility of Language used in the Science Textbook and Science Achievement in Terms of Learning Objectives at Primary level in the State of Rajasthan, Unpublished Doctoral Dissertation Education, Meerut University.

Mukhopadhyay, M. (ed) (1993) *Educational Technology, Year book 1988,* New Delhi: AIAET.

Mukhopadhyay, M. and Others (Eds) (1993) *Optimizing Human Learning,* New Delhi: *Amar Prakashan.*

NCERT (1997) *Fifth Survey of Educational Research 1988-92,* New Delhi: NCERT.

Pandey, I.D. (1980) Use of Programmed Instruction in Teaching Mathematics at Primary Level, Unpublished Doctoral Dissertation in Education, Patna University.

Pandya, N.L. (1974) A Study of the Effectiveness of Programmed Learning Strategy in Learning of Physics in X Class of Secondary Schools, Unpublished Doctoral Dissertation in Education, S.P. University.

Percival, F. and Ellington, H. (1984) The Nature of Educational Technology in *A Handbook of Educational Technology,* Kogan Page.

Rabindradas, B. (1984) Development and Try-out of Self-Instructional Materials on Health Education for High School Students with Special Reference to Communicable Diseases, Unpublished Doctoral Dissertation in Education, S.G. University.

Reddy, N.Y. (1975) Programmed, Learning vs. Conventional Learning in the Instruction of Language — A Comparative Study, Osmania University.

Sanguan, S. (1984). Development and Try Out of PLM in the Subject of Educational Psychology for B.Ed., Students of Teacher's Colleges in North-East Region of Thailand, Unpublished Doctoral Dissertation in Education, S.P. University.

Seshadri, M. (1980) An Experiment in the Use of Programmed Instruction in Secondary Schools, Unpublished Doctoral Dissertation in Education, M.S. University.

Shah, G.B.; Mehta, S.J. and Kulkarni, S.S. (1978) Educational Technology : A Trend Report, in Buch, M.B. (ed), *Second Survey of Research in Education,* Baroda : SERD.

Shah, I.K. (1980) Developing a Teaching Strategy for the Course on Educational Evaluation at the B.Ed. Level An Studying its Effectiveness, Unpublished Doctoral Dissertation in Education, M.S. University.

Shah, M.S. (1964) A Programme on Equation Solving, New Delhi: NCERT.

Shah, M.S. (1969) To Develop Auto-Instructional Programmes in Algebra for Standard VIII and to Find out their Effectiveness in Relation to Different Variables, Unpublished Doctoral Dissertation in Education, Gujarat University.

Shah, S.G. (1984) Development and Try out of Programmed Learning Material on Population Education for the Students of Class IX, S.G. University.

Sharma, A.K. (1989) Effects of Linear and Branching Instruction Strategies on the Performance on Social Science of Tribal High School Students in Himachal Pradesh in Relation to Academic Motivation and Test Anxiety, Unpublished Doctoral Dissertation in Education, H.P. University.

Sharma, M.M. (1966) A Comparative Study of Outcomes of Teaching of Algebra by Conventional Classroom Method and Method of Programmed Instruction, Johari HS School, Rajasthan.

Shukla, S. (1991) Educational Technology : A Trend Report, in M.B. Buch (ed), *Fourth Survey of Research in Education,* New Delhi : NCERT.

The World Bank (1997) *Primary Education in India,* Washington D.C.

Trivedi, I.U. (1980) Use of Branching Variety of Programmed Learning Materials as Diagnostic and Remedial Tools, Unpublished Doctoral Dissertation in Education, M.S. University.

Acknowledgement

This is based on a Research Project funded by IASE, UMI, New Delhi. I acknowledge with thanks the support provided by IASE.

[**Dr. Madhu Parhar** is Reader in Distance Education. *Correspondence :* Staff Training and Research Institute of Distance Education, Indira Gandhi National Open University, New Delhi, India. Fax : 91-11-685 7073]