

BOOK - REVIEW

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Title of the Book : LEARNING SCIENCES

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INTRODUCTION :

In the OCT/DEC 1994 issue of this journal, I had reviewed a book TOBIN DR : Re-educating the corporation. The main thrust of this book was the advice to the business corporations to ensure sustained learning effort for the long term development of the corporation. This advice is, however, based on the assumption that every one knows what "learning process" means.

While trying to understand what 'learning' means. I found that the earlier theories in educational psychology i.e. S-R theories, Gestalt, behavioural science etc. considered cognitive activities-activities carried out by brain as a black-box, whose inner processes were inferred only by the observation of the overt connections between stimulus event and the learners response. The approach, however, failed to explain certain phenomena like perceptions, a feeling of understanding through meaningfulness, operations of the memory, thinking process which caused time-gap between the stimulus and the response.

The advent of cognitive psychology has made it clear that the overt action or response by the learner is the result of not the stimulus alone but the way the information provided by the stimulus is processed by the brain and made relevant to enable the learner to respond.

More and more theorists belonging to cognitive psychology branch are throwing light on the way cognitive activities take place which promote learning.

Merely understanding 'learning' is not enough. One must also know "learning of sciences", because sciences are now the foundations of all formal learning efforts-primary, secondary, post-secondary and higher education.

The book under review gives an excellent description of both 'learning' and 'learning of sciences'.

DESCRIPTION OF THE CONTENTS

This book contains ten chapters. The chapter 1, contains explanations on "values and aims of science education".

Science should be valued as a powerful tool to gain control on the environment. Such power can be acquired only when one masters the skill in learning and becomes alert, independent and a life long learner.

Acquiring skill in learning needs understanding of description and predictions about learning which are provided by psychology of learning. This science of learning helps a potential learner to know how to acquire systematized body of knowledge about 'learning'; how to acquire ability to rationally explain the educational universe; develop responsibility for one's own learning; and how to design new behaviours needed to preserve and improve learning environment.

This chapter lays the foundation for the themes of the next chapters, i.e. (a) nature of understanding, (b) nature of cognitive strategies; (c) how to acquire new behaviour using understanding and cognitive strategies.

Chapter 2 describes factors influencing learning. Learning is the result of the interaction between (a) the state of the learner (possession of knowledge, abilities and attitudes); (b) genetic inheritance and experience which influences the state of the learner; and (c) the circumstances under which the learner is placed. (Teaching, learning context, learners physical state.)

All factors mentioned at (a), (b) & (c) affect learner's perception of the context of learning and determines his learning needs. It is this learning need which determines the quality of learning act.

Chapter 3 discusses the elements of memory which is the seat of all learner's knowledge, abilities and atti-

tudes. Understanding the components of, knowledge, is the starting point for knowing how the memory helps in learning effectively.

Knowledge stored in memory comprises strings, propositions, images, intellectual and motor-skills; episodes. But these elements are stored in the memory, only when they are patterned.

Ability is defined as a set of cognitive strategies i.e. a set of procedures aimed at achieving long term learning goals. The cognitive strategies are broadly categorized as (a) assessing learning situations; (b) planning learning activities; (c) deep processing of information.

Chapter 4 describes how these knowledge elements are patterned in the memory. The patterning is done through the process of linking. Linking is the primary step of patterning. The linking is done by 'labeling' all categories of elements by common terms and linking them to one another. Such labels trigger recall of all other elements associated with this label.

When such a label connects several elements into a larger network, it is called 'a concept'.

The quality of the understanding of a 'concept' is the degree of relative proportions of strings, propositions, images, episodes and skills. Developing concepts systematically is the function of the learner's cognitive strategies.

Chapter 5 proceeds to explain the concept of "understanding", which is defined as the ability of the learners to use concepts to cope with unfamiliar or non-routine situations.

The quality of understanding is characterized by

(a) the degree to which the vari-

ous elements are linked and densely patterned.

- (b) Using these patterns of knowledge to explain situations and predict consequences.

A learner can be helped to improve his understanding by employing assessment methods which aim of :

- (a) eliciting learners internal patterning of knowledge,
- (b) internal pattern of analysis,
- (c) internal process of explanation and prediction.

Consciously, improving quality of concepts and understanding requires a learner to possess abilities. Abilities are defined as those cognitive strategies which enable a learner to acquire knowledge in such a way that it can be applied to attain learning goals in unfamiliar or non-routine situations.

Chapter 6 explains the nature of these cognitive strategies, which comprise sub-strategies i.e. strategies employed (a) to assess new learning situation, (b) to plan learning activities and (c) to carry on deep processing of information for effective learning.

Every learner has to be trained in acquiring cognitive strategies by (a) making him *aware* of the nature of cognitive strategies (meta-learning),

(b) providing him *practice* in employing cognitive strategies by designing learning experience over a considerable period of time.

The implication of this need to train a learner in cognitive strategies is that the school curriculum should maintain a balance between (a) teaching 'content' and (b) teaching "cognitive strategies".

Using knowledge and strategies for learning depends upon the *attitude* of the learner.

Chapter 7 describes the concept of 'attitude'. Attitude is defined as the "collection of beliefs about an object or event that is associated with an emotional reaction that stimulates decision to engage in an act or behaviour.

Attitudes are acquired through direct experience and/or social transmission. Attitudes become stable when both are present, but can be changed by (a) changing the nature of direct experience; or by changing the perception of the existing learning context. But in both cases, one should ensure pleasant sensation in the learner and addition of new strings, propositions and images.

The implication of this concept of attitude for the school is that the school should imbibe better and favourable attitudes among students toward learning i.e. they should value learning not for the purpose of passing examinations, but for understanding universe, preserving and improving it.

Learning new knowledge and attitudes and acquiring cognitive strategies depends upon how a learner perceives the learning context.

Chapter 8 explains the meaning of "learning context and its perception".

Perception of a learning context is influenced by (a) teaching, (b) physical context of learning, (c) state of the learner in a learning event.

Physical context of learning has several dimensions which influences perceptions of the learner about the learning event: (a) absolute dimensions like physical, population and social, and (b) subtle dimensions like atmospheric and diversity of events.

Teaching and physical state of the learner also affect perceptions.

Learner's perceptive activity under

the influence of other factors results in a *script* which describes to the learner (a) his expectation about the learning situation, (b) expectations about the static physical context of the learning situation; (c) expectations about what will happen next, and d) how and when to act.

Understanding the nature of the perception of the context is important, because it may hinder learning. To overcome such hindering, a teacher has to cause change in perception by (a) introducing new scripts for learning contexts, (b) designing new experiences to introduce new scripts, bit by bit, and teaching students how to learn in newly designed learning situations.

Or, if the teacher is unable to change the nature of the learning context, he must endeavour to change the learner's perception of the existing learning context by a) introducing new assessment methods; b) adopting new teaching strategies, new rewards, deepening students learning strategies.

So far, we have understood the influence of (a) knowledge, abilities and attitudes the learner already possesses; (b) perception of learning context, (c) influence of genetic, inherited and prior experience on his learning need. When the need to learn is established, when confronted with an unfamiliar situation, then the question is how does a learner proceed to plan his learning activity.

This brings us to the chapter 9 on "learning" - A Learner, during learning, takes a series of steps in sequence or in parallel or in reciprocal sequence. The steps are:

(a) The learner attends to the learning events and selects stimuli.

- (b) He translates these selected stimuli into meaningful form.
- (c) Processes these forms into larger network, which is as dense as possible and needed.
- (d) Uses cognitive strategies to use the acquired knowledge and attitudes to cope with unfamiliar situations.

The selection of stimuli is the result of attributes of the learning events (unusual, contrasting and understandable) and the attributes of the learner (alert, possessing cognitive strategies) and the nature of interaction between the two.

The learner interacts with the learning event, if the event is relevant to the current aim of the learner. Besides, to make it relevant, the learner must have ability to retrieve knowledge elements from his memory, chunking information and holding it in the Short Term Memory (STM) for sufficient time for processing, improving retention by frequent rehearsals or other aids. Further, the learner must have capacity to process available information deeply.

The capacity to deep processing of information is improved by (a) consciously choosing the educational goal of acquiring cognitive strategy, providing supporting script for the perception of the learning context, training student in judging the progress of learning and rewarding deep processing; (b) ensuring availability of the cognitive strategies; and (c) allowing sufficient time to the learner for deep processing of information.

How is deep processing of the information carried out by the learner? The crucial point is to understand that the quality of deep processing is deter-

mined by the level of attentions the learner is capable of. The chapter describes five levels of attention during learning activity.

At level 1, the learner simply observes the learning event, but does not select stimuli for attention and processing.

At level 2, he selects events and transforms them into meaningful form, but doesn't proceed further.

At level 3, he conducts some processing, but usually imaging terms without establishing larger network.

At level 4, he carries out deep processing where all acts of linking, explaining, predicting are carried out.

At level 5, the process includes activities carried out at level 4, but the learner is in full control of the processing activity i. e. he can extend it or stop it at will, thus determining the purpose of learning.

The characteristics mentioned above about learning are indeed the characteristics of an alert, independent and life-long learner. Such learners are not born. They need to be trained and can be trained by adoption of proper teaching strategies.

Chapter 10 proceeds to explain the process of "teaching" and enunciates principles of teaching

The role of a teacher is to change the *script* about the current conventional class-room based learning in the formal education system. The change is in the direction of the shift *from* the script which focusses on only the acquisition of knowledge *to* acquisition of *both* knowledge and cognitive strategies. This shift is possible only by adopting teaching strategies such as (i) selecting appropriate content; (ii) carefully select-

ing and explaining language for instruction; (iii) controlling sequence and pacing of presentation; (iv) adopting appropriate mode of questioning; and (v) making appropriate use of laboratory.

Each of the five strategies are explained briefly below :

While selecting content, teacher should take the needs of both elite students (intending to be specialists) and common students (intending to be informed about the subject). The content selected should keep the balance between conceptual (propositional) and observational (images, episodes, skills) content.

For choosing appropriate language for presentation of ideas, care should be taken to develop appropriate meanings to core words or terms used. It is especially necessary to focus on connective words, nouns, verbs. Sentences used should not be too long to cause information load on the memory. There should be economy in use of words.

The sequence of presentation is affected by (i) degree of linking between sentences; and (ii) rate of introduction of new ideas. Linking should be done overtly. New ideas should be first introduced, and then spaced by elaborations and keeping focus on the main ideas. Within the constraints of semesters, examination schedules imposed by the controlling authority, the teacher can judge the pace of presentation based on his assessment of the progress in learning of the marker students in the class. There are useful probes available for such formative assessment.

The well designed questioning strategy by the teacher serves the

purpose of (i) controlling the learning behaviour of the students; (ii) learning achievement of the student and (iii) controlling the pace of presentation.

The teacher should use laboratory exercise as a source of (i) training in skills; (ii) source of episodes; and (iii) source of images, thus giving meaning to the propositions; and finally (iv) means to understanding scientific method of enquiry.

In the light of above discussion of strategies of teaching, following three basic principles of teaching are enunciated.

(i) Principle of maximum opportunity.

This ensures that the learner acquires opportunities to acquire both knowledge and cognitive strategies.

(ii) Principle of matching, teaching and learning strategies.

This requires teacher to provide learning events in which teaching strategies and learning strategies are employed in a complementary way during acquisition of knowledge.

But in the acquisition of cognitive strategies, the teacher should ensure deliberate mismatch between the two.

(iii) Principle of balance

According to this principle, the teacher should maintain,

- (i) balance between didactic and discovery learning; avoiding, however, sudden shift from one mode to the other.

- (ii) balance of control of the classroom behaviour by the teacher and the student.

- (iii) balance between theory and practice complementing each other.

COMMENTS

This is probably the first attempt to transfer principles of cognitive psychology to the practice of teaching and learning. The author of this book calls this model of teaching and learning in this book as the one to be treated as a hypothesis open for debate by the professionals.

There is a great promise in this model for solving chronic educational problems both within the school-based learning as well as out of school learning situations. The ideas can be used in educational institution at all levels -primary, secondary, post-secondary and higher education.

While the book provides equal stress on knowledge acquisition, cognitive strategies and attitude formation, particular attention should be given to the explanation given in the book on cognitive strategies and attitude formation. Those are key abilities to become alert, independent, life-long learners. In my consultancy assignments to polytechnics, directorates of technical education, management institutions for the last 10 years, I have come across both types of clients, the successful and the unsuccessful. The successful are very small in number, while the unsuccessful are alarmingly greater in number. The number of unsuccessful represent the characteristics of human resources manning the educational systems i.e. teachers, heads of depart-

ments, Principals, regional and state level administrators. Majority of them are not even able to describe the educational situations they are in, let aside the definition of the problems and solving them. They face at every pace a learning situation, but this time in an out-of-school situation, with no prescribed syllabus, no teacher to guide, no examination to pass through rote learning, with no training in cognitive strategies to guide their own learning, for acquiring organized body of scientific knowledge, improving perception of the problem-situation, engaging in organized thinking to search for new al-

ternatives, designing solutions.

Situation becomes worse, when the client is in the higher level of hierarchy. Higher the level of hierarchy, greater is the complexity of the problem, he faces. Greater, therefore, is the need for long-term strategies for learning.

This book, in my opinion, is the first of its kind to explain the nature of cognitive strategies in intelligible terms.

I, therefore, strongly recommend this book to all my colleagues involved in educational tasks.

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