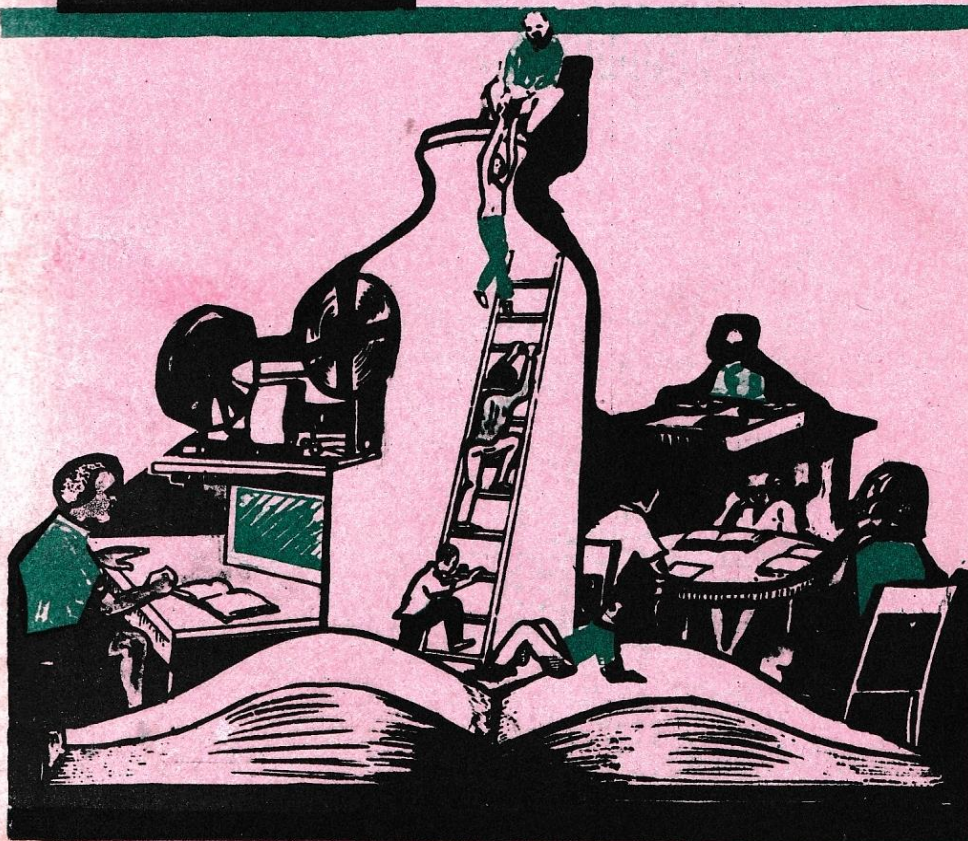


# **Educational Technology In Methodologies of Teaching. Science**

**KUNLE AKANBI  
DEMIOLA ADEKOMI**



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*Cover Page* — Dr. Kunle Akanbi  
Mr. Lade Adeyanju  
Mr. Johnson Oladiji

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## CHAPTER 8

### EDUCATIONAL TECHNOLOGY IN EVALUATION OF TEACHING

By:

Mr. Moses Inyang-Abia

#### *Introduction:*

If science and technology are accepted as interwoven areas involving systematic studies and skilful practices which focus on the exploration of nature and harnessing its sub-systems and operative forces to meet man's needs and objectives, then they can also be taken as an integral part of human civilization and global cultural components. Man's increasing awareness of the capabilities of science and technology has therefore facilitated a sharpened international focus on them thereby sky-rocketing their utility and functional values within all spheres of human endeavour. In the educational enterprise evidences of their importance, particularly those related to technology (which is the focal point of this chapter) are not far to seek within all levels and in all instructional settings.

#### *What Technology Involves:*

Technology is derived from a Greek noun 'technologia' which means *systematic treatment*. A Latin verb of identical conotation 'texere' means to weave or construct. Technology may, therefore, be interpreted to mean systematic and practical application of knowledge to solve human problems. It involves the systematic and skilful application of scientific ideas to achieve practical results relevant to a given discipline or culture. It has products, processes and settings which must blend if maximum efficiency is desired. While its products are the *hardwares* and the *softwares*, the processes constitute what Percival and Ellington (1984) call the 'underweaves.' They constitute the intangible aspects of technology as opposed to the physical products. The processes underlie the effective production and use of the hardwares and the softwares, yet belong to neither. The settings of technology, on the other hand, are constituted by all natural and/or artificial provisions which must exist for optimum performance of the products, given the right processes. Take darkened room as an example, for maximum printing of photographs; white surface for projection of films or a quiet library for perusal of textual materials. Whereas a textbook needs a relatively quiet setting, the sound-motion film can tolerate a noisy setting because of its attention-compelling components.

The layman, unfortunately, sees technology only from its 'product point of view.' The equipment (hardwares mostly) are usually equated with the entire field of technology. The processes and settings, to the dismay of the practitioners and the theoreticians within the field, are usually ignored. The processes and their related settings of technology, it must be emphasized, although less visible, are nevertheless equally, if not more, important.

#### *What Evaluation Involves:*

Evaluation may be thought of as a continuous process of generating, collecting, collating, analysing, assessing, interpreting and utilizing quantitative and qualitative data, based on given criteria, for decision making. It is a vital input in the decision-making process, particularly in the teaching-learning situation. This stipulative definition presupposes the presence of measurement, value judgement, predetermined criteria and possible unanticipated effects; the data may be quantitative as statistics or qualitative as non-statistical information.

As an instructional process it involves continuous, cyclical and pervasive assessment within the instructional system. In fact, for effective instruction to even start, major variables have to be assessed, let alone the end of an instructional programme, irrespective of duration, size or level. Unless the assessment outcomes and decisions are fed back into the instructional system the relevant process and operations are incomplete and the system hardly grows; rather such a system tends towards negentropy or death state. Evaluation is therefore a requisite for the life and growth of any man-made system. The comprehensive assessment of outcomes is the life-blood for the beginning, growth, development and even beyond the end of an instructional set-up. It is the *alpha* and *omega* of any instructional programme. When both technology and evaluation are critically scrutinized it becomes clear that they mutually co-exist.

#### *Technological Products in Evaluation of Teaching:*

The products of technology are the concretized output resulting from systematic technological processes. Within the instructional enterprise the technological products refer to coursewares which are instructional hardwares and softwares both of which are generic terms. The hardwares refer to pieces of equipment, gadgets or devices (e.g. cameras, projectors, television monitors, radio sets, micro-film readers and computers) which can be used for coding, storage, retrieval, projection or transmission of instruction in various forms and on different materials. The softwares, on the other hand, refer to the carriers of encoded instructional messages (e.g. video and audio cassette tapes, disc, filmstrips, slides, reels of films etc). They need the hardwares of corresponding characteristics and sometimes identical brands for temporary or permanent retrieval, production or projection.

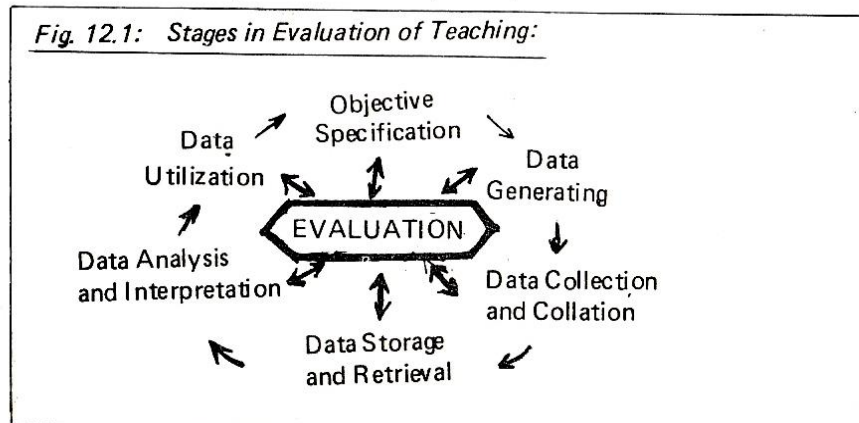


Owing to its wide variety, technological products are useful at every stage of evaluation: from objective specification to data reporting. The types and level of complexity of technological products relevant to the various stages of evaluation of teaching are discussed below.

#### *States and Relevant Technological Products In Evaluation of Teaching:*

Evaluation of teaching involves six interrelated stages (see Figure 12.1) each of which forms a component within a cyclical process.

**Fig. 12.1: Stages in Evaluation of Teaching:**



#### *Objectives Specification and Popularization:*

Behaviours expected to be exhibited by the learners during and particularly at the end of the lesson must be clearly defined and specified. As much as possible this all-important stage should have a scientific basis. The table of specification, for example is one technological device which can provide an acceptable empirical framework to justify the variety of contents and domains of instructional objectives.

The *behaviours (performance), conditions* under which such behaviours should be expected and the acceptable *standards* of such performance must be clearly stated. These three variables constitute the major things to look for in well-stated behavioural objectives. Others include the *target audience* and the *object* or content. (See Inyang-Abia: 1988). Again the objective must be stated as instructional outcomes expected of the learners. They are *intra and exit* behaviours.

The implication of this is that the objectives form the focus of evaluation. What is evaluated in teaching are the objectives set out to be achieved. They are usually stated to reflect the needs of the individual, society, curriculum demands, job credentials and proficiency, skills among others. Incidentally these too constitute the focus of evaluation, directly or indirectly. Objective

specification therefore constitutes the starting point or genesis of evaluation process in teaching.

Akinsanya (1984) among others emphasizes that students who are exposed to instructional objectives before the commencement of instruction perform significantly better than those who are not and that the degree of specificity determines the level of differences in performance. This implies that the learners must be made aware of the focus of the study before they start. This can sensitize them to the direction they are going.

Many technological devices exist at the teachers' disposal in an attempt to popularize the instructional objectives. Introducing the lesson through the ubiquitous tape recorder, for example, can add quite an interesting dimension. This can appeal even to some special learners such as those with seeing defects. The use of overhead projection with the specific behavioural objectives clearly written can also bring rejuvenated interest into the instructional situation, particularly for a large audience. What if the overhead projection is combined with audio presentation (audiovisual presentation), where these facilities are hard to come by, creative use of the chalkboard can be explored. Instructional objectives clearly written, masked and unveiled at appropriate time, not only intimate the learners of the desired direction but can also channel their interest. However, the characteristics of the target audience must be seriously considered in the selection of relevant technological product.

#### *Data Generating:*

No sooner does the analysis of the teaching context and content starts than data generating sets into motion.

For example, whether the learner is capable of exhibiting acceptable level of entry behaviour is an evaluative question which requires some data as evidence.

Evaluation data in teaching is not limited to the paper and pencil tests. Mere observation of overt activities such as willingness to co-operate can provide some required evaluation data. During the lesson presentation, a wide variety of data can also be generated. For example, the level to which the learners are responsive to the lesson or an instructional materials or mode can indicate to the teacher the level of his success. Through various learner responses to questionnaires, checklists, inventories evaluation forms, taped instruction or projected images all of which are technological devices, a wide variety of data related to learner entry behaviour, attitude and aptitude can be generated in the teaching-learning process.

#### *Data Collection and Collation:*

This very crucial stage in evaluation of teaching cannot be successful without technological devices of various forms. Through the use of various instruc-



tional modes (media and methods interwoven) such as experimentation, study tours, nature ramble, nature corners among others, various types of data can be generated, collected and collated. Through the use of specimens, models, maps, and other simple technological products, relevant data can be collected for evaluation of teaching. How the various modes and products are utilized by the teacher and the learners' reactions to them could provide valuable data for assessing the effectiveness of the various components of the teaching-learning situation.

Cameras of all types, the two-way mirror, television monitors, audio and video tapes and their respective players and computers are among some complex technological devices essential for collecting and collating evaluation data. In micro-teaching and mini-teaching classes their importance for evaluation of teaching skills cannot be under estimated, particularly as they facilitate storage and instant retrieval of information with minimal or no distortion.

#### *Data Storage and Retrieval:*

One of the greatest contributions of communications technology is the area of data storage and instant retrieval without distortion. The fact that data of various forms and descriptions can now be stored and retrieved instantly without distortion has contributed immensely to improvement in teaching skills, particularly since the invention of the portable video system. It has also facilitated evaluation of teaching.

Ordinarily reporting a teaching event either verbally or in writing always loses vital information as opposed to listening to an unedited audio-tape of the same teaching event. However, if videotaped the teaching event can be even more comprehensively evaluated because almost no information is lost. The videotape therefore has the greatest capacity for data storage and retrieval.

Also useful for data storage and retrieval are cameras, transparencies, film-strips, slides, phonodiscs and their players; film sound and micro-systems and their readers, projection units, books, among others. The computer too, although apparently a little too futuristic for Nigeria, presently is gradually gaining acceptance even in teaching. All these technological devices facilitate storage and retrieval of data. They are vital for accurate evaluation of teaching.

#### *Data Analysis and Interpretation:*

In order to be meaningfully employed for decision making, data must be analysed and interpreted. The role of ordinary paper and pencil is not enough. Pocket calculators, computers, monitoring units among other technological devices must be used. In a micro-teaching exercise for example data analysis and interpretation as a major stage in teaching skills development can only be achieved with the use of the video and/or audio recorders. These devices make it possible for the teaching experiment to be analysed and interpreted with

minimum distortion. Through watching a replay of the teaching encounter a better awareness can be created as to why a given teaching behaviour is or is not suitable at a particular time. This improves data interpretation from both the trainee's and the trainer's point of view.

#### *Data Utilization:*

Reporting the results of evaluation of teaching closes the loop set in motion at the objective specification stage of evaluation. Until the report gets to the ultimate consumer such as the teacher trainee, the trainer, parents, educational administrators or the employer the evaluative process is still incomplete. Pencil and paper, radio, television, the video or computers are basic technological devices for this stage.

#### *Technological Processes in Evaluation of Teaching:*

##### *ADPIE MODEL*

Technological processes involve a wide range of systematic functions directed towards maximum efficiency at minimum energy expenditure. They are constituted by a combination of theoretical considerations and research findings involving human behaviour. They also emphasize the intangible aspect and techniques rather than the visible, tangible concrete products. They stress systematic and scientific approach to specified problems. Modern technologists emphasize the processes which underlie the products and settings. Despite the existence of technological products, effectiveness can hardly be achieved if the right processes and settings are not adopted. That means technological products, processes and settings are not only complementary, they are mutually interwoven.

Five inter-related processes necessary for effective and comprehensive evaluation of teaching can be identified. They are Analysis, Design, Production, Implementation and Evaluation. These processes can be expressed as complex behaviours, the first letter of each constituting the acronym ADPIE.

- A Stands for Analyse the Context and Contents.
- D Stands for Design the Evaluation Instrument.
- P Stands for Produce the Evaluation Instrument.
- I Stands for Implement the Evaluation Instrument.
- E Stands for Evaluate the Instrument and the Process.

#### *Analyse Context and Contents:*

The teaching context and contents when analysed produces some vital information necessary for effective evaluation. For example the need for evaluation, resources available, and constraints envisaged are outcomes of context evaluation; task specification and objectives can best be generated when contents are analysed.



Within best teaching situations some constraints such as inadequate funds, materials, infrastructure, negative attitude, or even incompetence in the use of equipment may exist. They must be acknowledged and planned for. The type, quality, spatial distribution and capability of available resources vis-a-vis the ultimate desires (such as effective teaching at referent situation) must be identified and evaluated in order to facilitate goal achievement. Failure to properly identify the constraints including the available resources may result in serious implementation problems.

Analysis of the contents reveals the sub-contents, the required tasks and sub-tasks all of which are necessary for the specification and sequencing of the objectives. Through this process too the method and techniques, materials and mode of evaluation can be accurately determined to reflect the professional demands of teaching. For example the question: what major teaching skill components does the teacher trainee require can reveal that lesson planning, provision and use of instructional materials, presentation strategies, classroom management, lesson evaluation and professional-cum-personal qualities can be some focused sub-contents spelt out for training of the teacher. From each of these teaching sub-tasks behavioural objectives can be generated and sequenced

#### *Design the Evaluation Instrument:*

The success of this process depends upon clear specification of behavioural objectives. This is discussed above. Meanwhile, it is emphasized that proper links must be established between the content areas and among the objectives to reflect what teaching behaviours are emphasized. For example, the design principle dictates that all the major teaching behaviour components must be reflected in the evaluation instrument. The design question then is:

What teaching behaviour components will carry what weight. The use of table of specification can be very rewarding at this point. That table makes it easy and provides empirical background for the evaluator to weigh all the major teaching behaviour components according to their emphasis or need. This reflects the objectives and the evaluation items. It is like a ground plan for the builder, an evaluation blue-print for the evaluator.

#### *Produce the Evaluation Instrument:*

On the basis of the specified weight expressed by the total number of objectives determined for each teaching behaviour component, the evaluation instrument is produced along with the desired scale. While the weight determines the total number of questions or the percentage under each category, the scale provides a continuum for assessing the exhibited teaching behaviour. Table 12.1 below illustrates some teaching behaviours under the major components.

Table 12.1: A sample of an Evaluation of Teaching Instrument.

Teaching Behaviour		Scale				
		5	4	3	2	1
1.	<b>Lesson Planning:</b> a) Specifies all behavioural objectives in clear observable and measureable terms to reflect the three Bloomian taxonomic domains and relevant levels. b) Provides at least three learner activities to reflect the specified objectives.					
2.	<b>Instructional Materials:</b> a) Makes effective use of the chalkboard. b) Provides relevant instructional materials and adequately utilizes them.					
3.	<b>Presentation:</b> a) Introduces the lesson with interesting activities relevant to learner entry behaviour b) Varies examples, activities and techniques to provide for individual differences. c) Suggests transfer of learning by using relevant illustrative examples and non-examples					
4.	<b>Classroom Management:</b> a) Maintains cordial teacher-learner relationship and productive class control. b) Organizes class seating arrangement to facilitate learning and to reflect mode of instruction.					
5.	<b>Evaluation:</b> a) Asks various divergent questions to reflect particularly the higher levels of each of the three Bloomian domains. b) Keeps continuous assessment record accurately.					
6.	<b>Professional-Cum-Personal Qualities:</b> a) Exhibits high degree of mastery of subject matter. b) Shows acceptable classroom manners but not mannerism.					
7.	<b>Side observations (briefly comment).</b>					
Total						

Total Score: ..... Grade: ..... Signature: .....



Although the table of specification is an initial validation strategy, the evaluation instrument so produced must be field-tested and results fed-back for improvement before it is finally accepted for implementation.

#### *Implement:*

This process brings the evaluatee in contact with the instruments through the evaluator for purposive interaction. The evaluator has to selflessly and objectively assess the evaluatee on the basis of the specified criteria on the instrument. Indicators of the desired behaviours must be keenly watched out for. It should be noted here that the more specific the objectives are the easier to evaluate objectively. But teaching behaviours are usually very complex even within the micro-teaching domain. This is usually because a variety of teaching behaviours can convey same meaning while a single teaching behaviour can be given various interpretations by the on-lookers. Implementing the evaluation instrument therefore becomes a problem of objectifying a very subjective behaviour. That is why objective team of evaluators comprising peers, learners and the supervisors is advocated for. It can certainly be a rich supplement to the supervisor's multiple evaluation plan.

#### *Evaluate the Instrument and the Process:*

The validity and reliability of the teaching evaluation instrument are very important. Validity refers to the ability of the evaluation instrument to meet the purpose for which it was designed. Reliability, on the other hand, is the consistency to which an instrument produces identical results under different administrations.

At least four types of validity can be identified.

**Face Validity:** This refers to what an evaluation instrument appears to measure.

**Content Validity:** It refers to adequacy of sampling of the specified content areas. This is also referred to as subject matter or curricular validity.

**Predictive Validity:** This occurs if the subsequent administration of the instrument shows identical results. It measures level of predictability or reliability.

**Concurrent Validity:** If the items in the evaluation instrument are related to contemporary performance criteria, the instrument is said to be concurrently valid.

However, the concept of validity of an evaluation instrument is relative. It is a matter of degrees which is not completely dependent on the instrument itself. Rather the purpose of the instrument, the target audience, method of administration and the scoring framework all contribute to instrument validity.

#### *Technological Settings in Evaluation of Teaching:*

Technological settings refer to the environmental or situational arrangements designed for the maximum functioning of the technological products given the relevant technological processes. For optimum functioning of both appropriate settings are inevitable.

If the setting contradicts the requirements of the products or those of the processes the degree of effectiveness reduces to reflect the level of contradiction. Consider the front opaque projection in a bright environment or setting, for example. In such a situation, although the products (opaque projector and the front projection screen) are available and functional, the inappropriate setting prevents maximum results: the image is not visible. The technologist therefore needs the day-light (back) projection screen or a darkened setting to optimize the functioning of the product (opaque projector). It is evident therefore that appropriate technological settings are indispensable for optimum efficiency of technological products and processes.

Related to evaluation of teaching there is no denying the fact that seating arrangements in relation to the topic, method, instructional materials or mode used, the orientation of the chalkboard, the position and movement of the teacher in the classroom do contribute significantly to teaching effectiveness. Anything technological presupposes systematization and ordered arrangement. Technological setting is no exception. In evaluation of teaching therefore the classroom setting should receive the high attention it deserves. Different settings must be designed to suit the various instructional modes. That is, it may be necessary to reshuffle the traditional classroom setting to reflect the needs of a lesson and the demands of the method or mode. Whereas the lecture method may be suitable to the formal traditional setting, some audio, visual or audiovisual presentations may not. A situation where one learner looks directly at the occupant of the other or craning to see what is going on is not always suitable for effective instruction. Brainstorming may be better within small groups in circular or horse-shoe formation while the instructional values of debate may well be optimized within a combination of different settings.

#### *Evaluation and Feedback in Teaching:*

Teaching, whether seen as a concept, a profession or a series of systematized activities designed to keep a culture alive implies the use of various skills, within the context of intentional communication directed towards desirable changes in the behaviour of a clearly defined target audience, given a specific socio-cultural setting. Such desirable changes must be agreeable to the norms and philosophy of the society in which the teaching behaviours occur.

Teaching usually involves at least two individuals. While the teacher ins-



trucks, leads, directs, **arranges** the shared environment or provides the stimulus for the desired experiences to occur, the learner responds and continuously re-organizes his conceptual framework, skills and attitudes. Like buying and selling, somebody must learn before teaching is accepted as having taken place, for it nobody buys and nothing has been sold. Where the teacher and the learner are widely separated in time and space instructional materials provide the link.

Evaluation therefore constitutes an integral part of teaching, particularly because the re-organization of the conceptual framework of the learner must be continuously and systematically assessed to ensure that the desirable changes are actually taking place in the desired direction. Moreover the learner needs regular systematic feedback to facilitate regulation and control of the necessary re-organization of the conceptual framework.

Although technology has already assumed a central place in teaching behaviour modification, it is necessary to re-emphasize that the best measure of teaching effectiveness lies not on the grades received at examination but at the actual practice in the society and the referent situation. The grading concept limited to the classroom situation had long failed us because it focuses more on certification and educational status rather than on practical implementation. Evaluation as a matter of need must emphasize its referent role in the society. It must be a major pointer to the need for re-training of the teacher particularly as it concerns his level of content and pedagogic efficiency. This fact underlines the rationale for emphasizing the basic principles and practices within the field of Educational Technology through actual practices and the feedback mechanism.

Feedback is the observed recyclable response to a given stimulus which serves to intimate the stimulus object of its effects or impact on the organism or environment. Without this return function a technological process is incomplete. This is because the level of effectiveness of the inputs and their relevant interactions (process) would not be known. Feedback is the product of the assessment or evaluation. That means without evaluation there is no

feedback. As a means of regulating and controlling a process, feedback cannot be ignored. It is also a means of detecting and dealing with extraneous or nuisance variables. Feedback is also necessary for determining the level of success of the process or product. In figure 12.2 it has the following expressions: remediate, recycle, review, repeat and retain.

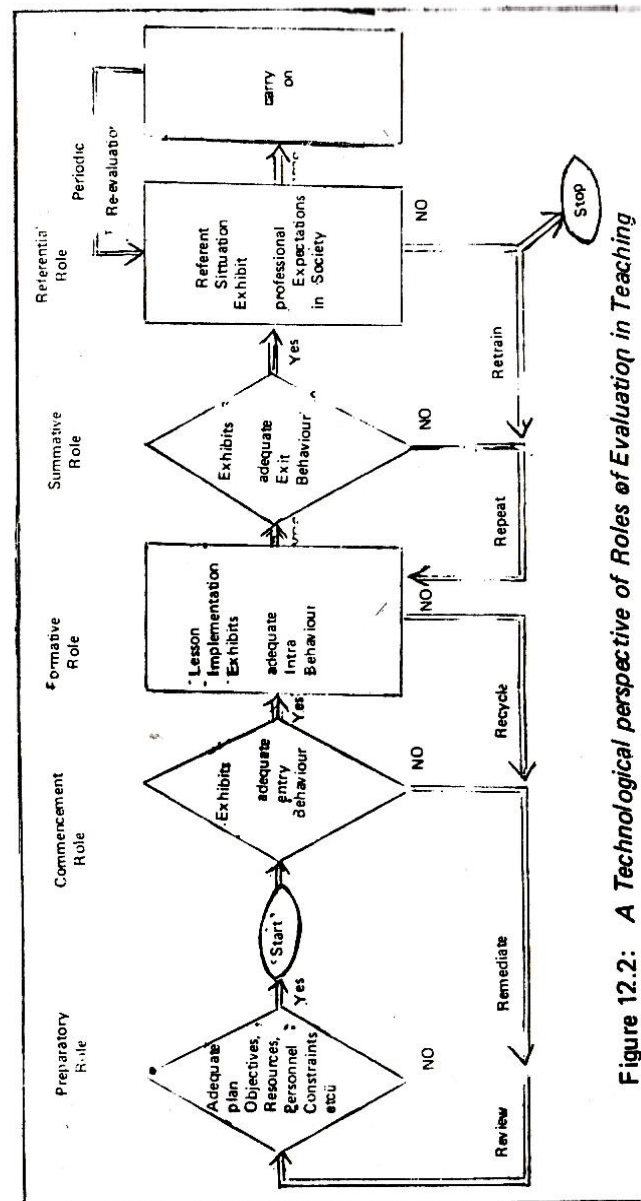


Figure 12.2: A Technological perspective of Roles of Evaluation in Teaching



### *The Role of Evaluation in Teaching:*

#### *A Technological Perspective:*

Scriven (1967) identifies two roles of evaluation: Formative and Summative. The former provides data which facilitate forming or improving the programme while the data generated from the latter are strictly for summing up or concluding a programme.

Stufflebeam (1971) goes further to refer to the two roles as process evaluation and product evaluation within his framework of Context-Input-Process-Product (CIPP) model. Gagne and Briggs (1979) also buy these ideas. But strictly speaking five major evaluative roles can be identified in evaluation of teaching. Scriven has not taken cognizance of the preparatory, commencement and referential roles of evaluation, the first and last of which are alluded to by Stufflebeam CIPP model. Evaluation in teaching therefore has five distinct roles: Preparatory, commencement, formative, summative and referential. This is illustrated in figure 12.2. It would be unwise to limit the role of evaluation in teaching only to the immediate teaching-learning process. The pre-and post-context evaluative roles are equally important.

#### *Technology in Evaluation of Micro-Teaching:*

Micro-teaching refers to an edited teaching encounter based on modelling, simulation and behaviour modification techniques, designed to evolve in the teacher trainee a functional pedagogic repertoire through highly structured teach-reteach approach within a laboratory setting. Percival and Ellington (1984:99) see it as a 'video-replay method used mainly in the training of teachers.' Focus is usually on specific teaching skills to be practised for short periods (5-20 minutes) with a small group (four to seven) before a video or television camera. The replay allows the trainees immediate feedback which can be reinforced by peers, students and supervisors. The resulting discussion facilitates analysis of trainees performance; it also provides evidence for restructuring the lesson and presentation strategies for another group of learners with similar characteristics. Thus the teach-reteach cycle supplemented with immediate feedback made possible by technological products, processes and settings not only facilitates improvement of teaching skills but also makes greater self-awareness possible.

This capital-intensive teacher training approach combines the effectiveness of try-outs within non-threatening environment with the values of immediate knowledge of feedback to facilitate teaching behaviour modification. The possibility of this is underscored by the use of technological products such as the portable video and audio recording units which keep a lasting record of the trainee's teaching behaviour. Through these technological products the trainees see and/or hear themselves in the actual teaching job, exhibiting the

actual teaching skills. This encourages participatory evaluation. That means the video or audio-tape presentation encourages and aids the teacher-trainee in self-evaluation.

By watching or listening to oneself better self-knowledge is gained. This makes it easy for the teacher-trainees to be readily convinced in terms of the observations and criticisms arising from the microteaching experience. Another implication is that the desired teaching behaviour can be more easily acquired while the undesirable mannerisms can be more easily eliminated. Thus the rich feedback mechanism resulting from technology can facilitate positive modification of knowledge, skill and attitude base of the teacher-trainees. While it would appear that the greatest value of technological products within the context of microteaching lies in immediate and self-evident feedback, the storage, use and re-use of the best recordings can present constructive models to the neophytes.

#### *Side-effects of Evaluation of Teaching*

Evaluation of teaching involves the assessment of efficiencies, deficiencies and side-effects of the outcomes of an instructional system inputs and their interactions on the basis of specified objectives within specified environment. Instructional efficiencies emphasize the positive aspects such as mastery, usefulness, proficiency and cost-effectiveness gained through the learning encounter. Outcome deficiencies assess the expected outcomes which have not been achieved. The side-effects which are an important evaluation outcome should also be assessed. They are the unanticipated effects of the instructional encounter on the inputs, process and output and their effects on the environment. Some examples of such side-effects are various kinds of phobia, unemployment resulting from bookish instructional programme or improved attitude towards instructional materials as a result of exposure to media-related programme.

Messick (1976:178) recognizes the importance of side-effects in evaluation. He says:

...it is misleading and mischievous to give special attention to one type of effect... merely because it was anticipated in advance as a goal.

In support of the importance of side-effects in evaluation result in Ball (1976: 365) says:

To ignore the possibility of side-effects an evaluation is to carry out incomplete evaluation

The pedagogic implication of these views is the emphasis on technological processes of evaluation. That is, when evaluating a teaching encounter, ac-



counts of the side-effects of the programme or relevant activities and function along with the technology involved should be emphasized outside those of the intended outcomes. Such side-effects should receive adequate emphasis when making major instructional decisions on the basis of evaluation results.

*Conclusion:*

Although evaluation is the *alpha* and *omega* of teaching, developments in technology make its instruments sharper, more analytical, more pungent and more discriminatroy, yet more embracing while the evaluation results become better stored, easily retrieved without distortion, better managed and more accurately reported than ever before.

To enhance the pervasive role of evaluation in teaching technological products, processes and settings must be streamlined and integrated into the entire instructional encounter; side effects of evaluation must also be adequately acknowledged. Technology will continue to establish itself as an integral part of global culture. Developments within this field cannot therefore be ignored for any comprehensive evaluation of teaching.

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