CHAPTER 7: ASSESSMENT OF STUDENT ACHIEVEMENT IN CURRICULA BASED ON TEACHING SCIENCE, MATHEMATICS, TECHNICAL AND VOCATIONAL SUBJECTS IN AN INTERRELATED WAY

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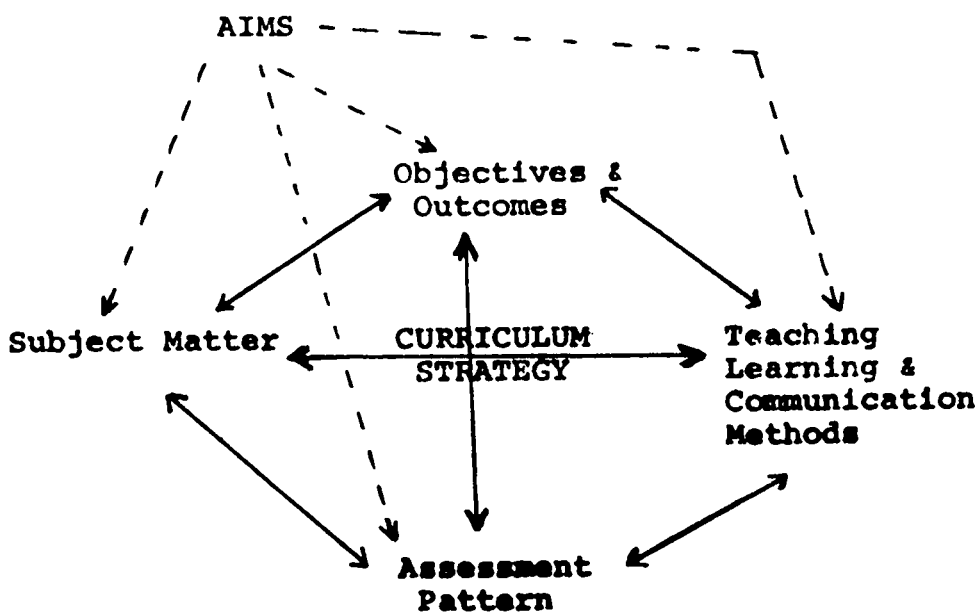
Introduction

Assessment as an educational strategy has been utilised by educators the world over for as long as education has been an organised system in the formal school setting.

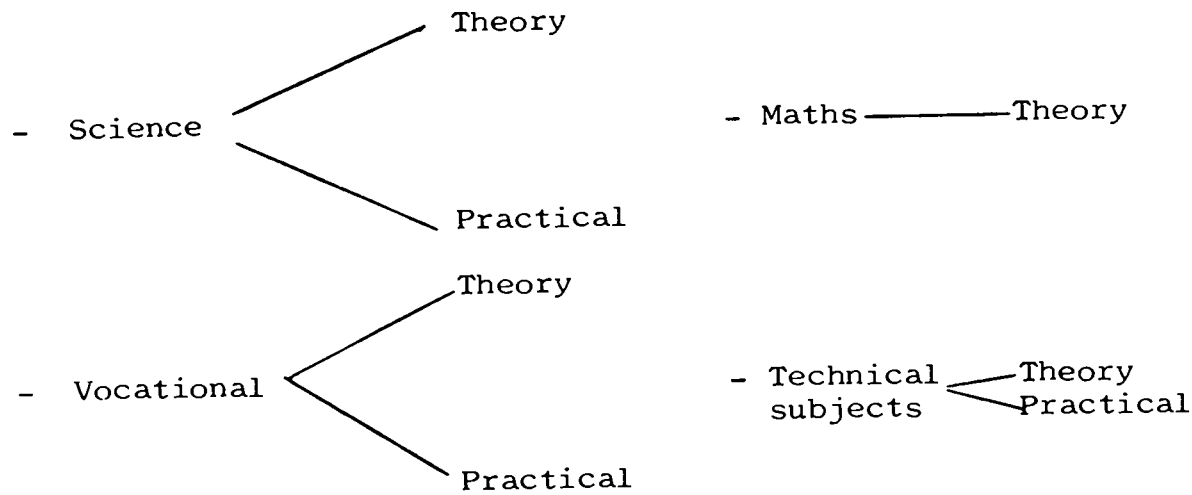
Many curriculum theorists have described the relationship between assessment and what actually goes on in an educational system by developing schemes or models of the curriculum process. One such model, developed by Kerr (1968), depicts subject matter, teaching methods and assessment. Their dynamic interconnections are shown in the diagram:



Assessment in any curriculum strategy provides necessary information in a formative as well as in a summative way with emphasis on diagnostic applications.

Assessment of Science, Mathematics and Technical/Vocational Subjects

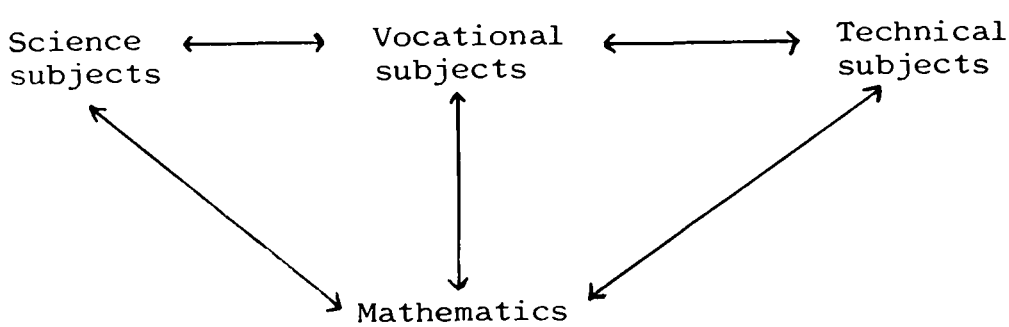
The strategies adopted in the testing of science, mathematics, technical and vocational subjects are simply as follows:



The modality adopted in the assessment of student achievement in all these subjects is the usual paper and pencil testing.

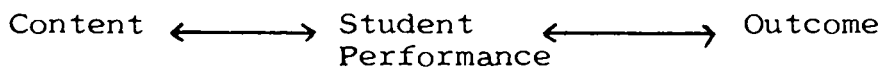
There is no doubt that science, mathematics, vocational and technical subjects are related but emphasis in the inter-relationship was highlighted in some countries only very recently.

Although science is seen as a useful tool in vocational and technical subjects, the role of mathematics is considered to be the most vital link between science, and its application in technical and vocational subjects.



In the assessment of student achievement in these subjects, emphasis has always been placed on outcomes in the cognitive domain. Cognitive assessment of science, mathematics and technical subjects follow a well established universal pattern

of determining how well an approved guideline, the 'school syllabus', has been understood. The students who are exposed to the prescribed syllabuses are used as the barometer of success. Their test scores, computed from many variables, give an indication of the teaching-learning pattern, but always, it is the student performance, the intervening variable in the link



that is crucial.

But there is now a shift in emphasis in assessment from the student to the whole learning environment. Academic subjects are expected to provide a good basis for the recipients to cope with the ever-changing social environment in which they live. Leaders in many countries are now beginning to demand outcomes not only in the cognitive domain but also in the affective and psychomotor domains, all of which play vital roles in the interrelated subjects of science, mathematics and technical/vocational education. While it is now possible to develop good assessment instruments in the cognitive domain, there is much controversy about the affective area. Whether affective objectives (attitudes, beliefs, values) are reasonable or indefensible objectives for formal educational programmes is an issue upon which profound views and differences of opinion have always existed. Yet if the assessment of science, mathematics, vocational and technical subjects is to be developed in an interrelated way, the affective domain provides a very good opportunity to do so. A critical examination of the reluctance of educators to develop assessment instruments in the affective domain stems from the following:

1. A general feeling that trying to develop attitudes and values in students is akin to indoctrination and brainwashing.

2. The inadequacy of available methods and materials designed for use in this domain.

3. The general dearth of evaluation instruments and techniques in the area of science affective measurement.

(Birnie, 1978)

Although the emphasis on cognitive objectives and abilities still persists in many countries, the emphasis on assessment in the affective domain is justified in part by the

fact that we are entering an era when we will be asked to acknowledge the importance of affect, imagination, intuition and attitude as outcomes of science teaching that are at least as important as their cognitive counterparts.

The Use of Tests as Instruments of Assessment

1. Accountability: Tests are used to hold teachers, schools and school systems accountable. Many educational authorities use achievement test scores as a rough gauge of the adequacy of the performance of a teacher, a school or larger administrative unit. The results of a test are then taken to indicate the amount of learning accomplished by the average student in a classroom. With such results, educational authorities decide whether the teaching system is adequate, inferior or superior.

2. Selection: Tests are used to make decisions concerning the placement or selection of individual students. Educational authorities use tests to place individual students in special programmes and classes. Most placement tests constructed by classroom teachers are pretests designed to measure

(a) whether students possess the prerequisite skills needed to succeed in a course, or

(b) the extent to which students have already achieved the objectives of a planned instruction.

3. Evaluation and Experimental Projects: Tests are used to evaluate educational innovations and experimental projects. Innovative educational projects have led to a number of reforms in many countries. School systems sponsor experimental projects in schools and seek to evaluate these projects through use of standardised tests. Science and mathematics have received particular attention in this regard. The evaluators have to match the tests to project objectives.

4. Instructional guidance or diagnosis: Tests are used to provide guidance to teachers in the classroom. Instructional guidance tests, also known as formative tests, are given periodically during classroom instruction to monitor the learning progress of students and to provide ongoing feedback to students and teachers. In a way, formative tests are invaluable as diagnostic instruments which teachers adopt for diagnosing student learning difficulties. Diagnostic tests enable teachers to gain detailed information on the particular points of difficulty for each student - information which is necessary if there is to be improvement of performance. Diagnostic tests are not easy to design.

The Why, Who, When and How of Assessment

1. Why assess? This is one aspect of assessment which is steeped in tradition, especially for many Commonwealth countries. The mode of public external examinations became institutionalised in many such countries and the assessment based on how much of the prescribed syllabus had been learned. The onus was on the learner to prove that he or she had learned anything at all. Nevertheless the external examination gives both status and credibility to many educational institutions. It also provides a pointer to the standards of the educational system as a whole.

In science the growing emphasis on practical skills meant the need to devise assessment tests for experimental work. Then came the need to assess project work. Assessment of science fairs and exhibitions of the work of young scientists provided opportunities to evaluate science, mathematics, vocational and technical subjects in an interrelated way.

2. Who should assess? Classroom teachers have an important part to play in assessment of student academic achievement, because the teacher is assumed to have detailed knowledge of the students. It has been claimed that the advantage which a classroom teacher has over the external examiner lies in the knowledge of the work of the student over a wider range of activities and over a longer period of time. However, the external examiner has the advantage of being able to relate the performance of a student to that of others across a country. In order, therefore, for school systems to benefit from both internal and external assessment, it may be desirable to standardise the internal element by external measures. Such standardisation may be accomplished in one or other of three ways:

- by using scaling assessments which are either syllabus-related or independent;
- by moderators visiting schools or looking at samples of the products of school work;
- by using national item banks, from which teachers can draw items or tests to standardise their own assessments.

3. When should assessment be made? Assessment aimed at improvement of performance and guidance must be given at appropriate times and frequency. Diagnostic tests, for instance, require to be administered with greater frequency than other forms of tests. For certification purposes, cumulative assessment has advantages in building up a comprehensive statement about students over their school careers. This however does not negate the use of end-of-course assessment since users of information on students' achievement are also interested in the performance of the individual students at the terminal point.

4. How should assessments be communicated and used? In communicating and using information derived from assessment a distinction must be made between that which is appropriate for use within the school, and other information which can be communicated to the outside world. The limitations identified on the scope of assessments to be transmitted beyond the school are likely to be set, not only by the requirements of fairness, reliability and validity but also by acceptability to the public. To be fair, it was argued, any grades awarded nationally should be comparable; to be reliable, agreed procedures should be carried out efficiently; to be valid the assessment should match the curricular objectives and be pitched at an appropriate level; and to be acceptable, the attributes to be assessed should be agreed among teachers, parents, and the public in general.

Complete transcripts on performance of individual students should form the basis for transmitting academic achievement instead of just the prevalent colourful certificates given in many countries at the present time.

Continuous assessment: Continuous assessment has been advocated by many Governments through their Ministries of Education and other educational authorities. The rationale behind continuous assessment is as follows:

(a) Assessment is an integral part of the teaching process. It is therefore reasonable that teachers should be involved in the final assessment of the students they have taught. The present system whereby the final assessment of students at the end of a particular level of education is carried out through a single examination set by an external body tends to deny teachers the opportunity to participate in the final assessment of their students.

(b) An assessment procedure which takes into account the student's performance throughout the entire schooling is likely to be more valid and more indicative of overall ability than a single examination.

(c) The readiness of teachers to introduce innovations into their teaching is often frustrated by the fact that a final external examination does not take account of innovation.

(d) An important aspect of instruction is the appropriate guidance of students both in their learning and in preparation for careers. A continuous assessment procedure facilitates career guidance.

(e) Teachers also need to assess their own instructional methods from time to time in order to improve performance. Data from continuous assessment can be useful for such self-assessment.

(f) Leakages of examination question papers and other malpractices at external examination or final examination occasions might be obviated if continuous assessment is given due weight in the overall evaluation of students. The pressure on students on the occasion of the single final examination is very great; this pressure will be eased if the assessment is carried out over the entire course.

International Perspective in Assessment

Through the efforts of the International Association for the Evaluation of Educational Achievement (IEA) international comparability studies have been made on student achievement in science and mathematics. A new IEA study on science is currently underway.

No such comparability studies have been carried out in technical and vocational subjects. This may be a reflection of the somewhat inferior attitudes attributed to these subjects and the lack, in some countries, of competent and pedagogically-trained teachers. It is a situation that calls for international co-operation, particularly with the trends towards interrelated studies of science, mathematics, technical and vocational subjects.

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