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Pedagometrics and its Application in Improving the Quality of Education²

1. Introduction

"Education is one generation's investment in the next". (Kaufman & Herman, 1991). It is also considered as a primary means for solving social problems (Worthen and Sanders, 1987). With such a view, the task of education is enormous. To carry out the task of education, there is need for an approach which is holistic and meets the expectations of the stake holders. System analysis is an approach with the required characteristics.

In applying systems approach to such a task, the intended outcomes are operationally defined and all possible variables that may affect its successful completion are identified. In planning stages, the system analyst will examine alternative ways of arranging resources in order to predict which combination and sequence of resources are likely to lead to task accomplishment in the least time and with least cost (Churchman, 1964 and 1965 cited in Morgan, 1990).

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Application of systems approach in education requires the application of three processes, namely research, evaluation and policy analysis. These three processes should be carried out in close coordination to make educational systems efficient (Kaufman, 1988). Research process provides necessary knowledge for identifying problems and working out solutions. Evaluation provides information for decision making.

In conducting research or evaluation, measurement is made and relevant statistical analysis is carried out. Based on the research information, necessary interventions (policies) could be formulated to improve educational systems.

In this context, the field of educational systems research can be divided into three main areas: (a) educational research and evaluation, (b) measurement theory, (c) statistical data analysis and policy formulation. Bazargan (1982) has coined the phrase Pedagogometrics to cover these three areas.

Educational research, as part of the first area of Pedagogometrics, appears to be well developed (see e.g. Werdeline, 1982; Keeves, 1990).

Evaluation, as the second part of the first area, which was an emerging field 20 years ago, is now an established field and maturing in its late adolescent years. As indicated by Conner and colleagues (1984, cited in Worthen and Sanders, 1987), in the early 1980s evaluation was making the transition from late adolescence to adulthood. Although, evaluation is now responding to the needs of educational systems, it is not far enough advanced.

As mentioned earlier, measurement has been used for both research and evaluation purposes. Hence, in the minds of many practitioners the

words measurement, testing and evaluation appeared to be used interchangeably (Choppin, 1990).

However, it should be noted that measurement is synonymous with testing, or in general, using instruments for assigning numbers to traits or variables; while assessment and evaluation are used to mean the determination of a thing's value. We elaborate on this point further in the next section.

The third area of Pedagogometrics includes statistical data analysis and policy formulation. Application of statistical techniques in the behavioural sciences in general, and in education in particular, have well developed. In most cases, data on educational factors or variables are provided by measurement scales which have nominal or ordinal scales. Treatment of data from such scales requires special techniques which have been developed since 1963 (Agresti, 1990).

Statistical techniques for treating such cutegorical data have been well developed and are increasingly used in educational systems data analysis (Sharma, 1996). However, using the results of educational research and evaluation for policy formulation is just beginning to make an impact on the practical aspects of educational activities (McGinn & Borden, 1995).

With regard to the above definition, how can Pedagogometrics help improve the quality of educational systems? To answer this question, we point out, first, that there are semantic distinctions between measurement, assessment and evaluation. Then definitions of quality in education are reviewed. Finally, the role of Pedagogometrics in improving the quality of education is discussed.

2. Measurement, assessment and evaluation

The dictionary definition of measurement is the act or process of assigning numeral quantity to ..." Based on this definition, educational measurement is the quantitative descriptions of student behaviour and behaviour of other elements of educational systems. With a view to this definition, educational measurement flourished in the United States during the first two decades of the present century (Worthern & Sanders, 1987). The testing movement, which emphasized norm referenced testing, was very popular in North-America in the 1990s. Between 1920 and 1965 attempts, were made to use testing programs accross the United States. The statewide testing in this country was considered as National Assessment of Educational Progress. During this period, the Tylerian evaluation approach (Tyler 1942, 1950) was popular. In this approach achievement of students is measured and judged against curriculum objectives.

Similar attempts to use testing, test development and assessment of students achievement started in many industrialized countries during 1960s and 1970s. Furthermore, newly industrialized countries and several other developing countries have been active in the use of testing in school-settings during the past decade.

Based on such historical background and experience, the term assessment refers to judgement on what has been learned by students. However in some countries (e.g.U.K), assessment is used synonymously with evaluation (Nevo, 1995). In general, the purpose of assessment in schools may be one of the followings (McGim & Borden, 1995): (a) screening, (b) referrals and (c) instruction. As it is discussed in the other sections of this paper, when assessment is used for the purpose of

instruction it would improve the process of teaching-learning, and consequently the quality of educational systems.

Conceptualization of the term evaluation has been carried out during the past three decades. Based on the experiences gained in developing and applying tests in the United States and other countries, attempts were made to assess achievement of students at the international level across different countries. Such practices and the need for making educational systems to be more accountable, influenced specialists and practitioners to present their experiences with evaluation models. Consequently the professional literature in evaluation has grown exponentially in the United States during the past 20 years (Worther and Sanders, 1987). Similar attempts were at the international level as well (Elley, 1994).

The use of indicators in educational systems in the industrialized countries has provided a ground for a rigorous application of evaluation approaches in these countries (Riley & Nuttall, 1994; CERI, 1994; Chapman et al. 1990). Furthermore, European Union (EU) has attempted towards using evaluation in accountability and transparency in higher education. Such attempts have contributed to a greater application of evaluation in rebuilding systems of higher education in the EU. (Teichler and Winkler, 1994; Bazargan, 1996). Based on such a background the term educational evaluation refers to judgement of value of elements of educational systems.

Essential to this practice, during the past 10 years, an ethic has emerged in favour of the "cultivation of quality, efficiency and enterprise" (Neave, 1988, P.7). Accordingly, the culture of evaluation gained ground in many countries around the world.

To summarize the foregoing discussion, the term measurement in educational systems research refers to the application of instruments such as questionnaires, psychological/ educational tests, attitude scales, etc. to describe student behaviour and behaviour of other factors of the educational systems. The term assessment is usually applied to refer to the applications in which achievement of students on particular course is judged. "It covers activities included in grading (formal and nonformal), examining certifying, and so on" (Choppin, 1990). The term educational evaluation has been preferably used for judging the "value" of an educational system or an element of educational systems (e.g. student, teacher, curriculum, teaching-learning process, etc.) in meeting specific needs.

As mentioned earlier, assessment is generally used to judge learner behaviour. However, in the case of student learning, the process of judgement sometimes is called evaluation of student learning. In such a case, assessment and evaluation are used interchangeably.

While the aim of assessment and evaluation is judgement, they have two functions: a) formative and b) summative. The formative function is applied to improve the activities during the course of implementation. The summative function is used to judge the prediction of activities and accountability of the systemes.

Making semantic distinctions between measurement, assessment and evaluation, the question usually raised is: How can these concepts be applied to improve educational quality? To answer this question, we review first, briefly the definetions of quality. Then the role of Pedagemetrics in improving the quality of educational systems is discussed.

3. Need for improving the quality of education

The quality of something is an attribute which is judged by people. To evaluate the quality of an element, we should compare its status vis-a-vis either a standard or expectations of the people who are dealing with the element. For instance to judge the quality of a school system, we may judge the status of its graduates against pre-established standards.

In evaluating the quality of educational systems, based on the objectives of evaluation, specific criteria is considered and judgment is made whether the status of the system is satisfactory, nearly satisfactory or unsatisfactory. These criteria include different elements of the system such as inputs, processes and outputs.

In other words, evaluation may focus on entry behaviour of students, capabilities of teachers, teaching-learning processes or knowledge, skills and attitudes of graduates. According to criteria, the quality of education is differently defined. Hence, based on the four elements of the system (input, process, output and outcomes), four definitions of educational quality have been proposed (Bazargan, 1994). Another criteria which has recently been proposed for evaluation of educational systems is value added. According to this criteria, quality is the extent to which value has been added by the educational system (McGinn and Borden, 1995).

In summary, definitions of educational quality which have been proposed are as follows:

- **The quality of inputs.** Refers to the extent that the inputs of educational systems (students entry behaviour, teachers' competencies,

curriculum, etc.) meet the pre-established standards or expectations.

- **The quality of process.** Refers to the extent that teaching-learning and other educational processes (e.g. structural, organizational etc.) are satisfactory.

- **Quality as outputs.** Refers to the extent to which the results of educational systems (graduates, research results and specialized services), as compared with a pre-established standard, or expectations, are satisfactory.

- **Quality as outcomes.** Refers to the extent to which employment status of graduates and their evaluation (by themselves, parents, employers, society in general) are considered satisfactory. Such definition of quality considers the relevance and scope of graduates, as outputs of educational systems, in affecting economic, political social, and spiritual lives.

- **Value added as quality.** When value added of an educational system is evaluated, the current state of its graduates (or other outputs) are considered and judged vis-a-vis the status that they might have had. In other words, to what extent, the state of graduates of a school system (their knowledge, skills and attitudes) can in anyway be attributed to the school system.

Improvement of the quality of educational systems requires to consider, first, a definition of the quality. Any of the first four definitions of quality may be applied for improvement. But, as has been indicated by some authors, the state-of-the-art in evaluation of educational systems is not yet far enough advanced to judge how much value has been added, therefore, "we are still in the stage of assessing outputs and outcomes" (McGinn & Borden, 1995).

Another approach to improving quality of educational system is "total quality education" (TQE). The TQE approach considers all the four definitions of quality in an integrated way. In other words, in the TQE approach quality of the inputs and quality of the process is assured to make sure that the quality of outputs and quality of outcomes would be provided. By applying the three areas of Pedagogometrics, and based on the definition considered for the quality, indicators are determined and evaluation is carried out. We elaborate on such a process in the next section.

4. Applying Pedagogometrics to improve the quality of education

To organize and improve the quality of educational systems continuously, there is need for information and intervention. The needed information should be provided by applying relevant research designs and evaluation models. Then by applying necessary interventions towards raising the quality of educational systems, current policies should be analysed and new ones formulated. These are the steps which are taken by applying the three areas of Pedagogometrics.

In doing so, first, the boundaries of the system are defined. Then, based on the definition of quality, evaluation objects are determined. Such objects include the following factors of the educational system:

- learners,
- educators,
- curriculum,
- organizational structure,
- instructional materials,
- other aspect of educational systems' inputs,

- any aspect of operation of educational systems,
- any aspect of educational systems' outputs.

Based on the objects, indicators for conducting the evaluation are considered (Hopkins, 1994; Rilay & Nuttal, 1994; and LeGuen 1994). Such indicators serve as signals and would "ring the alarm" of educational system, before it gets out of control. In doing so, data which are available are analyzed, then the data that should be collected, through measurement of the variables, are determined. Among these, performance indicators provide a set of signals to educational systems through which one could explore ways to improve educational quality.

In collecting and providing statistics on performance indicators, educational management information system (EMIS) should be developed. An EMIS consists of methods for data collection, organization, retrieval and presentation of information to educational decisionmakers. Such decision makers, among others, include administrators and teachers.

Statistical information which are included in the EMIS should meet the following criteria:

1. be linked to the goal of evaluation,
2. be available in time for formative and/or summative evaluation,
3. provide useful reports which would serve the needs of decision makers to improve educational activities.

In order to serve the needs of decision makers, the EMIS should have the following characteristics:

- (a) identify educational units (students, teachers, courses, schools, etc.) with highest and lowest rate of performance,
- (b) make it possible to find out the characteristics of the unit with the

highest and lowest performance,

- (c) provide information on what would take to bring the status of the units with lowest performance up to the average level.

Through statistical analysis of the data available in the EMIS, useful reports would be provided to the decision-makers.

The EMIS reports provide a ground for educational policy formulation. Experiences of policy analysis in developing countries have shown that, available data could be analyzed towards evaluating current policies and presenting analytical reports to decision-makers for policy intervention and improving the quality of the systems (Bazargan, 1992). Once such analytical reports are presented to the decision-makers, in a format which includes feasible policies, action towards improving the quality of educational systems are encouraged.

5. Conclusions

Education is considered as an investment. It is regarded, also, as a primary means for solving social problems. Based on this view, the task of education is enormous. To carryout this task, there should be transparency and efficiency in educational systems. To accomplish such a task, a holistic approach should be applied to education. Application of this approach requires that research, evaluation and policy analysis be carried out in educational-settings. The close co-ordination of these processes make educational systems efficient.

Pedagometrics is defined as the field of educational system research for: (i) identifying the gaps between the status of a system with pre-established standards (or expectations), and (ii) determining necessary interventions to narrow the gaps. It includes three areas: (a)

educational research and evaluation, (b) measurement theory, and (c) statistical data analysis and policy formulation.

Research design, as part of the first area of Pedagogometrics, traditionally, has been applied for identifying problems of educational systems, providing generalizable descriptions, testing hypotheses and generating theoretical models. However, it can also be used for improving the quality of education. Such an application, among others, involves the use of action research to improve knowledge, and skills of teaching staff (Kember & Gow, 1992).

Evaluation design, as the other part of the first area of Pedagogometrics, can be used for planning of improvement in quality. The second area of Pedagogometrics, measurement theory, traditionally has been applied in the educational settings to describe human behaviour and other related factors. It is obvious that evaluation designs are implemented through the application of conceptual frameworks of measurement.

This paper points out the semantic differences in measurement, assessment and evaluation. Attention is paid to the fact that educational measurement is assigning a numerical quantity to educational phenomena. Assessment is regarded as an action which, usually, refers to as judgement about human behaviour, such as student learning. However, in some countries (e.g.U.K.) assessment and evaluation is used interchangeably.

Evaluation refers to judgement about any aspects of educational systems.

Statistical analysis, which is the first part of the third area of Pedagogometrics, has been applied in educational systems research. To

improve educational systems; such analysis should be linked with policy formulation. In this respect the third area of Pedagogometrics needs further development. An example of such linkage is presented by McGinn and Borden (1995). They have proposed linking of educational research (and evaluation) with educational policies in the school-settings for developing countries. Based on application of Pedagogometrics, they have proposed four stages of improvement in quality of schools in developing countries (McGinn & Borden, 1995: 243-244).

In short, application of Pedagogometrics would encourage information-based decision-making in the educational-settings. Furthermore, it would enhance learning productivity, not only in the formal educational systems but also in the in-service training/education systems.

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