

## Systems approach in medical education

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### Abstract

A systems approach maintains a perspective in which the overall effectiveness and efficiency in achieving objectives depends on identification, understanding, and management of interrelated processes as a collective system. A system is a construct or collection of different elements that together produce results not obtainable by the elements alone. The elements, or parts, can include people, hardware, software, facilities, policies or documents; that is, all things required to produce systems-level results. The value added by the system, is primarily created by the relationship among the parts; that is, how they are interconnected. The components of a system are the input, process or throughput, output and feedback. In medical education the medical student is the input. The learning environment, resources, teaching and assessment methods make up the process. The graduate who matches the standard norms of the health needs of the society is the output. Systems approach is a way of managing problems considering the system as a whole, not of a particular part. The characteristics of a system are effectiveness, efficiency, dependability, flexibility and acceptability. The steps in curricular design can be likened to the steps in a systems management. Therefore a systems approach to medical education is the key to quality assurance in health care.

**Keywords:** effectiveness, efficiency, input, medical education, output, process, systems approach

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### Introduction

System is very commonly used word. The word system is derived from the Latin word 'Systema' which means a whole made of multiple parts. According to Acoff, "a system is the set of interrelated and interdependent elements."<sup>1</sup> A system is a dynamic entity, always in the process of evolution, innovation and correction of errors through feedback. The concept of system can be applied to all fields of science, research, technology, industry, education, management and organizations. A system has

functional identifiable parts that communicate efficiently and affect each other. The output of the whole system is greater than the sum of the parts put together. Therefore, a system is non functional when the individual parts are considered separately.<sup>2</sup>

The other aspect of a system is the presence of an inbuilt feedback or control mechanism, to trouble shoot whenever a problem is encountered. Computers are designed with multiple stepwise autocorrect options.

The systems approach can also be applied to medical education. This short communication deals takes the reader through the definition of a system with examples that help in understanding the systems approach; it then proceeds to classify the systems approach and describes the components of a systems approach while applying it to medical education and finally the qualities of a good systems approach are listed and explained.

### **Systems approach to medical education**

The human body is the most perfect example of how a system should function. Many organs which are different embryologically, histologically and functionally serve a common function. The function of every organ system is precisely regulated by nervous or hormonal feedback mechanisms and the ultimate aim is to maintain balance or homeostasis - therefore a 'systems approach' has clinical applications also.<sup>3</sup>

The way a computer is programmed or the human body is genetically programmed can be said to be a 'systems approach'. This denotes a step wise, problem solving or scientific approach to any process. Hence, this principle behind the success of our organ systems or computers is being tried in many organizations involving huge human resources.

But though the principle is sound and logical, applying the same to diverse minds at work is easier said than done! For the computer is a machine programmed by a single individual and the human body fortunately functions, mostly under the control of the autonomic nervous system.

But nevertheless, the systems approach has been the backbone of management in many business organizations and is a part of the regular curriculum in most of the management studies. Many reputed and long standing

organizations or business houses, consider a systems approach as the secret behind their success.<sup>4</sup> The application of the system approach to education evolved later.

A system and therefore the systems approach can be classified in many ways:

1. Natural or manmade systems.
2. Open or closed systems.

The human body is an example of a natural system, while communication systems are manmade systems.

Closed systems are those in which the input, process or throughput and output is predetermined and cannot or should not be changed during the course. An example is that of a spacecraft. In this situation, the system's approach calls for zero error.

Whereas in open systems, such as those involving student learning or other human resources, there should be provisions for continuous review and change. Transformation of input to output is called throughput or process.

The general system theory was proposed by Ludwig von Bertalanffy in the 1940s. As per this concept, all systems studied by physicist are "closed" – they do not interact with outside world e.g. Solar system, an atom, a pendulum. A living organism will die without environment and therefore is an "open" system because it interacts with the environment.

The four broad components of a systems approach are therefore "input, process, output, evaluation and feedback."<sup>5</sup> The above steps are indispensable for most of the engineering systems. In the field of education, systems approach has been widely practiced to manage, control and improve the process and products of education.<sup>5</sup>

The application of the components of a systems approach in medical education will be as follows:

1. **Input** would be the novice medical student who gets admitted into a medical college, with prior knowledge of general biology, physical and chemical properties of nature and compounds.
2. The medical student undergoes a **process** of experiencing a structured medical curriculum.
3. At the end of medical training a novice medical student is expected to be a competent medical practitioner, who is capable of independent patient management decisions. This is the **output** which goes back to the society.
4. A medical graduate thus qualified is being **evaluated** and given feedback by the society, which he is expected to serve.

The process within a system has been variously described as a "white box", containing a collection of interacting subsystems or as a "black box", without observable components, by Rumble.<sup>6</sup> In medical education, the white box where the components or subsystems are visible can be likened to the various departments or their syllabi. The black box or the invisible component is the actual learning process. A reductionist view is dissecting out the functions of subsystems as an approach to a problem. For example, in clinical settings a system consists of medical and diverse paramedical personnel. In the administration of medical institutions, the leadership can have a "black box" or holistic view. But an acceptable holistic approach requires a good interaction between the subsystems.

The system also has a hierarchy among the subsystems for smooth functioning. In medical education the order starts from the medical

councils, the colleges and then the individual departments. The system also has a boundary, which can be equated to the rules, regulations and curriculum the education system.

In the manufacturing sector, a systems approach is considered in the following steps: system analysis, system design and development, operation and evaluation. In medical education the Kern's six step approach<sup>7</sup> in curriculum design can also be followed as a checklist to ensure that the educational outcomes are delivered. The six steps are "(i) problem identification and general needs assessment, (ii) targeted needs assessment, (iii) goals and objectives, (iv) educational strategies, (v) implementation and (vi) feedback and evaluation."<sup>7</sup> If the output or patient management is as per the expected norms, we can be assured that the input, process and output is in alignment. But if the doctor fails to perform as per standard norms, feedback has to be sent to the policy makers and the respective institutions. A careful review of the entire curriculum is required and the level at which the fault lies needs to be identified and appropriate corrective measures have to be considered.<sup>8</sup>

1. At the input level, the selection criteria or process needs to be reviewed.
2. If the process requires correction, again a systematic review of the learning objectives, teaching learning methods or assessment methods is needed.
3. Again the output needs to be evaluated and checked, to ensure that the corrective measures have yielded the expected outcomes.

As per the general system theory, if a part is not functioning, the entire system has to be considered for adopting corrective measures. Consider the case of a slow learner in the medical education process. The deficiency can occur anywhere along the curriculum. The selection process could have been improper,

the learning objectives are not declared, the teaching learning methods are not in alignment with the goals of the curriculum or the assessment techniques lack validity. Another good example is the functioning of a hospital which requires tremendous teamwork for patient satisfaction.<sup>9</sup>

The qualities required for a successful systems approach are effectiveness, efficiency, dependability, flexibility and acceptability.

Effectiveness is the extent to which an organization or program produces particular outputs (which are concrete and measurable) or outcomes (which may not be measurable). In a medical education system, if all the graduates are able to provide the standard patient care the system can be said to be effective.<sup>10</sup>

Efficiency is defined as the extent to which an organization or program maintains a particular level of production with fewer resources or increases the level of goods or services it produces with a less than proportionate increase in the resources used. If a medical college is able to optimally use the teaching resources and give more number of qualified doctors to the society, then it is said to be efficient.<sup>11</sup>

### **Conclusion**

In conclusion, a systems approach is beneficial for efficient learning and quality assurance of medical education. But it is a complex process and requires teamwork from all stakeholders involved.

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