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ABSTRACT

This research assumes that systematic and systemic change are two components in instructional design (ID)--not dichotomous terms, but two sides of an interconnected dual structured system. Specifically, this paper examines the difference between systemic thinking and systematic thinking, the ideal mental model (dual structured systems) for ID, and the benefits from this mental model. The introductory section discusses the need for a dual structured instructional systems approach. An overview of the problems relating to systematic and systemic is then presented that covers the following topics: (1) dictionary definitions of the two terms; (2) different approaches of the two terms in the field of instructional systems design (ISD); (3) distinctions based on hard systems (typical tasks, step-by-step procedures) vs. soft systems (typical events, heuristic problems); (4) the conceptual model of dual structured instructional systems; (5) some guidelines for increasing systemic thinking, including the ability to see the problem as holistic, to set goals in a given problem situation, to link possible resources in terms of goals, and to drive a tentative result; and (6) the benefits of the dual structured systems approach. It is concluded that both systematic and systemic approaches are necessary for ID. (MES)

DUAL STRUCTURED INSTRUCTIONAL SYSTEMS APPROACH: AN INTEGRATION OF SYSTEMIC AND SYSTEMATIC APPROACHES FOR INSTRUCTIONAL DESIGN

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Abstract

This research assumes that systematic and systemic change are two components in instructional design - not dichotomous terms, but two sides of an interconnected dual structured system. Specifically, this presentation tries to determine the difference between systemic thinking and systematic thinking, the ideal mental model (dual structured systems) for ID, and the benefits from this mental model.

Needs for Dual Structured Instructional Systems Approach

Systems thinking has come to the attention of social scientists, planners, operational engineers, managers, educators, and the like, as a tool for problem solving and decision making. According to the SCANS (The Secretary of Labor's Commission on Achieving Necessary Skills) report (1991), systems thinking is an important problem solving skill needed both in school and industrial training curricula. Also, Reich (1991) has predicted that systems thinking will be an essential skill in promising job areas like symbolic analyst.

We might easily assume that if instructional designers (ID) are to join as members of symbolic analyst group, they should also possess systems thinking skills. Then how can they learn how to increase these skill? At present, there are no essential sources on how to teach and learn systems thinking skills. There is not even a clear definition of or guidelines for system thinking.

Historically, the instructional design field has employed systems approaches under the name of "systematic approaches." Dick and Carey's "systematic design of instruction" (1990) can be selected as representative material for these approaches. According to them, the instructional systems design (ISD) process is regarded as a procedure system, a series of steps such as design, development and implementation. The ISD model has recognized a means for not only effectively carrying out large-scale design and development efforts but also a means for ensuring quality control. The common language established by the model and its procedures facilitates communication among team members (McCombs, 1986).

However, it is argued that if instructional designers only followed the steps given, then quality instructional productions can be created in the same manner as industry productions on a conveyer system. In this approach, most of the ID might be involved in a series of activities such as dividing tasks into small chunks (reductional activities), finding step-by-step sequences (linear thinking), etc. Thus, analytic thinking skill can be important for ID.

On the contrary, there is another group of IDs (Banathy, Reigeluth, etc.) armored with the systemic point of view. They are regarded as a group which seeks authentic systems approaches. They use more the broad term like educational design instead of the narrow term like instructional design. The systemic approach provides instructional design practitioners with "the dynamics of process." for dealing with complex real-world instructional problems. This approach suggests that the design of education should be more open and adaptive to the larger societal system. In this approach, ID has to develop a holistic viewpoint or synthetic thinking skills.

In this context, we think both the systemic and the systematic approach are important and necessary in ID. The systemic approach provides a conceptually sound framework, which ensures the understanding of the complex and dynamic relationship between instructional system and its environment. The systematic approach provides actionable solutions, which are easy to follow. Thus we assume that systematic and systemic are two components interdependent with each other in the instructional systems design. They are not dichotomous terms; rather, the two sides are an interconnected dual structured system.

Specifically, this article tries to determine:

First, what is the difference between systemic thinking and systematic thinking?
Second, what might be the ideal mental model (dual structured systems) for ID?
Third, what benefits can we find from the mental model?

Overview of the problems relating to systematic and systemic

Dictionary definition

According to several dictionaries (The Oxford Dictionary, 1989; The Random House Dictionary, 1983; Webster's Dictionary, 1981), The meanings of systematic and systemic are as follows:

A. Systematic:
   (1) Orderly scheme or plan
   (2) Classification, procedure
   (3) Manifesting or involving a system

B. Systemic:
   (1) Body as a whole
   (2) Distinguished from local
   (3) Pertaining to or affecting a particular system

In terms of the first definition, systematic seems to be an orderly scheme or plan and systemic seems to be body as a whole. However, from the third definition, we learn that the terms, systematic and systemic both have a relationship with the term system. Let us say, the two terms come from the same root, system. Sometimes they are difficult to separate and even interchangeable. Systematic seems to be more a generic term, more well-known to non-experts than systemic.

The different approaches of the two terms in the field of ISD

A. Systematic design of instruction (Dick and Carey, 1990)
   Dick and Carey (p. 2-11) generally discuss the systematic approach model for designing instruction. They begin with an explanation of the relationship between a heating/cooling system (a sort of hard system) and an instructional process in terms of systems concept. They insist that the purpose of their work is to describe a systems approach model for the design, development, implementation, and evaluation of instruction. They define their approach as a procedural system, a series of steps, each of which receives input from the preceding steps and provides output for the next steps.

B. System design of education (Banathy, 1991)
   Banathy talks about the importance of the systemic viewpoint as a more fundamental approach to solving problems in educational situations. As an important aspect of the systemic approach, he stresses that the design of education should be more open and adaptive to the larger societal system. He is explicit in his criticism of the systematic approach without considering systemic aspect in educational reform.

The ship of education is sailing on troubled waters. There is an ever-increasing realization that unless we change the course, the ship will sink. But people are still trying to "rearrange the chairs" (systematic) on the deck of the sinking ship(p.6).

Distinction based on Hard systems Vs. Soft systems

We also assume that there might be some typical tasks (hard systems, step-by-step procedures, etc.) related with the systematic approach, some typical events (heuristic problems, soft systems, etc.) related with the systemic approach and other combinational events needing both approaches (most of the tasks in real situations might be these cases).

A. Systematic approach rooted in hard systems perspective
   Systematic approaches from systems engineering were translated into instructional systems design for military application (Settler, 1990). As a result, , hard systems thinking prevails overwhelmingly in ID practice.
   Saettler (1990) summarizes how a systems approach based on the hard tradition is practical in the instructional design process:

> Instructional goals and objectives were precisely defined, various alternative were analyzed, instructional resources were identified and /or developed, a plan of action was devised, and results were continuously evaluated for possible modification of the program (p. 350).

His statement implies that an instructional outcome can be achieved through "a series of steps activities" (systematic approach) carried out in some predetermined sequence.

B. Systemic approach rooted in soft system perspective
   The systemic ID process embedded in soft systems thinking must go through an iterative cycle as new experiences and insight, such as knowledge resulting from one design episode are gained. Through this iterative design process, relationships among the systems that surround an instructional enterprise will be better understood and instructional solutions refined. Therefore, the design process will become as ongoing learning process in flux.

Systemic thinking provides ID with "the dynamics of process" for dealing with complex real-world instructional problems. Instructional development grounded in soft systems thinking aims to be practiced as a social process. Thus, this approach represents a collaborative act where stakeholders engage in an interpretive understanding of instructional development through dialogue. It thus seeks accommodation among conflicting interests (Checkland, 1985, p. 764).

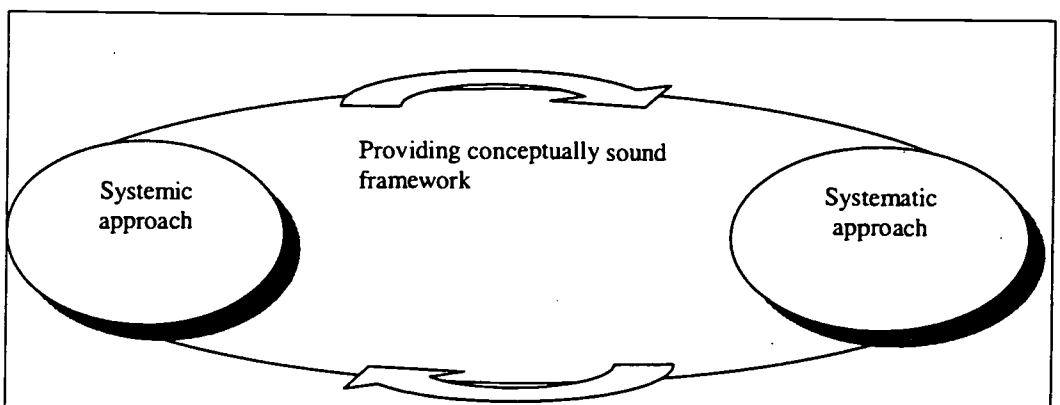
Instructional development is a part of larger systems, such as the school system, the community system, or the total social system. Thus, ID must see the design process as linked with the instructional program, the community, the human performance system in which skills or knowledge gained from an instructional intervention will be used, and the surrounding social system, all concurrently.

In most cases, the total set of problems of ID practice in educational and business contexts cannot be understood clearly. ID practitioners often face many complex situations in which multiple actors (e.g., teachers, students, and subject matter experts) and goals interact intermittently. This implies that practitioners in the field of instructional development need to develop flexible interventions capable of adapting to emerging objectives, needs, and problems (e.g., instructional constraints). In so doing, the design process becomes embedded in a context, and takes the form of iterative, collaborative inquiry. It might be necessary for ID to develop more systemic thinking skills.

The conceptual model of dual structured instructional systems

In our dual structured instructional systems, Systemic and systematic are not longer conflicting approaches any more. These two approaches provide complementary necessary knowledge bases. A more detailed conceptual model is shown *in Figure 1*.

Figure 1. Visual model of dual structured instructional systems



Systemic Approach Knowledge base for conceptual level (problem understanding and construction)	**Systematic Approach** Knowledge base for actionable level (procedural planing, solution finding and actionable intervention)
• Conceptual (understanding level) • Synthetic • Dynamic • Multi-layers (levels) • Global • Double loop process (meta-cognitive strategic) • More constructivistic	• Actionable (practical level) • Analytic • Liner • Single-layer (levels) • Local • Single loop process (Routine strategic) • More behavioristic

Some guidelines for increasing systemic thinking

Now, we do not want to give guidelines for systematic thinking because most of the IDs are already familiar with that skill. We want to categorize systemic thinking as several sub-abilities and develop some guidelines to increase systemic thinking skill:

- Ability to see the problem as holistic.
  The designer needs to study systems theory as a disciplines. The designer should be familiar with visual data like graphics, images, charts, drawings, etc. To obtain a holistic, imagery and intuitive point of view, visual literacy might be better than verbal literacy because verbal expression is subject to logical and linear thinking.
- Ability to set goals in given problem solving situation.
  Given a problem situation, the designer should be able to change the problem into a goal. This ability can be raised by need analysis because the goal setting phase is part of the analysis. Finding goal activities leads the designer to develop his/her purpose seeking sense in a broader area. Systematic thinking also might deal with goal finding activities. However, in this case, the activities deal with simply changing problems into goals without any holistic perspective.
- Ability to link possible resources in terms of goals in a given problem situation.
  To do so, the designer should be familiar with a multi-disciplinary approach. It might make possible resources meaningful and useful for solving the problem. Only when a designer sees all the resources available as interdependent in terms of the goal, it is possible that creative solutions can be developed.
- Ability to drive a tentative result (changes in system in terms of time and space) in a given condition through test.
  There might be several kinds of methods to make the designer think systemically.
  1. One method is to conduct the actual experiment in terms of models (models for solving problems). When a project is longitudinal and tasks are complex, it might be a very time consuming and costly approach.
  2. Secondly, using computer simulation might be more cost efficient than conducting an actual experiment. If the designer chooses several options among lots of input values, the computer quickly presents items corresponding to the selected option.
  3. Thirdly, through the various case studies containing real situation problems, the designer also learn how to think systemically. In this case, the problem solving approach should be systemic. There might be several guidelines given to increase systemic thinking ability.
  4. Fourth, thought experiment might be the most time-cost efficient method because human thought can go anywhere at anytime. But it is very difficult to get a valid result after administrating thought experiment. So follow-up activities through which the designer can find existing data from similar cases or scientific results should be involved. Also, the activities should be based upon theory or models. Some practical tips can be obtained from other fields like physics (Indeed, Albert Einstein used this method).

The benefits of Dual Structured Systems Approach.

There might be several benefits of Dual Structured Systems Approach, including:

- First of all, it can eliminate confusion between two aspects (systematic/systemic) because this approach incorporates the two.
- This approach can drive further study because the mental model still needs to be improved and elaborated.
- There might be some possibility that IDs can know when and where one aspect should be more dominant than the other during the instructional design process. For example, If the task is simple and procedural, then the designer may use systematic thinking like logical and step-by-step analytic ability. On the contrary, if the task is complex and heuristic like soft knowledge, then the designer may use systemic (synthetic) thinking; let us say, the ability to see the problem as holistic and to have a birds-eye perspective, which lead to find out some principles or relationship among several factors. Thus, in this case, the designer might be requested to handle a lot of factors needed to solve the problem. Perhaps, the factors might be appeared, at a glance, as unrelated things in the sight of the systematic oriented designer.
- Finally, IDs might know the meaning of "think globally (systemic), act locally (systematic)." Let us say, IDs could gain the ability to design in a more broader societal domain and to apply more systematic methods.

Conclusion

HD TV which was made in Japan, was a kind of innovation that has finally been proven as a failure because the developing group did not think of the systemic aspect, let us say, because environmental change (societal trends) go to digitized but they did not agree with that. So, if we design an innovation, we have to think about the systematic approach based upon a systemic viewpoint because it reduces the probability of failure.

As another example, before we build a building, we need to think about the outside of the system (building) like the quality of ground, strength of wind, etc. So, it is very important to think about the systemic point of view before we design a system to permit the system to develop safely and soundly.

On the contrary, when we start to do something in terms of performance level, it might be more practical and efficient to have a systematic viewpoint.

We need both systemic and systemic approaches for instructional design. Also, we have to know when or where systematic and systemic approaches are useful. So further study is needed to figure out these aspects.

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