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Systemic Issues in Asynchronous Delivery of Graduate Engineering Management Programs

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Abstract

The purpose of this paper is to examine systemic issues that impact the design, delivery, and maintenance of asynchronous engineering management educational products. Asynchronous education continues to rapidly evolve as an alternative to traditional classroom delivery. An asynchronous educational system requires the effective integration of technology, supporting processes, and infrastructure design to prepare, deliver, and maintain asynchronous educational products. Currently, the technological capabilities for delivery of asynchronous education have outstripped the ability to maximize those advanced technologies. To help understand this rift between technology and our ability to deploy that technology this paper examines three critical areas. First, the distinctions between asynchronous, distance (interactive televised), and live instruction are examined from a perspective of immediacy. Second, based on initial experiences in preparation and delivery of asynchronous education, a systemic issues perspective is developed. Finally, implications of systems design principles are presented as a guide for more effective future design of asynchronous educational products in engineering management.

I. Introduction

Asynchronous distance education has been increasing rapidly as an alternative to traditional delivery of educational products. For the following discussion, we take asynchronous distance education to be: *the delivery of educational products displaced in time and geography from the preparation of the product*. Technological sophistication has been increasing while the cost of asynchronous media has been decreasing. All indications are that these trends will continue into the future. Asynchronous distance education offers several advantages over traditional classroom instruction, including synchronous (video/audio) distance education. Among the recognized advantages are: (1) the ability to provide educational opportunities to geographically isolated areas that would otherwise be excluded from the educational experience, (2) use of advanced technologies to enhance the educational experience, and (3) providing convenience for students to receive educational products wherever they have access to a desktop computer or video device (DVD, VCR, or CD-ROM). However, there are multiple concerns involving the asynchronous delivery of educational products and their equivalence to traditional classroom based instruction or synchronous delivery modes. There is the persistent quality question that doubts the ability of the distance education experience to be equivalent to the traditional classroom experience. Depending on which side one prefers to argue, a compelling case and accompanying statistics can be generated to support a claim for either position.

The scholarly debate over the adequacy of distance education is not likely to subside in the near future. On the contrary, it is likely to intensify as more programs emerge and technology continues to create new opportunities. However, there are several compelling conclusions that we might consider before getting into the pedagogical debates concerning the efficacy of distance education. First, distance education is not going away. It is an institutional fact that education is being driven in this direction. Growth of televised programs, as well as the willingness of "traditional" institutions to begin engaging in "non-traditional" delivery of instruction, attests to the fact that this medium is not only here to stay but will continue to grow. Second, the work of educators must be to deliver the best possible product with the resources available. Thus, given that distance education becomes simply a "different" medium to deliver the educational product, the drive must be to "maximize" effective use of the medium. This requires the effective use of technology and integration of that technology with supporting systems/processes. Thus, educators must effectively utilize technology to deliver content. The debate as to whether or not the asynchronous medium should be used has for all intensive purposes become moot. Finally, success in the distance education environment requires different levels of thinking. The level of thinking that has generated success in traditional classroom settings will no longer be sufficient to master the distance education environment. Contrary to the popular arguments of distance education as simply an "extension of the traditional classroom", care must be taken in understanding how technology and design can leverage the non-traditional classroom in different directions.

The current challenge of this paper is to enhance the dialog for effective design of asynchronous distance educational products and environments. The paper is organized to first present the concept of immediacy as a point of departure for distinguishing a primary concern of asynchronous education. In effect, exploring a primary challenge facing the designers of asynchronous education. Next, the paper examines several systemic design issues for asynchronous educational products. Finally, several design principles from systems theory are explored for implications with respect to the design of asynchronous educational products and environments. The paper closes with a short conclusion regarding the implications for systemic design in asynchronous education.

II. The Asynchronous Educational Product: Absence of Immediacy

Asynchronous educational products have several characteristics in common. First, is the preparation of the content on an electronic medium. This creates the capability for instructional delivery that is independent of geographical or chronological limitations imposed by traditional educational processes. Second, the relationship of the instructor to the student lacks the immediacy expected in a traditional educational environment. Thus, immediacy, or the psychological distance between communicators is naturally reduced in the asynchronous environment. Early writings on immediacy establish three central characteristics of the phenomenon (Mehrabian 1968; Mehrabian, 1969). First, immediacy is established through the act of communication. As originally conceived, immediacy was directed to direct communication was between individuals in 'real-time' exchanges. Second, immediacy concerns itself with both verbal and nonverbal communication. The inclusion of nonverbal aspects includes gestures, body language, and other forms of communication without direct verbal exchange. Finally, immediacy has far reaching consequences for effective communication and learning. In effect, as Mehrabian (1971, p. 1) pointed out concerning immediacy, "People are drawn towards persons and things they like, evaluate highly, and prefer; and they avoid or move away from things they dislike, evaluate negatively, or do not prefer." In essence, creation of higher degrees of immediacy between communicators enhances the probability of both parties remaining engaged in the communication. When the psychological distance between the communicators is reduced and the relationship becomes more conducive to learning. Therefore, there is additional pressure in an asynchronous learning environment to create conditions for learning in the absence of "direct" immediacy.

Immediacy has been recognized as having a high degree of impact on learning in the classroom setting. For example, in an examination of student-teacher relationship, Frymier and Houser found that instructor immediacy has a strong relationship to both student learning and student motivation to learn (Frymier and Houser, 2000). The link of immediacy to student motivation for learning has also been suggested by Christensen and Menzel (1998). Additionally, student motivation to learn and verbal immediacy has been linked to out of class communications between students and their instructor (Jaasma and Loper, 1999; Fusani, 1994), as well as instructor ratings (Moore, Masterson, Cristophel, and Shea, 1996). The responsibility for immediacy rests with both parties in classroom communication. This point was amplified in a study of nonverbal immediacy in the classroom setting by Baringer and McCroskey (2000). The essence of their work pointed out that student immediacy in the classroom affected the instructor disposition toward the student. This was an important point since it articulated that the 'creation of immediacy' is a joint endeavor involving all parties in the communication.

Delivery of distance education has also recognized the importance of immediacy in enhancing the distance learning environment. Although immediacy was originally conceived as being created in face-to-face interaction between communicators, efforts have been made to understand the implications and utility of the concept into distance learning environments. LaRose (2000) has recently pointed out three major concerns in the generation of immediacy via web-based distance learning environments. Among the concerns voiced by LaRose are: (1) distance learning through the internet can severely limit instructor immediacy, (2) limitations on instructor immediacy can have a negative impact on student learning in the distance learning environment, and (3) the difficulty of establishing close relationships between students and instructors through distance learning mediums can have a negative effect on immediacy. Amplifying the difficulty of establishing immediacy in the distance learning environment, findings suggest that distance learners in televised settings had lower expectations for instructor nonverbal immediacy but the same expectations for verbal immediacy (Baringer and McCroskey, 2000; Freitas, Myers, and Avtgis, 1998).

Based on the research of immediacy in educational (distance and traditional) environments, the following major conclusions are offered:

1. Immediacy has a significant impact on student motivation for learning.
2. Satisfaction with the learning experience by students is enhanced by effectiveness in immediacy between instructor and students.
3. Instructor evaluation is positively influenced by immediacy.
4. Immediacy in the distance education environment is much more difficult and constrained by technology limitations.

The implications of immediacy for designers of asynchronous educational programs are critical. The integration of a delivery system, technology, and feedback are critical to enhance the immediacy of student to instructional product. Given the importance of immediacy for learning environments, we now shift attention to systemic asynchronous issues for design and delivery of distance education. These systemic issues and design principles should always be considered with respect to the goal of enhancing immediacy of the asynchronous educational environment.

III. Systemic Issues in Design of Asynchronous Educational Programs

The systems perspective provides a powerful framework for understanding the complexities inherent in the asynchronous educational environment.

Effective design of asynchronous educational programs requires an integration of technology, content, delivery, and support. Past successes and experience with particular educational designs will not assure similar success in the future. In the future, educational designers and managers will be challenged to develop resilient system solutions to what Ackoff (1981, 1999) has termed ‘messes’. Vennix (1996, p. 13) amplifies the concept of ‘messes’:

> One of the most pervasive characteristics of messy problems is that people hold entirely different views on (a) whether there is a problem, and if they agree there is, (b) what the problem is. In that sense messy problems are quite intangible and as a result various authors have suggested that there are no objective problems, only situations defined as problems by people.

Viewing the design of effective asynchronous learning environments as a systems problem can reveal insights to preclude unnecessary errors stemming from ineffective system design. Recent work in systems science amplifies the point that traditional thinking about problems will be ineffective in the future. Mitroff (1999) suggests that since real problems are unstructured and arbitrarily bounded, their resolution requires systemic inquiry. He concludes that “All serious errors of management can be traced to one fundamental flaw: solving the wrong problem precisely, or muddled thinking" (Mitroff 1999, p. 9). Systemic inquiry is designed to assist managers/educators in understanding 'messes' inherent in turbulent environments.

Linear, sequential, stepwise approaches that have been characteristic of traditional formal problem solving offer limited utility in complex turbulent environments. Ackoff (1994) stressed that environmental turbulence is evidenced by both an accelerating rate of change as well as increasing complexity. Complexity has been characterized by an exceedingly large number of entities, dynamic interaction, continuous unforeseen emergent conditions, a high degree of uncertainty, and structure modifications in response (Williams, 1997; Jackson, 1991). These environments, and the issues they generate, will require more sophisticated thinking and methods to effectively manage their complexity. As Waring (1996, p. 128) points out "Formal problem-solving is likely to be effective only in cases where uncertainty about the 'problem' and possible solutions (i.e. about cause and effect) is minimal, the problem setting is stable, and the level of complexity is low". Effective problem solving for complex issues requires an approach capable of addressing the uncertain, dynamic behavior inherent in complex problems.

In taking a systemic view of asynchronous educational problems there are three important assumptions. The first assumption holds that problems are a product of a 'complex problem system' that produces the often 'symptomatic' conditions labeled as problematic. Therefore, it is inconsequential to talk of complex problems, or the manifest conditions defined as problematic, as separate and distinct from the contributing system(s) that generates the conditions. This assumption is consistent with system-based problem solving approaches that recognize the complex system nature of problems (Flood and Jackson, 1991; Flood 1995). It is more appropriate to talk of a 'problem system', which produces the undesirable conditions, rather than the conditions themselves. In effect, problems represent faulty systems in disguise.

A second assumption for the systemic view suggests that the 'framing' of a problem as well as the problem system is an arbitrary activity. As such, there are multiple perspectives, problem system configurations, and representations that may emerge to depict the problem system. The need for inclusion of multiple perspectives (Jackson, 1991) has long been recognized as an important element is systems-based methodologies. In addition, there has been recognition of the influence of language, worldview, and perceptions on framing and making interpretations of problematic situations (Fairhurst and Sarr, 1996; Weick 1996). This supports the notion that a problem system is dynamic and subject to reformulation over time and across individual perspectives. Based on new knowledge, shifts in perceptions, changing conditions, or dialogue, the potential exist for problem system reframing. Therefore, it is inappropriate to consider that a problem (system) can be truly static and closed from influences that may change initial formulations. Thus, there is no absolutely 'correct' depiction of a problem system. This echo's the importance of dialog, interpretation, and shared understanding in the systems literature (Senge, 1990; Argyris and Schön, 1996; Isaacs, 1999).

Finally, the systemic view assumes that actions taken to modify a problem system will produce intended as well as unintended consequences. Since problem system formulation is not precise, the consequences of making modifications to the problem system (structure, relationships, patterns) will produce effects that cannot be predicted in advance. Therefore, the design for effective problem resolution must include the provision for continuing modification of the system based on initial or latent unintended consequences.

Given the three systems view assumptions we can move forward to examining design principles as they relate to the asynchronous educational environment. For purposes of discussion, we have selected four principles to be examined in the following section.

IV. Four Systems Principles for Design of Asynchronous Educational Programs

In taking a systems perspective, to sharpen our focus, we submit four fundamental concepts that influence thinking for the design of asynchronous educational systems.

<u>System Purpose</u> - The purpose of a system is 'what it does' (Beer, 1979, 1981). Although this point seems trivial, it is not. In considering the purpose of a system, the output (patterns, products, and services) and outcomes (impacts) of the system in operation must be considered. Complex systems are designed and operate to produce outputs and achieve objectives. The systems perspective of purpose does not confuse intention with results. Regardless of the well-meaning intentions for a system design, purpose is based on 'actual' results, not those that were 'intended'. Therefore, it is a fundamental error to analyze a system based on design intentions or desires. In this sense, we conclude that every system is actually two systems. The first system is the *system-as-designed*. This system is the system as it was intended to operate and meet the desired objectives. The second system is the *system-as-performed*. This system emerges as the system-as-designed is deployed in an operational setting. The result is usually less than ideal as the system produces intended as well as unintended consequences. Thus, system purpose must be derived from the system-as-performed.

System purpose may be specified in advance, however; only after operation of the system can the achievement of the designed purpose be confirmed. Beer (1985) also adds that the system purpose is dependent on the perspective of the observer of the system. Therefore, multiple vantage points of a system may yield multiple purposes. This implies that system purpose is observer dependent and should not be considered an *a priori* property for an operational system.

<u>Self-Organization</u> - Self-organization holds that most of the structural and behavioral properties of a system emerge through interaction of the system elements (Clemson, 1984). Therefore, the actual design of a system can only be partially specified in advance of system operation. From the systems perspective, this explains why the most thoughtful and carefully designed systems have unintended consequences. In essence, system behavior and informal structure emerge only through system operation, regardless

of the detailed design efforts conducted prior to system deployment. Effective design of complex systems ensures that only the essential constraints are imposed on the operation of the system. In systems theory this concept is known as *minimum critical specification* (Cherns, 1976, 1987).

Overspecification of system requirements: (1) is wasteful of scarce resources necessary to monitor and control system performance, (2) reduces system autonomy which in turn restricts the agility and responsiveness of the system to compensate for environmental shifts, and (3) fails to permit subsystem elements to self-organize based on their contextual knowledge, understanding, and proximity to the operating environment. Therefore, self-organization suggests that system solutions should specify only the minimal requirements necessary to achieve system objectives.

Complementarity - The principle of complementarity suggests "Any two different perspectives (or models) about a system will reveal truths about that system that are neither entirely independent nor entirely compatible" (Clemson, 1984). Each system perspective is correct from a particular vantage point of the system. In addition, each system perspective may also be considered, to some degree, incorrect from an alternate system vantage point. The important argument is that there are multiple system vantage points, each adding to a more holistic impression of the system. Shifts in vantage points, environmental conditions, or knowledge will influence perspectives of a system. It is naïve to consider there is only one system perspective that is "correct". Therefore, it is a mistake to conduct inquiry as to which system perspective is 'right'. Assumption of a 'right' system encourages advocacy and competition instead of dialog and collaboration.

Dynamic Stability - A system remains dynamically stable as long as it can continue to produce required performance during environmental turbulence. Maintenance of stability, or dynamic equilibrium (Skyttner, 1997), in complex systems is achieved through adjustments to environmental shifts and disturbances (internally or externally generated) that impact system performance. Neither complex systems nor their environments remain static and free from change. Therefore, maintenance of stability must be a continuous struggle to adjust and compensate for shifts. Robust system designs provide for dynamic stability over a wide range of fluctuating conditions.

Stability in resolution of complex problems is a function of system design. System design must provide for stability monitoring, evaluation, and adjustment for as long as the system is to remain in operation. Failure to design systems for continual modification assumes that the operational environment and the system itself will remain static. For complex systems the assumption of a static environment is erroneous. In essence, a system solution to a complex problem should have built-in monitoring to continuously maintain stability of the solution.

Table 1 below provides a summary of the different systems principles and the imperative for systemic design of asynchronous educational systems.

Table 1. Primary system issues for design of asynchronous education design.

SYSTEMIC ISSUE	ASYNCHRONOUS EDUCATION DESIGN IMPERATIVE
1. System Purpose	Purposes of the system must be identified and mechanisms for transformation provided within the design. This is critical, since it is necessary to have some degree of alignment of perspectives to avert unnecessary conflict.
2. Self-Organization & Minimum Critical Specification	Minimal constraints should be specified for the operation of the asynchronous educational system. However, sufficient structure must be established to provide for effective functioning of the system. This is always a trade-off. However, "overspecification" will most certainly lead to inefficient use of resources through unnecessary system constraint. On the contrary, "underspecification" of system constraint will inevitably lead to inefficiencies due to constant and inconsistent endeavors to provide "minimum organization" for each emergent issue.
3. Complementarity	Design of the system must include multiple stakeholders' perspectives. This is critical since the asynchronous environment included many non-traditional stakeholders (for example, technologist).
4. Dynamic Stability	The asynchronous educational system must have sufficient feedback mechanisms to provide for the detection and correction of errors as well as the transformation of the system. This prevents the system from becoming obsolete without question. Every well designed system included the feedback mechanisms to question its continued relevance and determine its own obsolesce.

IV. Conclusions

Appreciation of the systemic nature of asynchronous learning environments can enhance the design, delivery, and transformation of educational products. The systemic design perspective offers utility to future development of asynchronous distance education environments. Systemic development of asynchronous learning environments can provide for more effective integration of technology, delivery, and content. However, the systemic development of asynchronous educational environments has received limited attention. Several considerations for systemic design with respect to asynchronous distance education have been presented. The intent of this discussion was to heighten the awareness of systemic issues and elevate considerations for systems design of asynchronous learning envirionments.

Consideration of the design perspectives can suggest more responsive strategies to avert unnecessary inefficiencies, conflict, and cost (both human and resource) in the deployment of asynchronous educational systems. In effect, systemic design can leverage technology as a means to enhance the immediacy of asynchronous education while simultaneously enhancing the delivery of asynchronous products. The net effect is a more advance delivery of asynchronous products through systemic design and problem solving.

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