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The International Journal of Instructional Technology and Distance Learning is refereed, global in scope, and focused on research and innovation in teaching and learning.

The Journal was established to facilitate collaboration and communication among researchers, innovators, practitioners, and administrators of education and training programs involving instructional technologies and distance learning. The editors and peer reviewers are committed to publish significant writings of high academic stature.

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Executive Editor

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Editorial

Global Learning

Industry has developed a variety of models for efficient production and distribution of goods and services. Many of these have been applied to education, with varying degrees of success. For example, the production line, batch processing, and the supermarket are emulated in our egg-crate classrooms, cohort groups, and periodic progress to higher grades, certificates, and degrees. The supermarket model offers user choice, and this opportunity is expanded at higher grade levels.

Quality control is another industrial concept. In the older production lines, quality is measured at the end of the process and problems are sent back to be corrected. Deming taught the Japanese automobile industry a better way. Correcting problems at the stage of production where they occur produces a better product, faster, and at lower cost. The computer revolution added a third model, customized production.

The education analog of the old production line uses social promotion to move students through the system and assigning grades of A - F. As a result, many students graduate with sub-standard knowledge, skills and aptitudes. Correcting problems where they occur is limited by teacher load. It is practical only in advantaged schools with small classes, advanced students, and appropriately trained teachers. Technology and learning management systems support individualized education and enable a diversity of needs to be supported, monitored and evaluated simultaneously.

Social promotion produces failures, but the alternative systems are difficult to evaluate because standardized tests are based on mental exercises and trivia that have little relevance to the world the student will work and live and grow in after graduation. Our evaluation systems need to be reoriented to reflect identified needs and performance objectives.

Industry conducts market research to translate customer needs into products and services. ADDIE is the equivalent process in education - **A**ssess, **D**esign, **D**evelop, **I**mplement, **E**valuate. Assessment must be focused on the present and future; otherwise our certificates and degrees are as relevant as a drivers license to fly an airplane.

Drucker's *Theory of the Business* highlighted relevance as a source of failure in industry. He identified the need for congruence between mission, competencies and environment. Have we, as educators, assessed the world (environments) in which our graduates will live and work? Do we design, develop and implement learning to prepare students for that world? Do we continually evaluate outcomes and the success of our products before and after graduation? And do we benchmark our success against local AND global standards?

R&D budgets are an essential for growth and development of education and training. Collaborative research, shared findings, and adaptation for different needs, cultures, and environments are crucial to design and develop relevant and effective learning. This Journal is part of a global movement to improve teaching and learning by knowing what to apply and applying what we know.

Editor's Note: e-Learning and associated developments such as learning objects require review and even a revision of pedagogy to use these tools effectively. This paper examines changes in pedagogy to increase effectiveness of e-learning.

Pedagogy Considerations for E-learning

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Abstract

Pedagogy is focused on enabling learning and intellectual growth of students in contrast to instruction that treats students as the object of curriculum implementation. Successful learning pedagogy requires teachers to understand how students learn and must have the capacity and autonomy to design, implement and assess educational activities that meet the needs of individual and all students. E-learning pedagogy is one that incorporates this form of learning pedagogy but goes beyond it to include a deeper study into the incorporation of instructional strategies that take into account real-time personalized learning content-to-learner adaptability.

Introduction

Pedagogy is focused on enabling learning and intellectual growth of students in contrast to instruction that treats students as the object of curriculum implementation. Successful learning pedagogy requires teachers to understand how students learn and must have the capacity and autonomy to design, implement and assess educational activities that meet the needs of individual and all students. E-learning pedagogy is one that incorporates this form of learning pedagogy but goes beyond it to include a deeper study into the incorporation of instructional strategies that take into account of real-time personalized learning content-to-learner adaptability.

It is important to note that the proposed e-learning pedagogy is not intended to represent the full spectrum of complex tasks that comprise teaching; rather, it represents instructional activities that promote active student learning in the context of e-learning. It will focus on the exploitation of information technologies to adapt to the varying learning scenarios and diverse student needs. This paper visions the keys to effective e-learning pedagogy as sound instructional strategies and consistent curricular design that is based on the principles of relevancy and placement.

This paper is organized as follows: introduction, literature review pertaining to the theories of pedagogies and its application in the e-learning context, key principles of e-learning, relevancy and placement, proposed content development methodology based on the modified ADDIE model, key pedagogy considerations for e-learning, and recommendations for future research. (ADDIE is an acronym for instructional design that incorporates **A**nalyzing learners, **D**esigning instruction, **D**eveloping instruction, **I**mplementing instruction, and **E**valuating instruction).

Theories of pedagogy in current ICT era

Pedagogy applies to all types of learning. Pedagogy is broadly defined as the art and science of teaching and is anchored strongly at the heart of learning. Theories of pedagogy pertaining to teaching or learning are well documented and will not be discussed in this paper. Instead, this section will focus on the current status of pedagogy in Information and Communication Technology (ICT). While e-learning has revitalized learning by transcending the boundaries of traditional learning, the use of computers per se for learning or teaching cannot make up for the poor pedagogy and content.

In relation to the new approaches to teaching, learning and the restructuring of training practices for e-learning, current theories of pedagogy in the ICT era require urgent review. The pressing need to develop pedagogy appropriate for ICT is well documented (Becta, 2002; Lynch, 2001; Ofsted, 1999). Although research has been carried out to develop pedagogy for integrating the use of technology into teaching, its development has lagged behind the massive investment in hardware, software and teacher training in using ICT (Newton & Rogers, 2001). Current pedagogic changes to integrate educational technology seem to be evolutionary rather than revolutionary (Hennessy et al., 2005; Cuban, 2001; Kerr, 1991).

The pressing situation is not helped by the complex psychological nature of learning. Literature reviews on pedagogy assert that models of learning pedagogy held by researchers and academics have become more complex over time. This results from incorporation of cognition and meta-cognition (Watkins and Mortimore, 1999), complex interactions between curriculum, assessment, and pedagogy, and effect of these interactions on student educational and social outcomes (Carr et al., 2000). Complex inter-dependent interactions between teaching and learning processes, curriculum, assessment and pedagogical approaches further complicate the situation (Carr et al., 2000). This together with the multi-faceted nature of knowledge and the mystifying and foreign characteristics of its nature make such a demanding task more difficult (Rowan et al., 2001).

Thus, aiming to build upon the proven and tested pedagogical theories, we see a need to devise new pedagogical models that grow directly out of current e-learning practice or out of designs of real e-learning curriculum materials. This view is also reflected in (Kelly, 2003) who sees opportunity for new pedagogy model to potentially create stronger link between the research study and the practice environment, where presumably, learning materials are being used by students and teachers in realistically scalable ways. In particular, our focus is on new pedagogical ways of learning and organizing that blossom from inclusion of ICT in the learning environment.

Therefore, the aim of this paper is to present our research findings, produce new scientific knowledge and generate innovative, theory-based pedagogical methodology in the field of educational technology. It is through this conservative form of research, based solidly on established theory and applying proven research methods, that we can add new knowledge incrementally and cumulatively (Wilson, 2005).

Relevancy and placement

Typically, what makes e-learning effective lies in the eyes of the beholder? One person's meat may be another person's poison. What satisfies the stakeholders' artistic eye may not even capture the interest or attention of the learners. This is what makes drafting a universal set of pedagogies or guidelines for e-learning difficult. While there are other aspects of e-learning that are important, this proposed e-learning pedagogy places the principle of relevancy as the core principle that distinguishes effective e-learning materials from 'beautified content holders'. The principle of relevancy primarily addresses the main vision of e-learning; that is, learning on the fly where learners decide what, where and how they want to learn.

It is advocated that the ability to retrieve and present the right information at the right time to the right learners requires the principle of relevancy. More often than not, it is without doubt that current e-learning systems, even with the most sophisticated search engines, fail the relevancy tests. However, what is more alarming is the fact that many proponents of e-learning have mistakenly concluded that it is the technology that has failed. Technology, no matter how advanced, can only contribute to the speed and ease of retrieval. It is helpless in the fight for relevancy. Instead, what is lacking in current e-learning systems is the appropriate design and use of content. Relevance is obtained through content precision, not technology. A resource when well designed, written and focused will contain enough 'relevant' content in itself to be its own

metadata. This, coupled with the use of a standard metadata and correct placement, is all that is needed for fulfilling the promise of just-in-time retrieval of the right learning resources.

Content placement is another key principle for the successful implementation of e-learning solutions. While the creation of relevant content is essential, the location whereby these resources are stored is equally important. From the learner's point of view, every additional second spent navigating the learning space is wasted time and effort. Besides the wasted time and effort, it also distances the learner from the solution. Distance creates perplexity and perplexity means less effective learning, frustration and an increased drop-out rate.

Content Development Methodology

Envisioning the shift in the future of e-learning direction from a content-oriented approach to a knowledge synthesis approach, our research puts forward a principled basis for designing an e-learning environment (Teo & Gay, 2005a; 2005b). While advanced information technology has been fully exploited for the delivery and presentation of learning resources, this paper contends that the bulk of today's e-learning systems still consist of simple conversion of classroom-based content to an electronic format while still retaining its traditional distinctive knowledge-centric nature. Utilizing higher-level cognitive strategies to capitalize on the distributed nature of the web is still rare. We believe that the unique characteristics of e-learning technology (i.e., the distributed nature of the distance learning modality, the physical separation of learners from instructor, the asynchronous communication paradigm, etc.) require adjustments in the nature of instruction specifically designed for that modality.

It is in this vein that this research attempts to marry the power of computer-based technology with an understanding of the psychological principles of learning to improve the educational outcomes. Extending our previous research work in using concept maps as an envelope for learning resources (Teo & Gay, 2004a; 2004b), we devise a novel and comprehensive content development methodology using the basic concepts of the ADDIE Model. Adopting the five design phases, vital e-learning requirements such as learner-centric, concept-map based and personalized aspect of learning are incorporated into the model. Most importantly, essential pedagogies and scaffolding strategies have been devised and integrated into the content development methodology.

Table 1

Analysis Phase

Steps	Purposes	Activities
1. Feasibility Analysis	Justify the creation of E-learning content	Ť Conduct Feasibility Survey Ť Analyze Feasibility Report
2. Pedagogy Analysis	Establish the type of instructional strategy	Ť Conduct the 4-Ts Ť Determine the type of learning event
3. Course Profile Analysis	Determine the scope, context, and performance augmentation	Ť Identify the overall (high level) educational Goal Ť Identify the conceptual scope Ť Identify the application domain Ť Identify the type of performance augmentation
4. Learner Profile Analysis	Establish the target audience and their learning needs	Ť Identify the target audience Ť Identify the target audiences' learning needs Ť Identify and categorize target audiences into their different learning styles Ť Perform the course-to-learner profile matching

Legend:

Ť: Main Task to be performed by the content developer

Ŧ: Sub-task to be performed by the content developer

Ă: Task that is automatically performed by system without the need for human intervention

Table 2

Design Phase

Steps	Purposes	Activities
1. Performance Design	Craft the learning and performance goals into quantifiable objectives	Ť Identify all the measurable learning and performance objectives Ť Determine the assessment guidelines
2. Scaffolding Design	Defining the scaffolding approaches	Ť Identify the learning context in which the concept resides Ť Scaffolding Goal Design Formulate: Ŧ Scaffolding Aim Ŧ Scaffolding Problem Ť Scaffolding Tasks Design Formulate Tasks to address: Ŧ Activation of prior-knowledge Ŧ Encoding specificity – resemblance of problem to learning concepts Ŧ Elaboration of knowledge application Ť Learner Considerations Formulate Tasks to address: Ŧ Identify the learner's goal through the process of needs analysis Ŧ Knowledge Gap Analysis - Assess learner's current knowledge point (Assess what the learner is currently able to do without help) - Assess learner's desired knowledge point (Find the desired performance) - Determine the level of learner support to design (While all 3 levels should be designed, the most appropriate level should be determined and designed first and used as a guide to spearhead the design) - Ă Knowledge Gap Mapping (Analyze what has to be achieved to move the learner from the current knowledge point to his desired goal) Ť Specific what is necessary to narrow or eliminate the knowledge gap Ť Specific what is the appropriate instructional strategy to scaffolding the design Ť Determine how to measure success or failure
3. Course Structure Design (Extrinsic Properties)	Generate the course structure in terms of tree-hierarchy and concept map structure	Ť RLO Identification (Identify individual modules that made up a course) Formulate: Ŧ Educational Goal Ŧ Cognitive Level Ŧ Type of content presentation Ŧ Associated Keywords Ť RIO Identification (Identify the individual topics that made up a modules) Formulate: Ŧ Educational Objective Ŧ RIO type (Concept/Fact/Procedure/Process/Principle) Ŧ Associated Keywords Ă Course Tree Hierarchy Ă Course concept map Ă RLO/RIO search for reused/repurposed Ť Verification of course structure Ť Verification of RLO/RIO status (develop/reuse/repurpose)

Table 3

Development Phase

Steps	Purposes	Activities
1. Course Composition Overview Development (Intrinsic Properties)	Generate the course composition in terms of learning resources	Ť RLO Composition Formulate: Ŧ Overview Item (Introduction, Outline, Importance, Pre-requisites) Ŧ Content Item Ŧ Summary Item (Conclusion, Review, Additional Notes) Ť RIO Composition Formulate: Ŧ Preview Items Ŧ Content Items (Outline, Constraints, Assets Identification and Considerations, Storyboarding) Ŧ Practice Items Ŧ Assessment Items
2. Instructional Materials Development	Select and develop the instructional materials	Ť Review and select particular learning resources, its pedagogical considerations and instructional strategy Ť Develop content flowchart Ť Design graphic user interface and screen templates Ť Develop storyboarding Ť Develop scaffolding Ť Develop interactive multimedia content

Legend:

Ť: Main Task to be performed by the content developer

Ŧ: Sub-task to be performed by the content developer

Ă: Task that is automatically performed by system without the need for human intervention

Due to length constraints, this paper will only focus on the pedagogy considerations of e-learning. Specifically, the instructional strategies (micro-level), learning events classification (macro-level) and scaffolding framework will be discussed.

Table 4

Implementation Phase

Steps	Purposes	Activities
1. Conduct formative evaluation	Review concepts, metaphors, ideas, graphics, and adherent to pedagogical considerations and instructional strategy	Ť Formulate 'beta' version of course Ă Finalized Course Tree Hierarchy Ă Finalized Course concept map Ť Send for evaluation
2. Technical Review	Review all technical issues that may hinder delivery	Ť Determine delivery methods and parameters Ť Formulate technical specifications (to state the required tools needed for content delivery)

Table 5

Evaluation Phase

Steps	Purposes	Activities
1. Revision	Evaluate course	Ť Conduct teacher and learner feedbacks Ť Review learner's performance Ť Schedule for revisions
2. Conduct summative evaluation	Finalize course delivery matters and synthesize new map with the existing course concept map (based on the theory of learning dependency and knowledge gap)	Ă Synthesize Course concept map Ť Send for verification
3. Deployment to server	For delivery	Ť Meta-tagged for efficient searches

Instructional Strategies (micro-level)

Instructional strategies determine the approach a teacher may take to achieve learning objectives. Instructional methods are often used by teachers to create the learning environment and to specify the nature of the activity in which the teacher and learner will be involved during the lesson.

Instructional materials that have been effectively designed with sound instructional strategy will facilitate the desired learning outcomes for the students, enabling them to acquire higher order skills to be able to think and apply what they have learned in a different context. E-learning materials belong to this category of instructional materials. However, e-learning programs can, but do not always, deliver improved learning outcomes. This is due mainly to the fact that the

current instructional strategy for e-learning, if any, is often adopted from traditional instructional strategy where face-to-face communication is assumed. It is advocated that in the absence or reduction in face-to-face communication, effective design of the e-learning materials has to rely on improved instructional design processes to reflect and replicate the real time interaction. Also, the online learning materials need to be structured in a way such that it can communicate the knowledge in ways that enable students with diverse learning styles to understand and apply the knowledge that has been learned.

Traditional instructional strategy is concerned about how the learners are going to learn and chart their personalized routes to achieve their learning objectives. However, it goes beyond the basics of content sequencing or simple course structure generation. It is concerned with how the learners will interact and learn from the instructional content. When traditional instructional strategy is used in the context of e-learning, additional conditions must be considered to take into account those considerations that are traditionally deferred when face-to-face delivery is assumed.

Two forms of instructional strategies will be employed: essential activities (4T) and learning event classification considerations.

The essential activities (4T) are centered on 3 main concepts: (1) identification of goals, (2) identification of critical factors required to achieve the goals and (3) determination of how achievement can be measured. In order to achieve these three main concepts, a total of four activities must be performed.

Learning event classification will be carried out once the essential activities have been performed. The learning event classification is important as different learning events must be designed with different teaching and scaffolding methods.

Additional key issues to consider:

1. Learners' learning preferences
2. Nature of knowledge delivered
3. Learning outcomes and learning/performance objectives
4. Prerequisites knowledge
5. Scaffolding

4-Ts of a learning session: Target, Training, Transfer, Transformation

1. Target
    - Identify the governing motivation underlying the need for training
        - Educational-centric: educate/inform
        - Performance-centric: Specific skills acquisition
    - Identify the entrance pre-requisite list
    - Identify the non-coverage (exclude) list
2. Training
    - Activation of prior knowledge
    - Identify the nature of the Training Tasks
        - Collaborative / Individualistic

        - Analytical / Passive
        - Divergence / Convergence
        - Discussion / Questioning
        - Project / Assignment
        - Demonstration / Practice
        - Lecture / Case Study / Role Playing
    - Identify the Training Materials
        - Main subject matter – purely on textual content
        - Supplementary subject matter – purely on textual content
        - Subject matter presentation
            - Learning styles
            - Cognitive level
            - Interactive multimedia
    - Identify the Training Support
        - Subject Matter Sequencing
            - Chronological
            - Cognitive level
            - Knowledge Gap (only if profile of learner is available)
            - Taxonomic (based on structure)
            - Problem / Case study-centric
        - Scaffolding Means
        - Degree of Abstraction
        - Degree of Complexity
        - Degree of student independence
        - Pace of learning
3. Transfer
    - Pre-assessment
    - Practice
    - Post-assessment
    - Remediation
    - Enhancement – introduction to next level of understanding
4. Transformation
    - Assess the accountability of the teaching
    - Feedbacks – both learners and teachers
    - Revision

Target

The target (goal) identification is conducted at the conception of a new course. It is situated at the heart of the pre-instructional activities. The learning target identification is important because human being have a built-in goal seeking "success mechanism" that is part of the subconscious mind (Maltz, 2002). This success mechanism is constantly searching for ways to help us reach our targets and find answers to our problems. According to Maltz, we work and feel better when our success mechanism is fully engaged going after clear targets. Besides, setting the learning target also helps to concentrate the time, effort, establish priorities, and provide a development roadmap for the learning materials. Thus, the target phase explicitly marks the generating of the governing motivation underlying the need for training. It also states the essential questions that must be thoroughly examined before the commencement of the course design. This includes defining the essential entrance criteria as well as the list of non-coverage.

In the subject matter expert's (SME) perspective, the most important step in any learning event is to focus on guiding learners to understand the main learning concept. Depending on the type of learning outcomes that are desired, different teaching styles and hence, their appropriate learning (teaching) event must be adopted. Therefore, the first step in any instructional strategy is to state clearly the underlying motivation behind the learning event. The motivation can be categorized under two teaching perspectives: educational-centric or performance-centric.

The main purpose in an educational-centric learning event is to educate or inform. Its sole purpose is to augment knowledge and is inclined towards imparting theoretical and abstract concepts. This mode of learning is extremely beneficial in conveying paradigms of thinking and information. The application of knowledge and the development of communication skills are however secondary. Such learning events are characterized by learning contents that are hierarchically organized and aim to guide the learning process through structured syllabi and tests. The training is usually housed in a certain context but the students are assessed both inside and outside the arena in which they hope to minister. Upon the completion of the training, the newly acquired expertise which attests to the level of training will be recorded in learner's cognitive map.

Performance-centric learning event on the other hand looks at the practical usage of the knowledge. It focuses more on the application of the knowledge rather than its fundamentals. This mode of training is based on the premise that students learn most effectively through experiences and practice in a deliberately organized program. It uses real life examples as the basis for purposeful training. Such a mode of learning is highly relational yet unstructured in the sense that training is focused on the working towards problem solving and the teaching materials are structured outside the normal school curriculum. The student has complete control over his learning and this mode is participatory in nature.

The formulation of the learning/performance objective together with the non-coverage list is a key aspect of the instructional strategy that caters to the learner-centric aspect of e-learning. Learning/performance goal and the non-coverage list states, in a less formal terms (so that the learners can understand), of what is or not required of the learners during the learning event. This is essential as the learners need to be informed of what is going to happen during the learning event so they can focus and determine what is relevant to them and what is not.

The entrance pre-requisite list sets the context and some essential pre-requisites. This list connects the learners with the training tasks and aids the learners to house the new information into a context based on what they should already know. This list sets the foundation on which the present learning concept will build. This step is necessary to aid synthesis of knowledge.

Training

With the target set, the attention now falls on the instruction set. However, before any content deliberation, in a learner-centric learning environment, it is crucial to invite the learners to clarify where they stand, at present, in terms of the new content. The prior knowledge activation task is important. Many prior studies have demonstrated the importance of informal and formal prior knowledge (see Dochy, 1992). Essentially, prior knowledge activation sets the stage for learning by sharpening the perception of the learner. It tells the learner not only what s/he has to learn but also what the person perceives s/he already knows. Sometimes this is a rude awakening, sometimes a corroborating experience. The result of such reflection when compared with the system record of the learner's past expertise can aid in the identification of the appropriate starting point of his learning route. The activation of prior knowledge is applied for learning preparation. It is used to connect the new with existing knowledge; to synthesize prior knowledge with the new content. Hence, the main design consideration of this part is to effectively plan the querying methods to accurately retrieve the learner's prior knowledge and investigate how to connect the learner's prior knowledge to the new content.

Once the prior knowledge correlation is achieved, then training can begin. The training development plan is sub-divided into three phases: Training Tasks, Training Materials and Training Support.

Training Tasks identify the nature of the content presentation. The training task defines the way to structure the training. Depending on the type of learning event, different training tasks are used to create and ensure engagement of the learners with the new content. Structuring the nature of the training task is one way to effective teaching as it dictates and creates a consistent overall design for the training. The teaching challenge here is not to present the training materials as static content but as an integral part of a dynamic learning process where the learners have to work over, contest, digest and recreate the new information to fit into their cognitive structure. Instead of receiving information, the aim here is to turn the learning process around and offer an opportunity for students to construct their own knowledge.

Training Materials identify the type of content. It is important to note that no form of content presentation, formatting or delivery medium is taken into consideration in this phase. While SME has to deliberate over the learning styles, cognitive level and interactive multimedia for the learning content, it is the pedagogic issue that is of concern, not the technological or delivery aspects. The entire content structure need not be formulated here, only the key concepts and their associated teaching methods.

Training Support is to ensure that the learners get the most out of training materials. Depending on the nature of the teaching tasks and the type of learners, different supports such as sequencing, pacing, scaffolding, complexity, and abstraction level will be employed.

Transfer

The transfer of learning is perhaps the most important aspect of learning. Transfer of learning is the application of skills and knowledge learned in one context to another context (Cormier & Hagman, 1987). The transfer of learning is important as the learning context is often different from the context of application. Hence, the goal of learning is never accomplished unless transfer occurs. Successful transfer of learning requires that training content be relevant to the task, that the learner must learn the training content, and that the learner must be motivated.

The triggering of knowledge synthesis usually lies in the activation and application of the newly acquired knowledge. Such a knowledge transfer can occur in three ways: (1) from prior knowledge and skills to new learning, (2) from new knowledge and skills to new learning

situations (learning now preparing for later learning), and (3) from new knowledge and skills to applications in work and daily life (learning for practice) (Simons, 1990). An example of category (1) transfer is a student from China who reads a document in English but uses the knowledge and skills from his native language (Chinese) to interpret the contents. An example of category (2) transfer is a student who is learning the concept of differential equation but knows that he has to master the concept of stability later (the concept of differential equation is an essential pre-requisite to the learning of the concept of stability). An example of category (3) transfer is a student from China who learns to speak English in the lesson, knowing that he has to perform it in real-life context when he speaks to his professors. The transfer of knowledge can also be classified under near or far transfer. In near transfer there is a close connection between the learning situation (or the prior knowledge) and the application (or the new learning situation). In far transfer the distance between prior knowledge or learning and application (or the second learning situation) is much greater (see Mayer & Greeno, 1972). These modes of knowledge transfer will be catered for at the macro-level of the instructional strategies.

In general, in order to demonstrate that learning has taken place, practice and assessment are included in the transfer of learning. However, it is important not to confuse practice with assessment. Learners at the practice stage are still learning; they are not being assessed. There are many different learning strategies for demonstrating understanding of the course ranging from requiring the learners to compare, classify, induce, deduce, analyze, construct or to make abstraction of the new acquired knowledge. Typical activities include open-ended questions, summaries, research, quizzes, and assignments.

While both practice and assessment are classified under the transfer of learning, the assessment of learning forms the evaluation portion of the learning event and must be based on a well devised methodology to determine if the e-learning event has been successful and learning has taken place. If the learners did not achieve the required understanding of the subject matter, sufficient scaffolding should be incorporated. Beyond the application consortium of practice and assessment is the higher level of understanding: remediation and enhancement.

Remediation is the application of the newly acquired knowledge in an entirely new situation. This gives the learners an opportunity to transfer what they have learned to other situations and use it in different ways. Collaborative learning is one good method to ensure that learners apply what they have learned to new situations. Lastly, the enhancement aspect of application of learning can bring learners to another cognitive level. It introduces ‘post-requisites’ concepts and broadens the scope of understanding.

Transformation

Transformation is the final phase that assesses the change in one’s approach that is brought through by the training and transfer. It sets the accountability of the training process and is also the channel through which the learning content is enhanced and revised by appropriate reviews and feedbacks. Feedback and comments may be in the form of electronic surveys or direct feedback from the teachers or learners.

Transformation differs from transfer in the sense that transfer of knowledge is more of an application of the knowledge but transformation is set at a higher level as it looks at the behavioral change that is brought about by the new training.

Context-Dependent Classification of Learning Events (macro-level)

The micro-level of instructional strategy prescribes four essential activities that must be performed. However, at the macro-level, different strategies should be employed according to the

context-dependent learning events involved. For example, when courses to be taught require only straight-forward knowledge impartation (i.e. rote learning where memorization is a key necessity for learning), the teaching strategy is usually centered on the use of the storage-retrieval of the knowledge process. However, for courses that teach problem solving, this does not usually involve the gathering of new knowledge but may involve teaching strategies that help the student in the reorganization of their cognitive data or remembering how to deduce or apply knowledge to achieve required solutions.

Hence, different sets of guidelines should be provided for the different classifications of the learning events. These learning events are classified based on their ability to promote the transfer of knowledge. While the learning events are set in various settings, it is important that all these learning events must start from the learner's perspective (Simons, 1999). The learning events also take into account the target audience (conducted under the Analysis Phase: Learner Profile Analysis) by adopting the research findings from Simons' Transfer of Learning (Simons, 1999). i.e. for young students, design learning materials so that students apply their prior knowledge more actively, overcome some of their pre-conceptions and learn on their own (see scaffolding section); for adults, design the learning materials through embedding a learning-to-learn approach into their regular training so that they learn how to transfer their knowledge and skills.

With the abovementioned research findings in mind, the learning events can be classified under two main categories: educational learning events (What-is learning) and performance learning events (How-to learning).

Educational Learning Events

Educational learning events are typically theoretical in nature and cover all fundamental learning theories and concepts such as facts, laws and principles. They must be delivered at the outset of the lesson and form a bulk portion of the learner's initial academic learning phase. It is characterized typically by knowledge impartation (from teacher) – cognitive awareness (student) – and cognitive reorganization (student).

1. **Factual Learning**

   Factual learning events are characterized by learning materials that are presented as a hierarchy of topics. One topic is set as the main topic and all the other topics are termed as the sub-topics. These sub-topics are either pre- or post-requisites concepts of the main topic and must bring the learner towards comprehending the main topic. Learning is structured, logically and usually sequenced in a linear fashion where there is an explicit assignment of topics as the entrance and termination learning points. Learning always proceeds from the known to the unknown and is directed by the teacher. It involves directing the student attention towards specific learning (main topic) in a highly structured learning environment (main topic – sub topics interlinkage). The topics and contents are usually broken down into small modules, taught and assessed individually through the usage of explanation, demonstration and practice. The attention of students is important and listening and observation is the key to success in this phase.

2. **Conceptual Learning**

   Conceptual learning events are characterized by learning materials that can be presented as verbal, written summary, outline of a topic or visually as a set of concept maps. It can exist as a new concept or tied to a factual learning concept (either at the beginning of the unit, or module).

   While conceptual learning is also centered on a main topic, the main learning objective is not to master the main topic but to present the big picture that houses the main topic. Gaining an

overview of how the new concept is related to other concepts is another form of learning. Besides mastering the fundamental theories underlying a particular concept, the ability to link and synthesize new knowledge into one's existing cognitive structure is another complex learning process that requires supervision. In addition, connecting new ideas to information students already understand makes it easier to retain.

The topics that are presented in the map need not be pre- or post-requisites concepts of the main topic. Instead, these topics can be stand-alone main topics by themselves that aim to portray the association between themselves and the main topic.

Learning in conceptual learning events is usually unstructured in the sense that the learners are allowed to explore relevant information in a manner that is comfortable for them. This form of learning is something like learning from the Web where learners can follow any relevant keywords or concepts to look up a topic. Conceptual learning allows the learners to explore any concept quickly and easily and to also see how this topic is related to other concepts. Conceptual learning typically distills difficult or complex concepts through the use of a simpler definition or example before showing how such a concept relates to other information. It emphasizes the learning process of 'cognitive reorganization' to make a concept meaningful.

3. Supervised Learning

Supervised learning events are characterized by a substantial amount of teacher/agent help. In this kind of learning event, the learners undertake various tasks with the help of a mentor. Help can take the form of direction intervention to scaffolding to learning hints.

While complex tasks form the bulk of supervised learning events, supervised learning events need not be fully characterized by the nature of complexity. Tasks/theories that are ambiguous, subjective or open-ended in nature can also benefit from having a mentor's supervision. The structure of supervised learning events will vary depending on the type and intensity of supervision being employed.

It is important to note that this type of learning event should only be used when needed, so as not to make the learners over reliant on the mentors' help.

Performance Learning Events

The performance learning events, in contrast to educational learning events, take a more practical approach to learning and typically cover handy skills that are required to perform specific tasks. It moves from the concept of the learner as a student to one of the learner as a professional who needs to gain and apply the knowledge so as to contribute to his field. Such learning modes usually rely on authentic and diverse real life problem-based examples. It focuses on helping the students to link and interconnect their learning. Opportunities are provided by such events to break away from the compartmentalization of knowledge and skills and to help students to construct a better network of knowledge and skills. Furthermore, such learning events are an authentic form of learning that prepares students for the increasing demands of the workplace (Kwok & Tan, 2004).

Performance learning events, when used in a corporate context, is like on-demand training (the latest trend in e-learning). Companies using e-learning technologies have found that long lectures do not cut it online. Short, targeted learning segments with simulation or how-to scenarios let employees take classes when they have time or when they need the help. It is far less disruptive than taking week-long seminars. When the learning events are housed in an academic context, it is similar to project-based learning which is action-oriented and focuses on doing something

rather than learning about something (Moursund, 1999). However, project-based learning while important has many practical issues (i.e. too much work to prepare, difficult to assess, learning outcomes undetermined, difficult to assess if learning takes place, no in-process feedback, cannot monitor and facilitate progress, etc.) that cause great difficulties in realizing the goals of project-based learning (Kwok & Tan, 2004). Hence, we feel that the coverage of project-based learning is too broad and undefined. We advocated that through the proper classification of such project-based learning into performance learning events, we can divide and simplify the complex cognitive and meta-cognitive process while maintaining the learning outcome. Also, through the usage of computing resources, many taxing (preparation works, grading of reports, progress tracking and monitoring of students) and ambiguous tasks (assessment criteria, learning outcome formulation) can be programmed.

1. **Guideline**

   Guideline learning events are characterized by learning events that are generally more process and procedure oriented. It typically teaches a flow of events that describe how something works. This set of guidelines is applicable in all scenarios and minimum or no interpretation on the part of the learner is required. Although the tasks undertaken are the same, learners have to been trained to understand what and why such actions are undertaken and how to apply troubleshooting techniques.

   The most difficult aspect of such learning events is to generate interest in the learner because such learning events are typically less intellectually stimulating.

2. **Reference**

   A reference learning event is one that is similar to the guideline learning event. However, as opposed to the guideline learning event where the process or procedure can be replicated in all situations, a reference learning event is one that requires sound judgment on the part of the learner. While a reference learning event contains the necessary information on a particular problem domain, some discretion must be exercised when devising a solution to the problem.

3. **Troubleshooting**

   A troubleshooting learning event is the most common type of informal learning where the learning event consists of a set of questions representing common problems. Instead of presenting the theory underlying the problems, the set of possible actions to the problem is presented in a form of a decision matrix. The possible scenario that will occur as a result of the action selection will be presented. From the set of actions taken, the learner is indirectly revealing his understanding of the problem. Thus, this type of learning event is an effective way of identifying the learner's mistakes and wrong understanding about certain concepts.

Scaffolding Framework

Scaffolding is touted as one effective instructional means to escalate one's understanding from a novice viewpoint to that of an expert. Scaffolding instruction as a teaching strategy originates from Lev Vygotsky's sociocultural theory and his concept of the Zone of Proximal Development (ZPD). The zone of proximal development is the Vygotskian concept that defines development as the space between the child's level of independent performance and the child's level of maximally assisted performance (Vygotsky, 1978; Bodrova & Leong, 1996). This concept of ZPD was later broadened by contemporary Vygotskian scholars to serve as a general metaphor for human development in a sociocultural context (e.g. Newman & Holzman, 1993).

The term "scaffolding" was coined by Burner (Wood, Burner & Ross, 1976) to specify the types of assistances that make it possible for learners to function at higher level of their zones of

proximal development. The term is often used to describe how an expert can facilitate the learner's transition from assisted to independent performance (Berk & Winsler, 1995; Meyer, 1993). With adequate support, this novice to expert transformation (Quitana, 2004) can enable the student to create meaningful inferences from seemingly unrelated raw data. Following the guidance of the more knowledgeable expert, the student will become competent with academic tasks that are initially beyond their ability (Palincsar, 1998; Wood, Bruner, & Ross, 1976). The more knowledgeable expert can also successfully diagnose the complex needs of students at various stages of the intended learning and employ proper instructional strategies adaptively to their progress (Tabak, 2004).

Scaffolding differs from other types of instructional strategies through the key characteristics of fading and student support.

Fading refers to the gradual reduction of support by the more knowledgeable agent in successful tutor-tutee (Wood et al., 1976), mother-child (Wertsch & Stone, 1985), teacher-student (Fleer, 1992; Flick, 2000) or expert-apprentice relationships (Brown et al., 1989). Scaffolding-minded learning meddling can incorporate fading either as an implicit part of student's learning or as an explicit part of an active intervention strategy. While fading is an important aspect of scaffolding, the detailed mechanisms of fading in the scaffolding framework are not clearly understood (Stone, 1998).

Besides the basic teaching advantages that scaffolding brings, the unique characteristics of e-learning requires scaffolding teaching strategy to be selected as one essential component of e-learning pedagogy because of the following reasons:

1. Scaffolding can provide individualized support based on the learner's ZPD (Chang, Sung & Chen, 2002). Individualized or personalized support is of utmost importance to e-learning and has been documented in our previous works on learning personalization and its importance (Teo & Gay, 2004a; 2005a; 2005b).
2. The scaffolds enable the facilitation of a student's ability to build upon prior knowledge and to internalize new information (Van Der Stuyf, 2002). Prior knowledge activation has been highlighted in the earlier section (4-Ts of a learning session) as one of essential e-learning methods.
3. Fading can mimic the process of teacher-student interactivity. This is important because in traditional learning environment, the teacher is in constant communication with the students and thus, is sensitive to the progress of individual student. Hence, the teacher, equipped with ample knowledge of the student, can select the most effective fading mechanism for guiding different students to complete complex reasoning tasks. However, when learning is housed in an e-learning context, the luxury of face-to-face communication and real-time teacher-student assessment is no longer available. In the absence of teacher-student interactivity, it is important to address complex reasoning tasks early and incorporate this into the instructional design.
4. The scaffolds that usually consist of models, cues, prompts, hints, partial solutions, think-aloud modeling, and direct instruction (Hartman, 2002) can be easily programmed and delivered over the network.
5. Noting Vygotsky's view that learner does not learn in isolation (in fact, learning is strongly influenced by social interactions which take place in meaningful context) and the ironic fact that the 'distance aspect' of e-learning while transcending the boundaries of traditional learning, has minimized (or even eliminated) social interaction, scaffolded instructions, by its nature, can be designed to overcome this gap (Ngeow & Yoon, 2001).

6. Scaffolding inherent disadvantages (i.e. time consuming to develop supports and scaffolded lessons to meet the needs of individual, most teachers not properly trained to implement scaffolding instructions, most teachers are not trained or comfortable to give up some of their control and allow the students to make errors and traditional teacher's education does not teach scaffolding as a teaching strategy) as pointed out in (Van Der Stuyf, 2002) can be easily solved through the usage of e-learning technology. For example, once characteristic of e-learning material is reusability. The scaffolds can be developed once and reused or repurposed many times. Hence, the scaffolding development process can no longer be considered time–consuming as the return in investment (ROI) is manifold. Also, the teacher's inexperience and reluctance to build scaffolds can be minimized or even solved through the semi-automation of the development process and the incorporation of a scaffolding guide.

Hence, in view of the numerous advantages that scaffolding can bring to e-learning, this research proposes an instructional design approach to investigate a fading approach that enables the curricular materials to fade scaffolds systematically based on the diagnosis of student progress.

Scaffolding Principles:

Scaffolding principles that originate from (McKenzie, 1999) are modified to suit the e-learning context. Also, some activities and tasks proposed by (Ellis et al., no date) have been incorporated into the scaffolding framework.

- Begin with what the students can do

  It is important to start the course with something that the learner can associate with. Activation of one's prior knowledge is one excellent introduction to the lesson as it allows the learner to be aware of his strengths and to feel good about what he can achieve without help.

- **Clarify learners' current knowledge point**

  This invites learners to clarify where they are in terms of new concepts they desire to master. This is used in combination with the "begin with what the students can do" principle to set the stage for scaffolding.

- **Begin with small, simple granular tasks**

  Small, simple granular tasks should be used at the beginning of the course. Although the learner needs challenging work in order to learn, frustration and loss of focus will set in when s/he experiences a constant cycle of failure. Hence, it is important for the learner to experience constant success and a sense of fulfillment and confidence before s/he embarks on larger, more complex and challenging tasks. As the learners' mastery increased, the granularity and complexity of the tasks should increase progressively.

- **Frequent Assessment**

  It is important to know when is the time to stop. Scaffolding is important to help the learner perform certain tasks but too much might impede learning and create over-reliance. In a traditional learning environment, the teachers needs to watch for clues from the student that show when and how much teacher's assistance is needed. In the context of e-learning, frequent assessment of the learner's progress is used in place of the teacher's judgment. Scaffolding support needs to be removed gradually as the learner demonstrates mastery. Support will be totally removed when the learner is able to perform the tasks independently.

- **Engagement of student with his learning**

  The learner will become more motivated and invested in the learning progress when he is able to dictate and plan his instructional goals and learning route. To help the learner monitor his own progress, the teacher must assign constant checkpoint and guidelines such that the system can automatically summarize the learner's progress and explicitly note and record behaviors that contributed to the learner's success or failure.

- **Use scaffolding only when appropriate**

  Not all tasks, be it complex or large, need to be scaffolded. Llearners learn differently, hence, not all the learners need scaffolding. A survey of learning needs and preferences should be conducted.

- **Practice generating more than one possible prompt**

  The first prompt or hint that the learner received may fail. Therefore, more than one prompt or hint using different methods or cues is needed to generate the appropriate response. Typical tailored assistance includes cueing, prompting, questioning, modeling, explicit message box, mandatory discussion and request clarification. The teacher must devise teaching methods and plans to 'advise' the agent when to use them and how to adjust them to meet the learner's needs.

Justification of Scaffolding Assessment Level Category:

1. **Support /Coverage**

   This is inline with the scaffolding principles of fading.

2. **Direction (Grouping)**

   Grouping of learners as the scaffolds reduce is of utmost importance as an essential element of scaffolding is that the participants must be in social interaction whereby they negotiate or compromise by constantly striving for a shared view of the situation (Berk & Winsler, 1995). Following the use of teacher provided scaffolds (level 1), level 2 introduces the usage of grouping to allow the students to ask and answer questions. In this type of learning environment, students help students in a small group setting but still have some teacher assistance. This is an essential step in the process of decreasing the scaffolds provided by the teacher and is needed by the students (Hartman, 2002). Lastly, level 3 removes the group / peer support to let the student assumes full control and the problem-solving capabilities, knowledge and responsibility can be said to be transferred from the teacher to the self (Berk & Winsler, 1995).

3. **Granularity**

   Supply learners with appropriate learning materials. In *starting small*, teachers relate how 'calling it as they see it' was very effective (Kearn, 2000).

Table 6

Scaffolding Framework

Goals	Tasks	Reasons
Curriculum Considerations	1. Learning Curriculum Goals 2. Context	The teacher must first identify the curriculum goals and select the context in which the learning concept resides. S/He must be knowledgeable of the content and be sensitive to the learners (e.g. aware of the learners' background knowledge and misconceptions) to determine if they are making progress.
Learner Considerations	1. Needs Analysis 2. Knowledge Gap Analysis i. Identify the students' current knowledge point ii. Identify the students' target knowledge point iii. Identify the necessary teaching materials to move the learner from his current knowledge point to the target knowledge point	The teachers must identify the learners' needs in order to effectively plan the teaching routes and methods. This is an essential step to cater to the learner-centric aspects of e-learning. Learner consideration is an important element in the pre-engagement process that links the students with the curriculum. The pre-engagement process aims to establish a shared goal between the teachers and the students so that appropriate teaching plans can be selected to suit the students. It is through this shared goal between the teacher and the student that the student will become more motivated and invested in the learning process (and hence reduce the drop-out rates). The process of needs analysis aims to conceptualize the learner's goals and their immediate learning needs. Ideally, this process assumes that the profile of the learner is available at curriculum design time and the teacher is able to work with the student to plan the instructional goals and materials. However, in the context of e-learning, the distance aspect and the learning on the fly mentality makes the needs analysis difficult or even impossible. Even with the advancement of the networking technology, the exact profile of the learners who are going to take this course can never be established. Hence, this needs analysis is actually conducted based on the nature of the course offered and the feedbacks that are received based on similar courses. For example, if a course on "Web Service" is to be designed, the needs analysis will be centered on the context whereby such courses will be held in (i.e. info-communication context audience). Based on similar courses held in that domain (i.e. software engineering), the learners' profile and their feedbacks will be analyzed to identify and estimate the learning needs for that particular group of learners. Once learning needs are identified, the teacher must assess the knowledge gap. The gap analysis has three phases. Phase one identifies the learner's current knowledge point. Without a profile of the 'real' learner, this phase relies on the teacher's past experience when conducting such courses. S/he will have to assess what the learner is currently able to do without help. Basically, the pre-requisites are a good indication of the learners' current ability and can be used an effective starting point. Next, the teacher will identify the desired performance of the students (that is, the goal of the student which is identified in step 1). Lastly, the teacher will analyze what is to be achieved to move the learner from the current knowledge point to his desired knowledge point. This analysis will form the core of the next step.
Scaffolding Design	1. Scaffolding Path 2. Fading Design Tasks 3. Scaffolding level assessment	The scaffolding path reestablishes the starting and the finishing point of the scaffolding design. The starting point is the learners' current knowledge point and the finishing point is the learners' target knowledge point. The fading design will be classified into three stages: First, the teacher does it, second, the group or peer does it, and then lastly, the learner does it. (See scaffolding assessment level table for details) **Stage I: Teacher-directed learning** This stage is the teacher-directed phase where the level of support used is the greatest. Most of the learning content will be covered in details and explicit links to concepts and references will be provided. Learning process is step-though and the teacher will model how to perform entirely new or difficult tasks. **Stage II: Group / Peer-directed learning** This stage is the group / peer-directed phase where level of support is reduced. Only about half of the major learning concepts will be covered in details as this phase relies on induced inference. This is semi-guided learning in the sense that help will not be as spontaneous as in stage I and teacher support will be asynchronous. However, there will be aids and implicit hints to new or difficult concepts and tasks to simulate the cooperation between the teacher and learner to perform the tasks together. **Stage III: Learner-directed learning** This stage is the learner-directed phase where level of support is negligible. That is, the learner is no longer dependent on the teacher's extrinsic signals to begin or complete a task. Only key learning concepts will be covered in details as this stage emphasizes on intellectual prediction, concept synthesis and reflection. While this is an independent practice stage where the individual learner can demonstrate their task mastery, this is still practice and not assessment. Hence, necessary aids will be provided if the learner needs it.

Table 7

Scaffolding Assessment Level

	Level 1	Level 2	Level 3
Support	Full support	Moderate support	Minimal support
Direction	Teacher-centric	Group/Peer-centric	Self-centric
Coverage	> 70% Major Concepts	40~70% Major Concepts	< 40 % Major Concepts
Granularity	Small (Problem-based)	Moderate (Case-based)	Large (Scenario-based)
Assessment	Frequent (weekly)	Less Frequent (monthly)	Minimal (quarterly)
Discussion	Scheduled: 1. Mandatory group feedback 2. Mandatory peer feedback 3. Discussion boards 4. Forums 5. Emails	Unscheduled: 1. Mandatory peer feedback 2. Discussion boards 3. Forums 4. Emails	Unscheduled: 1. Discussion boards 2. Forums 3. Emails
Tutor's Aid	Synchronous/Asynchronous e.g. 1. Q&A sessions 2. Discussion boards 3. Forums 4. Emails	Asynchronous e.g. 1. Discussion boards 2. Forums 3. Emails	Asynchronous e.g. 1. Emails
Task Support	1. Provide explicit links to concepts 2. All references provided 3. Guided learning 4. Step through process	1. Induce inference building 2. Implicit hints to relevant concepts 3. Semi-guided learning	1. Intellectual Prediction 2. Concept reflection 3. Concept synthesis

Conclusion

In this paper, a practical, novel content development methodology for crafting and assembling of e-learning content is presented. In contrast to most e-learning content assembling systems that is centered on the 'technical aspects' (delivery and presentation of learning resources) and treats students as the object of curriculum implementation, the proposed methodology is based on the science of teaching to incorporate the correct use of teaching strategies. Through incorporation of such pedagogy considerations early in the content design, it is advocated that such enhanced content should have a positive effect on the learner's motivation and learning performance.

Existing research work is extending content development methodology to include the concept of metacognition. The term metacognition refers to a body of knowledge that reflects on knowledge itself. It's concept of creating awareness of mental processes and strategies is similar to the proposed prior knowledge activation (as discussed under the training aspect of the 4-Ts). However, initial research shows that the concept of metacognition is able to provide new insights into the domain of cognitive functioning and has caused researchers' and academics' conceptualization of pedagogy to changed in tandem to their understanding of cognition and meta-cognition (Watkins and Mortimore; 1999). Hence, research into its relevancy and possible inclusion to the field of e-learning will be conducted.

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Editor's Note: This is a detailed and exacting study of display factors that influence learning from a computer screen. This data has value for instructional designers since the results differ from Eastman Kodak's data for visual projection and the Ford Foundation specifications for television viewing. It also incorporates research on complexity and aesthetic values.

Web-Based Distance Learning Technology: Interface Design Variables and their Effects

Cristina Pomales-García and Yili Liu
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Abstract

This research measured simplicity, visual attractiveness, organization, clarity, and excitement factors in a Web-based distance learning (WBDL) environment where multimedia such as audio, video, figures and text were displayed simultaneously on the computer screen. Thirty-three simulated Web-based instructional modules with different interface design characteristics (information delivery modality, color of text and figures, and slide text font size) were evaluated through a controlled experimental study. The results showed that Web modules with instructor video, use of color words in slides with text, and text font size 14 had higher ratings of simplicity, visual attractiveness, organization, clarity, and excitement. This study provides empirical evidence to support the importance of appearance in the design of WBDL environments and demonstrates that guidelines in screen design could be applied to WBDL design.

Keywords: Web-based distance learning environment, distance learning screen design, user preferences, aesthetics, multimedia, Web-based instructional modules

Introduction

Web-based distance learning (WBDL) technology is playing a more and more important role in education, and it is important to understand how interface design variables such as screen layout and organization may affect the appearance and usability of the WBDL technologies. Stewart, Hong, and Strudler (2004) found appearance and structure of Web-pages to be an important factor related to the quality of Web-based instruction. Zhang and von Dran (2000) considered layout as a visual attractiveness factor that enhances user satisfaction. Other researchers have also emphasized the role of layout in design.

Layout is a publication design term used to refer to the planned visual arrangement of text elements on a page or screen (Grabinger 1989). Brink, Gergle and Wood (in Darlington 2005) proposed a set of guidelines for page layout design, including consistency, simplicity, focus, use of metaphors and functional stability. Tullis (1983) suggested that the most desirable screen features are simplicity, clarity and understandability. A visually pleasing composition or design aesthetic is defined as attractive to the eye, drawing attention subliminally, conveying a message clearly and quickly; and simplicity is defined as a combination of elements that results in ease in comprehending the meaning of a pattern.

Grabinger and Amadeo (1988) conducted an experiment in which 31 participants sorted a sample of text types according to their "study-ability"—the ease with which text in cathode ray tubes (CRT) displays could be read and studied—to understand which design variables are related to the comprehensibility of text. The results showed the advantage of arranging test materials in ways that support perceptions of structure, simplicity and organization. In this study, structure was described by text designs that indicate a hierarchical and systematic arrangement of subject material with isolated headings, spaced paragraphs and directive cues (underline, italics, and bold

type). Simplicity was described by designs with presenting narrow text (45 characters), with double spacing and organized paragraphs. Organization was described as text with a block scheme, and including a heading at the top of the page. The authors suggest that these factors contributed to a feeling of ease, spaciousness and simple manageable text.

Ngo (2001) developed a mathematical model to describe thirteen different spatial properties of a multi-screen interface and determine how these different properties relate to the aesthetic value of a screen. One of these properties is simplicity, which is defined as the extent to which component parts are minimized and the relationships between the parts are simplified. Bauerly and Liu (2003, 2006) conducted computational modeling and experimental evaluation work on quantifying the effects of number of components, grouping, symmetry, and balance on interface aesthetics. The concept of minimizing the components of a screen is similar to several other related ideas including Tullis' (1983) idea of counting the total number of fields in a screen and choosing screens with minimal number of fields, Grabinger and Amadeo's (1988) feeling of "spaciousness", Brink, et al. (in Darlington 2005, 49) "keeping the page structure simple and uncluttered", and Nielsen's (2000) use of white space to guide the eye and help users understand the grouping of information. Nielsen (2000) suggests that content should account for at least half of a page's design, and preferably closer to 80 percent. When designing Web pages some general design guidelines should be followed, including using meaningful headings, bulleted lists to break the flow of uniform text blocks, and highlighting and emphasis (color text and underline) to make important words catch the user's eye.

Grouping or organization is another important factor in screen design. Grabinger and Amadeo (1988) found "organization" to be one of the group perceptions. With respect to design, line borders can greatly enhance groupings of information and direct the viewer's eyes in the required direction of information scanning. Thacker (in Galitz, 1993) found that displayed information with a border around it was reported to be easier to read, better in appearance and preferable.

A series of experiments by Champness and De Alberdi (1981) were designed to uncover the main factors of judgment people use when they evaluate teletext pages, assess the extent to which slide presentation of pages produces similar responses as presentation by TV, and assess the effect of specific designs of pages on users' subjective reactions. Participants sat in front of a TV screen and were presented with a succession of teletext pages. They were given memory tests after seeing pages for a fixed length of time and asked to rate further pages on seven-point rating scales. Results showed that attractiveness, clarity and usefulness were the three main factors of user reaction. The researchers found that these factors were stable across both situations and methods of presentation. Both individual scales and factors were extremely sensitive to changes in page design, in a meaningful and useful way. The authors conclude that the way information is presented on a page does not just affect how pleasing it is to the eye but it also affects the time to read it. They suggest that paragraphing or segmenting text along with underlining, color and bullets to provide emphasis are important to improve ease of reading.

Web-based modules used in distance education include many different formats and media. For text presentation, it is recommended to include no more than 40-60 characters on each line, to separate paragraphs by at least one blank line, and emphasize important things by bold typefaces. According to Galitz (1993) using bold to emphasize important things makes the screen more interesting. When creating text in PowerPoint it is recommended to consider the distance between the display and the student and use font size between 24 and 36 to increase legibility. This creates a problem because material used for a regular face-to-face class using font sizes larger than 24 might be larger than needed in Web-based modules. Grabinger and Amadeo (1988) also found that simplicity was described by designs with narrow text (45 characters). Based on this idea, in our study we expect to find designs with font size that averages 40-60 characters per line to be more appealing, simpler and exciting than designs with larger font sizes.

Purpose

The research literature, as reviewed above, suggests that several factors or aspects of design should be taken into consideration when designing Web screens. These factors include simplicity, visual attractiveness, organization, clarity, and excitement. Previous studies have measured these factors in screen displays, teletext, and TV environments. Our study measured these factors in a Web-based educational environment where multimedia such as audio, video were displayed simultaneously with figures and text on the computer screen. The purpose of this study was to conduct a controlled experimental study to evaluate and systematically measure perceived ratings for these factors based on different Web module design characteristics (information delivery modality, color of text and figures, and slide text font size). This study will provide empirical evidence to support the importance of appearance in design of WBDL environments and understand how guidelines in screen design and multimedia could be applied to the design of WBDL environments. In this paper, the following questions are addressed:

1. What is the relationship between interface design features (color, font size and information delivery modality) and ratings for each factor?
2. Does the principle of simplicity-complexity apply to WBDL modules? What is the relationship between number of fields in a screen and ratings of simplicity-complexity in a WBDL module?

Based on the literature review, we expect to find the following results:

1. Modules with text modality and small font have a larger number of fields, and will therefore be perceived as more complex and generate lower simplicity ratings using magnitude estimation ratio scale.
2. Modules with an average of 40-60 characters per line will be considered to be more appealing, clear and organized than designs with less number of characters per line.

Experimental Methods

Participants

Sixteen engineering students between the ages of 18-22 years participated voluntarily in the experiment (8 females and 8 males). All students were enrolled undergraduate students at the University of Michigan, College of Engineering, in Ann Arbor. Participants were paid $15 each for 1.5 hours of their time.

Web Modules

Thirty four images, simulating WBDL modules, were created using PowerPoint. These images were created with different information delivery modalities, color of text and figures in the course slides, and slide text font size. Two types of similar layouts were designed based on the information delivery modality variable. Information delivery modality corresponds to the use of video, audio only or transcription text of the course material, displayed on the left side of the screen. Figure 1 shows the general layout within a Web module and how the module layout changes with the different types of information delivery modality. In Figure 1, **A** indicates the area of the display with video and audio with player controls. **C** is the area with the table of contents for modules with video or audio, **D** corresponds to the area where transcription of course audio appears when there is no audio or video, and **B** is the location of the course slides or material, which are PowerPoint slides.

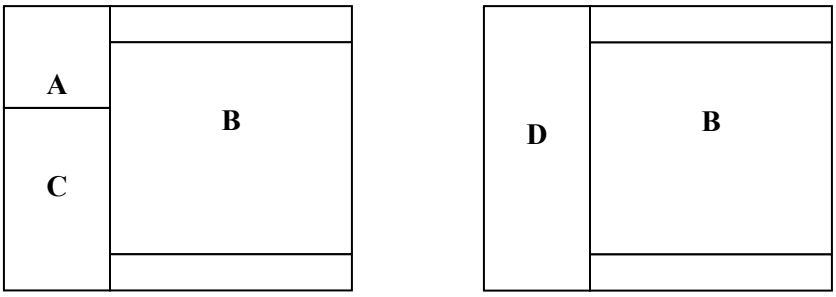

Figure 1. Basic structure of Web module screen layout.

Information delivery modality was represented in the Web module in one of three different ways: (1) a color picture and audio player controls simulating a course lecture with video and audio; (3) audio player controls to simulate modules with course audio only, or (3) a text transcription of the course audio. Figures 2 shows three examples of simulated Web modules used in the experiment with the three different information delivery modalities. All examples include standard headings and different slide content (right side of module) with either figures (Figure 2(a)) or text (Figure 2(b)-(c)). Course material was simulated using either slides with text or figures. In modules where slides with text was used, the text was organized in bullets, with the text either in all black fonts or with selected words in color or bold font. The words in color were not bold. Slides with figures were represented by a graph in either grayscale or color, using the same set of colors used for color text. Color used for the slides were, red (HEX code #0000CC), green (HEX code #000080), and blue (HEX code #3333FF). In modules with text on the slides, only one color was used per bullet if there were more than one highlighted word. Font size in bulleted text was either small (14-point), medium (16-point) or large (18-point) using a sans-serif Arial font.

A total of 34 original images (test stimuli) were designed using all combinations of design variables. The “modality*figure” combination (a 3x2 design) produced 6 different module combinations, and the “modality*text color*font size” combination (a 3x3x3 design) produced 27 modules. An additional benchmark image was created using audio modality and a slide with text in block format, no bullets, and left justified. As described below, the benchmark image was used solely as the baseline for generating subjective ratings on other images.

Experimental Procedure

The experiment was conducted in a well-lit (approximately 21 footcandles) laboratory. As shown in Figure 3, participants sat at a desk facing two 17-inch LCD monitors at 1024 x 768 pixel resolution. Power Point was used to display the simulated WBDL modules, one at a time in slide-show or full screen mode.

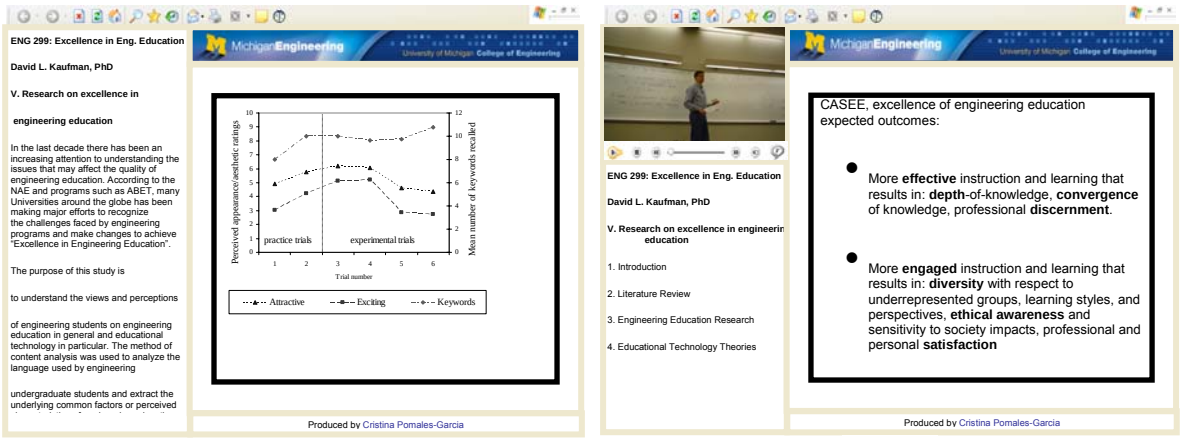

Figure 2. Examples of simulated Web-modules with different information delivery modalities: (a) text, (b) video, and (c) audio. All images include standard headings and sample slides (right side of module) with either figures (a) or text (b and c).

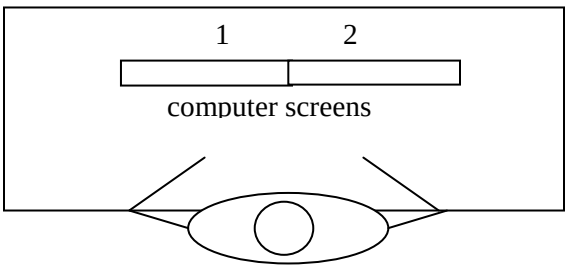

Figure 3. Location of computer screens with respect to participant.

Data was collected by manually recording verbal responses to standard questions about each image. Each participant was instructed avoid thinking too much about their responses, and to take into account the different types of information delivery modality (audio, video or text) while disregarding the content or topic of the slides. He or she was asked to compare each of the 34 simulated modules to the benchmark module on different perceptual factors. In this process the

participants also compared the baseline to itself although the results for this rating were not included in the results. Their task was to rate each design using the method of ratio-scale magnitude estimation. At all times the benchmark image (baseline magnitude rating of 10) was presented to the left (Screen #1) of the test image (Screen #2). The set of questions asked participants the following: "The module on your left contains the same material as the module on your right and it represents a _____ (factor) rating of 10. How much more _____ (adjective) is the Web module shown in the computer screen on the right?" Table 1 lists the different factors and corresponding adjectives used to complete the blanks for the set of questions. All simulated Web modules were rated on one factor at a time until all 34 modules were rated for each of the 5 factors. The order in which the factors were presented was randomized between participants.

Table 1

Factors used by participants to rate the simulated Web-modules

Factor	Adjective
Simplicity	Simple
Organization	Organized
Visual/aesthetical attractiveness	Aesthetically appealing
Excitement	Exciting/interesting
Clarity	Clear

Data Analysis Methods

A mixed model within-subject ANOVA was used to analyze the data. The nature of the experimental design allowed the data to be restructured into different models. The dependent measures were perceived ratings for the different factors (clarity, simplicity, organization, attractiveness and excitement), using ratio-scale magnitude estimation. The independent variables were slide content (figure and text), slide content color (black, color and bold), slide text font size (small, medium and large), and information presentation modality (audio only, video with audio, and text). Model 1 was designed to study the effects of modality, slide content color and size on modules with text on the slides only (3x3x3 design). Model 2 examined the effects of modality and slide content color on modules with figures on the slides (3x2 design). Model 3 was designed to study the effects of modality, and slide content color on modules with text and figures on the slides (called slide content variable) (3x2x2 design). In both models 2 and 3, the variable representing slide content color had only two levels as figures were only designed in grayscale or color, and the bold variable was eliminated. Also in these two models font size was not considered in the analysis. SAS 9.1 software was used as the data analysis tool.

To compare the measured simplicity ratings with the complexity of the design, Tullis (1983) measure of screen complexity was incorporated. This technique was originally used to measure text screens and we have adopted it for more complex displays with text and images. Measuring complexity involves the following three steps: (1) draw a rectangle around each field on the screen, including captions, data, title, etc. and count each one as a general field; (2) count the number of columns in which a field, inscribed by a rectangle, starts (horizontal fields); (3) count the number of rows in which a field, inscribed by a rectangle, starts (vertical fields). To compute the total number of fields the results of these three steps are added together. Figure 4 shows a simplified Web module (similar to the modules used in this experiment but with reduced number of lines with text) with the rectangles around each field.

In our study the navigation bar, the upper and lower banner by the slide area, and the audio player controls are considered "fields" as they are inscribed by rectangles. Based on the characteristics of Figure 4 there are 21 general fields, 18 horizontal fields and 5 vertical fields, for a total overall complexity value of 44.

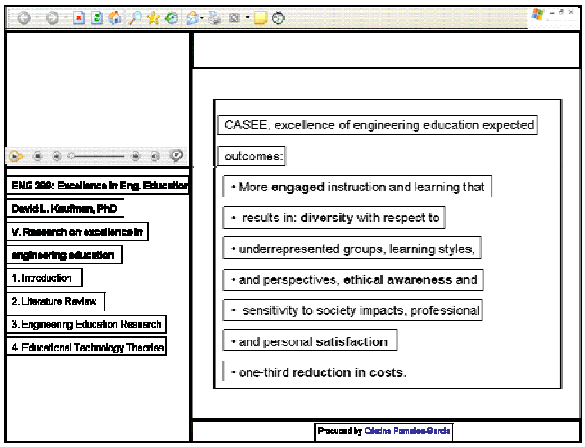

Figure 4. Sample Web module with identified fields (rectangles) used in complexity calculation

Results

The results of the within-subject ANOVAs for the different models and measured factors are shown in Tables 2 thru 7. As mentioned in the method section, model 1 represents the analysis for modules with text on slides, model 2 is for modules with figures on slides and model 3 corresponds to the analysis of modules with text or figures on the slides. Result tables show only the main effects of modality, color, size, and slide content (figures or text) as there were no significant 2-way interactions between the independent variables.

Perceived clarity

Analysis of the results for clarity ratings (Table 2) showed significant differences between information delivery modality, color and font size (only modules with text). To better understand which of these variables were different from each other a paired t-test using Bonferroni adjustment was used.

Table 1

ANOVA results for perceived clarity

Effect	Model 1				Model 2				Model 3			
	Num DF	Den DF	F Value	Pr > F	Num DF	Den DF	F value	Pr > F	Num DF	Den DF	F value	Pr > F
Modality	2	30	40.73	<.0001	2	30	11.84	0.0002	2	30	10.70	0.0003
Color	2	30	19.17	<.0001	1	15	8.72	0.0099	1	15	11.74	0.0037
Slide content	N/A				N/A				1	15	0.00	0.9493
Size	2	30	21.29	<.0001					N/A			

For modules with text only (model 1) the three information presentation types (audio, video and text) were significantly different from each other, with video modality having higher clarity ratings. In modules where only figures were analyzed (model 2) or both text and figure modules were compared (model 3) on the perceived clarity ratings, modules with audio and video delivery modality were not significantly different from each other. On the other hand, video and audio modules were significantly different from text. Another important result was finding no significant difference in clarity ratings when comparing modules with text and figures. With respect to font size on modules with text only there was no significant difference between small and medium font size and black and bold text color.

Perceived organization

With respect to ratings of organization of the Web modules evaluated, all the modules showed significant differences in information delivery modality, color, size and slide content (Table 3). For the three models examined the three information delivery modalities were significantly different from each other according to the paired t-test using Bonferroni adjustment. In general video had higher ratings than audio, and audio had higher ratings than text delivery modality. Similar to the analysis of perceived clarity, in the ratings for perceived organization was no significant difference between small and medium font size and black and bold text color.

Table 2

ANOVA results for perceived organization

Effect	Model 1				Model 2				Model 3			
	Num DF	Den DF	F value	Pr > F	Num DF	Den DF	F value	Pr > F	Num DF	Den DF	F value	Pr > F
Modality	2	30	49.21	<.0001	2	30	23.06	<.0001	2	30	28.48	<.0001
Color	2	30	14.11	<.0001	1	15	14.87	0.0016	1	15	21.20	0.0003
Slide content	N/A				N/A				1	15	9.68	0.0071
Size	2	30	45.83	<.0001					N/A			

Perceived simplicity

The analysis of simplicity ratings (Table 4) showed significant differences in delivery modality across all the different models. For modules with only text on the slides there were significant differences in color and font size. The results for a paired t-test using Bonferroni adjustment showed that for modules with text only the three delivery modalities were significantly different from each other. For modules with figures only or modules that compared text and figure, simplicity ratings showed no difference between text and audio, and audio and video. The only delivery modalities that were considered to be significantly different from each other when analyzing modules with figures were those with text and video modality. With respect to color there was no significant difference in use of color on modules with figures only. This suggests that use of color does not make a figure complex or simpler, but might make it more organized and clear based on the results of other factors. Similar to clarity ratings, perceived simplicity ratings showed no significant difference in modules with text and figures (model 3) therefore these two variables in our study were considered to be equally clear and simple.

Table 3

ANOVA results for perceived simplicity

Effect	Model 1				Model 2				Model 3			
	Num DF	Den DF	F value	Pr > F	Num DF	Den DF	F value	Pr > F	Num DF	Den DF	F value	Pr > F
Modality	2	30	25.70	<.0001	2	30	4.77	0.0160	2	30	4.70	0.0168
Color	2	30	13.25	<.0001	1	15	2.29	0.1514	1	15	4.97	0.0415
Slide content	N/A				N/A				1	15	0.50	0.4906
Size	2	30	30.33	<.0001					N/a			

As expected, simplicity calculations for the simulated WBDL modules in this experiment (Table 5), show that as the number of fields increases the design is considered to have higher complexity (less simple). In our study, those modules, with an overall lower total number of fields (calculated) were the ones with higher (measured) simplicity ratings. Modules with video modality and figure in the slides had higher simplicity ratings as well as the lowest complexity calculations. Independent of the information delivery modality, the modules with the largest number of fields correspond to those with text in slides and font size 18, and these modules were given the lowest simplicity ratings. Complexity calculations based on Tullis' (1983) guidelines does not takes into account color in the display as color has no effect on the size or spacing of the text. Between the calculated and measured values, on average the text only slides with large font had the lowest simplicity ratings and highest complexity calculations. With respect to modules with audio and video modalities, the results were inconclusive as calculations were similar to each other and for font size, the measured values were not different between small and medium size text.

Table 4

Measured and calculated values for simplicity based on the design variables

Information Delivery Modality	Slide Content (text or figure)	Calculations (based on Tullis, 1983)				Mean Simplicity Measured Ratings (0-100)
		Fields	Vertical	Horizontal	Overall Total	
Text	Small	46	11	39	96	15
	Medium	49	11	40	100	14
	Large	50	11	41	102	11
	Figure	37	13	34	84	14
Audio	Small	30	10	25	65	16
	Medium	33	10	26	69	17
	Large	34	10	26	70	13
	Figure	21	12	19	52	17
Video	Small	31	10	25	66	18
	Medium	34	10	26	70	18
	Large	35	10	26	71	15
	Figure	22	12	19	53	19

Perceived attractiveness

Analysis of results for attractiveness ratings (Table 6) showed a significant difference in information delivery modality, color and font size in modules with text only (model 1), similar to other measured factors. Comparing modules with text and figures on the slides (model 3), there were significant differences in information modality, color and slide. The paired t-test with Bonferroni adjustment showed that for modules with text only (model 1) modules with text and audio modality had similar attractiveness ratings but when modules with figures only (model 2) were analyzed all delivery modalities were significantly different from each other. Comparing modules with text and figures on the slides for perceived attractiveness, ratings were higher for modules with figures (mean rating=20.4) than for modules with text on the slides (mean rating=16.9). Similar to simplicity ratings, there was no significant difference in color for modules with figures on the slides (model 2).

Table 5

ANOVA results for perceived attractiveness

Effect	Model 1				Model 2				Model 3			
	Num DF	Den DF	F value	Pr > F	Num DF	Den DF	F value	Pr > F	Num DF	Den DF	F value	Pr > F
Modality	2	30	50.16	<.0001	2	30	18.80	<.0001	2	30	29.99	<.0001
Color	2	30	16.39	<.0001	1	15	2.41	0.1415	1	15	13.44	0.0023
Slide content	N/A				N/A				1	15	22.17	0.0003
Size	2	30	12.63	0.0001					N/a			

Perceived excitement

The analysis of results for excitement ratings (Table 7) showed a significant difference in information delivery modality, color and font size in modules with text only (model 1). Comparing modules with text and figures on the slides (model 3), information modality, color and slide content were significantly different from each other. Using a paired t-test with Bonferroni adjustment to understand which of these variables were different from the results, it was observed that independent of the slide content there were no significant differences between text and audio delivery modalities. Similar to attractiveness ratings, when comparing modules with text and figures on the slides, mean ratings were higher for modules with figures (mean rating=18.2) than for modules with text on the slides (mean rating=15.7). Also, similar to simplicity and attractiveness ratings, there was no significant difference in color for modules with figures on the slides (model 2).

Table 6

ANOVA results for perceived excitement

Effect	Model 1				Model 2				Model 3			
	Num DF	Den DF	F value	Pr > F	Num DF	Den DF	F value	Pr > F	Num DF	Den DF	F value	Pr > F
Modality	2	30	52.27	<.0001	2	30	11.85	0.0002	2	30	17.72	<.0001
Color	2	30	17.34	<.0001	1	15	3.09	0.0992	1	15	10.71	0.0051
Slide content	N/A				N/A				1	15	9.75	0.0070
Size	2	30	9.75	0.0005					N/A			

Across the five measured factors, there were significant differences between delivery modality, color and size for the modules with text only (model 1). Similarly, the analysis for modules with figures only (model 2) show significant differences in delivery modality across the five measured factors. Different from modules with text only, for modules with figures only, there were significant differences in color for perceived clarity and organization factors. For both of these factors figures in color had higher mean ratings than figures in black and white (Figure 5). For the factors of perceived simplicity, attractiveness, and excitement there was no difference in using color or black and white figures.

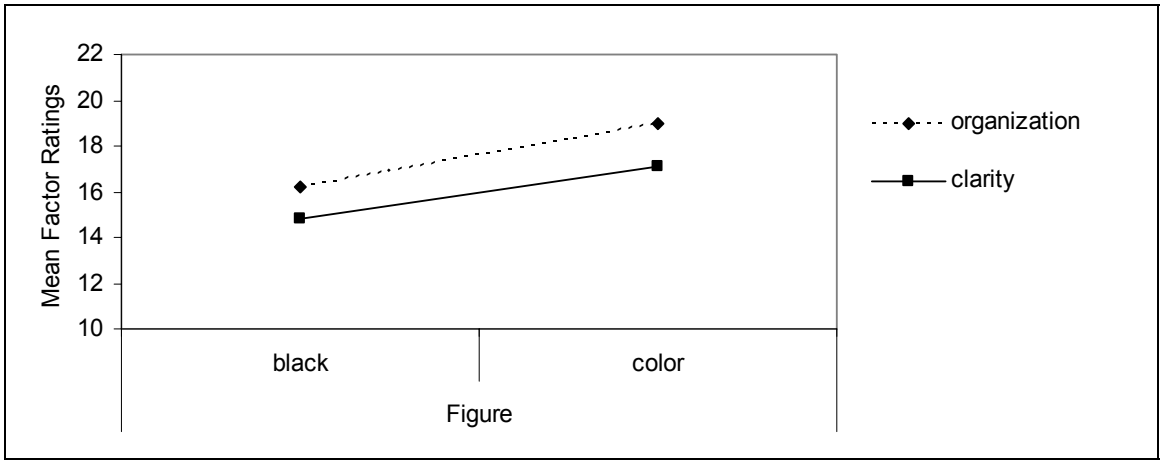

Figure 5. Mean ratings of figure color for perceived clarity and organization factors in modules with figures only.

When Web modules with both figures and text in the slides were analyzed (model 3), there were significant differences in delivery modality, color for all the measured factors. With respect to slide content only for perceived organization, attractiveness and excitement factors there were significant differences between slides content. The results suggest that with respect to simplicity and clarity presenting the information using text or figures makes no difference. But, ratings of organization, attractiveness and excitement (Figure 6) suggest that figures were preferred over text.

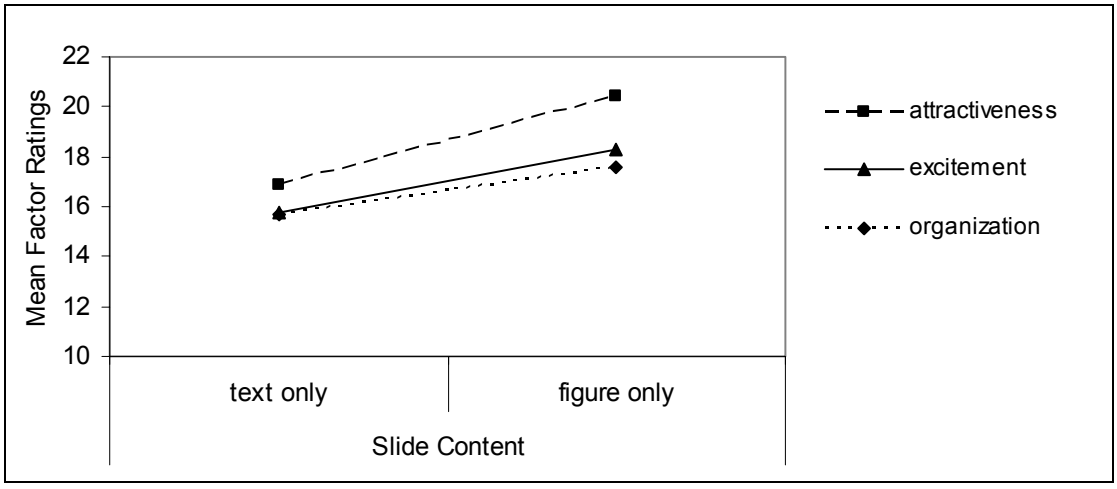

Figure 6. Mean ratings of modules with text and figures on the slides for perceived organization, attractiveness and excitement factors.

Figure 7 shows a summary of the results for independent variables tested in the study. The results for modality, color and font size were based on mean results for modules with text on the slides (model 1). The results for slide content show the differences in the ratings for the factors as reflected in the paired t-test, where there was no significant difference between simplicity and clarity ratings, but a significant difference between the ratings for perceived organization, attractiveness and excitement factors.

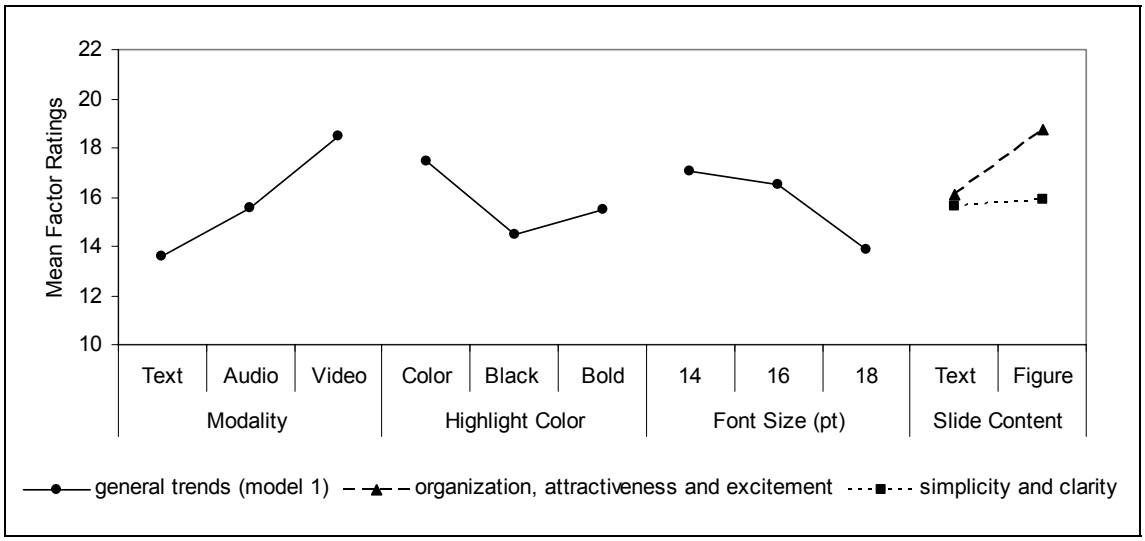

Figure 7. Summary of results for modality, slide content color, font size and slide content variables.

The text used in the slide content was the same for all WBDL modules, which included a total of 578 characters. The different font sizes studied changed the number of lines of text in each simulated slide. Table 8 shows the font size used in the WBDL modules, the number of measured lines with text and the average number of characters per line.

Table 7

Average number of characters per line based on measured number of lines and font size

Variable Name	Small	Medium	Large
Font size	14	16	18
Measured number of lines with text	12	15	16
Average number of characters per line (Total /Average number of characters)	48	38.5	36

According to the calculations shown in Table 8, the types of modules that fit the profile of 40-60 characters per line were those with small font size (Arial 14pt). Across the board, for the analysis of all each of the factors, there was a significance difference between font size for modules with text on the slides. Analyzing which one of the variables differ from each other showed that there was no significant difference between small and medium font size, and both 14 and 16pt font were different from 18pt font. In general, as shown in Figure 5., 9 designs with small (14pt) text

were rated as more attractive, clear, exciting, simple, and organized when compared to designs with larger font size.

Discussion

Usability is an important aspect of Web design and one of the goals of the usability principle is to incorporate the users into the design process. According to the literature clarity, organization, excitement, visual/aesthetical attractiveness, and simplicity are important design factors within Web environments. In the process of evaluating the display designs it is important to understand how the users perceive the factors that will be measured. Results for simplicity showed that with respect to color there was no significant difference in use of color on modules with figures only. The results of this study, suggests that use of color does not make a figure complex or simpler, attractive or exciting, but might make it more organized and clear based on the results of other factor ratings. According to the literature there are many definitions or aspects that represent simplicity, including font and spacing (Grabinger and Amadeo, 1988), bullets and color (Nielsen (2000), navigation and interaction (Darlington, 2005), comprehension and appearance (Galitz, 1993), and the amount of information on the display (Darlington, 2005; Galitz, 1993; Ngo, 2001; and Nielsen, 2000). In this study amount of information of the display was measured (complexity) and compared to ratings of simplicity but this measure of complexity does not takes directly into account variables like color, use of bullets, font and spacing, which might have been taken into consideration by our sample to rate Web module simplicity. On one hand the literature review suggested that different aspects are emphasized for every factor and not all of the factors are taken into account when evaluating design characteristics. Asking participants to define what characteristics of the design they focused on to rate each factor would give us more insight to understand the differences between student definitions and literature descriptions and develop a more unified, qualitative and quantitative description of each factor incorporating research and users perceptions.

According to the literature clarity of a screen refers to its information being clear and organized (Champness and De Alberdi, 1981). In our experiment with respect to slide content there was no difference in clarity and simplicity ratings for modules with figures or text on the slides. On one hand, this was a surprising finding as it contradicted the literature on clarity as using figures and text are two different ways of organizing information, and based on simplicity literature it is best to have less amount of information. On the other hand the results then suggest that the characteristics used to design both types of slide contents (bulleted text and figures with no text) presented the information in a similarly clear and organized manner with “plain” displays.

With respect to perceived excitement and attractiveness, the results suggest that they are both important factors to consider. As mentioned in the literature attractiveness and excitement are important variables to consider as they impact student motivation and retention. In general, for Web modules with text only there was no difference in attractiveness and excitement between text and audio modalities. For modules with figures only still text and audio modality had similar excitement ratings, on the contrary, attractiveness ratings showed that all delivery modalities were significantly different from each other. Using then video modality in Web-based courses makes the modules more exciting, clear, organized, simple and attractive (Pomales and Liu, 2006).

Based only on font size it was surprising to find font size 14 to be preferred over larger font sizes (16 or 18) as many guidelines suggest that the larger the font size (between 24 and 36) the better. On the other hand, text with font size 14 had the highest average number of characters per line which corresponds to higher ratings of organization, clarity and appeal. The results of this study suggest that characters per line or font size on their own are not as valuable as taking both into consideration. Similar to screen design evaluations, simplicity-complexity measurements can be used to evaluate WBDL environments where multimedia is incorporated.

This study offers a quantitative way of measuring the perceptions of clarity, simplicity, organization, attractiveness, and excitement factors of WBDL modules using a controlled experimental procedure and an easy process to gain more insights into the design characteristics. Future studies should incorporate other design characteristics and different formats of slide content as well as explore the perceived importance of different factors in the design of Web-based environments. This study gave us a clear idea on how design characteristics impact a small group of perceived factor ratings. In the future other design factors should be evaluated and rated.

Based on the results of this study and overall higher ratings across all factors we would recommend Web modules to include instructor video, use of color words in slides with text, and text font size 14. These recommendations are based on the results for the sample population of undergraduate engineering students. Further studies need to be done to test if these recommendations apply to different samples (older adults and students in fields other than engineering). Through this study we have provided empirical evidence to support the importance of appearance in the design of WBDL environments and results to show that guidelines in screen design and multimedia could be applied to the design of WBDL environments.

The study reported in this paper is a significant extension of the study by Pomales and Liu (2006) because the slide content in a WBDL module is controlled. These two studies in a row further demonstrate the importance of considering the effects of interface design features on the usability and aesthetic ratings of WBDL modules.

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Editor's Note: This paper is an assessment how students value of different learning media. This data is useful to determine pedagogy and instructional design. The research introduces terms that apply to broadcast media in India: Gyn Vani is an FM radio channel dedicated to education and Gyan Darshan is a satellite downlink.

A Survey of the Electronic Media Utilisation by Distance Learners of Indian Open Universities

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India

Abstract

The pedagogy and instructional design in open and distance education lay great emphasis on proper use of suitable media. Different forms of media have their own significance in their own context and said to affect the learning. The open and distance education institutions have developed and are using various media, keeping in view the resources available to them. Some are using traditional media like radio, television, audio and video cassettes; while the advanced universities or institutions have gone fully online providing online support to their learners. In this paper, we obtained opinion of the learners in Indian Open Universities on the use of media. The objectives of the study were to obtain the feed back of learners in respect to their accessibility to various media; media use profile, views on usefulness of media, impact of media on their learning activities, problem faced in the use of media and suggestions for improving the utilization of media in distance education. The problems faced by the learners and suggestions for the improvement in the media usage have also been presented.

Key words: distance education, distance learners, electronic media, media utilisation, media impact, media use profile, agreement index

Introduction

Distance education places main emphasis on the learners rather than upon teachers. In this system it is the learner, who is undergoing primarily transformations and hence the learning process is determined more by what and how learner wishes to learn rather than what teacher has to teach. In other words until the learner is prepared to learn, no learning activity can take place. It is the learner who in actual terms 'rules' the roots and sets the conditions. (S)he is autonomous entity within educational process. Learners in distance education may come from various categories ranging from eighteen-year-old student in a remote area, who could not complete his course because of geographical constraints to a senior person, who wishes to make education a life long activity. They may be housewives to management professionals, who want to update their skills. The common points among all categories of distance learners are sense of isolation and the time constraints. Therefore, all efforts in distance education are made to help learners to minimize their sense of isolation and provide them platform so that they can study at their own convenience. The role of media thus becomes very crucial and of fundamental importance as it attempts to 'bring together the learners and teacher across the time and distance to facilitate communication process' (Khan and McWilliams, 1998). Because of their qualities, such as greater delivery capabilities, contributing to specific learning activities, promoting participatory learning, motivating the learners to get involved with learning activities, accommodating individual needs and extending the role of the teacher, electronic media such as radio, television, computer and Internet have been embraced as a part of learning by many Open Distance Learning institutions.

This is the 'cardinal point that distinguishes distance education from traditional classroom education as well as the correspondence education' (Khan and Dikshit, 2006).

In practice, the patterns of technologies in use among institutions across the world are varied, and are commonly influenced by non-pedagogical factors, such as cost, access and availability as much as by pedagogical factors. The ways in which different institutions employ any one particular technology are also subject to great variation (Harry and Khan, 2000).

The present study aimed to get the feedback of learners in respect to their accessibility to various media; media use profile, views on usefulness of media, impact of media on their learning activities, problem faced in the use of media and suggestions for improving the utilization of media in distance education.

Objectives

The study was undertaken with a view to achieve following objectives:

- To prepare the demographic profile of the distance learners
- To assess the media accessibility of the learners
- To identify the media use pattern of the distance learners
- To obtain the student's opinion on helpfulness of electronic media in understanding the subject matter
- To analyze the feedback of the learners on practical issues related with use of electronic media in their academic activities including the factors that impede its use.

Research method

Questionnaire

Two types of questionnaires were developed by the investigators for administering to the learners enrolled through distance education to obtain information related to objectives of the study. Items gathering data on the personal and professional background of the respondents were also included. Most of the items were structured to provide different alternatives to the respondents to be identified. A Likert scale procedure is commonly used for attitude scales (Dyer, 1995) and was used in part of the questionnaires with three options. Some items were open ended to get feedback of respondents on the nature of problem faced during the use of electronic media and the suggestion on how to improve their use. The major items of the questionnaire for two categories are given in Table 1.

Collection of data

For the present research, a descriptive sample survey method was adopted because respondents who were involved in the research were scattered over the entire country. This study was conducted by mail whereby structural questionnaires were sent to the sample respondents to collect data relevant for this study. 1800 questionnaires were distributed to students enrolled in various programmes of open universities of India. A time period of 45 days was fixed for receiving the filled in questionnaires. After 45 days, a reminder was sent to those who did not send back the filled in questionnaire extending time for completion by another 30 days. This resulted in collection of 665 responses from distance learners.

Table 1

Number of information items in each section of the student questionnaire

Major sections in the Questionnaire	No. of information items
Personal Information	9
Visit to Study Centre	2
Media Availability	1
Media Use	1
Media Usefulness	1
Opinion on Various Learning Activities	12
Problems in Use of Media	1
Suggestion for Improvement in Use of Media	1
Total	28

Findings

The responses obtained have been discussed under the sections demographic profile of Learners, availability of media to students, media used pattern of the learners, View point on media helpfulness in understanding the subject, opinion of learners on various learning activities, problems faced in the use of electronic media and suggestions for improving the usage of electronic media at the learner's end. The term 'respondents', 'students' and 'learners' have been used interchangeably for the purpose of the study

Demographic profile of Learners

The 665 learners who came from diverse backgrounds varied in their age, category, educational attainment, study habits and area of residences etc. Identification data showing their characteristics are summarized in Table 2, which shows most of the respondents, were male (75%) while rest (25%) were females. The age of learners ranged from 18 year to 52, in which vast majority of learners were below age 37 years (97%) and only 3 percent of them were more than 37 year old. 41% students were in the age group 23-27 years followed by age groups 18-22 (34%), 28-32 years (15.6%), 33-37 years (6.8%), 38-42 years (0.8%), 43-47 years (0.8%), and 48-52 years (1.2%).

Students' educational attainment level ranged from 10^{th} grade to doctoral degrees. Slightly more than 44 percent (44.5%) had some form of graduation degree; while nearly 30% had only 12^{th} pass qualification. 22.7% of learners under study joined Open Universities courses after completion of their Post Graduate degree, while this percentage was 1.3 for Ph.D. holders. Cumulatively this figure becomes 24 percent. This confirms to the role of open universities to promote learning as a life long activity.

Category wise analysis of respondents indicated that more than 82% of the learners belonged to general category whereas, learners in reserved categories registered their presence for less than 18%. The data break up for reserved category students are as follows: OBC (13.8%), SC (2.7%), and ST (1.2%).

Table 2

Characteristics of learners

Characteristics	Frequency	Percentage	Cumulative %
Gender			
Female	168	25	25
Male	497	75	100
Age			
18 to 22	226	34	34
23 to 27	272	40.9	74.9
28 to 32	104	15.6	90.4
33 to 37	45	6.8	97.2
38 to 42	5	0.8	98.0
43 to 47	5	0.8	98.8
48 to 52	8	1.2	100
53 to 57	0	0	100
58 to 62	0	0	100
Educational attainments			
10th	17	2.6	2.6
10+2	192	28.9	31.5
Graduation	296	44.5	76
Post Graduation	151	22.6	98.6
PhD	9	1.4	100
Category			
ST	8	1.2	1.2
SC	18	2.7	3.9
OBC	92	13.8	17.7
General	547	82.3	100
Area			
Rural Turned Urban	33	5	5
Rural	87	13	18
Urban	545	82	100
Programme wise-distribution			
B_OTHER	61	9.18	9.18
BCA	60	9.02	18.2
BDP	146	21.95	40.15
Certificate	81	12.18	52.33
DIPLOMA	46	6.92	59.25
M_OTHER	83	12.48	71.73
MCA	188	28.27	100
Medium of instruction			
English	415	62.4	62.4
Hindi	165	24.8	87.2
Others	85	12.8	100
Read SIM regularly			
Yes	590	88.7	88.7
No	75	11.3	100

Table 2 also indicates that 82% of the learners belonged to urban population.18% of the respondents had rural background out of which nearly 28% (5/18) learners came from rural to urban area, may be for the continuance of their course. It suggests that distance education has not been able to make sufficient impact in rural areas.

For the purpose of this study, academic programmes offered by open universities were clubbed in following categories: BDP (BA, B.com., and B.Sc.,), BCA, B_Other (All bachelors degree programmes except, BDP and BCA), MCA, M_Other (All master level programme except, MCA), Diploma, and Certificate level programmes. The programme wise break of students shows that highest percentage of respondents belonged to MCA programme (28.27%) followed by BDP (21.95%), Certificate level programmes (12.18%), and Masters level programmes other than MCA (M-Other, 12.18%). For remaining categories student strength was less than 10% of their total population.

Table 2 also shows that most of learners had opted English as medium for instruction (62.8%) followed by Hindi (24.8%). While percentages of learners choosing the languages other than English and Hindi as medium of the instruction for their courses was only 12.8 %. The reasons attributed to this may be the offering of most of their programmes through English medium by open universities as well as the preference of English as medium of instruction by majority population in urban area besides many other factors.

The study habits of the learners' reveals that vast majority of them read their instructional material regularly (88.7%), while remaining are not very regular in their studies. This indicates that most of the learners of open universities are serious towards their studies and take out some time for interaction with the study material in-spite of their various responsibilities.

Reasons for joining the programme

On the issue of reasons for joining the programmes of open universities, learners were allowed to exercise their multiple options. In their response , around 40 percent learners expressed more than one reason for joining the course. Half of the respondents had joined the course with an aim of getting a better opportunity. 41% learners wanted to add qualification and 36% wanted to update their knowledge. This supports the view that open universities play an important role in making learning a life long activity

Table 3

Reasons for joining the programmes

Reason	Frequency	Percentage
Better Job	334	50.2
Add Knowledge	238	35.8
Add Qualifications	271	40.8
Get Degree	89	13.4
Total	932	140.2

Visit to study centers

Study centers in open universities act as nodal point for providing various academic supports such as counseling, library, media use, and information regarding schedules in respect of submission of assignments, examination, and admission etc. The feedback of the learners on frequency and purpose of visit to the study centers are compiled in table 4.

Table 4 indicates that 69 percent of the learners visited study centre regularly, nearly 30.4 percent were occasional visitors of study centers as per their need, while four percent of the learners never went to study centers. Visit of 99.4 percent of learners either regularly or occasionally confirms the sincerity of the distance learners.

The responses of the learners on the issue of purpose of visiting study centers indicated that most of them visited the study centers for multiple reasons. Approximately 80% learners visited study centres for attending face-to-face counseling, followed by information seekers (38.5%). While nearly one fourth respondents visited study center for using media (25.7%) and availing library facilities (23.8%). This confirms the importance of face-to-face counseling in distance education and also highlights the importance of study centres in delivering various student support services.

Table 4

Visit of learners to Study Centre

Frequency of Visit to Study Centre		
Visit Habit	**Frequency**	**Percentage**
Regularly	459	69
Occasionally	202	30.4
Never	4	0.6
Purpose of visiting Study Centre		
Purpose	**Frequency**	**Percentage**
Counseling sessions	533	80.2
Media/Tech use	171	25.7
Library	158	23.8
Information	256	38.5

Availability of media to distance learners

On the question of availability of various media to learners either at home or work place, responses are presented in Table 5.

Table 5

Availability of media to students

Media/Tech	Available at home or work place	%	Not available	%	Total
Telephone	423	64	242	36	665
Computer	235	35	430	65	665
Internet	135	20	530	80	665
Gyan darshan	225	34	440	66	665
Gyan vani	130	20	535	80	665
Cable TV	385	58	280	42	665
Audio cassettes/CDs	306	46	359	54	665
Video cassettes/CDs	164	25	501	75	665
Fax	76	11	589	89	665
Television	413	62	252	38	665
Teleconference	52	8	613	92	665

Table 5 indicates that the facility of learning through telephone (64%), television (62%) and cable television (58%) were available to nearly 60% student population while audio cassettes were available to only 46% of them either at their home or at their work place. Teleconferencing (92%) were not available to more than 90% students' population. The availability of remaining media was not encouraging as it varied from 11% (Fax) to 35% (computer). It means these are not available to more than 65 percent learners. Therefore, to compensate for this non availability, Open Universities should well equip their study centres with the electronic media that they are going to adopt towards course curriculum, otherwise a big gap between media haves and media have-nots might be created.

Media used pattern of the learners

The response of the learners on media used by them indicated telephone as most frequently used media by vast majority of student community (81%) for their various academic activities. The remaining media had not been used by more than 50% of the learners for their learning activities. The reasons may be of accessibility, relevance to the course or attitudinal barriers. The morning television and cable television was available to more than 60 percent learners either at their home or at work place (table 4) but were used by 11% and 18 % of them respectively. Except telephone (available 64%, used 81%), computer (available 35%, used 43%), and internet (available 20%, used 28%), similar trend could be seen for all the media under the study. The higher percentage of utilization than availability of media at the dwelling or working place of learners, also indicates their dependence on facility of the study centers or outside agencies**.** Teleconferencing (6%), Fax (7%), and Gyan Vani - dedicated FM education channel (7%) were used by less than 10% student population. Lower participation level of learners in teleconferencing was also reported by Raghubanshi and Mishra (1996) in Indian context. The percentage of population using the remaining media ranged from 15% for CDs to 21% Gyan Darshan – a satellite downlink. Table 6 summarizes use of various media by various groups.

Table 6

Media used by learners

Media/Tech	Consolidated		Gender-wise				Area-Wise					
	Freq.	%	Female	%	Male	%	Rural	%	R-T-U*	%	Urban	%
Telephone	540	81	158	94	382	77	43	49	17	52	480	88
Computer	288	43	82	49	206	41	9	10	12	36	267	49
Internet	187	28	54	32	133	27	5	6	0	0	182	33
Gyan darshan	140	21	43	26	97	20	16	18	6	18	118	22
Gyan vani	49	7	31	19	18	4	5	6	4	12	40	7
Cable TV	121	18	48	29	73	15	0	0	9	27	112	21
Audio cassettes/CDs	134	20	49	29	85	17	5	6	9	27	120	22
Video cassettes/CDs	122	18	42	25	80	16	12	14	9	27	101	19
Fax	43	7	22	13	21	4	0	0	0	0	43	8
Television	72	11	31	19	41	8	0	0	0	0	72	13
Teleconference	42	6	22	13	20	4	5	6	0	0	37	7

* Rural Turned Urban

The gender wise analysis of media used by the students indicates that use of electronic media was more by Female students in comparison to Males. While data break up of media use on the basis of area of residence of respondents revealed higher level of media utilization by urban population as compared to other counterparts leaving some media like cable television, audio cassettes, Gyan Vani and video Cassettes, for which, percentage of learners belonging to rural turned urban category was higher in comparison with other categories.

Viewpoint on media helpfulness in understanding the subject

The viewpoints of students' population on the issue of help provided by media in understanding the subject matter indicated that more than three fourth population (78%) were evaluating the help extended by various media as *poor*, while 12% viewed it *average* and only 10% learners had graded the help of media as *high*. Their opinions about usefulness of every media under study are summarized in Table 7.

Table 7

Media helpfulness understanding the subject

Media/Tech	High	%	Average	%	Poor	%	Total
Telephone	61	9	134	20	470	71	665
Computer	212	32	118	18	335	50	665
Internet	147	22	96	14	422	64	665
Gyan darshan	59	9	139	21	467	70	665
Gyan vani	32	5	89	13	544	82	665
Cable TV	45	7	59	9	561	84	665
Audio cassettes/CDs	61	9	64	10	540	81	665
Video cassettes/CDs	71	11	88	13	506	76	665
Fax	17	3	29	4	619	93	665
Television	54	8	72	11	539	81	665
Teleconference	39	6	42	6	584	88	665
Total	**991**		**1199**		**7785**		**9975**
Percentage	**10**		**12**		**78**		

Table 7 shows that that half of the learner population under study considered computer helpful in understanding the subject *(high+average*). However, 32% of the learners rated computer *high* on the scale of help derived from the media in understanding the subject.

Internet was considered as *highly* useful by 22% student population and viewed as *average* by 14% of them. Cumulatively this figure was 36%, which was next to computer in terms of usefulness of media followed by Gyan Darshan (30%) and telephone (29%).

Fax (93%), teleconferencing (88%), cable television (84%), Gyan Vani (82%), audio cassettes/CDs (81%), and Television (81%) were graded poor by more than 80% population under study on the scale of understanding the subject.

In order to compare various media on the scale of helpfulness in understanding the subject , *Help index(H_s)* has been defined :

$$H_s = (I_h * f_h + I_a * f_a + I_p * f_p) / N$$

Where

f_h= frequency of students considering high help from media in understanding the subject

f_a = frequency of students considering average help from media in understanding the subject

f_p = frequency of students considering poor help from media in understanding the subject

N = Total population of distance learners.

Table 8

Indexing scheme

Index Value (I)	Description
3	High Help
2	Average Help
1	Poor Help

Table 9

Possible rating of media

Range	Explanations
Hs≥ 2.5	High Help
1.5≤ Hs <2.5	Average Help
Hs <1.5	Poor Help

Greater the H_s index value, higher the extent of help expected by learners from the media in understanding the subject. The H_s indices of various media in decreasing order of their helpfulness are given in table 10

Table 10
H_s index values of various media

Media/Tech	H-M-S-index
Computer	1.82
Internet	1.59
Gyan darshan	1.39
Telephone	1.38
Video cassettes/CDs	1.35
Audio cassettes/ CDs	1.28
Television	1.28
Gyan vani	1.23
Cable TV	1.22
Teleconference	1.18
Fax	1.09

Table 10 reveals that a poor rating towards understanding the subject matter has been given by the learners all media except computer and Internet. (1.5<Hs). They evaluated computer and Internet as being average helpful media. Computer (Hs=1.82) was considered as more helpful than internet (Hs=1.59) where as, fax was rated lowest helpful by the majority (Hs=1.09) on scale of understanding the subject.

Opinion of learners on various learning activities

Feedback of students were obtained on some practical issues related with the use of electronic media for their academic activities such as help of counselors in using various media, relevance and effectiveness of electronic media to their course, understandability of language thru electronic media used in distance education, and availability of necessary infrastructure at the study center etc. The agreement of the learners on five point scale i.e. strongly agree, agree, undecided, disagree, and strongly disagree are presented in table 11.

Table 11

Activities for media use

Activities	SD*	%	D*	%	U*	%	A*	%	SA*	%
Counselors in my programme provided help while using various media/ technologies	73	11	75	11.3	69	10.4	309	46.4	139	20.9
I was able to understand or follow various media/technologies adopted in my course material	61	9.2	28	4.2	76	11.4	365	54.9	135	20.3
Media/ technologies used in my programme are relevant	104	15.6	289	43.5	109	16.4	91	13.7	72	10.8
Media/technologies used in my programme are interesting	73	11	56	8.4	99	14.9	299	45	138	20.8
Language used in media/ technologies in the programme is difficult	175	26.3	242	36.4	119	17.9	108	16.2	21	3.2
My study centre has necessary physical facilities related to use of these media/ technologies	96	14.4	87	13.1	177	26.6	203	30.5	102	15.3
I am satisfied with time alloted for media use at my study centre.	389	58.5	102	15.3	54	8.1	92	13.8	28	4.2
I have participated in an online discussion	202	30.4	165	24.8	168	25.3	107	16.1	23	3.5
Watching video/audio is more interesting than studying the SIM	87	13.1	74	11.1	188	28.3	207	31.1	109	16.4
Watching video/audio is more useful than Studying the SIM	130	19.5	158	23.8	165	24.8	134	20.2	78	11.7
Use of electronic media is effective in improving you're my interest in studies	61	9.2	13	2	57	8.6	327	49.2	207	31.1
Use of electronic media is effective in improving my performance	56	8.4	13	2	64	9.6	330	49.6	202	30.4

- SD= Strongly Disagree, D= Disagree, U= Undecided, A = Agree, SD= Strongly Agree

The observations on various activities based on table 11 are given below:

Help of counselors in using various media

67.3%of the respondents agreed (*agreed + strongly agree*d) that counselors provided helps in using media for their academic activities, 10.4 % were *undecided* on this issue while 11% *disagreed* with the statement and remaining 11.3% had shown their disagreement with more emphasis (*strongly disagreed*).

Following up of various media adopted in course material

Nearly 55% learners could follow (*agreed*) the various media adopted in their course materials, 20.3% showed their *strong agreement* on this issue. 11.4 % had shown their neutral opinion and the remaining population had opposed (*strongly disagreed + disagreed*) the said idea.

Relevance of electronic media

Cumulatively 69.1% students evaluated various media adopted in their course as non-relevant, only 24.5% participants had *agreed (*13.7%) *or strongly agreed* (10.8%) that electronic media used in their course were relevant. The remaining 16.4 had expressed their neutral opinion on the subject.

In response to the statement that ***media used in their programme were interesting***, 45% of learners had shown their agreement 20.8 % expressed their *strong agreement*, 14.9% were neutral, and 19.4% showed their disagreement (*disagreed + strongly disagreed).*

Language of adopted media

Approximately 63% of students did not agree (dis*agreed + strongly disagree*d) that language used in the media and technology adopted in their course was difficult, approximately 18% were indecisive about it and remaining 19% consented (*agreed + strongly agree*d) that language used in media were difficult to follow.

On the question of ***availability of necessary infrastructure at the study centre*** for using various media, agreement level of 15% student population was strong (*strongly agree*d), 31% students were moderate (*agreed*), 26% learners were undecided and remaining population registered their opposition (dis*agreed + strongly disagree*d).

Satisfaction with allotted time for use of media at study centre

Nearly 74% student populations felt that time allotted for media use at the study centre was not adequate (dis*agreed + strongly disagree*d). Approximately 18% seemed to be contented (*agreed + strongly agreed*) with the timings of media use at the study centre, while remaining 8% learners did not express their clear views.

In response to ***Participation in online learning*** only 19.5% of student population expressed their agreement to strong or moderate degree (*agreed + strongly agree*d), 55.2% replied negatively (dis*agreed + strongly disagree*d) and remaining 25.3% perhaps could not understand the concept of online learning and showed their indecisiveness.

Effectiveness of audio-visuals

On the issue of comparing the effectiveness of audio/video with that of printed self instructional material in terms of their usefulness and interestingness, nearly 47.5% showed their agreement (*agreed + strongly agree*d) that learning through audio/video was more interesting than printed SIM, nearly 28.3% were neutral in their opinion and remaining 24.2% did not find audio/video lessons that interesting (dis*agreed + strongly disagree*d). With regards to their usefulness 43.3% opposed the idea, 24.8% were undecided and remaining favoured the usefulness of audio/video lessons over printed SIM (*agreed + strongly agree*d).

Effectiveness of electronic media

With regards to effectiveness of electronic media in improving the interest of learners in studies as well as their performance, 80.1% of the learners felt that use of electronic media is effective in improving their interest in studies (*agreed +strongly agree*d), 11.2% showed their disagreement (dis*agreed + strongly disagree*d) and remaining population could not express their clear opinion. Approximately similar opinion was expressed by learners in response to the effectiveness of electronic media in improving the overall performance of the learners. Their percentage wise break ups for various categories were: strongly agree (30.4%), agree (50%), undecided (9.6%) disagree (2%), and strongly disagree (8.4%)

In order to compare the agreement of learners on various practical aspects of use of electronic media, **Agreement I*ndex*** of each activity has been defined.

Agreement index $(I_a) = (I_{SA} * f_{SA} + I_A * f_A + I_U * f_U + I_D * f_D + I_{SD} * f_{SD}) / N$

Table 12

Indexing scheme

Index Value (I)	Accessibility
5	Strong Agreement
4	Agreement
3	Undecided ness
2	Disagreement
1	Strong Disagreement

Table 13

Possible rating of media

Range	Explanations
$I_a \geq 4.5$	Strong Agreement
$3.5 \leq I_a < 4.5$	Agreement
$2.5 \leq I_a < 3.5$	Undecided
$1.5 \leq I_a < 2.5$	Disagreement
$I_a < 1.5$	Strong Disagreement

Agreement index of various activities are given in Table 13 in the decreasing order of their agreement. Higher the value, greater is the level of agreement for a particular academic activity.

It is evident from table 14 that agreement of learners on effectiveness of electronic media in improving their interest in studies as well as performance was higher in comparison with other activities under discussion. Similarly agreement index of satisfaction of learners with the time allotment for use of media at the study center reveals that most of them were not satisfied with media use time given to them at the study centres.

Table 14

Agreement indices of various activities

Activities	Agreement Index
Use of electronic media is effective in improving my interest in studies	3.9
Use of electronic media is effective in improving my performance	3.9
I was able to understand or follow various media/technologies adopted in my course material	3.7
Counselors in my programme provided help while using various media/ technologies	3.6
Media/technologies used in my programme are interesting	3.6
Watching video/audio is more interesting than studying the SIM	3.3
My study centre has necessary physical facilities related to use of these media/ technologies	3.2
Watching video/audio is more useful than Studying the SIM	3.2
Media/ technologies used in my programme are relevant	2.6
I have participated in an online discussion	2.4
Language used in media/ technologies in the programme is difficult	2.3
I am satisfied with time allotted for media use at the study centre.	1.9

Problems faced in the use of electronic media

The reported problems as faced by learners in the use of media are presented below.

- Relevant audio video cassettes/ CDs as per the requirement of the course are generally not available.
- The counseling sessions are arranged on Saturday/ Sunday's, and in the evening hours of working days. On the same day and time approximately 7-8 counseling sessions are scheduled for which audio video are also available, but due to availability of only one television all groups cannot use the audiovisuals.
- Timing of teleconferencing did not suit to learners. During counseling through teleconferencing, mostly counselors were not available to explain the concepts dealt by the resource persons. The problem gets further aggravated because of poor communication with the resource persons at studio because of constant telephone calls from many centers and less time allotment for interaction. As such may queries of the learners remained unanswered.
- Non-receipt of schedules of radio counseling and programmes telecasted through Gyan Darshan, teleconferencing, morning television and Gyan Vani.
- Facility to access Internet at the study centers is mostly not available.
- Most of the local cable operators are reluctant to telecast Gyan Darshan channel.
- Power failure
- Non-availability of trained manpower to operate various media.

Suggestions

The suggestions given by distance learners to improve the electronic media usage in distance education mainly pertained to the proper accessibility and relevance of various media as given below.

- Media for the sake of adaptability only should not be considered, but the media, which could be accessed by the students and relevant to the course, should be included in course curriculum.
- Counselors/Study Centres Staff/ Student also should be trained in handling various media.
- Access to internet should be made available at the study centres.
- More general type of information should be placed at the web site of respective universities. It should be regularly updated.
- Functionaries of open universities should be instructed to respond to the queries of the learners sent through e-mail in time. In absence of any response learner gets de-motivated.

Conclusions:

The analysis on feedback of learners indicated that distance education has been accepted by nearly all segments of society; ranging from eighteen-year-old student to a service man, who is nearing his retirement, 10^{th} class pass learners to Ph.D. holders. Open universities have been successful in their endeavor of making learning a life long activity.

With a view to exploring the possibilities of reaching the learners with the help of various electronic media, they were requested to give their viewpoint on various aspects pertaining to the usage of media in distance education. On the question of usefulness of various media in their learning activities, the learners envisaged supplementary role of electronic media, by grading the usefulness of all media (under study) except computer and Internet, as poor. In their opinion, help extended by computer and Internet was also considered as average. This indicates the student's preference for computer and Internet.

Trend in media use by the learners did not present a very encouraging state of affair, as except telephone; none of the media were used by more than half the population. The poor availability of media to learners either at their home, residence or at the study centers could be the probable reason for the same. This also confirms the study conducted by Voyageur (2001) on learners of first nation's community in Canada, who concluded that use and availability of electronic media were closely linked.

The agreement index of the learners also reveals that most of the learners were not satisfied with the time allotted for media use and many learners were also not sure of the availability of necessary infrastructures at the study centers. This puts more responsibility on the part of open universities to see to the proper accessibility of media before adopting it for their course curriculum, otherwise a gap between media haves and have-nots will be created and the very purpose of open universities to bring education to the doorsteps of the learners will be defeated.

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Editor's Note: In less than three decades, distance learning has evolved from correspondence school through television to online universities. Many traditional brick and mortar universities and their faculties have accepted distance learning as a way to bring quality education al programs to underserved and unserved populations of learners. Resistance to change is giving way to acceptance of the value of the new learning tools for on-campus and distance learning.

Faculty Attitudes towards Distance Education: A Review of the Literature

Samuel Kofi Badu-Nyarko

Ghana

Abstract

The concept of distance education and its practice has over the years been shrouded in controversy. A controversy that stems from both instructional design and delivery. For many academics, the delivery of instruction via the distance produces little learning and discussions as well as interactions university education to them is basically an art of meeting the challenges of life and learning deeply from the instructor. The issues of university culture, autonomy, quality and accessibility have provided grounds for rejection of distance education in many circles.

To others, distance education offers the best chance for people to work and learn at the same time while exploring other avenues regarded as critical to their everyday activity.

These arguments have greatly divided faculty on the lines of how to participate in distance education endeavours. This review of the literature tries to bring into the fore the various positions of faculty on the issue of distance education in practice.

Introduction

In writing this literature review considerable effort is given to the concept of change (innovation) and faculty attitudes in general. It describes the field of higher education and perceptions held by faculty members in relation to distance education.

The role of faculty

Research has studied faculty roles in distance education and educational change (Bradley & Habeshaw, 1991; Scott, 1993; Beaudoin, 1990; Pardy & Wright, 1992). Keegan (1990), focussing on faculty performance in both the dual mode educational system and that of conventional universities, found out that faculty in dual mode heavily tasked. Garrison (1989), in an examination of distance education, stated that "while it is currently fashionable to advocate for student-centredness, the crucial role of the teacher cannot be ignored" (p. 120).

Traditional Roles of the Faculty

According to Badley & Habeshaw (1991), the only way to appreciate the changing role of the teacher in higher education is to understand the traditional roles. Beard (1976) raised two main traditional views of the faculty, philosophical and scientific. From the philosophical view, the lecturer is to engage the mind of the student by bringing him/her into contact with scholarly and cultural comparisons. The scientific view, which emphasizes the need to inculcate a body of knowledge, tends to undervalue the social and broad educational purposes of higher education.

According to Badley & Habeshaw "neither view of the traditional role of higher education presented us with an image of a professional teacher committed to examining the purposes of

higher education and the methods and content to be used to meet these purposes" (p.15). Focusing on university teaching, Henderson (1969) identified the lecturer as performing a double role – that of pursuing research and teaching. This view was later supported by Titmus (1981). Fincher (1993) added a third dimension, that of carrying out its duties in an international context.

Traditionally, higher education teachers have been criticised as failing to encourage their students to participate in research and to express new ideas. Rarely challenged by the student, faculty members were authorities who assumed the roles of correctors of students' errors and talkers rather than listeners (Freire, 1990). This traditional role emphasized the dominant, traditional teaching method, the lecture. The claims made for its continued use are based on the notion that it is the only way to make sure the ground is covered, and is the best method to deliver facts (Gibbs, 1982.) Many faculty members assumed that lectures were the best way to encourage students to think. It is argued that lecturers are inspirational and ensure that students have a proper set of notes. Furthermore, the attention of the lecturer is needed as some students are identified as being incapable of, or unwilling to, work alone.

Gibbs (1982) suggested that faculty members have clung to the traditional method because:

- They are ignorant of the evidence about the effectiveness of lectures and of alternatives techniques;
- They are overworked with the view that alternatives to lectures may appear to involve more work and changes take time to introduce;
- There exist shortages of resources, particularly books and other material;
- Lecturers' attitudes obstruct change and so use lecturing as a coping strategy; and
- Institutional constraints do support lecturing since teaching hours are counted especially in the relationship between individual courses. (p. 54).

Other roles performed by faculty included: supervising individual and group dissertations and projects, serving as tutors for solving students' problems, assessing students' work, evaluating teaching and courses, administering courses, and sharing in departmental and institutional administration, and maintaining subject expertise through research and staff development (Beaudoin, 1990; Wilson, 1979). Additionally, faculty may be involved in extension, community and international service.

Changing roles in distance teaching

The expansion of the university's responsibilities to a broader constituency through distance education has created a new dimension in the role of the faculty. With this new vision, the pressures of shared academic values, professional status, and maintenance of common academic standards have increased. In the light of these, the lecturer has to adjust to the anticipated changing roles required. The anticipated changes include the acquisition of new skills, teachers becoming facilitators, and their involvement in distance teaching (Landstrom, 1995). In addition to the increased workload, the university lecturer has to be retrained or reoriented to adapt to the innovations.

Jordan and Layzell (1992) found that faculty at Arizona State University worked an average of 50 hours a week. Of this time just under 50% was spent in-class and in preparation of teaching, 33% was spent on research activity, 14% on administration and 6% on public services. Increasing workloads were also a problem for British academics. A recent survey by court (1994) found the average number of hours worked per week by UK academics to be 54, an increase of 6% from 1969 figures. Fisher (1994) found out that 75% of a sample of 268 British academics felt frequently or always overworked. A similar report was made by Siaciwena (1989) in Zambia. It is

necessary, therefore, when considering other innovations like distance education to consider faculty workloads. In considering future trends, Allen (1994) concluded:

> *A generation ago faculty members resolved the conflict between teaching and research by expanding their work-weeks. But the eight-hour growth to a 53-hour work-week makes future increases unrealistic (p.26).*

Where faculty consider themselves already heavily burdened with teaching responsibilities, they will not consider expansions of educational opportunities that involve further teaching and less time for research. Haughey (1986) noted that the professors who depend on the lecture format to carry out instructional intents do not understand what to teach at the distance and which style to adopt. Faculty often argue as to whether the workload of both off-campus and on-campus ought to be the same.

Similarly, Beaudoin (1990) maintained that "those faculty accustomed to more conventional teaching modes will have to acquire new skills to assume expected roles not only to teach distance learners, but also to recognise instructional resources suitable in content and format for independent study" (p.27). The main thrust of this statement rests on the premise that faculty members would have to be re-oriented to their new roles if they were to accept them. Further, faculty engaged in distance education must be adept at facilitating students' learning by paying particular attention to process, unlike classroom-based teachers whose traditional role is largely confined to selecting and sharing content (Beaudoin, 1990).

To buttress this view and to promote effective strategies for distance learning practice, a few faculty with experience in distance education could provide orientation and training to enable new instructions to become acclimatised to the unique requirements of distance teaching. Beaudoin (1990) was apt in stating that:

> *Attempts to provide faculty with assistance or advice designed to acquaint them with program procedures and student needs may be resisted by some faculty who will interpret such efforts as telling them how to teach. But, it is essential that expectations be made clear from the onset, least faculty assume whatever previous experience they may have had with adult learners will carry them through this new assignment when, in fact, their new instructional roles may require drastically different activities and approaches.*
>
> *It is therefore important that administrators seeking resources for the establishment of a distance learning programme take pains to cultivate the support and interest of faculty, since many faculty members may not be familiar with how the new concept actually works. Thus, the major refrain is that most innovations towards distance education fail to create an academically sound, degree granting program as many faculty members continue to remark "well, those new techniques may work in some other disciplines, but they certainly won't in mine" (p.28).*

Adding support to this assertion, Purdy & Wright (1992) stated there should new approaches, techniques, or styles in situations were communication with the students is through written lessons or computer exchange in asynchronous time formats. Of particular interest: these factors have suddenly changed the role of the faculty to a new form of teaching and learning. According to Dillon & Walsh (1992), little has been written about the faculty although lecturers constitute the basic source of distance education. To them, "the view to understanding distance education as an innovation provides an important means for understanding the phenomena of distance education, particularly from the perspective of those upon whom its acceptance depends: the faculty." (p. 53)

These salient issues have moved the concept of education from dissemination to development. According to Boot & Hodgson (1989), the role of the teacher invariably changes from a subject

expert and guardian of knowledge to a facilitator, serving more as resource person and a co-learner. This dissemination to development model has far reaching implications for both curriculum and faculty roles. Meacham (1990) examines the issue differently from an innovative point of view. Regarding distance education, he was concerned about the faculty acquiring information and having an awareness of the innovation, and the "consequences in terms of lecturer action and intervention." (p. 250)

The shift from the traditional campus has resulted in tension with regards to the functions and roles of lecturers. Croft (1992) writes that the absence of the lecturer's freedom to develop and present subject matter has affected both instructional and research integrity, academic freedom and the authority derived from expertise in the field. Her notion is that much of distance education is in direct conflict with the autonomy of the faculty member. Distance education has been seen as an innovation that "changes the nature of the classroom in a manner which may seem to undermine the teacher's central role and autonomy in the instructional process and limit his/her freedom" (p.54). The faculty takes a 'back seat' role in developing courses and allows the media to take his place with regards ton instructional delivery. Faculty, according to Croft, see distance education as threatening the integrity of traditional instruction and learning processes:

> *Nothing dispels the attitudinal aspects of discomfort with distance education –a fear of technically complex devices used to deliver courses; concerns that students may not get the education they deserve, about one's own reputation, about job security, that distance education will make faculty superfluous, a resistance to learning new things, a worry that students will not adapt, skepticism about the abilities of distance education to deliver what it promises, and previous negative experiences. (p. 54)*

Demonstrating the importance of institutional support for increased faculty participation on the basis of tenure and promotion, Olcutt & Wright (1995) emphasized that participation goes beyond merely providing instructional leadership. They argued that

> *Institutional leadership suggests that faculty are intimately involved in the instructional design process, the design of student support services, in student advising and in the rigorous evaluation of technologically mediated instruction. Moreover, faculty participation includes engaging in discipline-based research and the serving of the academic community (p.19)*

The functions may exert pressure on faculty while participating in distance education.

Faculty attitudes towards distance education

Traditionally and historically, academics have held a less than positive attitude towards distance education (Black, 1995; Johnson, 1984; Rishante, 1985; Dillon and Walsh, 1992; Clark, 1982). Mcafee (1972), for instance, stated that the immediate objections to using correspondence courses in universities and colleges probably centre on one or more of the following:

- A belief that students taking distance courses will not learn as much as those in regular universities;
- The fear that distance education courses cannot be used to meet the entrance requirements of institutions of higher learning;
- The belief that the use of distance education courses will adversely affect the accreditation of the degrees; and
- The belief that distance education courses are poorly prepared by unqualified persons (p.34).

In contrast, Meachem (1982) indicated that the goal of innovations such as distance education is perceived as development of effective distance teaching materials by staff who have little or no experience.

The acknowledgement of faculty support or resistance towards distance education shows that faculty may support innovation even when unfamiliar with the system (Black, 1995). The literature on higher education, according to Johnson (1984), showed that faculty have often appeared unfavourable to innovation and resistant to change. Recent studies on faculty attitudes have empirically confirmed this (Black, 1995; Landstrom, 1995).

In writing about faculty attitudes towards distance education, Verduin and Clark (1991) maintained that attitudes play a significant role in decisions about who will use it, and how and when it will be used. Faculty may be resistant to public exposure, fearing that their course materials/content or their teaching styles may come under attack. According to Levis & Wall, (as cited in Verduin & Clark, 1991),

> *Some instructors are resistant to dealing with students who cannot get to campus, having little or no sympathy for the student whose life situation does not permit attending college in the traditional manner. Among these re teachers who believe they cannot teach if they "cannot see the students' faces," or who are [even] reluctant to try interactive transmission systems in classrooms located distance across the campus. Some believe that 'you can't teach this way' no matter what (p.12).*

The implication is that many faculty members do not recognise the university operating outside the domain where it traditionally belongs.

Opinions, however, do differ among faculty members. Verduin and Clark (1991) pointed out that attitudes are related to status. Scott (1985), reported that although admission and graduation requirements may be similar for both off-campus and on-campus programs, most external degree instruction was performed by adjunct professors who were paid less and who often felt slighted in terms of professional advancement. Faculty who participated in distance education perceived their teaching as of higher quality than that of colleagues in conventional programs (Landstrom, 1995).

Similarly, Dillon & Walsh (1992) established that faculty teaching at a distance are positive towards such teaching and their attitudes tend to improve with experience. Clark (1993) found that familiarity and previous experience were moderately predictive of respondents' receptivity to distance education. Generally, faculty motivation to teach distance students is derived from intrinsic rather than extrinsic incentives (Siaciwena, 1989); Black, 1992; however, lack of commitment has been identified as a basis for rejection of distance education by faculty (Siaciwena, 1989). Mani, (as cited in Siaciwena, 1989) found that it is the perception among faculty that distance teaching is neither rewarded by academic departments nor perceived as a scholarly activity by a significant number of colleagues.

Smith (1979), writing on the Australian distance education system, explained the reaction of the University of Sydney professorial board as saying:

> *External studies are necessarily greatly inferior to internal studies and even with the most carefully organised and well-staffed external department so little could be achieved and so imperfectly that the establishment of external studies cannot be recommended … indeed, there is a pressing danger that external studies will give the illusion of a university education without the reality. Students will go through the motions of study and believe that they have had a true university education when they have not (p. 26).*

This marked reaction later proved untrue as the development of distance education continued to progress in Australia. Chick (1992) saw Australian faculty as being ambivalent and with the exception of a few, those at Queensland had been hostile towards distance education.

With regards to decision making processes, faculty members have been identified as having ambivalent attitudes about participation (Wilson, 1979). Haughey (1989) and Croft (1992) found that faculty were concerned about their own disciplines rather than the importance of institutional growth.

Attitudes towards quality and accessibility

Recent studies on faculty attitudes towards distance education had centred on the need to maintain the quality of students graduating from the universities. Clark (1993) highlighted the issue of faculty in part-time studies by pointing out that for faculty "the most demanding part of their environment is other academics in the same field." (p. 207) In arguments between discipline-driven faculty and consumer-oriented sectors, the latter would be effectively blocked by an inward-looking faculty.

For many academics, the question rests on quality. If more students are admitted, will not standards fall? This seems to reflect the economic principle that what is scarce is valuable. The basis for this viewpoint is the traditional admission and examination system, where entrance requirements and grading procedures are presently monitored. An additional concern is that the high student-lecturer ratios will involve more work, equipment and other facilities (Guition, 1992; Blix, Cruise, Mitchell & Blix, 1994).

Central to these questions is the issue of 'parity of esteem.' criticisms on distance education have generally centred on the quality of instruction and the degrees obtained. Garrison (1989) wrote that distance education has long sought 'parity of esteem' with conventional education. However, recent issues have focussed on equal and quality learning packages and content of courses targeting specific segments of the market instead of mass production of materials. Ellis and Chapman (1982) suggest that institutions of higher education must make "changes in their regulations and ways of dealing with remote adult students before [they] can be accepted as having received an academically equivalent course." (p. 276)

This revelation, similar to what Black (1992) and Tight (1993) identified, calls for serious considerations. Tight noted the positive and negative aspects of access in relation to flexibility and relevancy to restructure further education. Those in support of elite education "are anxious about the fluctuation and decline in the use of conventional further and higher education." (p. 62) These anxieties have provided an impetus for limiting the number of students because of the fear of 'falling standards or 'more means worse'.

Black's (1995) study of faculty support for distance education illustrated the different roles, conflicts and compromises associated with a mass versus an elite conception of university education based on accessibility and quality. A mass system places value on more open access to larger numbers of the population. This conflicts with the values of an elite system, which is more selective and focuses on preparing a smaller number of individuals with the highest of academic credentials.

Griffin (1983) argued that:

> *For although attitudes in further and higher education may be opportunistic in certain conditions, there are not logical barriers to open learning systems but rather material ones. However, in terms of access, the open university committee report acknowledges 'the fact that any proposal made for increased scope in continuing education are substantially reduced in value if significant numbers of students do not have access to what is produced.' (p.58)*

Griffin was of the opinion that accessibility to adult education means people will be able to take courses of their choice at recurring intervals. This implies that these courses will be available when and where the student can use them; however, some academics believe that allowing students to take courses in a system of recurrent education lowers the credibility of the courses. Recent studies in support of the accessibility of distance education have emphasized the need to make education more equitable, so that other people would have access to university education (Black, 1995, p. 17). Yet, those who oppose mass distance higher education have maintained that it is important to get good quality people into the system, not necessarily denying educational opportunities to people.

Black (1995) acknowledges the views held by many faculty who oppose distance education. The opposers view campus experience as essential. They argue that university campus experience is the most "ideal community of scholars where students from a variety of disciplines bump into each other and debate issues from various points of view." (p. 20) As well, it forms an arena for socialization, the shaping of character and developing scholarly outlook (Black, 1995).

Verduin & Clark (1991) hold the view that increasing faculty knowledge about distance education is the key to gaining acceptability. Faculty may also influence committee decisions about proposals to offer distance education even though they have limited knowledge about, or involvement in distance education (Black, 1992; Johnson, 1984). This view adds support for black's (1992) premise that distance education is often dismissed on the grounds of prejudice.

University culture

The concept of university culture like any organisation provides insights into the beliefs, structure and processes within its organisation. Such knowledge helps to consider the ways innovative teaching methods and distance education may or may not fit into the culture of the traditional university (Croft, 1992). Harris (1987) contended that most faculty members refuse to cooperate on the grounds of the 'culture industry'. The culture industry constitutes the status quo that university learning must occur on campus where the lecturer controls the instruction. Their main concern was that the credibility of the open university of United Kingdom is based on the argument that face-to-face contact between teacher and the taught is not essential. This is criticised, however, by current research by Haughey and Fenwick (1996). Their study established that "when the tutor made personal, frequent, face-to-face contact with the students, the perception was that students learned more and generally had a more positive experience with distance education" (p. 6).

According to Trow, 1987

> *Elite higher education is marked by high selectivity, a close student-teacher relationship and intense, structured study of arts and science subjects associated with a liberal education. It is concerned with shaping the mind and character of professions (p. 269).*

For faculty members, maintaining the status quo that their courses cannot be taught at a distance had been the basis for resistance. Paul (1989) for instance, criticised faculty's role at Athabasca University towards distance education based on university culture by saying that

> *Several unfortunate experiences with external academics led to a deliberate decision not to develop courses in a disciplinary area unless there was at least one resident academic in the field in question to plan and oversee the overall development of courses in that discipline. (p. 148)*

In most instances, the Athabasca faculty regard distance education as a second rate, low level job. Athabasca University faculty resisted administration's efforts to hire full-time academic staff for distance teaching by employing retired professors and paying them less or allowing junior lecturers to handle the courses.

Many faculty members, according to Grossman (1989), see distance education as playing a 'second fiddle' to on-campus study. This second-class status of distance education is attributed to the fact that distance educators fail to understand the traditional academic culture that prevails in institutions of higher education. Distance education, to Dillon and Walsh (1992), has failed to become integrated into the academic culture, not as a result of the commonly cited factors of cost and faculty resistance, but rather due to the insistence of distance educators on perpetuating a culture that is out of touch with the driving force of higher education. (p. 17)

Similarly, Croft (1992) supported the issue of ownership and compatibility that traditional academic values prevent lecturers to "(p. 17). The issues of ownership and compatibility were also of interest to Dillon and Walsh (1992) as a means to successful diffusion of distance education.

They emphasized that distance educators must respond to the needs of the faculty as they, in turn, respond to the needs of the students. Their conclusion emphasized that the ingredient most neglected in diffusion of distance education is leadership, the very foundation of change. They stressed that current distance education literature "fails to view faculty development within the framework of a system which supports professional development (faculty growth)." (p.18)

Academic independence and credibility

Faculty members in higher education greatly value the tents of academic freedom and its corollary of independence (Croft, 1992). Croft (1986) maintains that the major problem facing distance education is a "reluctance to accept someone else's course because the "slant" or emphasis does not correspond exactly to one's own" (p,35) most often faculty members hold tenaciously to the notion that 'if we didn't make it, it cannot be good enough." (Smith, Daniel & Snowden, 1984, p. 84)

According to Smith and others (1984), the method of establishing academic credit often creates problems in distance education. Time-based formulae that equate contact hours in lecture, laboratory and field placement to course credits do not apply in distance education. Based on this many faculty members dismiss distance education with ease.

Biggs et al. (as cited in Konrad and Small, 1989) indicated that

> *Some academics still claim that distance education lacks legitimacy, arguing that it can give the shadow but not the substance of a university education, that it provides predigested instruction rather than the open-ended dialogue that is the essence of good education, and that its students miss the intangible but priceless benefits of residence on campus. (p.38)*

The fear of the loss of credibility of the universities becomes real when many of the traditional trappings of university education are not present. This adds to the reluctance of some academics to support distance education ventures (Konrad & Small, 1989). The fact that it is normally conducted as overload work and the perception that it is not integral to the institution's primary purpose strengthen misconceptions

Studies of faculty involvement in distance education

The relative importance of faculty resistance had been investigated extensively by Johnson, 1994; Siaciwena, 1989; Taylor & White, 1992; and Black, 1995. Black (1992) studied faculty-voting behaviour towards distance education at committee meetings in university of British Columbia, a large research-intensive university.

Support for distance education has been thoroughly reported by Black (1992). In her study faculty support for distance education was explicit, even when they were unfamiliar with the system. The

study was one of beliefs and values. Faculties who were concerned about maintaining the elite status of universities were resistant to change. In the study of 487 respondents and 50 interviews, 78% indicated they would vote in favour of distance education courses for undergraduate credit although the general consensus was that" they could not be in favour of more extensive endeavour" (p.168). The implication, here, is that faculty with high familiarity of distance education spoke more favourably about distance education than those with low or some familiarity.

Most of the faculty support for distance education in Black (1992) centred on accessibility. They believed that university education should be more accessible to a large section of the people. Black's (1992) study concluded that faculty support for distance education was largely determined by factors related to compatibility of distance education with faculty beliefs and values about the purpose of higher education. Faculty beliefs about accessibility of face-to-face interaction and campus experience were the most important factors. However, the large section of the study on qualitative analysis failed to address vividly the interrelationships among the variables used. Evidence should have been made to draw categories of support in terms of age and influence of other significant factors.

Clearly related to Black's (1995) study but using quantitative analysis is Clerk's (1993) survey of 317 faculty members in the United States. He reported that faculty members using distance education in their programs were more favourable toward the use of distance education in college credit courses and held very positive attitudes towards their personal participation in the programme. Approximately, 40% of college instructors had very positive attitudes towards using distance education.

One of the main issues established by Clark relates to interaction. Criticisms were based on the notion that distance education precludes interaction. One professor in his study disliked distance education on the grounds that "face-to-face interaction is part of what he considers education - distinct from transferring information or skills." (p.29)

In Clarks's study, concern for access and quality of education were positively identified by 48% of the respondents. Major criticisms centred on socialization and affective development (14%), class study (15%) and learner access to resources needed for college study (9.9%). Acceptance for distance education was based on the type of content and the type of students for which distance is appropriate. Other issues for disinterestedness in distance education by faculty were "the inability of rewarding faculty adequately for their work, research and publication and distrust of administrators" (p.31). Clark established that support for greater access was mixed with concern about (i) quality, especially quality of interaction, (ii) about ensuring effectiveness through the use of distance education in appropriate circumstances with adequate administrative support; and (ii) technical support and professional rewards. Both supports and skeptics agreed on the need for high standards, adequate resources, and personnel, whatever the mode of transmission.

Concluding Clark (1993) indicated that department and division chairs were relatively positive in their attitude towards distance education when compared to their professors. In his opinion, respondents who held positive option towards distance education despite their little or no experience with teaching at distance were likely to "support the growth of distance teaching in higher education" (p.32)

Taylor and White (1991) also studied faculty attitudes towards teaching in distance education in Australia with emphasis on job satisfaction. Using the valence model developed by vroom (1964) and a questionnaire on eighteen factors, they found out that five factors were rated consistently as being important to faculty in achieving personal job satisfaction. These were:

- Quality of interaction with students;
- Working with motivated students
- Satisfaction from the act of the teaching
- Feeling of personal achievement, and
- High level if student outcomes (p.8)

Their conception rested on the notion that

- Faculty could be attracted to the increased flexibility in their work schedule
- Associated with the distance education mode, since they are not tied so much to regular schedule classes. This possibly could enhance research and consultancy opportunities during normal working hours. (p. 11)

The finding clearly demonstrates that faculty placed more of a premium on intrinsic rewards associated with teaching than with research-based activities. Benefits perceived to be associated with off-campus teaching include autonomy, flexibility in work schedule and contribution to the needs of the broader community. To them, working with distance students "provides extensive opportunities for interpersonal interaction." (p.11)

Taylor and White noted that the attractiveness for distance teaching centres on the flexibility of the instructor. Of much concern to instructors in distance education is the quality of the interaction with the students, described as the most rewarding feature of teaching.

In another study at a Canadian university, Landstrom (1995) used questionnaires to interview twenty instructors involved in distance education on their preferences and needs. This study, although not extensive as the others, established that in most dual mode institutions, there are some detractors among faculty who fear or suspect that the courses are not as rigorous as regular courses, and that student contact will be less rigorous than classroom-based programs. Even among those who have written course guides, there exit some ambivalence about being involved in the program. There have also been some questions about the academic standards in distance education raised at faculty meetings.

From the instructors point of view, the lack of contact and the anonymity of distance students were the major drawbacks to distant courses. To some, lack of student contact prevents the instructor from testing his/her command of the subject, and limits his/her ability to teach effectively and to engage in discussions. Thirteen out of twenty respondents did not change their minds or attitude towards distance education during the length of time they taught at distance.

Haughey and Fenwick (1996) provided yet another insight into the attitude of tutors towards distance education. Their study of 181 school superintendents and staff established that "face-to-face learning is essential to the learner." (p.5) Some of the superintendents they studied felt in-school facilitators provided more of the necessary encouragement, assistance and guidance than learners separated from their tutor-markers. In the survey, 45% viewed distance education as a desirable replacement for traditional classroom instruction but many were skeptical as they indicated that on-campus studies may be an old-fashioned concept, "but we feel that the best opportunities for students are in the classroom with a teacher, because this situation offers immediate feedback and immediate assistance" (p.11).

The majority of respondents felt that 'face-to-face' contact between students and teachers was the best way to mediate learning effectively. Others felt classroom instruction 'spoon-feeds' students and that distance education helps even passive students to develop self-reliance and become more self-directed, independent, and resourceful as learners. Haughey and Fenwick's study suggested that supplementing distance learning with face-to-face instruction could be a useful innovation.

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Editor's Note: The Digital Divide is a global phenomenon with economic, social and political dimensions. Education agencies see information and communication technologies for education as a solution to many social and economic problems.

Networking Universities to Bridge the Digital Divide

Ana Jesús López and Rigoberto Pérez

Spain

Abstract

In recent years, attention has been focused on the digital divide, defined as "the gap between individuals, households, businesses and geographic areas at different socio-economic levels with regard both to their opportunities to access Information and Communication Technologies (ICTs) and to their use of the Internet for a wide variety of activities".

Reduction of these gaps is considered as a strategic goal in different contexts and it is widely agreed that the education can play an important role in the achievement of this objective.

In the context of the European Union several initiatives have been launched in order to achieve "the world's most competitive and dynamic knowledge-based economy, capable of sustainable economic growth and with more and better jobs and greater social cohesion" as approved at the Lisbon Summit (2000). Thus, the e-Learning initiative aims to boost the change from traditional education to systematic applications of Information and Communication Technologies (ICT) for the provision of flexible learning, encouraging the development of contents, services and learning environments, improving cooperation and dialogue at different spatial levels and between all the participants in the field.

In this paper we suggest the convenience of stimulating the development of university networks, describing some recent initiatives. We mainly focus on the European university context and we briefly summarize the experience of the G9 Virtual Network including nine Spanish universities.

Keywords: Information and Communication Technologies (ICT), e-learning, digital divide, Spanish G9 Virtual Network

Introduction

The development of the Information and Knowledge Society shows outstanding differences, thus leading to the existence of the so-called digital divide. According to the OECD (2001) this term refers to *"the gap between individuals, households, businesses and geographic areas at different socio-economic levels with regard both to their opportunities to access information and communication technologies (ICTs) and to their use of the Internet for a wide variety of activities"*.

Despite the potential benefits that can be offered by Information and Communication Technologies (ICT) developing countries face significant obstacles to ICT access due for a wide variety of reasons including technical, economic, legal and educational factors. In this paper we focus on the higher education as a strategic tool in order to bridge the existing digital divide.

According to a recent study by UNESCO (2005) one of the most significant divides between the world´s richest and poorest countries refers to the amount of schooling a child is expected to receive. A big part of this difference due to the provision of higher education. More specifically,

it is found that the average length of tertiary education is more than 30 times greater in the ten countries with the highest participation rates compared to the ten with the lowest rates.

In this context, development of cooperative experiences can be very helpful since they can lead to a significant reduction in the existing gaps. In this paper is organized as follows:

1. Analyze the potential of university networks as a strategic tool to bridge the digital divide.
2. Describe the current situation, summarizing the main geographical technological and educational differences and suggesting the potential of establishing university networks.
3. Focus on the European context, describing its position in education and research and analyzing the role ICT can play in the challenge of developing the European Area of Higher Education.
4. Briefly describe the Spanish virtual networks, focusing on the G9 Virtual Network experience.

The paper ends with some concluding remarks.

Digital Divide and Education

Information and Communication Technologies (ICT) offer opportunities for developing countries to narrow the existing development gap with industrialized countries. Nevertheless significant barriers must be faced including problems of infrastructure, legal regulations, the economic situation and also educational aspects which are the main aim of this paper.

The existing differences between geographical areas have been analyzed by UNCTAD (2005) through several indicators of ICT connectivity, access and diffusion. Figure 1 summarizes some outstanding results.

	Best Position (Ranking)	Worst Position (Ranking)	Average
OECD	United States (1)	México (73)	23
East Europe and CIS	Slovenia (23)	Kyrizkistan (151)	82
Latin America & Caribbean	Barbados (34)	Haití (164)	80
East Asia	Singapur (9)	Vanuatu (162)	88
Arab Status	Unión of Arab Emirates (20)	Djibouti (147)	87
South of Asia	Maldives (50)	Bangladesh (145)	107
Sub-Saharian Africa	Mauritius (52)	Guinea-Bisau (165)	130

Source: UNCTAD/ITE/IPC(2005)

Figure 1. ICT diffusion rankings by geographical areas.

Since the education, and more specifically the tertiary level, can be considered both as an explicative factor of the existing gap and as a strategic tool for its reduction, a comparative analysis of some available education indicators would be advisable. More specifically, figure 2 shows the rates of access to university education and the expected length of education, which can be interpreted as the number of years that a child at age 5 can expect to be enrolled in the considered educational level. This second indicator is a particular case of the School Life Expectancy (SLE) which indicates the average duration of schooling but not the grades reached

(since it computes years spent repeating grades, the SLE results overstate duration per child in countries with high repetition rates).

	Rates of Access to University Education (%)			Expected Length of Education (years)	
	Total	**Male**	**Female**	**University**	**Total (primary to tertiary)**
Africa	8	10	7	0.2	7.8
North America	55	48	62	3.1	14.3
South America	29	26	32	1.6	13.7
Asia	16	18	15	1.0	9.9
Europe	59	52	66	3.0	15.4
Australia	53	47	59	…	…

Source: UNESCO (2005)

Figure 2. Rates of access (%) and average length of education.

Although the European position is quite positive, a more detailed analysis (see Figure 3) shows that European figures on investment in education and R&D intensity are modest when compared with the leading countries in the world. Therefore, the European Councils have stressed the importance of research and innovation by setting the goal of increasing the level of expenditure in research and development to 3% of GDP by 2010, also emphasizing the need of a better co-ordination though the European Research Area (ERA) and some related actions.

Concept	EU-15	EU-25	USA	Japan
Public expenditure on education (% GDP)	5.22	5.22	5.35	3.6
Private expenditure on education (% GDP)	0.59	0.59	1.9	1.2
Annual expenditure on public and private higher education institutions (PPA per student)	8562.3	7945.9	18260.1	10253.3
Annual expenditure on public and private higher education institutions compared to GDP per capita (%)	37.1	36.9	57.8	43.9
R&D Expenditure (% GDP)	1.93	1.99	2.76	3.12

Source: EUROSTAT, OECD (2004)

Figure 3. Expenditures on education, research and development.

Since Information and Communication Technologies have a great potential to connect people for collaboration, they can help to make knowledge more accessible and sharable for advanced teaching and learning. Focusing on the European level, according to a recent study by PLS Ramboll Management (2004) around one third of the universities in the EU-15 Member States are currently involved in co-operating with universities from other countries with the aim to offer e-learning courses jointly.

Two main levels of trans-national cooperation can be identified, respectively referred to the EU-wide co-operation and one-to-one partnership. The first one is more usual, since the European Commission has financed during the last years many cooperative projects which are summarized at the E-learning website (www.elearningeuropa.info).

Furthermore, the E-learning program 2004–2006 launched by the European Commission seeks the effective integration of Information and Communication Technologies in education and training systems in Europe, including a specific action line referred to European Virtual campuses. In fact, the priority of this line (which represents a 30% of the program funding) is to add a virtual dimension to European co-operation in higher education by encouraging the development of new organizational models for European universities (virtual campuses) and for European exchange and sharing schemes (virtual mobility).

The development of cooperative initiatives has also been encouraged in the Ibero-American University Council (2004), suggesting the convenience of agreements allowing the recognition of studies. Although most of the existing university networks in this framework are traditional some virtual experiences have also been developed, such as the *Network Alive* project included in the "Luis Vives" ALFA Network between the European Union and Latin America.

Since the development of virtual networks must face organizational, educational, technical and financial problems, existing institutional networks and e-learning communities can play an essential role. In order to encourage these actions (which often depend on volunteer initiatives) some incentives should be established by national governments and universities. In this way, networking between higher education institutions would lead to resource saving collaborations, the development of joint teaching offers and the improvement of quality in higher education.

European Universities at a Glance. Is there a Digital Divide?

The European Union must face the challenge of increasing its investment in education and research in order to become a more competitive and dynamic economy. In fact, the European Councils stressed the importance of research and innovation by setting the goal of increasing the level of expenditure in research and development to 3% of GDP by 2010, also emphasizing the need of a better co-ordination though the European Research Area (ERA) and some related actions. The main differences between European Member States are shown in Figure 4.

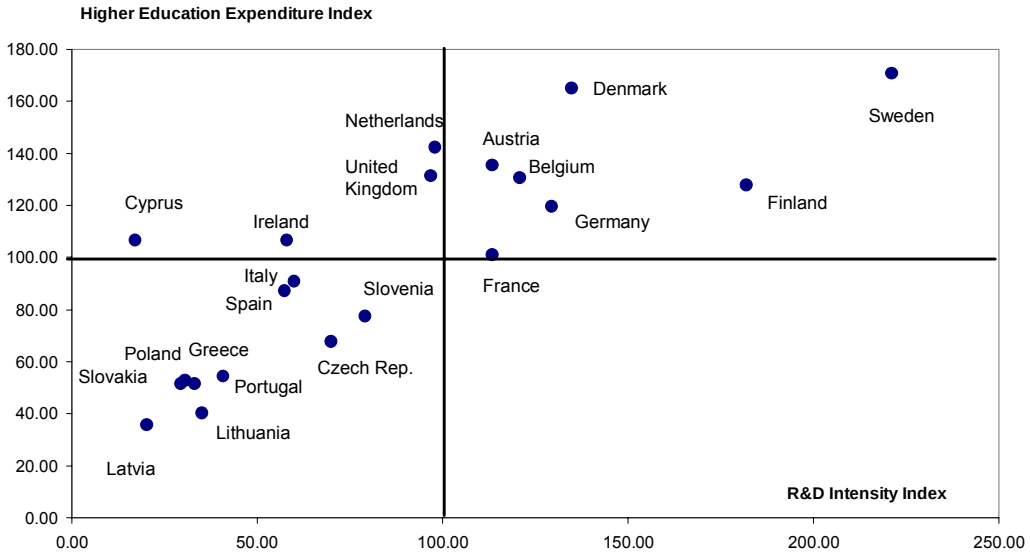

Figure 4. R&D Intensity versus Higher Education Expenditure
(Indexes, EU-25=100)

According to the information provided by Eurostat the highest R&D intensity was registered in Sweden (4.2% of GDP) then Finland (3.5%), followed by Denmark, Germany, Belgium, France and Austria, showing these countries also outstanding positions according to their expenditures

on higher education. It can also be seen that in general terms the ten new Member States lag behind the European average with regard to investment in higher education and research.

Although a high level of correlation was found between both indicators (leading to a Pearson´s linear correlation coefficient of 0.82), it can be noticed that some countries show an atypical behavior. This is the case of Cyprus, whose R&D intensity level is the lowest while its expenditure in higher education exceeds the EU-25 average level.

The existence of significant differences in the current position of some European countries suggest the convenience of analyzing their strategies regarding the use of Information and Communication Technologies on higher education. In fact, this is the aim of some recent researches which are summarized in Figure 5.

	Trends IV: European Universities Implementing Bologna	**Virtual Models of European Universities**	**Study of the e-learning suppliers market in Europe**
Reference	Reichert, S.; Tauch, C.- European University Association (2005)	PLS-Ramboll Management - European Commission (2004)	Danish Technological Institute- European Commission (2005)
Methodology	62 site visits to Higher Education Institutions in 29 European countries	Survey to more than 200 European Universities. Interviews and Cluster Analysis	Published Reports on e-learning in 26 European countries. Interviews with 15 organizations from 11 countries
Main Findings	General acceptance of the need for reforms seems to be widespread in universities. Many of them have made efforts to incorporate Bologna issues.	Most European universities show a positive attitude towards ICT integration and e-learning, although the support and priority allocated by university management is a critical obstacle in many of them.	E-learning products and services market remain small. Higher education is the market where Open Source e-learning platforms would represent a serious competition to commercial products by 2010.

Figure 5. Description of recent investigations on European Universities

The described investigations show some similarities, although the European University Association focuses on the implementation of the Bologna objectives across Europe, while the Study developed by the Danish Technological Institute is mainly interested in the economic aspects of e-learning. Finally, the analysis of the implementation of Information and Communication Technologies in European Universities is the main aim of the PLS-Ramboll Management investigation.

According to this last approach, some outstanding differences can be found allowing the division into four university clusters concerning their current use of ICT in the organizational and educational setting. Thus, following the study by PLS Ramboll Management, the “front-runners universities” (18%) are distinguished by their pre-eminence in all respects, including their level of co-operation with other universities and other suppliers of education.

The second cluster is defined as “co-operating universities”, which are characterized by the extensiveness of their involvement in strategic co-operation with both domestic and foreign universities and with other education suppliers. These universities (33%) are, like the front-runners, quite advanced in the integration of ICT into their campus-based teaching, but show a more limited use of e-learning courses and digital services.

"Self-sufficient universities" comprise the largest cluster, encompassing 36% of the universities. Their level of ICT integration in the organizational and educational setting is similar to that of the co-operating universities, but they engage in strategic co-operation with other universities or suppliers of education only to a minimal degree.

The remaining 15% corresponds to the "skeptical universities" which are observed to be lagging behind the rest in almost every respect. In general terms these institutions are characterized by a limited use of digital services, limited ICT integration in their on-campus teaching, and a very low proportion of e-learning courses.

On the basis of this analysis, PLS Ramboll Management has generated some recommendations at European, national and university level, mainly focusing on the dissemination of experiences and good practice, the quality assurance and assessment procedures, the design of joint degrees, the use of common metadata standards and the development of European networks.

The European dimension has also been recently stressed by the European University Association (EUA) in the Glasgow Declaration (2005) entitled "*Strong Universities for a Strong Europe*", which refers to the reinforcement of the European dimension in a variety of ways, including benchmarking curricula, developing joint degrees using European tools or enhancing intercultural and multilingual skills.

A Spanish Experience. The G-9 Virtual Network

As we have previously said, existing institutional virtual networks can be very helpful in the development of European virtual campuses. In this section we describe the Spanish experience, mainly focusing on the so-called G9 Virtual Network.

The European emergent trend towards a higher level of institutional co-operation also appears in the Spanish context, as it is pointed out in some recent studies carried out by López et al. (2002) and CRUE (2004). The following table summarizes these experiences including three university networks (ADA-Madrid, Intercampus and the G9 Virtual Network) and also a cooperative alliance involving both public and private organizations.

ADA-Madrid	Intercampus	G9 Virtual Network	IUP
U. Autónoma de Madrid; U. Carlos III; U. Complutense de Madrid; U. de Alcalá; U. Politécnica de Madrid; U. Rey Juan Carlos	U. Autónoma de Barcelona; U. de Barcelona; U. de Girona; U. de Lleida; U. Oberta de Catalunya; U. Pompeu Fabra; U. Politécnica de Catalunya; U. Rovira i Virgili	U. de Cantabria; U. de Castilla-La Mancha; U. de Extremadura ; U. de les Illes Balears; U. de La Rioja; U. de Oviedo; U. de Zaragoza; U. Pública de Navarra	U. Carlos III, U. Autónoma de Barcelona, U. de Alicante, Santillana Formación
30 subjects	48 subjects	70 subjects 1 Master online	9 Masters online
http://adamadrid.uc3m.es	http://www.catcampus.org	http://www.uni-g9.net	http://www.iup.es/

Figure 6. Spanish Virtual Networks

The G9 Group of Universities was created in 1999 and it currently includes nine public universities located in different Spanish regions. As figure 7 shows the geographical diversity is one of the most outstanding characteristics of this network, while ADA-Madrid and Intercampus are respectively located in the regions of Madrid and Catalonia.

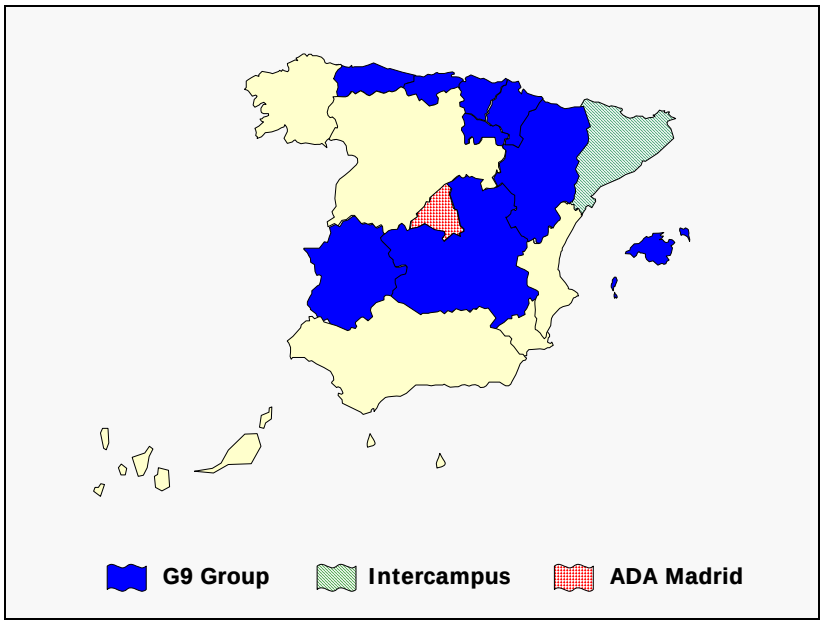

Figure 7. The G9 Virtual Network

During the last years the G9 Virtual Network has gradually increased the level of interaction between the involved institutions, thus adding a new dimension to the e-learning experiences (where students usually interact with the content, instructors, classmates and themselves). Several legal, academic, technical and administrative challenges have also been faced in order to guarantee the full academic recognition of the credits coursed at each of the G9 universities. At the present moment the G9 Virtual Network involves 2485 students, 70 subjects and a joint master degree is under development.

Opinions of all the agents involved in the G9 virtual network are yearly collected through online surveys. Furthermore, annual meetings are organized providing teachers, students and technical staff with an excellent opportunity for sharing their experiences.

According to the online surveys, students of the G9 Virtual Network are mainly motivated by the use of new learning methods and their flexibility and most of them consider this experience very positive. Students are connected to the Shared Virtual Network an average of three hours per week and they find the learning materials as adequate or very adequate (82.6%) of a high quality and well structured (80.4%) and available in time (71.7%). A more detailed description of the G9 Shared Virtual Network experiences can be found in Salinas et al. (2002) and López and Pérez (2005a).

In general terms students highly appreciate the tutorials and communication facilities (forum, chat, mail, video-conferences, …) and the interactive learning materials. On the other side, most of them find that the university infrastructures do not fully satisfy the e-learning requirements.

For which it refers to the near future, as Pérez (2004) points out, the G9 Virtual Networks aims to continue improving quantitatively and qualitatively its educational offering, with the incorporation of new joint master degrees, to implement common incentives for the G9 virtual teachers and tutors, to develop joint research projects in e-learning and to undertake an internationalization process, with its incorporation to both European and Latin American networks.

Concluding Remarks

The available information shows the existence of a digital divide between developing and industrialized countries. Furthermore, a significant divide is also found when analyzing the education indicators and more specifically at the university level.

Since the education can be considered both as an explicative factor of the existing gap and as a strategic tool for its reduction, it would be advisable to increase the investment on education, research and innovation also encouraging the co-operation in higher education and research.

In the European context, the E-learning program 2004-2006 includes a specific action line whose priority is to add a virtual dimension to European co-operation in higher education by encouraging the development of virtual campuses. Although this objective must face some legal, academic, technical and financial difficulties, the experience achieved by existing cooperating initiatives and virtual communities can be very helpful in this process.

The experience of Spanish G9 Virtual Network has shown the potential of the university co-operation, also suggesting the need of further efforts to improve its learning offer and the convenience of establishing international alliances with existing networks both in the European and the Latin-American contexts.

In summary, we can conclude that making university networks a widespread reality is still a challenge and it should be considered a strategic goal for the coming years, which could highly contribute to increase the quality also decreasing the existing digital divide.

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Editor's Note: Fuzzy cognitive maps can play an important role in decision making. This article shows how a myriad of attributes can be mapped to determine the probability of success of a distance learning course.

A Methodology for Evaluating a Course for Distance Education

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USA

Abstract

Determining whether a technical course will succeed if delivered through some distance education means involves judging how a myriad of attributes will interact and impact its success or failure. Although some of these attributes should be common to most courses, instructors and curricula, many are specific to the institution and its educational environment. To assess the efficacy of a course for distance education, fuzzy cognitive maps are proposed as a methodological technique for capturing the unique attributes and interactions that must be examined. To illustrate the technique a representative fuzzy cognitive map is constructed for a generic technical course and used to assess it chances for success through remote delivery under various conditions.

Keywords: fuzzy cognitive maps, distance education, asynchronous lectures

Introduction

Increasingly engineering and engineering technology programs are evaluating the efficacy of non-traditional delivery mechanisms for coursework. This is being driven in part by the need to increase class sizes to meet financial constraints while maximizing the accessibility of students to particular faculty expertise. It is also, in part, the result of enhanced capabilities in computer networking, video teleconferencing, remote access to laboratory equipment and to a variety of other new Internet-interfaceable technologies. [1] But not every course is or should be considered a candidate for distance education. A variety of attributes about the course, the instructional environment in which it takes place and the technology available to support its delivery all interact to determine its success or failure. Drawing on the experiences of the authors, this paper delineates these attributes and their interactions to provide insight into how to assess the likelihood that a particular class will be received by students and faculty positively if delivered through some remote technique. [2]

Any assessment of a course for its potential for distance delivery necessarily must incorporate a variety of attributes. [3] To fully predict whether a course will succeed or fail if delivered through some remote mechanism requires more than a listing of these attributes. It requires an understanding of how these attributes will interact with each other to enhance or mitigate certain effects. Although one can define certain attributes and interactions as "universal" that will probably occur with any distance education course, many of these will be unique and specific to instructors, students, institution and educational environment in which it takes place. As such the intent of this paper is to develop a methodology rather than an answer for evaluating whether a course can be successfully delivered as distance education.

To provide a framework for the evaluation of a course, several assumptions will be made about techniques for distance delivery of a course and about the environment in which this delivery takes place. Although teleconferencing technology has the potential to develop new paradigms for technical education that replace the traditional lecture/laboratory format, these will only be

mentioned in passing. [4] For this paper, it is assumed that the candidate distance education course will be structured in such a way as to generally mimic a traditional lecture/laboratory format. An additional assumption will be that, to the extent possible with available technology, lecture and laboratory materials will be delivered to students through some distance communications means, such as the Internet, with the goal being minimal visitation by a faculty member to the remote site.

In our case, the following attributes were used for judging whether a distance education course was a success or a failure. Any distance education offering should not require substantial additional expenditures of financial resources. If it does, then the first rationale for offering distance education is not met. If students will not take the courses and faculty will not teach them, then adding faculty around the state of Indiana will not provide the distributed foundation of faculty expertise required to meet the second rationale listed above, namely, to allow all students access to faculty expertise within Purdue Statewide Technology regardless of location. Thus, to satisfy the above rationale, both students and faculty should be satisfied with the results. This, then, provides three attributes for evaluating a course for potential distance implementation: whether additional financial resources are required, whether faculty are satisfied with the results and whether students are satisfied with the results.

Fuzzy Cognitive Maps

As will be described below, a variety of attributes can be identified that will impact whether a candidate course for distance education will likely succeed. These attributes interact in a variety of ways (some of which are not always obvious) to determine an overall assessment of the likeliness that a candidate course can be effectively delivered using some means of remote access. A tool is needed that can accommodate diverse types of attributes and their interactions in assessing whether a course is a good candidate for distance education. The tool chosen here is a fuzzy cognitive map.

A fuzzy cognitive map is a signed di-graph that captures the cause/effect relationships that subject matter experts believe exist about a problem. [5] Causes and effects are represented in a map as nodes, with signed, directed edges between nodes indicating the existence of a relationship. [6] Nodes are restricted to three numeric values: 1, 0 and -1, with these values indicating an increase, no change and a decrease, respectively, in the underlying concept represented by the node. In some cases, the underlying concept represented by a node is such that it realistically has only two values, 1 and 0, representing the presence or absence of this attribute respectively. Thus, nodes in a fuzzy cognitive map capture changes in the concepts represented by a node.

Fuzziness enters the map through the edge strengths. Each edge is given a value on the interval [-1,1] to indicate the strength of the relationship between the nodes. Negative values indicate inverse causality, i.e. increasing the cause decreases the effect. Positive values indicate direct causality, i.e. increase the cause and the effect increases. Fractional values for the edge strengths indicate partial causality, and are used to capture linguistic modifiers such as *somewhat, a little, a lot*, etc. [6]

The fuzzy cognitive map is a true model of a problem and its solution in the sense that outputs can be predicted when inputs are applied. In a fuzzy cognitive map, certain nodes are designated as inputs, with the actual set contextual. The actual input nodes are dependent on the available data and what information is desired, with the representative nodes changing as the context of the problem changes. [7] These input nodal values are applied to the map and become sources of causality, much in the same way that voltage sources become sources of energy in an electric network, and are held constant throughout the inference process.

With the input nodes applied, the values are propagated through the map until it either equilibrates to steady values or oscillates between several values. The inferred value for a node is calculated by summing all nodal values causing it weighted by their edge strengths. A thresholding function is then applied to the result to map the result of the summation to one of the three valid state values (-1, 0, +1). The inferred output is the value of all nodes in the map that result from the application of the inputs, with the totality of the nodes representing a "state of affairs" for the system given the input nodal values. [8]

Fuzzy Cognitive Map for Distance Delivery of Courses

The following figure is a graphical representation of the fuzzy cognitive map constructed by the authors to understand how different attributes interact to determine the success or failure of a remotely delivered course. Each node within the map represents some variable quantity that has, can or will impact a distance education course. The attributes used were obtained from the literature, from personal experience with delivering remote coursework and through interviews with students that have taken them. [9,10] As constructed the map has a purely feed-forward structure; feedback is not present. Causality in the map flows from basic characteristics of the course and delivery environment like *Quality of Text* and *Similarity of Equipment Onsite-Host*, to the value judgment nodes of *Resources Required*, *Faculty Satisfaction* and *Student Satisfaction*.[1] Although there are 24 different attributes represented in the map they naturally cluster into six areas: lecture resources, laboratory resources, delivery method, student satisfaction, faculty satisfaction and resources required, with some overlap of nodes.

Lecture Resources

Since it is assumed here that any distance education course will attempt to mimic a traditional lecture/laboratory format and not try to use any new paradigm for content delivery, the quality of traditional classroom resources at the remote site are very important to the overall success of the course. *Quality of Text* refers to the usefulness of a text for the class as resource for students in understanding the material. The better the text, the clearer its explanations and the more closely it matches the content of the course, the more likely a student at a remote site is to find it useful in helping him/her grasp the material being presented. Thus, *Quality of Text* is a cause of *Usefulness as a Resource* in the map with direct causality (+ edge strength).

Quality of Lecture refers to the organization of the class and the clarity of the explanation provided in the classroom. Poor explanations provided in the classroom reduce their value as a resource for the student in mastering the material (*Usefulness as a Resource*) and necessitating the need for personal interaction with the instructor for additional clarification of a concept (*Access to Instructor for Consultation*). [11] In a distance education course this interaction is usually accomplished by phone, through electronic means such as email or online chat, or with a periodic visit by the instructor to the remote site. Regardless of the method, the more opportunities provided the students to get clarification on a topic or questions answered by an instructor (*Access to Instructor for Consultation*), the more useful such interaction is going to be to the student (*Usefulness as a Resource*).

[1] Names of nodes in the fuzzy cognitive map will be italicized in the text.

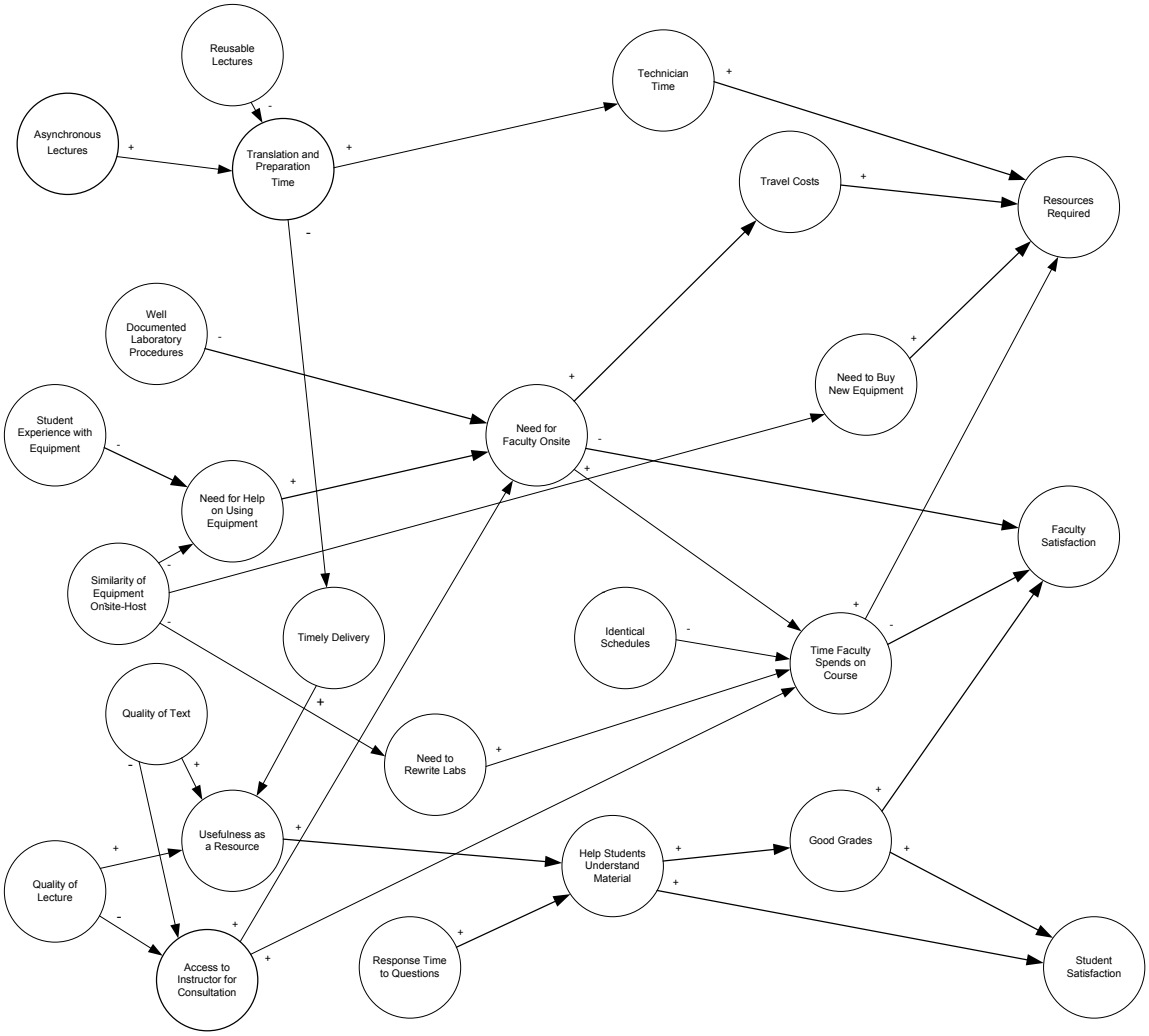


Figure 1. Fuzzy Cognitive Map of Remote Delivery of Technical Courses

The more the need for the instructor to be onsite (*Access to Instructor for Consultation*), though, the more time the faculty member will spend on the course (*Time Faculty Spends on Course*) and the greater the need for the instructor to actually visit the remote site (*Need for Faculty Onsite*).

The more useful these secondary resources are to the student (*Usefulness as a Resource*), the more likely they are to understand the material (*Help Students Understand Material*). This understanding is also predicated on a timely response to questions. To be of value in grasping material, a question must be answered quickly enough that the student understands it before they are tested on it, or before the concept is used as the basis for the development of a succeeding concept (*Response Times to Questions*). Anything that tends to decrease the response time will tend to increase the likelihood that the student will understand the material.[2] Students that understand the material presented in class (*Help Students Understand Material*) will more than likely also get good grades (*Good Grades*).

[2] Since this relationship has inverse causality, decrease *Response Time to Questions*, increase *Help Students Understand Material*, the edge strength has as negative value.

Laboratory Resources

Of the two components to a traditional technical course, probably the more difficult to reproduce in a distance education class is the laboratory experience. The greater the similarity between the equipment at the host and remote sites (*Similarity of Equipment Onsite-Host*), the less is the need for assistance by the instructor or a laboratory assistant in teaching the students how to use particular equipment or take certain measurements (*Need for Help on Using Equipment*). Dissimilar equipment will require different settings and, in somewhat extreme cases, may actually look different from equipment at the host location. In this case, the laboratory procedures must be re-written (*Need to Rewrite Labs*) or the instructor (or an assistant) provided onsite to clarify the procedures (*Need for Faculty Onsite*). Likewise, if the students have previous experience using the equipment (*Student Experience with Equipment*), the less they will need onsite assistance in doing a particular exercise or laboratory procedure.

Well written, well documented laboratory procedures are also a necessity. In an onsite course, the instructor has less need to be absolutely thorough in their laboratory instructions because they will be present when the students work on the problem and can immediately answer questions or troubleshoot problems. They can, in fact, "forget" to document things and the exercise can still be a success. Poorly or incomplete laboratory procedures at a remote site, though, will hinder the progress of the students in their task thereby requiring additional time to be devoted to the laboratory by both the instructor, who may have to visit the remote site to recast the procedures to make them compatible with the local equipment, and the student, who may have to defer completion of the exercise until further information is provided. Well written, well documented laboratory procedures (*Well Documented Laboratory Procedures*) are required to reduce the need for the faculty to visit the remote site (*Need for Faculty Onsite*) and prevent any delays in students completing them.

Delivery Method

The particular methods used to deliver the distance education course, whether it is the lecture or the laboratory portion, can have a significant impact on its viability. Since the authors only experience has been with asynchronous delivery of lecture (taped and made available through the network), the analysis will concentrate on this type of remote access for lecture. Using asynchronous delivery (*Asynchronous Lectures*) of lectures requires potentially extensive translation and preparation of the recorded material to make it available on the Internet (*Translation and Preparation Time*).[12]The time that it takes to prepare the material for student use can negatively impact it usefulness as a resource for them. Any increase in the preparation time (*Translation and Preparation Time)* will decrease the likeliness of its timely delivery to the students (*Timely Delivery*). If materials are late in getting to students they may miss or need to delay assignments and laboratory exercises thus reducing their usefulness to the learning process (*Usefulness as a Resource*). However, preparing recorded materials for delivery to students in a short period of time will require a potentially significant effort by a technician or other support staff member (*Technician Time*).

Student Satisfaction

Student satisfaction is one of three key attributes a distance education course (and distance education experience) must have. Remote delivery of courses has been proposed as a mechanism for solving or alleviating problems schools face with in the new reality of limited budgets and declining enrollments. But remote delivery of courses will have no effect on these problems if students avoid them. And students who have had a poor experience with a remotely delivered course will not enroll in future offerings.

The exact factors determining whether a student will be satisfied with a course will vary greatly by context, by subject and by their personal psychology. As such, any criteria used to judge

"student satisfaction" are necessarily generalizations. The authors assumed that a student will be satisfied with the outcomes of a course if they learned the material, thereby giving them the foundation to apply the concepts to real-world problems, and if their grades were "good". Good grades would be an indicator of mastery of the material and an acceptable reward for the efforts expended by a student in taking the course. In the fuzzy cognitive map, *Student Satisfaction* has two causes, *Help Students Understand Material* and *Good Grades*. Any resource or effort in delivering the distance education class that increase either of these will improve the satisfaction of the student with the course.

Faculty Satisfaction

Like students, faculty must be satisfied with the distance education experience or they will avoid teaching other courses in this manner. Faculty satisfaction (or dissatisfaction) can be affected by both the additional effort they must expend in teaching the course and by the results, as determined by the level of student performance in the class. If a distance education class ends up requiring or needing a significant level of effort beyond a regular course taught onsite (*Time Faculty Spend on Course*), it will create faculty dissatisfaction with remote delivery of classes (*Faculty Satisfaction*). Faculty members are much less likely to voluntarily participate in future distance education classes under these circumstances.

When dealing with two different locations, there is the possibility that they will have different academic schedules. Dissimilarity in academic schedules can have very negative effects on faculty satisfaction. If holidays, vacations, final exam schedules, starting dates and ending dates for the semester are different, instructors may find themselves reteaching or repeating materials several times thereby increasing their work load. Thus, the lack of identical schedules (*Identical Schedules*) will tend to increase the work load for the faculty (*Time Faculty Spend on Course*) and decrease their satisfaction with the distance education experience (*Faculty Satisfaction*).

Any need for faculty to be onsite at the remote location will negatively directly and indirectly affect the satisfaction of the instructor. The need to be onsite (*Need for Faculty Onsite*) directly reduces faculty satisfaction (*Faculty Satisfaction*) because it requires travel time to reach the remote location that could have been better spent doing other things. Indirectly it will reduce faculty satisfaction because it invariably increases the work (and time) required for the course (*Time Faculty Spends on Course*).

Resources Required

The final cluster of nodes in the map involves the resources required for delivery of the distance education course. One of the determining factors for many institutions in the development of distance education classes is the need to increase the access of students to courses while minimizing additional expenditures to do so (*Resources Needed*). In this framework, the more successful distance education courses are going to be those that are implemented with minimal additional resources. Classes that require significant purchases of new equipment (*Need to Buy New Equipment*), large expenditures for travel (*Travel Costs*), more support staff (*Technician Time*), or considerable release time for faculty with the need possibly to reassign duties to others (*Time Faculty Spends on Course*) are not likely to be viewed favorably by the administration. In the extreme case, if the total of new resources needed exceeds some threshold, it may make more sense financially to hire an additional faculty member at the remote site.

These clusters of nodes capture the basic relationships that exist for evaluating a course as a candidate for remote delivery. In most cases the input nodes, given in table 1, are assessable for a course prior to its implementation. With this assessment in hand, these nodal values can be applied to the map to infer whether the constituencies involved with the course will be satisfied with the results. Possible sources of information for assessing values for the different input nodes

include class surveys, instructor evaluations, laboratory inventories, faculty surveys or expert judgments.

Table 1

Inputs Nodes for Fuzzy Cognitive Maps of Remote Delivery of Technical Courses

Input Node
Quality of Lecture
Quality of Text
Similarity of Equipment Onsite-Host
Student Experience with Equipment
Well Documented Laboratory Procedures
Asynchronous Lectures
Reusable Lectures
Response Time to Questions
Identical Schedules

Candidate Courses

By assessing values for some or all of the input nodes given in table 1, an inference can be made about the expected levels of satisfaction of students and faculty participating in a course, and the resources required to implement it. Ideally, all of the constituencies involved in the course will be either satisfied or not satisfied, making the decision about offering the course easier.[3] In all likelihood, though, it is possible for the inferred judgment nodes to be contradictory in the sense that some indicate satisfaction while others indicate dissatisfaction. It has been the authors' experience in developing and delivering distance education coursework that all three of the principal players involved in the distance education course, the students, the faculty and the administration, must be satisfied with the result or they will not participate in them again. As such, the map should infer for any candidate course that the students and faculty are satisfied (*Student Satisfaction* is +1 and *Faculty Satisfaction* is +1) and that the additional resources needed to offer the course are minimal (*Resources Required* is 0 or -1). Courses that give other combinations that do not meet this stringent requirement will be considered inappropriate candidates for delivery through distance education.

When evaluating a course not all nine defined input nodes given in table 1 need to have values for the map in order to make an inference. The fact that the map will infer results without a complete set of input nodes is an important feature of this technique. However, the more nodes that are assigned values, the better the "quality" of the inference. If only one nodal value was available,

[3] Note that the *Resources Required* node is being used as a surrogate for the administration of the programs. They are "satisfied" if there is no significant increase in resources required to offer the course. This then means that the node *Resources Required* should have an inferred value of -1 (decrease in resources required) or 0, no change in resources required.

for example *Quality of Text*, then a decision maker might be justifiably suspicious of the inference from the map because so little data was used. On the other hand, if seven of the nine input nodes provided values, then, although still not complete, the inference may be deemed acceptable. Ultimately it will be up to the decision maker to judge whether to accept inferences from the map made with fewer than all of the input nodes.

Candidate Courses

Four example candidate courses will be evaluated using the fuzzy cognitive map just provided: good lecture and laboratory attributes, bad attributes for both, good lecture but bad laboratory resources and bad lecture but good laboratory resources. For these the input nodes are clustered into lecture and laboratory resources, and are presented in table 2. In all cases asynchronous lectures are assumed. These four examples were chosen because two (good attributes for both and bad attributes for each) tend to validate the inferences made by the map, and because two (good attribute for one and bad attribute for the other) illustrate additional possibilities for real world situations. These four examples also specifically cover a broad range of the types of situations instructors and administrators might find themselves in when evaluating candidate courses for distance education. Individual nodes within each cluster can be changed to reflect the actual situation present.

Table 2

Input Node Classification

Lecture Attributes	***Laboratory Attributes***	***Other***
Quality of Lecture	*Similarity of Equipment Onsite-Host*	*Asynchronous Lectures*
Quality of Text	*Student Experience with Equipment*	*Reusable Lectures*
Response Time to Questions	*Well Documented Laboratory Procedures*	
Identical Schedules		

Nominal Case: Good Lecture and Good Laboratory Attributes

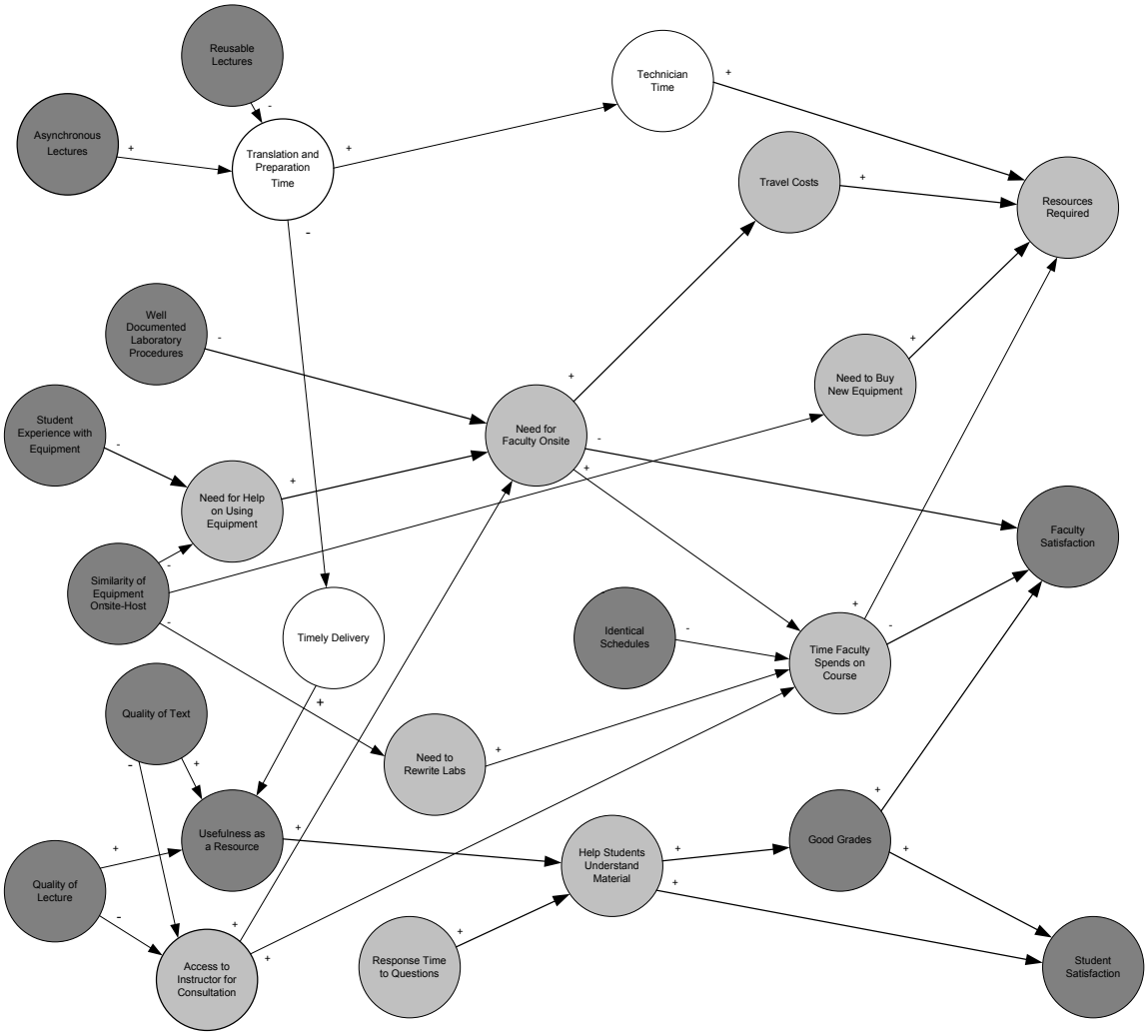
This case represents the best of all possible worlds. The attributes of the lecture are such that they fit well with the characteristics expected for a course that will succeed through distance delivery, the textbook is good as are the lectures delivered by the instructor. Additionally, laboratory procedures are well written, the students have previous experience with the equipment and software, and the equipment at the remote site is the same or significantly similar to that at the host site. The resulting map is given in figure 2.

In the map, these nodes are given values of +1 (dark gray) to indicate an increase in or presence of the underlying concept represented by the node in the map. Only one input node, *Response Time to Questions*, is given a -1 value. This is to indicate that there is a decrease in the response time to questions which is actually positive for the overall situation. The inputs and outputs for the map are given in the following table.

Table 3

Input/Output Nodes for Fuzzy Cognitive Map

Input nodes	Output nodes
Reusable Lectures	*Resources required*
Asynchronous lectures	*Faculty satisfaction*
Well documented laboratory procedures	*Student Satisfaction*
Student experience with equipment	
Similarity of equipment onsite-host	
Quality of text	
Quality of lecture	
Response time to questions	



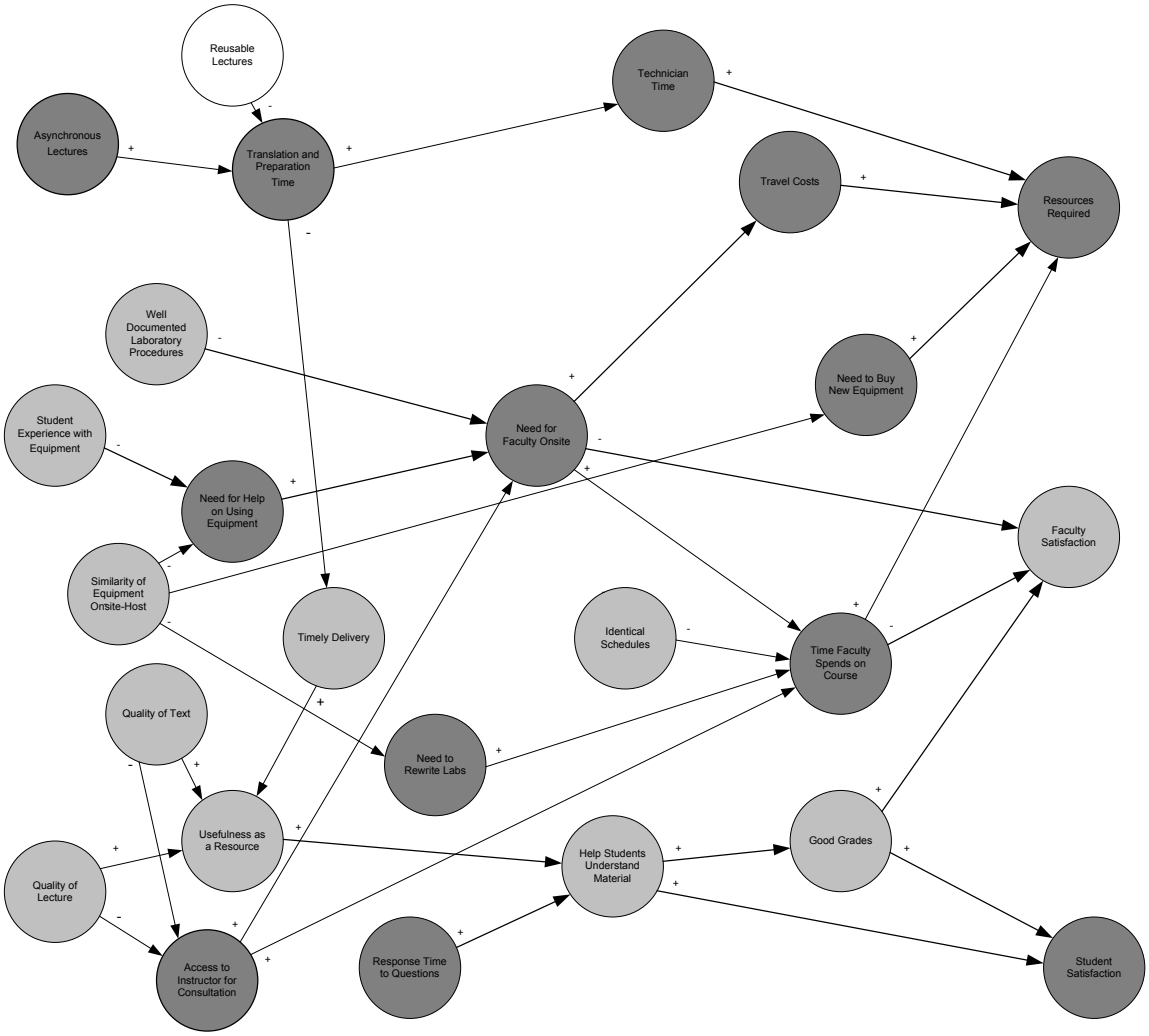
Light gray indicates a nodal value of -1, dark gray a nodal value of +1;
no background color a nodal value of 0.

Figure 2. Nominal Case: Good Lecture, Good Laboratory Setup

Following the procedures outlined above, these input values are propagated through the value to infer state values for the three output nodes: *Resources Required*, *Faculty Satisfaction* and *Student Satisfaction*. The inferred values in this case match the requirements given previously for a successful distance education course. *Resources Required* decreases (light gray, -1), *Faculty Satisfaction* increases (dark gray, +1) and *Student Satisfaction* also increases (dark gray, +1).

Nominal Case: Bad Lecture and Bad Laboratory Attributes

This case is the dual to the previous example and represents the worst of all possible worlds. For this example none of the lecture attributes nor any of the laboratory attributes meets the necessary standards for a successful distance education experience for the students, faculty or university administration. The text is poor as are the lectures. Response time to student questions is lengthy. Class schedules between the host and remote site are not in sync. The laboratory equipment is different between the host and remote sites, and students have little useful experience with it. Laboratory procedures are poorly written.



Light gray indicates a nodal value of -1, dark gray a nodal value of +1;
no background color a nodal value of 0.

Figure 3. Nominal Case: Bad Lecture, Bad Laboratory Setup

All of the input nodes is this case are assigned values of -1 (dark gray) to indicate a decrease or absence of the concept, except *Response Times to Questions*. This nodes is assigned a value of +1 (light gray) to indicate an increase in the time it takes students to get their questions answered. The map is allowed to equilibrate inferring that the resources required increase and both student and faculty satisfaction decrease. This state of affairs would suggest that the candidate course being examined is not suitable for remote delivery.

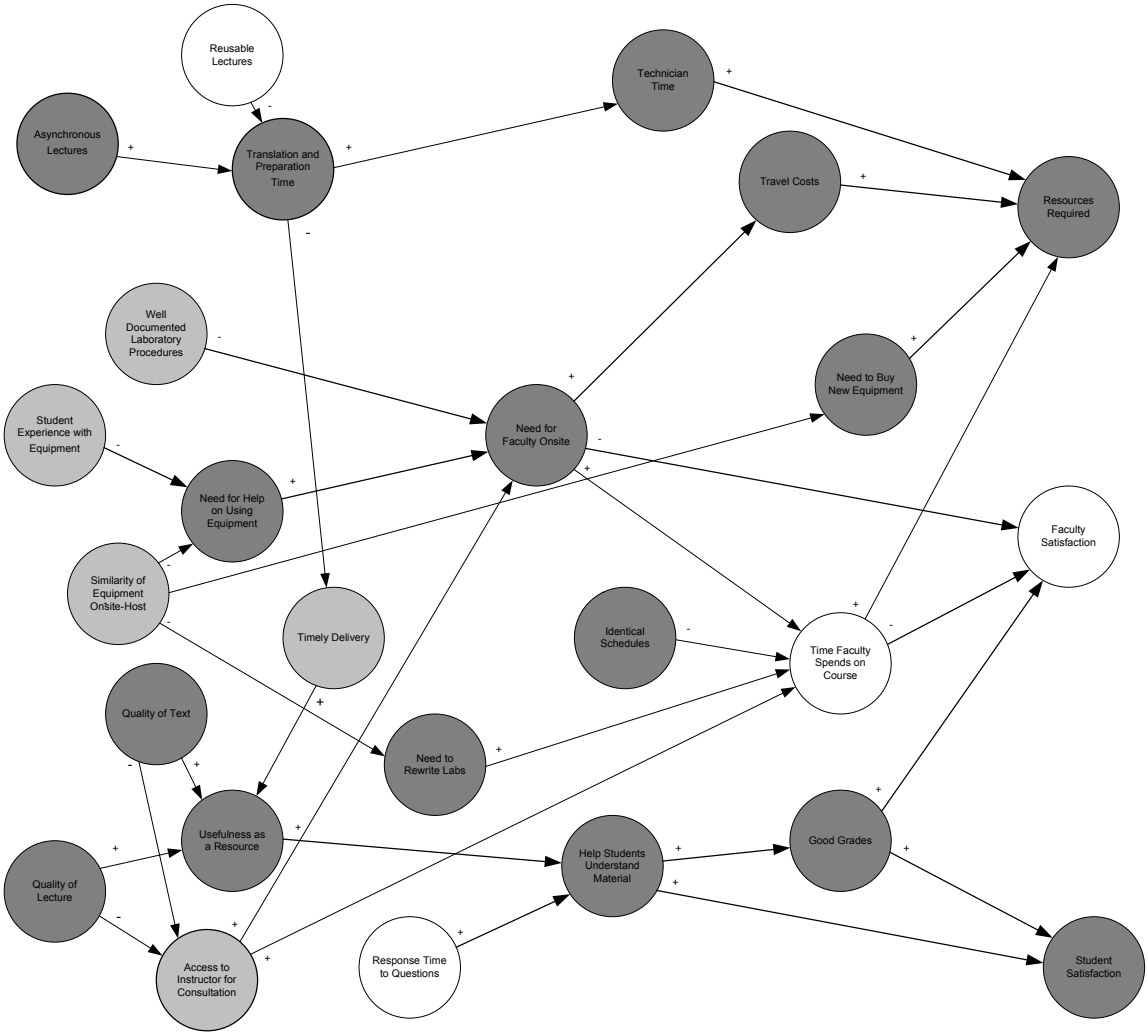
Case: Good Lecture and Bad Laboratory Attributes

The two nominal cases just presented represent the two possible extremes for the characteristics of a candidate course. Unfortunately, "real" courses will have a mix of attributes that make it fall somewhere in between the extremes of the best of all possible worlds and the worst of all possible worlds. Two additional cases will be examined that fall into this category. For this case, the lecture attributes of the course are assumed to be good, but the attributes of the laboratory portion of the course fall short. Class schedules are identical. The text and lectures are good, but the laboratory procedures are poorly documented. Additionally, the equipment at the remote site is significantly different from the equipment at the host site and the students taking the remote course have little experience with it. The map with these inputs is given in figure 4.

Given these inputs, good lecture and poor laboratory characteristics, the map infers an increase in the resources required to operate the course (*Resources Required*, +1), ambivalence about faculty satisfaction (*Faculty Satisfaction*, 0), and an increase in student satisfaction, (*Student Satisfaction*, +1). Given the strict requirements listed previously, a course with these attributes would not be a good candidate for distance delivery. An increase in resources would be required to offer it, and faculty satisfaction does not increase.

This case also illustrates another use for the map, identifying interventions, i.e. ways to change, that might alter the results in the desired direction. Because the map is constructed as a detailed series of cause/effect relationships, it can also be used to identify which, if any, relationships must be altered or broken to affect a change. For this case, assume that an increase in resources is not as important as increasing faculty satisfaction. A candidate course must provide both faculty and student satisfaction, with an increase in resources allowable. Back chaining through nodes in the map from output to inputs can be used to identify possible ways to change them or possible ways to alter the structure of the map to change the outcome. Altering the structure, though, would require a change in the environment modeled by the map.

Examining figure 4, faculty satisfaction is caused by three nodes, one of which is already positive for the desired outcome, *Good Grades*. *Time Faculty Spend on Course* would be a good candidate because two of its four causes are already positive for the desired outcome, *Access to Instructor for Consultation* and *Identical Schedules*. Of the two remaining causes the simplest to alter would be *Need to Rewrite Labs* because it has a single cause. In this case it might be possible to change its cause, *Similarity of Equipment Onsite-Host*, by buying the same equipment for both sites. This would change the value of this input node from -1 (dissimilar) to +1 (similar). Propagating this value through the map will in fact change the output *Faculty Satisfaction* to +1, the desired outcome, while leaving the other two output nodes with their same values.



Light gray indicates a nodal value of -1, dark gray a nodal value of +1;
no background color a nodal value of 0.

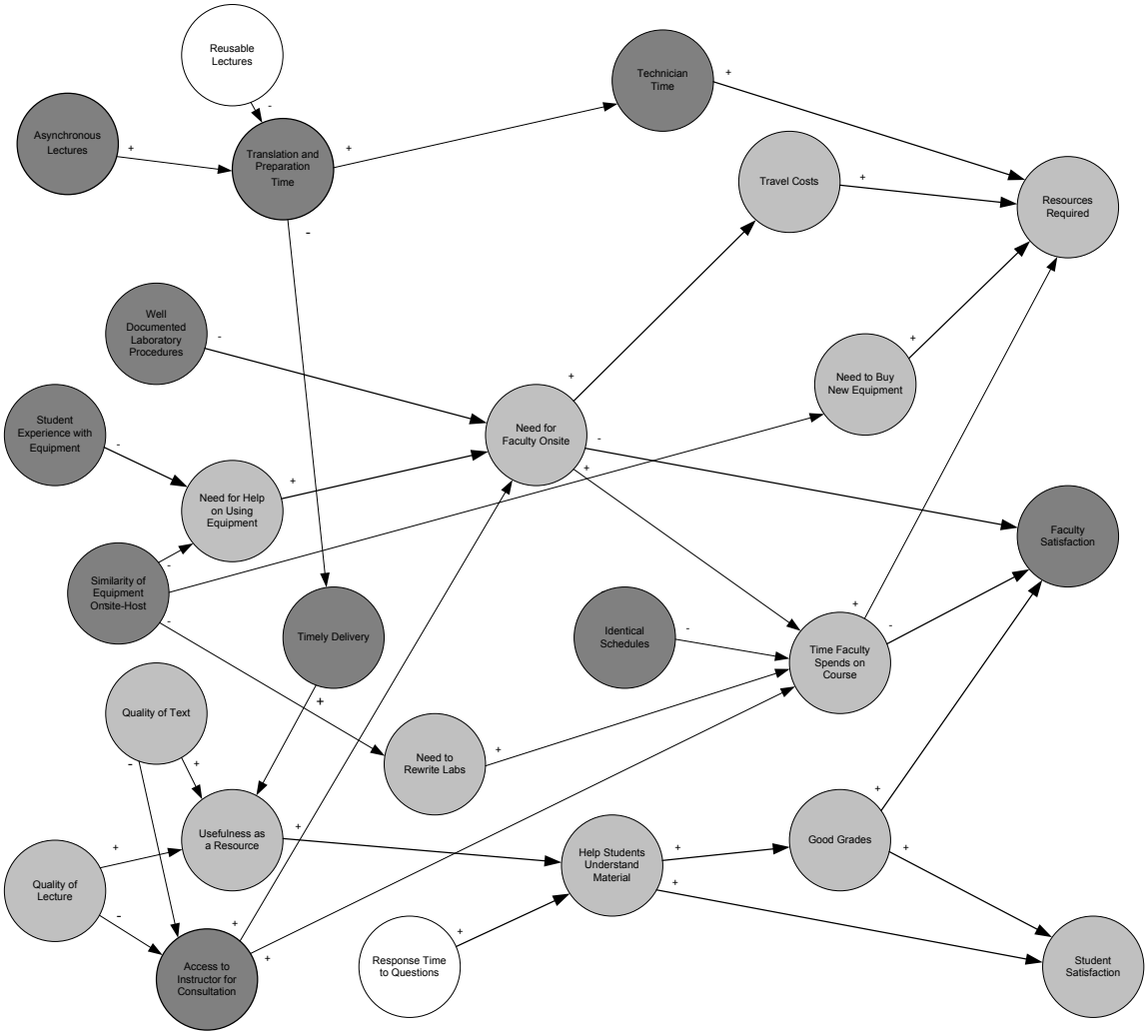
Figure 4. Good Lecture, Bad Laboratory Setup

Case: Bad Lecture and Good Laboratory Attributes

The final case examined is the opposite of the one just presented. In this case, given in figure 5, the laboratory attributes of the course are good, but the lecture attributes are poor. The equipment is similar or the same between the host and remote sites, students have experience with it and the laboratory procedures are well documented. On the other hand, the quality of the text and lectures is poor. The map infers that resources required will decrease, faculty satisfaction will increase, but student satisfaction will decrease. A course with these attributes does not meet the required criteria because student satisfaction has decreased.

Again, back chaining can be used in the map to identify environmental changes or interventions that might be used to alter the state of affairs to the one desired, in this case, an increase in student satisfaction. Examining the map in figure 5, there are really only two inputs that can be altered that will change student satisfaction: *Quality of Lecture* and *Quality of Text*. Both must change to increase (+1) for *Usefulness as a Resource* to increase (+1). Propagating this value through the

map will in fact change student satisfaction to increase (+1). Thus, in this case both the quality of the lectures and the text must be changed to alter the inference in the desired way.



Light gray indicates a nodal value of -1, dark gray a nodal value of +1;
no background color a nodal value of 0.

Figure 5. Bad Lecture, Good Laboratory Setup

Conclusion

When evaluating candidate courses for distance education, it must be recognized that its success or failure will depend on the complex interaction of variety of different attributes. These attributes do not always interact in an obvious or intuitive way. Further, many of these attributes and interactions are specific to the course, students, instructor and institution offering it. To model these interactions for evaluating a course, fuzzy cognitive maps were chosen because they can seamlessly capture these different interactions. To illustrate the process, a map was constructed that incorporated a variety of attributes, lumped loosely around lecture, laboratory and resource characteristics that might impact whether a technical course would succeed or fail through remote delivery. Success or failure was assessed by resources required, faculty satisfaction and student satisfaction. In the variety of cases examined no clear criteria emerged as

generalizable about whether a course would be a good or bad candidate for remote delivery. Thus, careful evaluation must be done when assessing a course for remote delivery from a host campus.

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