

Distance Education: Internet Tool Selection Process

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ABSTRACT

New audio, visual and textual communication technologies, both synchronous and asynchronous, allow instruction in ways and places that were previously not available. Numerous new choices are becoming available for the engineering educator, but the high rate of introduction is making it difficult to select among the different tools. To help in this respect, this methodology encourages engineering instructors to identify what factors should be considered during the design of distance education experiences through the internet and other low-budget supporting media. The focus is on the educational objectives that are sought in these educational interactions and the motivational objectives to energize the students. To test out the application it is applied to the design of an actual educational interaction between the University of Missouri - Rolla and Cibertec Institute of Technology in Lima, Peru, to be held in April, 1997 and a brief description of the interaction plan is included to further describe this process.

INTRODUCTION

The advent of internet tools and the widespread distribution of the internet are opening new windows of opportunities for engineering educators. These new low-budget tools allow for more choices with regards to how, when and where information is shared between the instructor and the students, with promising results. Most of the distance education research has found that students in well-designed distance education courses perform as well as students in well-designed traditional courses¹. At the same time the need is rising for instructors to find more economical methods to educate students. These are the driving forces behind the frantic development of new distance education tools which are revolutionizing the education industry.

METHODOLOGY

The methodology, shown in Figure 1, links the educational and motivational objectives of an educational interaction with appropriate educational techniques and delivery media. This interaction can constitute an entire course or seminar, or specific functions within the course. It is important to recognize that different delivery media can and often should be utilized to simultaneously achieve a number of the educational objectives.

The key to this approach is the identification of the educational and motivational objectives of the interaction. Once these objectives are clear, the selection of the educational methods and the delivery media are greatly simplified. The educational method is the approach that is used to

achieve the objective, such as lecture, discussion or simulations. The delivery media is the medium of communication that is utilized to perform the chosen educational methodology, such as hard copy documents, video conferences and web pages. The objectives, educational methods and delivery media are the building blocks of this methodology that are now described in more detail.

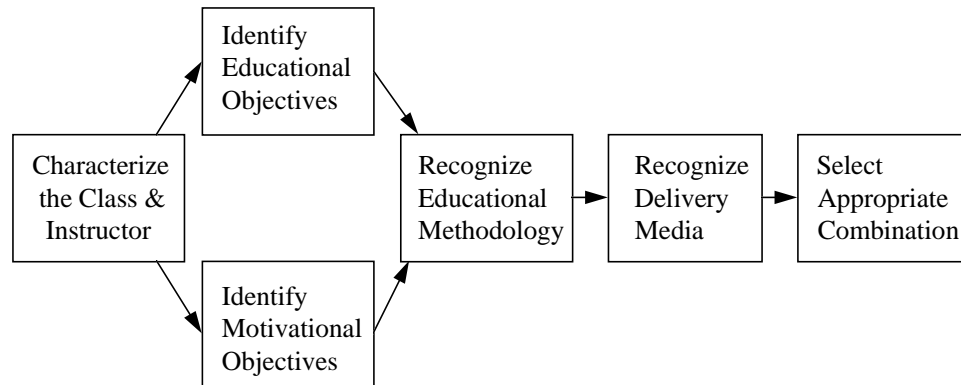


Figure 1. Tool selection methodology

Characterize the Class and the Instructor - The characteristics of the class that will influence tool selection include: the telecommunication hardware and software currently or potentially available; type of internet connection; number of participants in the class; their location; their level of knowledge regarding the topic; and their level of intrinsic, or self motivation. The characteristics of the instructor include: the telecommunication hardware and software currently or potentially available; type of internet connection; level of knowledge regarding the topic; time and financial resources available for the session; and the teaching style preferences.

Educational Objectives - These objectives are the desired outcomes of the educational interaction and can be segregated into three domains² : cognitive, affective and psychomotor. This article focuses on cognitive domain objectives since these are the ones that most commonly are emphasized in engineering classes. These objectives are related to the depth of knowledge that is desired, where each lower level domain is necessary but not sufficient to attain the next higher level.

- **Knowledge** - become familiar with facts, conventions and jargon.
- **Comprehension** - grasp the meaning of the material and be able to paraphrase.
- **Application** - use abstract ideas in particular concrete situations.
- **Analysis** - break down complex problems into parts so that each part can then be solved and the relationships between the parts can be determined.
- **Synthesis** - take many parts and put them together to make a new whole solution.
- **Evaluation** - appraise characteristics of a solution, process, design, document or concept.

Motivational Objectives - Motivating factors can greatly impact the success of the educational interaction. This is particularly true in distance learning situations where the direct contact

between the instructor and the class that often provides a major motivating force does not exist. For this reason the instructor should explicitly consider methods to encourage the students to participate with a high level of commitment and energy. The distance education experience should be designed to maximize the utilization of the following motivational enhancers³ :

- **Confidence** - attainable by minimizing the perception of failure and maximizing the perception of success. Self assessments and tests can be used to inform the student of their level of competence in specific areas as well as motivate them during the learning process to assure acceptable performance. A clear communication of what is expected from the interaction helps generate confidence that it can be achieved.
- **Challenge** - accomplished by the progressive and responsive modulation of the task difficulty in an attempt to apply the maximum level of achievable challenge and excitement, while avoiding boredom.
- **Sense of control** - in which the students are given the opportunity to decide what to do, when and how.
- **Curiosity** - the student's natural desire to satisfy their curiosity can be nurtured to direct their attention.

Educational Methodology - Once the objectives have been identified, the planned interaction between the class and the instructor can be designed choosing among the following methodologies:

- **Lecture** - This includes any transmission of knowledge through audio and or visual presentations that is a predominately one-way in nature, not limited to traditional lectures.
- **Discussion** - The use of video, audio, and document conferencing technologies can be used to promote discussions that help students comprehend, analyze, synthesize, and evaluate the knowledge being transmitted.
- **Project based learning** - Individuals or teams of students apply directly the concepts being taught and develop advanced skills that are achieved through the learner's interaction with the subject matter. The role of the instructor are to provide structure, feedback and modulation of the task difficulty.
- **Modeling and experimental simulations:** Models provide students synthetic environments to experiment and apply their knowledge. This method is very promising since it allows for active learning and effective motivation with the growing interactive and virtual reality capabilities.
- **Independent study** - Multimedia, hypertext, and hard copy documents are used to provide and enhance the knowledge, comprehension, analysis, and synthesis skills of the students. Computer-assisted instruction can also allow the student to apply the knowledge shared while providing immediate personalized feedback and monitoring. This allows for modulation of the level of challenge to enhance motivation.

Delivery Media -These include traditional as well as new tools to perform the chosen educational methodologies. Some of these new tools do have current limitations in terms of reliability. However, taking their limitations into account they can be effectively used today and their role will greatly expand as they continue to improve. Web pages are quickly becoming very

effective and widely utilized for instructive purposes because of their flexibility, low cost and global access. These delivery media can be categorized as synchronous or asynchronous.

Asynchronous media allow the instructor and the students to interact at their own convenience and are less susceptible to the variability in performance inherent in today's internet connections.

- **Hard copy documents** - books and journals.
- **Correspondence** - e-mail, FTP, mail (Post Office) and fax.
- **Prerecorded media** - web pages, CD-ROM's, video cassettes tapes, and audio cassette tapes.
- **Interactive computer programs** - PC and network based programs in which there is immediate response to the actions taken by the student. These include applications that use expert systems and JAVA.

Synchronous media require the coordination of all the participants, but allows for faster interaction among the players and generates an added level of interest and energy. Until till the arrival of the new internet-based media, live audio-video media have been very expensive. Even though their reliability and quality shortcomings are currently limiting their industrial and educational applications, they are quickly improving creating vast areas of opportunities.

- **Live textual communication** - chat conferences (IRC).
- **Live audio** - internet teleconference, radio, and phone.
- **Live audio-video** - internet: one-way broadcasts, one-way broadcasts with textual or audio feedback, and two-way audio-video.

Appropriate Combination - The large number of possible combinations of methodologies and media is reduced to a much smaller subset based on the resources and capabilities of the instructor and the class. Given the instructor's resources and capabilities, funding and time available, as well as the level of motivation of the class, their resources and capabilities, the instructor selects which combinations to use and which activities and approaches to include to heighten the students level of motivation.

APPLICATION OF THE PROCESS IN THE LIMA CONFERENCE

The process described above was applied to design an educational interaction between the University of Missouri - Rolla and Cibertec Technological Institute in Lima, Peru. The objectives of the session are to: share the results of this research; apply this methodology in a realistic situation; experience a sample of the promising tools available for distance education; experience the distance education process as it crosses cultural and language barriers; and learn from the participants experience. Utilizing the Tool Selection Methodology, the following section describes its application and the associated planning process.

CHARACTERIZATION OF THE CLASS AND INSTRUCTOR

Instructor site: (UMR)	telecommunication channel: T1 internet connection hardware: Pentium 133 MHz, multimedia, digital color camera, full-duplex sound board
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Instructors: software: VideoPhone, CuSeeMe, Netmeeting 2.0.
Univ. of Missouri - Rolla - H. Nystrom,
D. Rodriguez
S. Grenquist
M. Daily

Class Participants: Cibertec Technological Institute, Lima, Peru (faculty and students)
telecommunication channel: dedicated line internet connection
hardware: Pentium, digital color camera
software: VideoPhone, CuSeeMe, Netmeeting 2.0
high intrinsic motivation since all participants are interested
volunteers

Limitations: low budget
long distance
limited experience and technical knowledge on both sides

IDENTIFICATION OF EDUCATIONAL OBJECTIVES - The cognitive domains presented in the earlier section help the instructor clarify what is really sought from the session. A summary of the application of this and the following steps are presented in TABLE 1.

IDENTIFICATION OF MOTIVATIONAL OBJECTIVES - The list of motivational enhancers help to explicitly design into the distance education sessions activities that enhance the educational interaction.

RECOGNITION OF EDUCATIONAL METHODOLOGIES - The range of methods helps the instructor consider alternatives to lecture and other traditional methods. In this case, the independent study method can perform most of the initial transmission of information. However, discussion is needed to achieve higher levels of comprehension, as well as to evaluate the methodology and highlighted media.

RECOGNITION OF DELIVERY MEDIA - Web pages were chosen for independent study because it allows for great flexibility, access by students and peer researchers in widespread locations and at times convenient to them without need for additional intervention on our part. This article along with other supplementary material and linkages to other relevant examples are made available to all interested parties through the WWW. All participants are encouraged to read the paper, and experience a number of different delivery media that are linked to the session home page.

SELECTION OF APPROPRIATE COMBINATION - Taking into account the specific resources and preferences, each of the combinations are evaluated for selection.

EDUCATIONAL OBJECTIVE:	METHOD:	DELIVERY MEDIA:	SELECTION OF COMBINATION:
1) Motivate participants to prepare	Curiosity	correspondence: e-mail, phone; web page	RECOMMENDED
	Confidence	web page & self assessment	RECOMMENDED
	Sense of control Challenge	web page project	RECOMMENDED RECOMMENDED
2)) Knowledge of paper content	Lecture	IRC	too slow for communication
		internet: live audio	faster, but poor use of time
		internet: live video	undependable, poor use of time
	Independent study	web page interactive	RECOMMENDED beyond capability of instructors
3) Analysis	Independent study	web page	RECOMMENDED
4) Comprehension of paper content and media applied	Discussion	IRC	too slow for communication
		internet: live audio-video	RECOMMENDED (see note 1)
		correspondence: e-mail	RECOMMENDED (see note 2)
5) Application	Project based	web page	RECOMMENDED
6) Evaluation	Discussion	internet: live video	RECOMMENDED

TABLE 1. Summary of Rolla - Cibertec Session: Alternatives and Selections.

Note 1: The combination consists of a plan to use live internet video, but have live audio and IRC as a back-ups in case of transmission problems.

Note 2: The correspondence by e-mail seeks feedback from the participant subsequent to the live session. It allows for comments generated with further reflection, or from participants who did not have the opportunity to give their feedback during the live session.

SUMMARY

This process assists engineering educators to design educational interactions that takes into account educational and motivational objectives as well as available resources to utilize appropriate methods and delivery media. As an example, the interaction between the University of Missouri - Rolla and the Cibertec Technological Institute is presented.

This educational interaction is designed with two parts: asynchronous web-page independent study and synchronous live discussion using the internet. The web page contains this article as well as all the supporting and coordinating information for the participants, utilizing a variety of delivery media. It is the home base for the entire interaction because it is the most convenient way to transfer the bulk of the information to the participants and because it is less dependent on the temporal nature of current internet connections. The live portion of the session will be held in April utilizing video/audio two way applications. If the connection is not adequate, other media will be substituted until a connection is made that allows for a discussion among the instructors and participants. The agenda in this interaction will include discussion on: the paper, the various delivery media utilized, trends in distance education, and implications to future educational efforts. This will further the objectives to comprehend, analyze, synthesize and evaluate specific issues regarding distance education.

Together the two parts of the interaction take advantage of the strengths of current distance educational tools while avoiding their weaknesses to fulfill the predetermined objectives.

REFERENCES

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BIOGRAPHICAL INFORMATION

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Dr. Nystrom is an Assistant Professor of Engineering Management at the University of Missouri - Rolla. He obtained his B.S. in Mechanical Engineering at the University of Illinois, his MBA from Stanford, and his Ph.D. in Industrial Engineering from Arizona State University. During his Ph.D. studies he was an NSF Fellow, and has 14 years of management and engineering experience in the electronics and food industries.

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