ISSUES IN ONLINE LEARNING:
A CONCEPTUAL FRAMEWORK FOR COURSE DESIGN AND DELIVERY

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The design and delivery of post-secondary courses is undergoing extraordinary change. Like many phenomena related to communication, it has undergone progressive evolution in the post-war era, with explosive growth in the five years of commercial Internet availability. A post-secondary course could traditionally be taken either by correspondence or in a 'conventional' place-based format; the Internet has created a confluence where courses can be delivered on a technological continuum. Remote learners can now interactively participate in online seminars with some or all of the learning process delivered in an asynchronous mode. Course designs, in turn, can be a slightly modified version of past methods using novel technology for delivery or radically redesigned to accommodate some new media opportunity. This paper outlines the evolution and current revolution, discusses a challenge in the evaluation of effectiveness of alternative modes of delivery, and concludes with a proposed empirical design to approach the evaluation.

1. INTRODUCTION

Potential advantages of distance learning appeal to the crisis faced by public Canadian universities. Funding cuts leading to fewer resources, greater demands for accountability, and newfound competition by private educators and other 'virtual' groundbreakers are prevalent. Queen's University[1] and The Ivey School at the University of Western Ontario[2] in Canada now offer Executive MBA programs via teleconferencing at locations across Canada, and are expanding into Asia and Europe. Athabasca University[3] offers complete programs with technology support, as do several international institutions such as the University of Phoenix[4] in the USA and the Open University[5] in the United Kingdom. Most universities now have a growing distance education component. The debate over the appropriateness of course delivery options without 'face to face' contact can be a heated one[6], particularly if university policies are not updated to consider new issues arising from alternative teaching configurations. Issues such as faculty workload, quality of the educational product, and transferability of program modules taken from different post-secondary providers offer mixed benefits to different institutional stakeholders. Pioneers in this area have been tending toward the implementation of entire programs[7], rather than offering a mixed mode of place-based versus distance programs. Adding to

[1] http://business.queensu.ca/execmba/video/index.htm
[2] http://www.ivey.uwo.ca/executive/emba/subpages/videoconf.htm
[3] http://www.athabascau.ca/
[4] http://online.uophx.edu/
[5] http://www.open.ac.uk/frames.html
[6] See, for example, 'Digital Diploma Mills' by David Noble at http://www.firstmonday.dk/issues/issue3_1/noble/index.html
[7] For example Simon Fraser University's Graduate Diploma Program in Business Administration at: http://www.gdba.sfu.ca/gdba/

the complexity of the environment, there are even new publicly traded for-profit startup projects in Canada offering internet-based programs exclusively[8] without the traditional accreditation process. Several hybrid offerings, however, are beginning to emerge.

2. CURRENT ONLINE OFFERINGS

ONLINE CONFERENCING

Online conferencing tools support the creation and management of discussion groups. Tools offered include organized discussions, such as weekly topics or modules, data about participants, such as short resumes and personal information, and organization tools, such as grade records and access to files for up and downloading. This area is newly supported by tools available on the Internet, which are evolving rapidly.

'VIRTUAL' SEMINARS

Traditional alternatives for university educational delivery have been between place based and correspondence based formats. The correspondence course format, which emerged after the Second World War, most closely resembles a predecessor of a contemporary virtual seminar. The virtual seminar differs from the correspondence course because the objectives, interaction, and timing are more closely representative of a regularly scheduled classroom seminar. Students can submit assignments according to particular due dates, exams can be offered, and participation can be expected and graded as a component of the course itself. The Internet has offered many novel opportunities to handle transactions, and educational delivery is not exempt. The distinction between 'distance education' and 'online offerings' is being blurred by the growth of innovative technological options and creative new approaches to teaching.

HYBRID MODELS

A university level course can be offered in an increasing option of formats. Traditional, *place-based seminars,* the status quo, have differed little over several hundred years. Instructional media support has modified the nature of the interactions, but the teacher/student relationship remains approximately the same as it traditionally has. Lessons are given, notes taken, and exams and assignments used to evaluate students' performance. An approximately opposite model would be that of *correspondence* courses, where the content of a course is encapsulated into a materials package, the work is completed in a self-paced format, and assignments and examinations are submitted for grading.

Novel technological opportunities are providing an increasing number of hybrid alternatives to these extremes. Seminars can be enhanced with media such as online activities, notes and multimedia materials distributed in various ways, including the World Wide Web (www). Faculty members are then made more available through telephone contact, electronic mail, some form of computer supported conferencing, or online chat/discussion sessions. Further along this continuum is a course where actual seminar content is substituted by a form of online learning. Several computer conferencing applications exist to support this concept, such as First Class[9], or the Virtual University at Simon Fraser University[10]. These tools offer a comprehensive environment for online discussion based seminars. The seminars can be enhanced by technological support, providing levels of access to learning materials and faculty similar to that available to a placed based seminar. Differences are substantial in terms of preparation and

[8] Such as Unexus University at http://www.unexusu.com/index.html
[9] FirstClass Systems Corporation at: http://www.firstclass.ca/
[10] http://virtual-u.cs.sfu.ca/vuweb/VUenglish/

delivery, but learning objectives and possibilities appear, based on preliminary results, to be very similar.

3. THE COURSE DESIGN CHALLENGE

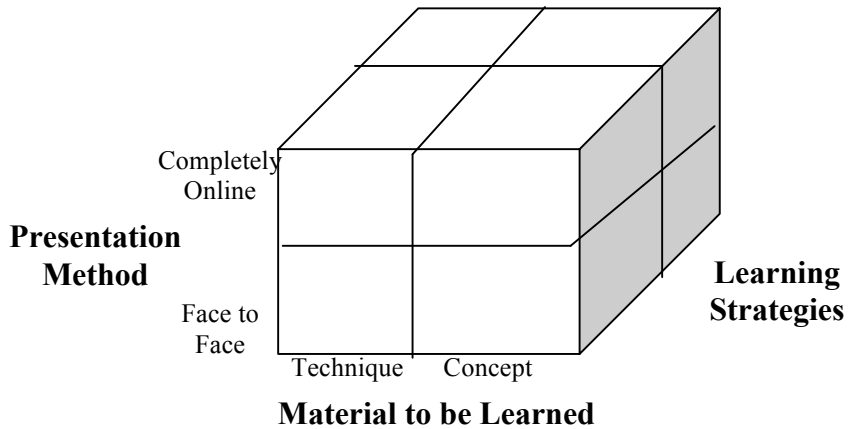
Assessment of learning from the new and different types of teaching formats made available by new telecommunications support is, as yet, preliminary and tentative. Arguments such as the 'Digital Diploma Mills' discussion suggest online learning is a 'copout' designed to marginalize the work of the professoriate and routinize and de-skill the learning process. Alternately, the argument has been made (Parker *et al*, 1998) that online courses help students facilitate learning from remote locations, participate in seminars without a significant commute, and actually *increase* interaction through telecommunications.

The challenge at hand is shifting. The advent of online learning has opened new doors in course delivery and design, and provided a new flexibility in the delivery of teaching material. Past efforts have explored the opportunities availed through innovative use of technology. Future efforts will be needed to inventory different modes of delivery and understand how each mode can be exploited to improve learning. Our choices are not limited to replacing educators or classrooms with technology, or resisting technology in course design. The challenge is to apply educators and technology in ways that optimize the teaching and learning process. It is hoped that the conceptual framework provided in this paper is a step in this direction.

4. CONCEPTUAL FRAMEWORK FOR COURSE DESIGN

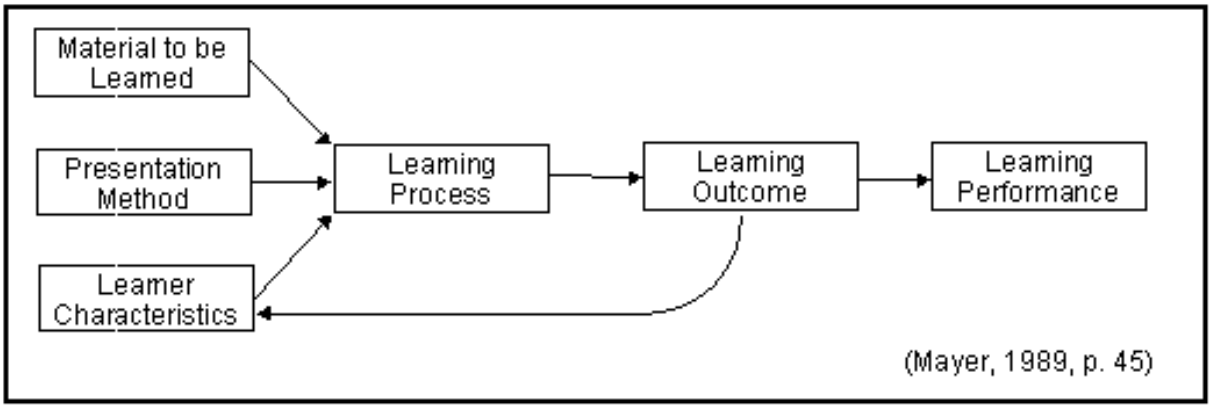
The framework is shown below in Figure 1. There are three dimensions in the framework: Material to be Learned, Presentation Method, and Learning Strategy. The framework is based on a learning model presented by educational psychologist Richard Mayer (1989). Each of the dimensions represents a choice that the course designer makes when developing a course. The framework provides an easy reference for these important dimensions and provides an aid for viewing these dimensions independently.

Figure 1: Model of Conceptual Course Design Framework



As noted, Mayer's learning model provides the foundation for the framework. The learning model contains six components as shown in Figure 2. Three of the components are antecedents for the learning process (learning material, presentation method, and learner characteristics). The three remaining components identify the learning process, learning outcomes, and learning performance. The components are described in more detail below.

Figure 2: Components of Learning Process



MATERIAL TO BE LEARNED

The material to be learned is an important dimension in the model. The "material to be learned" refers to conceptual ideas and techniques that will be presented in the course. The material to be learned can, therefore, be organized under two main headings: concepts and technique. The material to be presented is considered independent of the method used to present the information. In other words, "what" will be learned is considered independent from "how" the material is presented.

The split between concepts and technique was developed from observation of a single course offered in two formats – first place based, the other on-line. The final outcomes (test results) in both classes were found to be similar. Differences were noted, however, in performance in various evaluative components of the course (Parker *et al*, 1999). *Concepts*, such as the role of an individual in a project, were seemingly best learned online where students could discuss issues at length. Such a discussion is not possible in a seminar format. Alternately, *techniques*, such as how to draw a technical exhibit or a specific chart, were better learned through the interactive facilities of a classroom tutorial setting. Preliminary results suggest a balance between online and place-based learning would be optimal, but the nature of that balance remains to be discovered.

PRESENTATION METHOD

The method(s) used to present the material to course participants is referred to as the presentation method. The presentation method is the dimension in the framework where the course designer decides when, where, and how the material will be presented. The designer also must decide who will present the information and how the communication will be structured. Online course technology has offered much more flexibility in the methods used to deliver the material to be learned. This flexibility offers an exciting opportunity for educators in taking selective advantage of technological options in their courses.

As an example of how the presentation method dimension can be structured, it will be useful to consider the difference between two presentation methods. In a traditional classroom teaching environment, for example, the material to be learned is presented to students in a single classroom by a teacher who speaks and uses a variety of audio or visual aids (projector, videos,

and chalkboard). The online learning environment, in contrast, may place more emphasis on student to student interaction, where students are geographically dispersed, and course designers must rely on multimedia teaching materials (text, graphics, video clips, sound bytes) rather than a personal face to face lecture. Table 1 below captures the differences across the four dimensions for a traditional classroom model and a conventional online learning approach.

Table 1: Classroom and Online Presentation Method Dimensions

Presentation Method Dimension	Traditional Classroom Environment	Conventional Online Environment
Who	Teacher to Student (One Way)	Student to Student (Two Way) and Teacher to Student (One Way)
Where	Single Classroom	Dispersed
When	Institution's Choice	Student's Choice
How	Lecture, Cases, Videos, Projector, Presentation Software	Personal Computer, Web Page, E-mail, Conferencing Software.

The table above is not intended as an accurate description of classroom or online learning environments. These examples are provided to show the utility of the four dimensions in analyzing course offerings. This simple example highlights the impact that online offerings can have on course design and delivery. Note that the introduction of an online environment can alter who, when, where and how information is presented. This flexibility should be recognized so that educators can choose to deliver course material using the most effective method.

LEARNING STRATEGIES: ASKING WHY BEFORE HOW

The learning model described above can be used to describe the design options available for course designers. The dimensions do not, however, provide a course designer with a direction for how the various combinations of material and presentation methods should be used. To address this design issue, it is necessary to consider the learning strategy to be adopted for the course.

The learning strategy indicates the broad direction for the course designer to take in developing and delivering course material. In other words, the learning strategy is used to answer the question of "Why" the material will be presented using the presentation methods we have chosen. We argue that before any questions of how material will be presented are answered, it is necessary to understand what impact the material is supposed to have on the participant, and how the learning will be accomplished. In essence, by determining a learning strategy the course designer is outlining and forming the learning environment for the course participants.

There are a variety of learning strategies. In this paper we will focus on three: Cognitive Flexibility, Problem Solving, and Dual Coding. A traditional lecture/seminar model generally fits a Cognitive Flexibility framework (Rossner-Merrill *et al*, 1999). In this framework, material is presented in a context familiar to the learner. As Rossner-Merrill *et al* (1999) note:

> *"The fundamental premise of cognitive flexibility theory is that complex learning is best facilitated by providing students with opportunities to acquire and apply multiple representations of new learning that is tailored to a particular context. Prior knowledge may be given at the outset through instructional or text-based overviews, but these serve primarily as advance organizers for the acquisition of richer layers of meaning to come"*

Alternative methodologies appear to offer support for the dilemma of differing learning strengths of different formats. The online course, mentioned in earlier work, followed a Cognitive Flexibility design. This design yielded mixed results, namely superior conceptual understanding and weaker technique skills.

Another learning strategy is Problem Solving. 'Problem solving' is an approach where students receive increasing challenges on their own and learn from those experiences. The learner takes on the responsibility of integrating information in an active role, rather than as a passive observer. The opportunity to build increasingly complex technique-oriented simulations may, in fact be a stronger form of support in an online setting, at least for particular technical material.

The development of techniques, which contain both text and graphical representations, raises a third possibility based on the 'Dual Coding' theory developed by Paivio (1971). In the Dual Coding Theory, it is assumed that visual and verbal information can be processed simultaneously. When both visual and verbal information is presented simultaneously, the learner is able to make connections between the visual and verbal information. These connections help in developing a more sophisticated cognitive model than when visual and verbal information are presented independently (Mayer & Sims, 1994). In this learning strategy a combination of text, graphical, and audio formats are combined to 'encode' technique-oriented learning. This strategy offers promise and can be delivered in a contemporary web-based course. New technological formats allow for such a multimedia presentation in a remote setting, either from CD-based instruction or streaming over a newer high speed network connection.

4.1 Other Considerations in the Framework

The three dimensions noted above present the three most important factors in the course design process. There are two additional considerations that are not contained in the model, but that should be considered in any course design. These considerations are the Learner Characteristics and the Learning Process. Their role in the course design process is described below.

Learner Characteristics

Learner Characteristics were not included in the framework because the learners are not normally selected by the course designer. Nonetheless, learner characteristics are an important consideration in course design. Every course participant brings with him/her a unique set of experiences and skills. Since every participant has different characteristics, it is not surprising that presentation methods have varied effects across individuals. This observation indicates the difficulty of measuring learning performance on an individual level. So while some presentation methods will provide more learning for some individuals and less for others, superior presentation methods should improve the average learning performance across a randomized group.

It should also be note that learner characteristics are dynamic. The learner characteristics change as participants learn. This is indicated by the feedback loop shown in Figure 2 between learning outcomes and learner characteristics. The inclusion of the feedback loop indicates that the learning process is not strictly sequential and that the learning cycle may be an important consideration in course design.

The Learning Process

An effective learning process is the objective of any good course design. The conceptual framework presented above identifies the important dimensions that are inputs to the learning process. Before finalizing course designs, it is important to develop an understanding of the way in which course participants interpret and enter material to be learned into short and long-term

memory. In this framework, it is assumed that course participants are not simple information processors, but instead are actively engaged in constructing their own knowledge.

Well designed presentation methods affect the learning process by helping individuals select appropriate information, and help to organize the information in short term memory. The selected information in short-term memory can then be integrated with prior knowledge contained in long term memory. The integration of short and long term memory results in a learned outcome that can then be encoded into long term memory. If the presentation method design is effective, the new information encoded into long term memory will provide the course participant with the potential for improved learning performance.

5. EMPIRICAL EVALUATION OF COURSE DESIGNS

The framework presented above provides a conceptual overview of the important dimensions in course design. The framework does not provide, however, an inventory of combinations of presentation methods and learning strategies that provide effective learning of concepts or techniques. To develop this inventory it is necessary to develop empirical comparisons that will provide information for guiding effective course design. While developing empirical comparisons will be difficult, the information gained from these comparisons will be valuable.

LEARNING PERFORMANCE: COMPREHENSION, PROBLEM-SOLVING, AND RECALL

Since the learning process is purely cognitive, it is not directly measurable. To develop an empirical comparison of combinations of presentation methods and learning strategies it is necessary to focus attention on the result of the learning process. **Learning performance**, as shown in Figure 2 above, refers to how a participant, as a result of learning, performs in tasks that require knowledge and understanding of the material that was presented to them. There are many ways to measure learning performance. One example of the use of measures to compare learning outcomes has been described in Mayer (1989). Mayer's measures and predictions have been substantiated in a large number of samples and situations, and Mayer continues to publish using the problem solving measure (Mayer & Gallini (1990); Mayer & Sims, 1994). A brief description of Mayer's measure is provided below.

Mayer began his experiments by identifying two treatment groups: one group was provided with a text description accompanied by a diagram ("model" group) and one provided only with text description ("control" group). He suggested that exposure to a diagram would improve the quality of the cognitive model developed by participants. After the participants viewed the material, Mayer asked them to complete three tests: comprehension, verbatim recall, and problem solving.

The comprehension tests included questions regarding the attributes of things or the relationship between things in the explanative material. For example, in Mayer and Gallini (1990) participants were provided with information on the braking system of a car. Comprehension questions included questions such as "What are the components of a braking system" or "What is the function of a brake pad". Mayer (1989) predicted that "model" (text and diagram) and "control" (text only) participants would generally have similar scores in comprehension tests. This is due to the fact that the content of the material to be learned is the same in both treatments. If the comprehension scores were significantly different, then some useful explanative information was not contained in one of the treatments.

Participants were next given a set of questions that went beyond the original explanative description provided. These types of questions Mayer referred to as *problem solving tasks*. The

questions are designed so that there is more than one correct answer. An example of a problem-solving task in the Mayer & Gallini (1990) study included questions such as "What could be done to make brakes more reliable?" or " What could be done to reduce the distance needed to stop." The idea behind the problem solving task was that individuals that are able to form more sophisticated cognitive models will provide a larger number of correct solutions to these problem-solving question than individuals with less well-formed cognitive models. The "model" group was predicted, therefore, to have higher problem solving scores than the "control" group. This prediction was the most important in that the problem solving score revealed the level of sophistication of the cognitive model developed by the learner.

After the problem-solving task, the participants were given a final verbatim recall test. The verbatim recall test provided each participant with a collection of paired statements. One statement was taken verbatim from the text description. The other statement was altered slightly from the verbatim statement. The participant was then asked to select the statement that was exactly the same as the statement that was given in the original description. For verbatim recall, Mayer predicted that the "model" (text and diagram) group would score lower in verbatim recall than the "control" (text only) group. The lower scores reflect the fact that the "model" participants reorganized and integrated the original information due to the impact of the diagram. The model group was less likely, therefore, to store the information in verbatim form than the control group.

The measures described above provide a useful set of tools for empirical comparisons of course designs. The suggested measures moves away from studies focused on a single measure of learning performance based on comprehension and towards multiple measures more heavily weighted towards problem solving. This movement may help provide a more useful set of empirical evaluations. The next section will briefly describe a proposed empirical design using these measures.

PROPOSED EMPIRICAL DESIGN

This section outlines the design of an empirical comparison of the combination of three learning strategies (cognitive flexibility, problem solving, and dual coding) and two presentation methods (online and place based). The course design conceptual framework will be used to identify the important variables in the empirical comparison. This proposed design is provided as a example of the use of the course design framework. The framework for this proposed study is provided below in Figure 3.

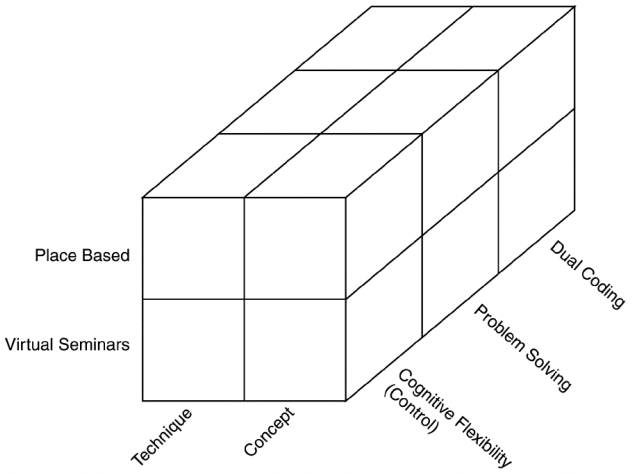


Figure 3: Dimensions in Empirical Comparison

MATERIAL TO BE LEARNED

The course chosen is an undergraduate course in system analysis design. The course has been chosen due to its relatively high enrollment and the fact that the same course will be offered in two semesters using two different formats: placed based in one semester and online in the other. The course content contains a large number of business and computing system concepts as well as a number of system diagramming techniques. This enables us to test both concept and technique. The course will be supported by the same textbook and cover the same material in both semesters. The same instructor will give the course.

LEARNING STRATEGY

Three learning strategies will be applied in the online offering of the course: cognitive flexibility, problem solving, and dual coding. The online course has been chosen for comparing learning strategies due to the ease of differentiating the class into separate and independent treatment groups. In addition the technology associated with the online course also makes the use of dual coding possible.

PRESENTATION METHOD

The material to be learned for each of the three treatment groups is identical for all three treatment groups. What will differ is the method used to present the data. The methods used to present the data will be driven by the learning strategy for each group. For example, the group provided with the "Dual-Coding" Strategy will receive materials that have both a verbal and visual information. This group will be presented with the same information as other groups but in a different format.

Rather than focusing on the entire course, the empirical comparison will be focused only on a small number of weeks in the semester and more particularly on very specific parts of the system analysis course (for example building data flow diagrams and developing entity relationship diagrams). This focus should help to reduce the number of confounds related to the observations.

MEASUREMENT

The set of measures described by Mayer (1989) will be used to compare learning performance between treatment groups. The same tests will be give to all three groups at the same time, and with the same format, to ensure independence. In addition, to make comparisons between the placed based and online version of the course, the midterms, assignment marks, and final exams will be replicated in the second course so that the results can be compared.

CONCLUSION

Online learning is coming of age. New technological opportunities have allowed the university to change in an unprecedented manner. The new 'form' of education delivery is settling down, but the effectiveness of each alternative has yet to be fully determined. Online versus place-based seminars offer different strengths for technique versus concept oriented learning objectives, and different learning theories suggest alternative presentation forms.

We now offer a combination of place-based and online learning opportunities, usually assumed to be interchangeable and designed with similar methods to achieve similar objectives. More work is needed to evaluate exactly *what* should be taught online, and *how* that online teaching should differ from more traditional methods of delivery. An empirical evaluation has been described to begin to address this question. The resulting evaluation, based on a randomized experimental design, will be presented in a subsequent work.

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