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Building a Theoretical Framework of

Web-Based Instruction

in the Context of Distance Education

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Abstract

This study attempts to analyze teaching and learning processes of web-based instruction (WBI) as shown in recent literature, and to develop a theoretical framework of WBI using a prominent existing distance education theory called Transactional Distance Theory in order to provide better understanding of the essential pedagogical components of WBI.   Recent studies have shown that the key elements of the structure of WBI are (1) content expandability, (2) content adaptability, and (3) visual layout.   And also three emerging types of interaction, or three aspects of dialogue, in WBI have been identified through the studies. Those types were: (1) academic interaction, (2) collaborative interaction, and (3) interpersonal interaction. Finally, both learner collaboration (or learner collaboravity, if we create a new term) and learner autonomy seem to have emerged in Web-based learning environments.

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Introduction

Since the emergence of the Internet and the Web as a means of providing instruction and the fast expansion of interest in these media in the mid 1990's, there have been a number of studies that investigated their technical features, and tried to connect these features to the problems of designing web-based instruction (WBI). Some example studies include: Hiltz (1994), Harasim (1995), Khan (1997), Simich-Dudgeon (1998), and Barron (1998). All, viewing the Web as a worldwide, efficient, and interactive technology for delivering instruction, outlined technical features of WBI and provided specific guidelines for the design of WBI.

Studies such as the above suffer from a common shortcoming. There is little linkage to established pedagogical theory in general or to distance education theory in particular. The questions they raise have little relationship to what is already known about learning and teaching at a distance, albeit that what is known has been developed over many years of research and experience with different communications technologies. Furthermore, little attempt has been made to develop a theoretical or a conceptual framework of WBI in order to understand its pedagogical feature in a logical way. To contribute to better understanding of WBI in the context of distance education theory, and to contribute to a revision of such theory to accommodate the new teaching experiences of WBI was the purpose of the research reported here.

The author believes that while the Web and Internet are new technologies, the problems of providing instruction via these technologies, i.e. WBI, are not totally new nor is instruction via these media necessarily pedagogically innovative. Pedagogical features of WBI can be

understood from the perspectives of already existing theories such as cognitive flexibility theory, constructivism, and information processing theory.   WBI can also be analyzed in the context of multimedia-based instruction, hypermedia-based instruction, or computer-based instruction in general. But mostly, what we have is an application of the new technology to distance education – a teaching method that has provided a flexible and open learning environment for more than a century. WBI thus shares many features with traditional forms of distance education such as correspondence study, videoconferencing lectures, and TV courses. What WBI offers that is unique among communications technologies, is the facility of combining the attributes of each of the older media, and thus provide a learning environment in which texts, pictures, video and audio are integrated into one system, access to huge databases is simple and easy, and more flexible interactions – especially asynchronous learner-learner interaction - are far simpler than before.

Thus, this study attempts to analyze teaching and learning processes of WBI as shown in recent literature, and to develop a theoretical framework of WBI using an existing distance education theory called Transactional Distance Theory in order to provide better understanding of the essential pedagogical components of WBI in the context of distance education. The main methodology of the study lies in a critical review of the journal literature in the field of WBI. As Porter (1992) pointed out, the literature of the journals in the field of WBI would represent ideas and knowledge of those who practice and conduct research in the discourse community of WBI. Knowledge of the development and evaluation of WBI discussed in the journals would allow better understanding of major pedagogical features of WBI that may lead to formulate a theoretical framework of WBI in the context of distance education.

Transactional Distance Theory

Transactional distance theory describes pedagogical relationships existing in a distance education environment i.e. one that can be defined as "the family of instructional methods in which the teaching behaviors are executed apart from the learning behaviors, including those that in

contiguous teaching would be performed in the learner's presence, so that communication between the teacher and the learner must be facilitated by print, electronic, mechanical, or other devices" (Moore, 1972, 76). According to the theory, there are three key constituent elements that define every distance education program: dialogue, structure, and learner autonomy. Dialogue refers to the extent to which teachers and learners can interact with each other and structure refers to the "responsiveness" of an educational program to an individual learner's needs (Moore, 1993). Learner autonomy is the extent to which learners make "decisions regarding their own learning" and "construct their own knowledge based on their own experience" (Moore and Kearsley, 1996, 204-205).

In first defining distance education in 1972, Moore hypothesized that "there is a positive relationship between distance as measured by individualization and dialogue, and autonomy"(Moore, 1972, 83) and later articulated this hypothesis by arguing that the degree of transactional distance between teachers and learners is a function of the extent of the dialogue, the extent of the rigidity or the flexibility of the course structure, and the extent of the learner's autonomy (Moore, 1993). This transactional distance is described as a relative term, meaning that there is an almost infinite range of interactions of the three key variables. At one extreme, transactional distance would be greatest when the institution or the individual teacher had no interaction at all with students, and the learning materials are entirely pre-planned and structured to the last detail. Under such circumstances from the point of view of the providing agency the individual learner's autonomy is not taken into account, though from the learner's perspective it may be necessary to exercise considerable autonomy in deciding when, where and how to learn.

The transactional distance theory, which first appeared in 1972, has been reworded as changes in external conditions of distance education have occurred, particularly as the delivery technologies have changed. Several studies (Bischoff et al., 1996; Saba and Shearer, 1994; Gayol, 1995; Bunker et al., 1996; Chen and Willits, 1999) have been conducted to test hypotheses derived from

the transactional distance theory across different technologies such as audio-conferencing, videoconferencing, interactive television, and computer network.

Review of these empirical studies indicates that the transactional distance theory provides a useful conceptual framework for defining and understanding distance education in general and as a source of research hypothesis more specifically. Most of the studies confirmed Moore's original proposal that transactional distance decreases when dialogue increases and structure decreases, and when structure increases transactional distance also increases, but dialogue decreases. However, some research such as Chen and Willits (1999) and Saba and Shear (1996) suggest several advances beyond the original concept, particularly the possibility of articulating the constituent concepts—structure, dialogue and learner autonomy—and of expanding the concepts to take into account more specific characteristics of teaching and learning environments including the technology employed in those environments.

In the following sections, this paper will suggest some key features of WBI which have been identified in previous studies, organize those features using the conceptual framework of the transactional distance theory, and articulate or expand the three constituent concepts of the transactional distance theory in light of this new, emerging data.

Pedagogical features of WBI

Discussing the technical features of the Web alone does not help explain how the Web as a medium interacts with the pedagogical process associated with WBI. It is necessary to explore how the Web is used to support teaching and learning process in a Web–based instructional environment, see how WBI employs specific attributes of the Web in a variety of ways and investigate emerging pedagogical features of WBI.

In order to explore pedagogical features of WBI, fifty-eight articles written in English have been reviewed. They came from six refereed international journals in the fields of distance education

and educational technology that were among the twenty most-cited journals in the ICDE citation

index (Bunker 1998). The journals included in this review are Educational Technology Research

and Development (USA), the British Journal of Educational Technology (UK), The American

Journal of Distance Education (USA), Open Learning (UK), Distance Education (Australia), and

the Journal of Distance Education (Canada).

General findings

The articles from these six journals used a variety of research methodologies and research foci

(see Table 1).

Place Table 1 about here

Unfortunately, not many studies investigated pedagogical processes in WBI in a rigorous manner.

That is, what was really happening in teaching and learning processes of WBI and why it

happened were seldom the focus of the studies. Rather how to design effective WBI, how to

encourage interaction, and what were the effects of WBI on learner satisfaction and perceived

learning outcomes were the most frequently asked research questions.

Overall, research on WBI has indicated 'student–centered learning environment', 'full of

multimedia resources', 'expanded interactivity', and 'adaptability to different student

characteristics' as distinctive features of WBI, most of which reflect integration of technological

features of Web into WBI. Most researchers come to WBI research with little background in

distance education, so that there is little research that compares these characteristics of distance

education in the Web environment and their manifestations in programs delivered by previous

technologies. Generally, WBI was claimed to be method of distance education which provided

more and better forms of learning dialogue and learning communities, though, as stated, there are

very few actual comparative studies to justify this claim.   Several evaluation studies showed that

WBI could create an adaptable learning environment by meeting different student characteristics,

such as prior knowledge level and preferred study modes. In addition to these interactive and adaptable features of WBI, resourcefulness and multimedia representation form of the resources were claimed as advantages of WBI to implement project–based or constructivist learning.

The pedagogical features of WBI that were found in previous studies are categorized in Figure 1 using the conceptual framework of transactional distance theory. Even though this framework appeared to be applicable for understanding the pedagogical features of WBI, several new concepts that have not been captured by the transactional distance theory were proposed. Figure 1 shows a theoretical framework for the pedagogical features of WBI found in recent studies.

Place Figure 1 about here

Structural features in WBI as a teaching variable

There are relatively few journal articles that research the structural aspects of WBI as compared to those on dialogue or the interaction aspects of WBI. There are no existing articles that empirically examine the rigidity or flexibility of WBI structure as compared to more traditional distance education courses. However, there is a high level of agreement across the various studies that WBI can provide a flexible teaching and learning environment because of some of the technical features of the Web.

The structural flexibility of WBI seems to be directly linked to the expandable feature of its contents. Several studies indicate that the contents of WBI can be extended beyond those prepared by instructors (Laffey et al., 1998; Hill, 1999; Jonassen et al., 1999). Laffey, et al. (1998) found the Internet to be an effective tool that is full of resources and can provide a shared dynamic knowledge base in project–based education. With the hyperlink features of WBI, course contents can be more easily expanded to the outside world and shared by instructors as well as learners.

Another aspect of the structural flexibility of WBI comes from its ability to generate and adapt contents to match each individual student according to his or her goals, previous knowledge, or other characteristics (Valcke and Martens, 1997; Vassileva and Deters, 1998; McLoughlin, 1999). When comparing WBI with conventional classroom courses, Valcke and Marten (1997) found that WBI provided a more adaptable and interactive learning environment than can be found in traditional distance education courses. McLoughlin (1999) reported that multiple zones of content knowledge could be created in a culturally responsive WBI course.

Visual interface, or screen, design is considered to be an important aspect of structuring WBI. Boshier, et al. (1997) examined WBI courses according to three criteria that they obtained from factor analyses of evaluation items. These criteria were: accessibility, interactivity, and attractiveness which includes the screen–design or visual–interface features of WBI. Similarly, McGreal (1997) indicated that visual interface was an important factor in designing WBI. As discussed, visual interface or screen layout is indicated in several studies as an important factor affecting teaching and learning experiences in WBI.

In general, previous studies of WBI showed that WBI provided a flexible and adaptable content structure using hyperlink technology. The key elements of this structure found in the studies are (1) content expandability, (2) content adaptability, and (3) visual layout, because the structure in WBI is presented on the screen.

Dialogue in WBI as a communication variable

In WBI, several different types of interaction besides interaction between the learner and instructor have been observed. Anderson and Harris (1997) identified the factors that predict the use and perceived benefits of the Internet as an instructional tool. Interpersonal interaction among learners and also social integration were among the most influential of these factors. This result is supported by another study investigated by McDonald and Gibson (1998), which found that

interpersonal issues remained prominent throughout the duration of an asynchronous computer–conferencing course.

Moller (1998) identified three types of virtual communities in WBI: academic community provided by interaction between learners and instructors or content experts; intellectual community provided through peer interaction; and interpersonal community developed through interpersonal encouragement and assistance. Collaborative learning shows similar environment as intellectual community described by Moller. Similarly, the effective collaborative application of a computer–mediated communication system was observed in distance education business courses (Salmon, 1999).

A number of studies that examined socially oriented factors in Web–based learning environments indicate that it is much more important in WBI than in other distance education courses for learners to feel or perceive that they are a socially integrated part of a virtual community and that they have a sense of human contact in the network. Anderson and Harris (1997) found that socially oriented factors, such as social integration and interpersonal contacts, contributed to the prediction of both network use and perceived outcomes. In addition, Gunawardena and Zittle (1997) revealed that social presence contributed to more than 60 percent of learners being satisfied with computer conferencing courses, and Kanuka and Anderson (1998) found that social–cognitive processes among participants in an online forum included significant time engaged in social interchange. Students' efforts to establish various forms of social presence in instructional electronic chats were identified in a study by Murphy and Collins (1997). All these findings indicate directly or indirectly that there is an emergence of various learning communities affecting dialogue in WBI.

By looking at studies that have examined the communication aspects of WBI, we can conclude that WBI contributes to increasing student' involvement in teaching and learning processes by allowing for various types of interaction. Three emerging types of interaction, or three aspects of

dialogue, have been identified through the studies. Those types were: (1) academic interaction between learners and instructors, including external experts; (2) collaborative interaction among learners; and (3) interpersonal interaction between learners and instructors, or among learners.

Learner autonomy as a learning variable

WBI seems to provide individualized learning environments that allow learners to exercise autonomy in their learning. Garrison (1997) perceived computer conferencing as a personalized technology, as opposed to the mass–produced, self–instructional packages typical of distance education.

It is emphasized in several studies that since WBI provides more flexible learning environments, learners have more autonomy in making decisions regarding their learning. Hill and Hannafin (1997) reported that adult learners in WBI used metacognitive strategies extensively in their learning, and Hill (1999) found that learners in WBI employed interactive, embedded, and instantaneous information–seeking strategies. In several Web–based courses, researchers have observed learners being autonomous individuals who construct their own knowledge (Laffey, et al., 1998; Bullen, 1998; Jonassen, et al., 1999) and being autonomous individuals who are actively involved in their learning (Shneiderman, et al., 1998; Hillman, 1999). All these results indicate that learners engaged in WBI use certain cognitive strategies or knowledge to exercise their learning autonomy, which maximizes learning and the construction of new knowledge.

In addition to autonomous learning, another aspect of WBI that has appeared in the literature is collaborative learning. Learners in WBI learn collaboratively as well as individually. Hillman (1999) compared the interaction patterns of face-to-face courses and computer–conferencing courses and found that the interaction patterns of the computer courses were close to collaborative discussion and that student involvement was higher in the computer–conferencing courses. In a synchronous learning environment made possible via electronic chatting, Murphy and Collins

(1997) identified collaborative communication conventions such as sharing information and seeking clarification through continuous interaction to reduce transactional distance.

The analysis of WBI studies on a learning variable leads us to a tentative conclusion that taking part in a WBI course requires that learners be collaborative as well as autonomous. Both learner collaboration (or learner collaboravity, if we create a new term) and learner autonomy seem to have emerged in Web–based learning environments. Of course, WBI can differ in the degree to which it accommodates these two elements.

Conclusions

Distance education, like any other educational method, is a method by which a learner engages in some form of communication with a teacher in order to acquire new information, transform that information into knowledge, and develop skills in using that knowledge in various contexts. However, distance education is different from other modes of education in that the learner and the teacher are physically separated from one another (Perraton, 1988; Rumble, 1989). Since this form of education takes place at a distance, some media of communication should be employed to bridge this distance (Moore and Keasley, 1996). WBI, a form of distance education, uses the Web or the Internet for this communication.

As indicated previously, the review of previous WBI research showed little resemblance to established pedagogical theory in general or to distance education theory in particular. While some studies raised their research questions and discussed the findings in theoretical frameworks, other studies had little relationship to established learning theories.   Furthermore, methodological limitations of WBI studies made it difficult to delineate effects of certain variables on teaching and learning on the Web. In these regards, we need WBI studies that discuss what is already known about learning and teaching at a distance and that examine teaching and learning experiences with different communications technologies.   And also we need more rigorous data on pedagogical

features of WBI in various teaching and learning context to make a firm conclusion on pedagogical features of WBI.

The analysis of recent literature on WBI used the conceptual framework of the transactional distance theory raises a number of questions that can guide future research. The variables identified from the analysis helped us generate some of these questions.

Questions regarding teaching or structural variables of WBI include:

- Does the extent of rigidity or flexibility in the structure of a WBI course affect dialogue and transactional distance, as is the case in other distance education modes?
- How can WBI be designed to provide more content expandability and adaptability than is available in conventional distance education programs?
- What WBI structure best supports interaction and learning?
- What are some pedagogically sound design principles that can be used for visual layouts of WBI?

Questions regarding communication variables of WBI include:

- What are the effects of different types of interaction on learning and satisfaction in WBI?
- How can instructors facilitate WBI in a way that applies the interactive conversational techniques that are emphasized in traditional distance education settings?
- How do learners' cognitive styles or other characteristics influence interaction?
- What features of Web-based courses support distant collaborative learning?
- How can WBI be designed to provide meaningful dialogue among participants through various types of interaction?

Questions regarding learning variables of WBI include:

- How can we balance learner autonomy and course structure in WBI?
- How can WBI be designed to empower learners or to increase learner autonomy?

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Table 1: Classification of Articles by Methodology and Medium

Methodology	Number of Articles (Percent)
Experiments (True or Quasi)	15 (26%)
Developmental Studies	18 (31%)
Evaluation Studies	13 (22%)
Idea/Position Papers	12 (21%)
Total	**58 (100%)**
Major Medium	Number of Articles (Percent)
WBI in Specific	30 (52%)
Computer conferencing	13 (22%)
WBI along with other technologies	15 (26%)
Total	**58 (100%)**

Figure 1: A Theoretical Framework for Pedagogical Features of Web-Based Instruction