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A Research Framework for Collaborative e-Learning in an End-User Training Context

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ABSTRACT

The growth in the application of information technology to end-user training (EUT) underscores a fundamental need to understand how these e-learning technologies improve the learning process. Results from the limited EUT studies provide an inconsistent picture of the effects of e-learning technologies. Also, collaborative learning has become one of the most used techniques in American education, yet, we could find only one EUT study on collaborative learning. This paper applies adaptive structuration theory (AST) to the specific area of technology-mediated end-user training. The main focus is on understanding learning, collaboration and technology structures involved, their interactions and appropriation, and their impact on learning outcomes. By integrating social cognitive and social development theories into the AST framework, the model presented investigates both the learning process and functional/structural aspects of technology-mediated end-user training. Propositions are developed for future empirical testing.

Keywords (Required)

End-User training, Collaboration, e-learning, adaptive structuration theory.

INTRODUCTION: END-USER TRAINING

Gartner predicts that knowledge worker's appetite for new tools and capabilities keeps growing, and vendors keep feeding them with diverse, new technologies to support individual, collaborative and organizational work (Gartner 2004). End-user training (EUT) deals with training end-users with these tools (software applications). EUT expenses can be as high as 20-30% of the overall project budget for a software implementation (Olfman et al. 2000). In spite of this, much of the EUT research has focused on individual differences and a limited set of learning methods. Given the importance of EUT, it is very important to develop efficient and effective ways of delivering EUT training. Two important trends to recognize are: 1) the influence of technology in all scenarios of training and 2) a move towards a more social or collaborative form of learning/training. Limited research exists on the impacts of technology-mediation (Olfman et al. 2000) or collaboration in EUT context, ignoring both the above trends (Arthur et al. 2003).

We use the broader AST framework presented in Gupta et al. (2004) as a starting point for developing a more specific model. The next section provides an overview of the research framework. In subsequent section, we discuss the specific structures involved as well as a review of the relevant EUT literature. Section 3 focuses on the learning process. Propositions for empirical testing are provided in each section.

THEORETICAL FRAMEWORK: ADAPTIVE STRUCTURATION THEORY

The research framework provides a broad foundation for investigating technology-mediated end-user training..

The model is shown in **Figure 1**. Epistemology establishes overarching beliefs about the nature of knowledge and about what it means to "know" something (Hannafin et al. 2004). These beliefs provide a strategy for designing the learning method structures needed to accomplish the learning outcomes. Structures are formal and informal procedures, techniques, skills, rules and technologies embedded in the learning method, which organize and direct individual or group learning behavior. EUT learning methods focus on improving peoples' effectiveness using computer applications. Learning outcomes of a EUT program are multi-pronged. The primary outcomes are the development of individual knowledge and skills and to provide a good learning experience to support future learning.

The model highlights the fact that learning achievements are governed by a fit between the structures of the learning methods: collaborative, technology and learning techniques. The model also argues that these fits are a necessary but not a sufficient condition to improve performance. Without proper appropriation of these structures, learning outcomes are less likely to improve even if fit exists (Dennis et al. 2001).

Three forms of structures are identified here i.e. collaborative structures which refer to the social setup of the group (Johnson et al. 1999); information technology presents an array of structures for possible use in interpersonal interaction and cognition (DeSanctis et al. 1994); and learning techniques which provide specific procedures to attain outcomes (Schunk 2004).

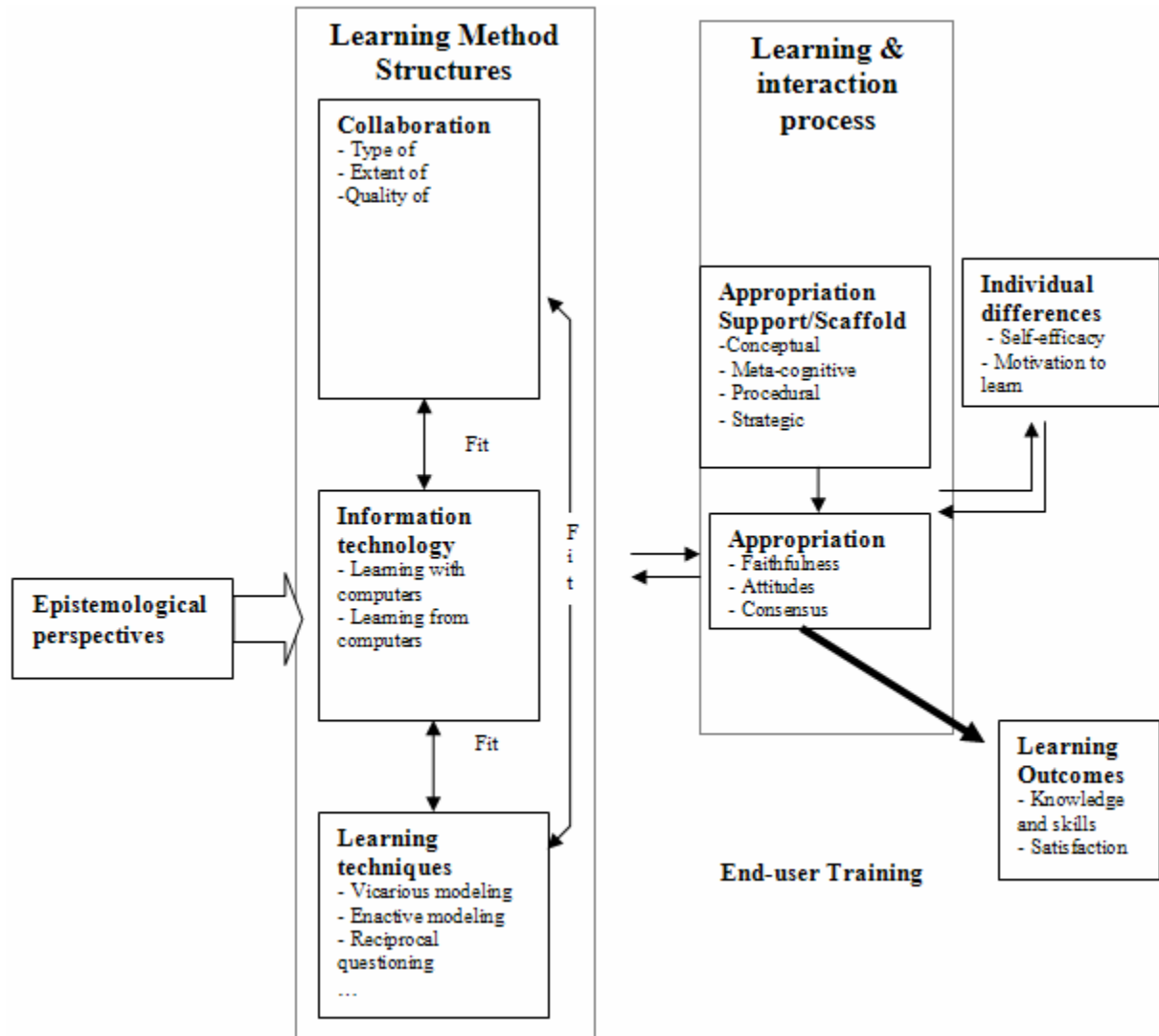


Figure 1 : Research framework for Collaborative e-learning in an end-user training context

Appropriation is the adaption process an individual or group goes through to establish and reproduce a structure (Poole et al. 2003). When well-designed and relevant structures are successfully appropriated (i.e. used in the spirit they were designed to be used), they will contribute to higher learning outcomes. An unfaithful appropriation of well-designed and relevant structures, on the other hand, might result in lower learning outcomes. Appropriation may be supported by providing training, though facilitation or other forms of support. The model also takes into account reciprocal causation between structures and people, where learning method structures not only affects an individual's use, but individuals' use also affects these structures over time (Orlikowski 1992).

The ultimate outcome of this line of research is to develop an increasingly specific model of e-learning in the EUT context. Examples of the development of such specific models already exist in the literature: DeSanctis et al. (1994) for group support systems, Jankowski et al. (2001) for geographic information systems, Sarason (1995) for organizational transformation and strategic management, and Roberts et al. (1985) for accounting.

The conceptual model shown above offers many advantages over current frameworks. Firstly, many of the more predictive and narrow, but relevant educational psychology theories can be integrated into this global framework. We integrate social

cognitive and development theories in this paper. Secondly, this framework allows for a simultaneous focus on the functional components that affect learning (structures) as well as the process of learning (appropriation). Third, a major strength that AST is that it expounds the nature of social structures within advanced information technology and the key interaction processes that figure in their use. Finally, the conceptual model can be applied to multiple levels, from individual to organizational, and be tested through various methodologies. An in-depth discussion of these benefits is beyond the scope of the paper but will be discussed in the presentation (for examples see Poole et al. (2003))

LEARNING METHOD STRUCTURES

Learning method structures are the functional component of the model. They provide the basis for the learning process and the subsequent learning. Below we investigate the three structural sets mentioned above.

Learning Techniques

Learning techniques are specific procedures to attain outcomes (Schunk 2004). Within EUT, the primary focus has been on vicarious learning or behavioral modeling (VM), which is one the primary components of the social cognitive theory (SCT) (Bandura 1977). VM emphasizes the importance of observing and modeling the behaviors, attitudes and emotional reactions of others. EUT literature, summarized in Table 1, provides considerable support for using VM vis-à-vis traditional techniques to enhance learning outcomes.

Study	Training intervention	Learning outcomes	Findings
(Gist 1988)	VM vs. non-modeling training	Skill: Task performance	VM yielded higher task performance scores for both younger and older trainees
(Compeau et al. 1995)	VM vs. instruction based training	Skill: task performance Affective: Computer self-efficacy (CSE)	Subjects in the VM condition developed higher CSE and performed better than those in the instruction based condition for spreadsheet program, but not for a word processing program
(Simon et al. 1996)	Instruction exploration and VM	Cognitive: Comprehension Skill: Task performance Affective: End-user satisfaction	VM outperformed the other two methods in all learning outcome measures
(Johnson et al. 2000)	Modeling vs. non Modeling	Skill: Task performance Affective: CSE, computer anxiety	Subjects in modeling condition developed higher CSE and performed better than those in non-modeling condition. Computer anxiety was significantly related to CSE and task performance.
(Bolt et al. 2001)	VM vs. non-modeling when controlling for complexity	Skill: Task performance Affective: CSE	VM outperformed non-modeling when complexity was high
(Yi et al. 2001)	VM with practice vs. VM with retention enhancement vs. VM with retention enhancement and practice	Skill: Task performance Cognitive: Attitude	Subjects in the VM with retention enhancement and practice showed higher levels of learning outcomes when compared to the other groups
(Yi et al. 2003)	VM vs. VM with retention enhancement	Skill: Task performance Affective: Self efficacy Cognitive: declarative knowledge	Subjects in the VM with retention enhancement showed higher levels of learning outcomes
(Davis et al. 2004)	VM vs. VM with symbolic mental rehearsal (SMR)	Skill: Task performance Cognitive: declarative knowledge	VM with SMR was better than VM alone. Learning outcomes were mediated by the trainees' knowledge structures

Table 1: Vicarious learning literature in end-user training

Most of IS research and practice has focused on the use of rehearsal of modeled behavior i.e. practicing what the instructor has demonstrated. SCT also focuses on enactive learning as a mechanism for learning but there has been no EUT research on this learning approach.. Enactive learning involves learning from the consequences of one's actions. Thus, enactive learning includes testing learned mental models in an environment that provides feedback based on action. It emphasizes the role of self-modeling in a structured environment, an environment with controls and feedbacks. Thus,

P1: *Participant's trained using vicarious learning supplemented by enactive learning will show higher learning outcomes than participant's training used vicarious learning alone.*

Learning techniques can also be implemented in a collaborative context, where participants interact with each other. Below we look at the structures involved in collaboration.

Collaboration

Simply placing participants near each other and allowing interaction to take place does not mean that learning will be maximized. Social interaction between participants can either be competitive, collaborative or they can simply ignore each other. Only one EUT study (Davis et al. 2004) that we know of used collaboration (paired learning) in EUT, but found no significant effects. This study, though, did not look at kind of social interaction or the level of interaction. Within IS, initial studies in pair programming have shown positive impact in a learning environment (Williams et al. 2002).

Research in collaborative learning shows that there are five important structures that enhance collaboration within learning group: positive interdependence, individual accountability, supportive efforts, team building efforts and group processing (Johnson et al. 1999). These structures are summarized in Gupta et al. (2004). Collaborative learning literature also shows that all of these structures are individually important as well as collectively necessary (Johnson et al. 1999). Thus, learning techniques need to focus on incorporating these structures to be effective.

Functionally, collaboration provides an environment where participants gain social understanding through observation and reflection on the learning process as a whole. When they apply this social understanding to themselves, they achieve higher learning outcomes. Thus,

P2: *Participant's trained using training supplemented with effective collaboration structures will show higher learning outcomes than participants in non-collaborative environments*

Technology-mediated training

Computer technology has been widely used in the educational literature. Large meta-analyses on the effectiveness of computers in groups in education have shown that, in the majority of experiments the use of technology has improved the learning outcomes (for review see Lou et al. (2001)) However, these meta-analyses do not distinguish between the pedagogical uses of technology. Instructional use of computer technology is now distinguished as learning-from-computers and learning-with-computers (Jonassen et al. 2001; Salomon et al. 1991). Learning-from-computers occurs when computer is the medium of instruction (e.g. computer-based training) whereas learning-with-computers occurs when computer technology is used as a tool to support teaching and learning (e.g. use of website by instructor, e-collaboration).

Learning-with-technology

No EUT studies were found using learning-with-technology Meta-studies looking at learning-with-technology in an individual context though, have shown a consistent positive effect of technology use, though little has been done to explain the reasons for the positive effects (Kulik 1994; Kulik et al. 1987). On the other hand, meta-studies in the learning-with-technology in a collaborative setting have shown high variability in results ranging from negative, positive to no effect (for a review see Strijbos et al. (2004)). A major shortcoming of this literature is that it does not distinguish between the effect of collaboration and technology, nor does it look at the structures employed by the technology in use. According to AST, the benefits of technology use come when the above capabilities are used to provide structures. Examples of structures include anonymity, synchronicity (DeSanctis et al. 1994), and comprehensiveness of the information presented (DeSanctis et al. 1989). It is only when these structures supplement existing pedagogical methods will technology have a positive influence on the learning outcomes. Thus,

P3: *Participant's learning-with-technology which embeds structures that facilitate existing pedagogical methods will show higher learning outcomes than participant's not using technology similarly.*

Learning-from-technology

Research comparing effectiveness of learning-from-computers to standard methods of instruction has provided inconclusive results in both Education and IS literature (Kovalchick et al. 2004). Limited research in EUT using computer-based training

(CBT) provides inconclusive understanding of the impact of learning-from-computers (see Table 2). A major problem with these studies is that CBT tools used are not grounded in theory or research, resulting in incomparable studies. Secondly, these studies have utilized technology differently. E-learning technology has only recently matured so that it can be effectively used to embed the learning techniques and theories discussed above.

Study	Training intervention	Learning outcomes	Findings
(Gist et al. 1989)	VM vs. CBT	Skill: Task performance Affective: Computer self-efficacy (CSE)	VM yielded higher CSE and task performance scores
(Bowman et al. 1995)	CBT vs. lecture	Skill: Task performance Affective: Satisfaction	No significant difference
(Bohlen et al. 1997)	CBT vs. lecture	Skill: Task performance, efficiency Affective: Satisfaction	Difference mediated by individual difference
(Desai 2000)	Vicarious modeling CBT vs. lecture	Skill: Task performance	Positive effect for Excel. No effect for Word.
(Piccoli et al. 2001)	A mix of techniques using CBT vs. lecture	Skill: Knowledge Affective: CSE	No difference in knowledge CSE was better for CBT users

Table 2: Literature review: Technology-mediated end-user training

To explain the benefits of using information technology in learning, the focus needs to shift to the structures embedded in CBT software. Based on previous academic literature and the e-learning technology used in the current research, five important structural features that influence learning in a EUT domain are isolated. Structures embedded within learning-from-computers include a smaller task focus, relative restrictiveness (Silver 1991), learner-centered activity (Zhang et al. 2004), richness of feedback (Cats-Baril et al. 1987) and learning guidance (Silver 1991), and feedback and realism is system interactivity (Zhang et al. 2004). According to AST, it is these structural features of a CBT software that influence learning outcomes. Thus,

P4: *Participant's learning-from-computer's using grounded in theory such as SCT will show higher learning outcomes than participant's not using information technology similarly.*

LEARNING AND INTERACTION PROCESS

Having discussed the functional components that affect training process, it is also important to look at the learning process. The above-mentioned structures enable as well as constrain interaction during the learning process. According to AST, it is not the capabilities of information technology, but rather how these structural features are appropriated that affect learning outcomes (Chidambaram et al. 1990/91).

Appropriation has a direct influence on learning outcomes (Poole et al. 2003). A recent study by Alavi et al. (2002) highlights this issue where participants with sophisticated systems had lower learning outcomes because of lack of appropriation of technology. This was primarily due to lack of training support as participants spend more time in understanding the technology rather than focusing on learning objectives.

When analyzing appropriation, Poole et al. (1989) suggest three dimensions that affect how successfully a structure is appropriated: faithfulness, attitudes and level of consensus. That is, a structure will only have its intended effect if its design principles are kept intact (faithfulness), if members do not react negatively to it (attitudes), and if members agree substantially over how structure is used (consensus).

A faithful appropriation occurs when the learners using the structures follow the spirit (the general objectives and procedures that the structures aim to promote) of the structures (Poole et al. 1992). Faithfulness of appropriation is not necessarily concerned with the precise duplication of the procedures provided; rather, it is concerned with whether the structures are used in a manner consistent with the overall goals and objectives. A unique or innovative use of the structures/features by the group may well be faithful appropriation as long as the use is consistent with the spirit that the system intended to promote.

Attitude is the vehicle that reflected the stability of the technology appropriation process. Attitude is the degree to which learners have a positive or negative disposition towards using the structures (Poole et al. 1990).

Consensus is defined as the extent to which the participants agree on how to jointly use the structures (DeSanctis et al. 1994; Poole et al. 1992). In a collaborative environment, if consensus on appropriation is not reached, effective coordination of user efforts may be difficult, and thus, would likely lead to unfavorable outcomes (Salisbury et al. 2002).

According to AST, it is the extent of appropriation of the structures that determine the extent of their impact. The extent of appropriation is determined by measuring the faithfulness, attitude and consensus towards the structure. Thus, drawing on this theory, the effects of structures would be dependent on the extent of appropriation of the structures embedded in the technology. Thus,

P5: *Extent of appropriation of structures (information technology, learning techniques, and collaboration) will have a positive correlation with learning outcomes.*

The extent of collaboration is dependent on the structures described earlier. Faithfulness, consensus and attitude towards each of these structures cannot be measured independently because each influences the other. Instead, a perceived measure on the appropriation of each structure described earlier represents the extent of collaboration happening in the group (Johnson et al. 1975).

Appropriation Support

Appropriation of the above mentioned structures is often supported or scaffolded. A scaffold provides initial assistance to support learning that gradually faded as learners become more independent, confident and competent (Hannafin et al. 2004). EUT research has demonstrated the importance of scaffolding, e.g., use of advance organizers (Sein et al. 1989). Thus,

P6: *The extent of appropriation support will have a positive correlation with the level of appropriation of learning method structures.*

Learning outcomes over time

The idea of structure being continuously produced and reproduced through action also leads to another significant aspect of structuration, that of routinization. Limited empirical research exists on using AST longitudinally and no EUT study has looked at learning over time even though most training is not a single event. Thus, evidence from the group development literature (Chidambaram et al. 1997) is used for inferences. Based on this literature, as the learning process moves forward in time, the level of appropriation for the above structures will change. Since the level of appropriation of the structures defines the structural potential to the participant, these changes will induce changes in learning outcomes achieved over time. Thus, we postulate,

P7: *Changes in the extent of appropriation of structures (information technology, learning techniques, and collaboration) will positively influence changes in learning outcomes over time.*

LEARNING OUTCOMES

Two types of knowledge have been identified in training literature i.e. declarative and procedural (Anderson 1982). Declarative knowledge, or know-what knowledge, is factual knowledge that describes physical features and relationships between the components. Procedural knowledge, also called know-how knowledge, describes the order of operations to apply and when to apply a certain procedure. More specifically for EUT, Olfman et al. (2005) identify seven levels of knowledge which should be the focus EUT programs.

Another objective of EUT programs is to enhance participants' satisfaction as well as make them comfortable about participating in future EUT activities. Satisfaction has been a widely used parameter to evaluate the effectiveness of learning environments both in academic (Alavi 1994; Alavi et al. 1995) and business settings (Wolfram 1994).

Finally, important outcome of the training is perceived self-efficacy of the individual in using the technology. (Bandura 1977) conceptualized self-efficacy as the most important factor affecting subsequent behavioral change. This has been supported in EUT context with Yi et al. (2003) study that found self-efficacy to be more important than declarative knowledge in subsequent performance on-the-job following training. Within IS research in general, perceived self-efficacy has been found to be an important factor influencing technology adoption (Fenech 1998; Venkatesh et al. 2000).

CONCLUSION

With the expanding role information technology in business activities, organizations are actively looking at improving end-user training outcomes. EUT, thus, represents a very important area of investment and concern within the corporate and academic environments. Both from a theoretical as well as practical point of view, it becomes very important to understand the impact of different EUT learning methods.

This research model presented has two important contributions to EUT literature. First, it brings together literature from education and IS to present a comprehensive model for investigating end-user training. Second, the model explains the how and why e-learning is effective in EUT. By looking at the functional components embedded in the learning method structures, IS researchers would better able to explain the causal link between technology use in training and training outcomes.

By simultaneously focusing on the learning process, the model can be used explain the variation within structural-based studies, as well as, provide a foundation to comprehensively examine the learning process over a period of time. Empirical testing of the seven propositions outlined above is the next step in attaining our ultimate research outcome, which is to develop an increasingly specific model of e-learning in the EUT context. Finally, this empirical testing will provide guidelines for pedagogical practices that will have immediate payoffs especially for proper implementation of technology-mediated training in academic and corporate settings. Empirical results to date will be presented at conference.

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