Scaffolding Discourse
in Asynchronous Learning Networks

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ABSTRACT

Discourse, a form of collaborative learning, is fundamentally a communications process. This in-progress study adapts Clark and Brennan's grounding in communications principles to investigate how to "scaffold" asynchronous discourse. Scaffolding is defined as providing support for the learner at his or her level until the support is no longer needed. This paper presents early results from an experimental study measuring learning effectiveness. In the experiment, content and process scaffolding are manipulated based on pedagogic principles. A major contribution of the study is building and testing a technology-mediated, discourse-centered, teaching and learning model called the Asynchronous Learning Networks Cognitive Discourse Model (ALNCDM). As discourse is one of the most widely used online methods of teaching and learning, the results of the study are expected to add to the body of knowledge on how to structure asynchronous online discourse assignments for more effective student learning.

Keywords

content scaffold, process scaffold, asynchronous learning networks, discourse, collaboration, learning.
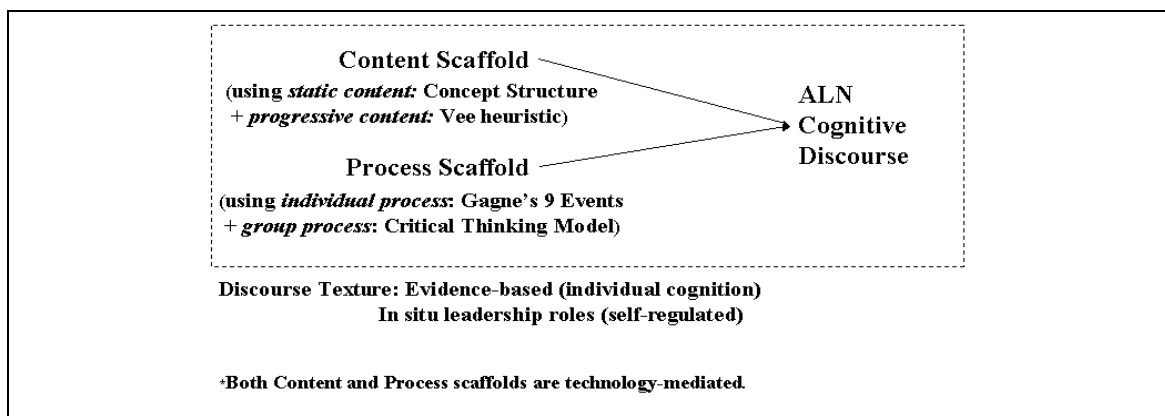
INTRODUCTION

Collaborative learning involves social processes as students work together on learning activities. In collaborative learning, the students communicate with each other to negotiate meaning and to reconstruct knowledge (Veerman, 2004). While these statements describe collaborative learning, they more fundamentally describe the process of communications. This study investigates how to scaffold asynchronous discourse for the purpose of teaching and learning based on the Asynchronous Learning Networks (ALN) Cognitive Discourse Model (ALNCDM). Scaffolding, which is based on Vygotsky's (1980) social learning theory, is defined as providing support for the learner at his or her level until the support is no longer needed. The two types of scaffolding are content and process scaffolds. The purpose of the content scaffold is to make explicit the information the learner needs to learn (Jonassen, 2003). The purpose of the process scaffold is to reduce time spent on task management, so the learner is able to spend more time on learning. While the most common types of scaffolding I involve instructors and peers, the use of non-instructor scaffolds which effect self-regulation (O'Neil and Herl, 1998) are particularly important in ALNs, where class sizes tend to be large. These include effective Information Systems support for more effective content and process scaffolds.

This 2 X 2 study is manipulated on two types of scaffolding: content and process scaffolds. Learning effectiveness is measured in terms of cognitive and affective outcomes. The paper begins with a description of the ALNCDM, followed by the research approach. Early results from the field experiment conclude the paper.

THE ALN COGNITIVE DISCOURSE MODEL (ALNCDM)

The ALNCDM is an original model derived from Clark and Brennan's communications theory on the premise that discourse, as a sense-making act, is fundamentally a communications process. In a seminal work, Clark and Brennan (1991) suggested

that, to succeed in communications, the parties have to coordinate both the "content" and "process" of communications. For example, two pianists playing a duet need to coordinate the content (e.g., Mozart) as well as the process (entry, exit, pace, etc.) of playing. Adapting Clark and Brennan's communications grounding theory within a technology-mediated environment for the purpose of learning (i.e., Technology-Mediated Learning environment TML), this research suggests that ALN collaborative discourse is more effective when it is scaffolded along two dimensions: a) that the content of discourse be scaffolded by a *technology-mediated* concept structure unfolded via a Vee-heuristic sequence (Novak and Gowin, 2003), and b) that the discourse process be scaffolded by an overall *technology-mediated process structure* following Gagne's Nine Events of Instruction punctuated by "discourse triggers" that transitions/morphs the discourse to conclusion. The underlying discourse texture is evidence-based (versus argumentation based) with assigned *in situ* leadership roles (facilitator, report writer and weaver). The use of evidence-based discourse places (and limits) the discourse model for learning objectives within the Application level of Bloom's taxonomy (Bloom, 1956), rather than higher levels such as Synthesis or Evaluation. For higher levels, the use of argumentation is necessary to demonstrate student mastery. This model is called the ALN Cognitive Discourse Model and is depicted in Figure 1. (Note 1: The ALNCDM is applicable for conceptual learning at the Application level of Bloom's taxonomy. Bloom's taxonomy is a taxonomy of cognitive assessments. Note 2: The Vee-heuristic is a meta-cognitive sequence prescribing an unfolding of what is to be learnt. Note 3: Gagne's Nine Events of Instruction describe the necessary mental pre-conditions for successful learning.)

Content Scaffold
(using *static content:* Concept Structure
+ *progressive content:* Vee heuristic)

Process Scaffold
(using *individual process*: Gagne's 9 Events
+ *group process*: Critical Thinking Model)

ALN Cognitive Discourse

Discourse Texture: Evidence-based (individual cognition)
In situ leadership roles (self-regulated)

*Both Content and Process scaffolds are technology-mediated.

Figure 1 The ALN Cognitive Discourse Model (ALNCDM)

Content Scaffold

More specifically, the content needs to be scaffolded by a technology-mediated concept structure that is unfolded in a meta-cognitive sequence based on the Vee-heuristic (Novak and Gowin, 1984). This sequence of unfolding (i.e., progression of content) begins with the full text version of an article (the record of events) which progresses through progressive elaborations from significant source statements (constraining the record of events) to the final learning artifact (i.e., (static) concept structure) transforming the record of events into a conceptual framework.

Process Scaffold

In parallel, the discourse process is scaffolded at two levels: at the individual level and at the group level. At the individual process level, each student is required to follow eight of Gagne's Nine Events of Instruction. At the group process level, the discourse progresses through a series of "discourse triggers" based on a five-phase technology-mediated group process structure following Gunawardena's Critical Thinking Model (Gunawardena, Lowe and Anderson, 1997). The Critical Thinking Model is a five phase model most often used in content analysis to indicate absence/presence of varying cognitive levels. The hypothesis is that each phase of the Critical Thinking Model takes the discourse to deeper levels of cognitive processing.

These two dimensions of grounding communications form the two manipulated variables of a field study that is underway. The full research approach is depicted in Figure 2.

RESEARCH APPROACH AND METHOD

The ALNCDM predicts that when discourse is scaffolded along the two dimensions of content and process, then learning effectiveness is higher. In this study, *learning effectiveness* is operationalized on two dimensions: a) cognitive outcomes (i.e., test grades, amount of quality evidence in group report, amount of task-related discourse interactivity[1]), and b) affective outcomes (i.e., satisfaction with group report, discourse and the learning artifact). The assessment strategy is multi-method including test grades, essays (i.e., group report), and participation (i.e., discourse interactivity) which should control for test-anxiety bias.

Besides learning effectiveness, the research approach includes a *motivation* measure operationalized in a self-efficacy scale. Self-efficacy is self-perception of one's ability to complete the assignment successfully. Increase in self-efficacy measures a more lasting accomplishment representing a separate dependent variable. Learning approach (Schmeck, Ribich and Ramanaiah, 1997) and group involvement (Krejins, Kirschner and Jochems, 2004) are two intervening variables in the research approach. In an assignment that requires comprehension, students with a synthesis-analysis learning approach may perform with an advantage. In this study, synthesis-analysis measures the student's pre-disposition to deep or shallow learning. Hence it is a mediating variable that should not be affected by the conditions of the study. Groups with sound "social space" (characterized by more affective work relationships, stronger group cohesiveness, trust, respect and belonging, satisfaction and a stronger sense of community) may perform better than groups that do not. (These two intervening variables were introduced after consultations with Novak and Kirschner via email. Early results suggest that synthesis-analysis is well-placed in the research approach.)

Hence, the overall hypotheses under this research approach shown in Figure 2 are:

a) Since content scaffold is expected to facilitate assimilation of information, learning effectiveness (i.e., test grade (H1a), group report (H2a), interactivity (H3a), satisfaction with group report (H4a)/ discourse (H5a)/ learning artifact (H6)) and self-efficacy (H7a) are higher with content scaffold than without content scaffold.

Since process scaffold is expected to increase time on tasks directly related to learning, learning effectiveness (i.e., test grade (H1b), group report (H2b), interactivity (H3b), satisfaction with group report (H4b)/ discourse (H5b)) and self-efficacy (H7b) are higher with process scaffold than without process scaffold.
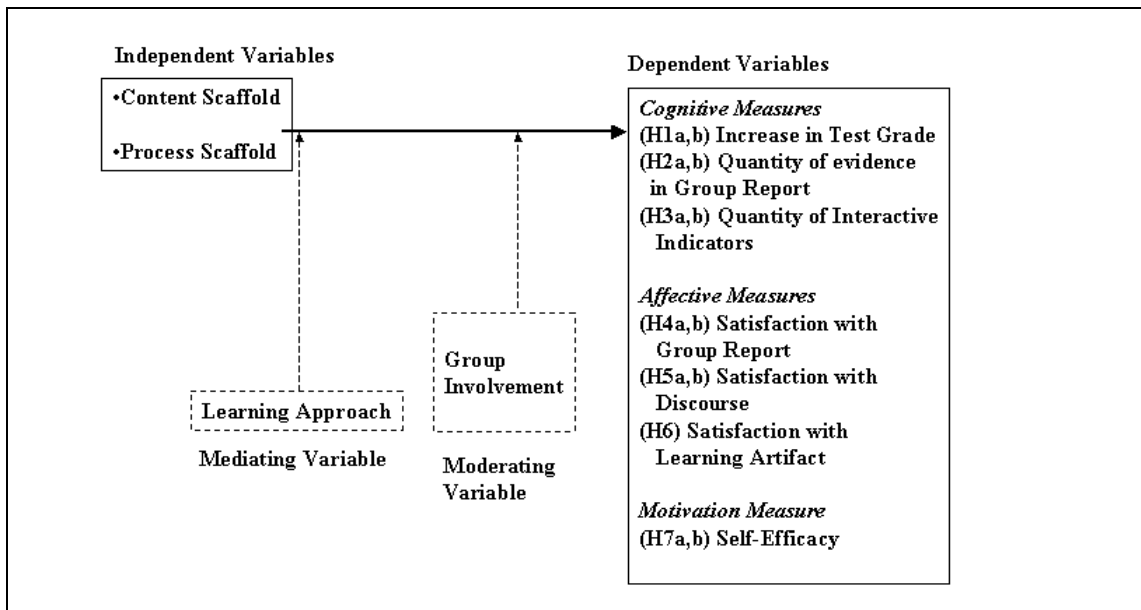
Figure 2 The Research Approach

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[1] While interactive indicators are one of the 'social indicators' in Swan's schema (Swan, 2001), it is applied here as an operational indicator of the presence of co-construction of knowledge, that is a cognitive participation indicator.

Field Experiment Design

A field experiment with pre- and post-test design is employed. The field experiment is a between group design (each participant in the research is in one and only one condition) with four cells (2 X 2 design). Each cell has twelve groups and each group has two to three undergraduate/graduate students. Computer Information Systems (CIS) graduate/ undergraduate students and Management Information Systems (MIS) graduate students are used for the study, drawn from the courses in which the subject matter of the experiment is appropriate for the syllabus. The students are randomly assigned to one of the four conditions, with the teams in each condition described by a color in order to simplify instructions and discussion of these conditions.

	CS= No	CS= Yes
PS= No	Red	White
PS= Yes	Blue	Orange

Table 1 Field Experiment Design

Key: CS: Content Scaffold   PS: Process Scaffold

The Task

The participants read the Mowshowitz (1981) article on theoretical perspectives and view the corresponding lecture slides individually prior to discourse. Mowshowitz is an abstract and complex article which discusses five social computing philosophies (aka Mowshowitz Framework): Technicism, Progressive Individualism, Elitism, Pluralism and Radical Criticism. It is selected for the study because it is a concept piece that students have found challenging and therefore in need of a supplemental learning activity as well as scaffolding. Afterwards in small discourse groups, they are asked to discuss and apply the Mowshowitz article to a second article (Keen, 1981). A final group report is compiled to summarize the discourse.

Pilot Studies

Between Summer 2003 and Summer 2004, the research approach was grounded through a series of six pilot studies. In total, 917 undergraduates and 24 graduates in Computer in Information Systems, and 14 graduate students in Management Information Systems participated in the pilots. During the pilots, several iterations were made to the field experiment design including revised instruments/scales, revised software for presentation of content scaffold, and addition of process scaffolding as a manipulated variable. Results from these pilots were published separately (Wong-Bushby, 2005).

EARLY RESULTS DISCUSSION

In Fall 2004, after the pilot studies were concluded, the main study began with the goal of gathering 48 discourse group samples with 12 groups in each condition. The main study is expected to run from Fall 2004 through Spring 2005 involving several undergraduate/graduate classes in Computer Information Systems and Management Information Systems. The rest of this paper describes early results from an undergraduate class in Management Information Systems. Thirty-four students participated in the study and they were randomly assigned to one of eleven groups: 2 Red, 3 White, 3 Blue and 3 Orange.

Figure 3 indicates that Satisfaction with Learning Artifact (Mean Squared= 19.43, F= 3.31, df=1, p= .08; not significant), Satisfaction with Group Solution (Mean Squared= 19.6, F= 6.13, df=1, p= .023; significant) and Satisfaction with Group Discourse (Mean Squared= 39.59, F= 4.26, df=1, p= .05; not significant) are highest in the Orange condition (with both types of scaffolding), about the same in the Blue/White conditions, and lowest in the Red condition (no scaffolding). As the sample size is small, these results should be interpreted as possible trends seen in early results. The rest of the discussion is focused on Satisfaction with Group Solution.
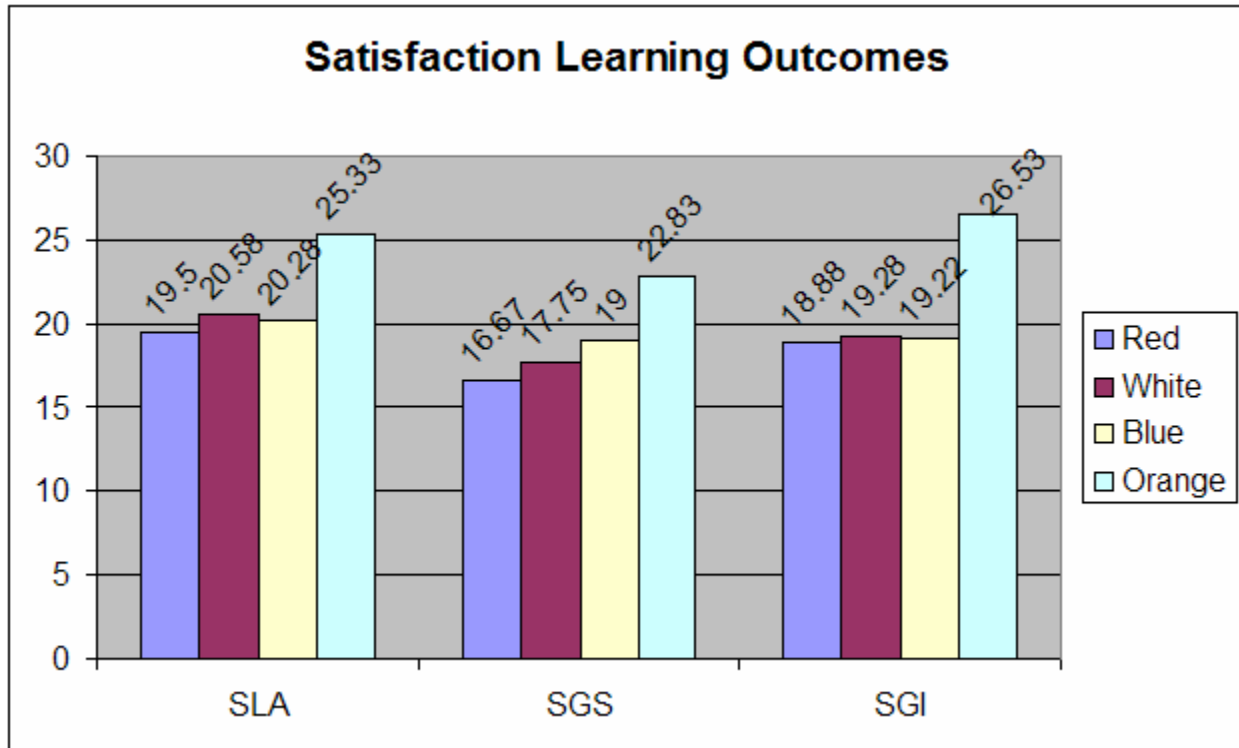
Figure 3 Satisfaction Learning Outcomes

Key:
Red: no content scaffold + no process scaffold
White: content scaffold + no process scaffold
Blue: no content scaffold + process scaffold
Orange: content scaffold + process scaffold
SLA: Satisfaction with Learning Artifact (Lowest 1 ..5 Highest)
SGS: Satisfaction with Group Solution (Lowest 1 .. 5 Highest)
SGI: Satisfaction with Group Discourse (Highest 1 .. 5 Lowest)

Additional analysis on Satisfaction with Group Solution (SGS) indicates that Concept Scaffold is a significant main effect (Mean Squared= 36.7, F=11.47, df= 1, p= .012); while Process Scaffold was not significant (Mean Squared= 16.1, F= 5.04, df= 1, p= .06). Furthermore, the use of Concept Scaffold combined with Process Scaffold has the highest SGS suggesting a synergistic effect between Concept and Process Scaffolds. One explanation for the synergistic effect is the process scaffold serves to focus students' attention on the content scaffold, which may go unnoticed otherwise.

The students SGS was validated against students' post-test score (i.e., question 52 on the post-survey) to correlate actual student learning to perceived learning (i.e. SGS). Test question 52 asks for the student's individual response to the group report. The percentage of correct solution reported in each condition before and after the discourse is as follows: Red 43%/14%; White 57%/57%; Blue 50%/30%; Orange 50%/100%. It is interesting that while the Orange condition shows an improvement in percent of correct solution, both the Red and White conditions showed a decrease. One possible explanation is that use of Content Scaffold helps ground the students' discourse and prevents the discourse from getting biased and subjective. Highly subjective discourse may lead to confusion and lower post-test scores on test question 52 (as in the Red and Blue conditions).

While preliminary results of this study suggest that Content and Process Scaffolds result in a learning environment that improves learning (as measured by the SGS affective score and question 52 test score), a review of students' Learning Approach shows that students in the Orange condition have the highest synthesis-analysis learning approach (25.33) compared to the other conditions (Red 19.58, White 20.58, Blue 20.27). Although the difference is not significant, it is possible that Learning Approach is an intervening variable in the Orange condition. The resolution of this question remains open until the main study is complete providing a larger sample size for analysis.

CONTRIBUTIONS

A major expected contribution of the study is building and testing a technology-mediated, discourse-centered, teaching and learning model called the ALN Cognitive Discourse Model. As discourse is one of the most widely used online methods of teaching and learning, the results of the study are expected to add to the body of knowledge on how to structure asynchronous online discourse assignments for more effective student learning. Current methods of structuring discourse such as required number of postings have not been effective beyond eliciting minimum participation from students (Hara, Bonk, Angeli, 1998). Since the study will not require special software, other than access to word processing and discussion board software, it will be widely accessible to teachers and students. Another contribution of the study is a comprehensive learning assessment strategy based on multi- dimensions of learning and multi-methods of assessment.

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