

INVESTIGATING PROBLEM SOLVING WITH COMPUTER-SUPPORTED COLLABORATIVE LEARNING

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Abstract

In this study, we investigated group problem solving behaviour of twelve graduate students using Computer Supported Collaborative Learning (CSCL). The problems were ill-structured design problems about the critique on the design of multimedia educational software. The students were asked to participate in an asynchronous online discussion which involved the following tasks: identifying design problems, discussing the design problems, developing solutions, and discussing the suggested solutions. The software program Knowledge Community, a CSCL that allows scaffolded online discussions, was used. Results indicated that the graduate students participated significantly more in identifying design problems than in discussing the design problem. They also participated more in identifying solutions more than discussing the suggested solutions. Implications about scaffolding ill-structured design problems can be drawn from the results of this study.

Keywords

Problem solving, Asynchronous online discussion, Scaffolds, CSCL

Introduction

Many educators agree that problem solving is regarded as the most important learning outcome (Jonassen 1997). Problem solving, in general, can be defined as “any goal-directed sequence of cognitive operations” (Anderson 1980). From an instructional perspective, problem solving activities may allow individuals to integrate their content knowledge and thinking skills. Problems, however, vary in their nature from well-structured to ill-structured types (Jonassen 2000). In this study, we investigated how graduate students solve ill-structured design collaboratively in an online environment, including how they identify design problems; discuss the design problems, develop solutions, and discuss the suggested solutions.

Literature Review

According to Jonassen (2000), design problems are classified as ill-structured problems. Goel and Pirolli provided a clear picture about design problems which summarized by Jonassen (2000, p.80) as follows:

Goel and Pirolli (1989) articulated the characteristics of design problems, including many degrees of freedom in the problem statement, which consists only of goals and intentions, limited or delayed feedback from the world, artifacts as outputs that must function independently of the designers, and answers that tend to be neither right nor wrong, only better or worse.

Literature reviews show that “peer discussion adds value to classroom instructions and recent perspectives on learning highlight the importance of peer discussion” (Hoadley and Linn 2000). Peer

discussion may be carried out in a face-to-face situation or computer-mediated communication mode such as an asynchronous online discussion. There is a positive effect upon individuals in solving problems when they are in a computer mediated collaborative learning environment (Uribe, Klein et al. 2003). Individuals have more time to reflect during the asynchronous online discussion than when they are in class (Hew and Cheung 2003). In a sense, asynchronous online discussion environment allows individuals to participate anytime, and anywhere. Research (Nussbaum 2002) also suggests that providing scaffolds can develop individuals' capacity for higher-order thinking skills. This preliminary study attempts to combine these two treatments, by looking at how learners behave in a scaffolded online discussion environment.

The Study

The purpose of this study was to investigate the effect of using scaffolds in an asynchronous online discussion environment to identifying design problems and to develop solutions for the problems. We focussed on the first four ill-structured problem solving steps from Jonassen's model (1997). We measured the number of ideas that each participant contributed in terms of identifying problems, discussing the problems, identifying solutions, and discussing the solutions. The unit of analysis is an 'idea' related to problem solving, which is a single point that a participant made. For example, a note that includes identifying the problem and two proposals of solutions were analysed as three ideas.

Twelve graduate students who were in a multimedia design module participated in this study. An instructor led, face-to-face session was conducted. Four problem solving activities were introduced to them with suggested scaffolds. The program "Knowledge Community," a computer-supported collaborative learning (CSCL) environment, was introduced to them. The CSCL provided the students with an asynchronous online discussion environment with scaffolds. The students were asked to critique on the design of the given multimedia educational software on the CSCL environment for two weeks. The data was collected from the CSCL discourse and analysed by using SPSS 11.0. The following three research questions were examined by using two-tailed paired samples t-Test.

Research Questions

The purpose of this study is to investigate how learners engage in a scaffolded online discussion environment. The results of this study could provide important clues as to how best to facilitate and foster ill-structured problem solving skills in such an environment. Specific questions are:

1. Is there a significant difference between the number of ideas in identifying design problems and the number of ideas in discussing the identified problems?
2. Is there a significant difference between the number of ideas in identifying design problems and identifying possible solutions?
3. Is there a significant difference between the number of ideas in identifying possible solutions and discussing the identified solutions?

Findings & Discussion

This section reports the findings and discusses its relevance in terms of the three research questions raised earlier. Table 1 provides the descriptive statistics of the four problem solving activities. Table 2 provides a summary of the findings by using paired samples t-Test.

Table 1 Four Problem Solving Activities Descriptive Statistics

	Mean	N	Std. Deviation	Std. Error Mean
Identify Problem	10.92	12	8.14	2.35
Discuss Problem	5.75	12	6.02	1.74
Identify Solution	11.33	12	8.32	2.40
Discuss Solution	6.17	12	4.95	1.43

Table 2 Paired-Samples t-Test

Pairs	Mean	Standard Deviation	Std. Error Mean	t	df	Significance (Two-tailed)
Identify problem & Discuss problem	5.17	5.75	1.66	3.113	11	.010*
Identify problem & Identify solution	-0.42	5.21	1.50	-0.277	11	.787
Identify solution & Discuss solution	5.17	9.11	2.63	1.964	11	.075

Research Question 1: Is there a difference between the number of ideas in identifying design problems and the number of ideas in discussing the identified problems?

There is a significant difference between the number of ideas in identifying design problems and the number of ideas in discussing the identified problems ($df=11$; $t=3.113$; $p = .010$). The result seems to indicate the participants contributed more ideas in identifying design problems rather than discussing the identified problems.

Research Question 2: Is there a difference between the number of ideas in identifying design problems and identifying possible solutions?

There is no significant difference between the number of ideas in identifying design problems and identifying possible solutions. One may argue that this group of students was not creative, because if they were creative, they would have generated more possible solutions for each identified problem.

Research Question 3: Is there a difference between the number of ideas in identifying possible solutions and discussing the identified solutions?

There is no significant difference between the number of ideas in identifying possible solutions and discussing the identified solutions. However, the associated probability of .075 (ie $p=.075$) is getting very close to a .05 significance level. Though it is not statistically significant, the number of ideas in identifying possible solutions is more than the number of ideas in discussing the identified solutions (refer to Table 1). The result tends to indicate that the students contributed more ideas in identifying possible solutions than in discussing the identified solutions. This could be due to the culture of the students. They may not be used to discussing ideas with others, or the scaffolds were more useful for them in identifying possible solutions.

Implications

This study has implications for designing scaffolds for ill-structured problem solving activities: identifying problems, discussing identified problems, identifying possible solutions, and discussing possible solutions. Though we have more scaffolds for discussing identified problems and discussing possible solutions, the students tend to participate less in those two activities. This may imply that the scaffolds are not appropriate for the corresponding problem solving activities. Another possibility is the students are used to identify problems and develop solutions, but they are not encouraged to discuss problems and solutions. As a result, they are not used discuss problems and solutions.

Future Research

The results of this study suggest some specific areas that should be addressed by future research. The scaffolds used should be examined if they are suitable to facilitate the corresponding problem solving activities. The participants' perceptions about the usefulness of asynchronous online discussion may

affect their participation. Their previous knowledge and experience in the solving design problems may affect the way they participate in the problem solving activities.

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