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Reframing Narrative Cases for Ill-Structured Contexts: The Design with Learners in Mind

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Abstract

This study reviews theories supporting the construction of student knowledge and found they rely upon theoretical operations with few pragmatic applications. A new paradigm of learning needs to emerge which focuses on how students actually construct their own knowledge, based on reconstructing current/past knowledge or experience, and their interpretation of the world. Such a paradigm implies ways that would enable educators to facilitate students' problem solving, and gears to help students construct hypotheses, select and transform information, and finally make decisions. Implications for designing effective narrative cases for ill-structured problem solving are discussed.

Keywords
Case-based learning; problem-based learning; narrative cases; ill-structured problems

First heading

Introduction

Bereiter and Scardamalia (1993) identified problem solving as an important aspect of professional practice. Professionals apply their problem solving skills to the ill-structured nature of their work (Schon, 1987), and ill-structured problems are prototypical of problems that are often found in real-world practices. Much research has identified and developed methods for supporting and facilitating organizational ill-structured problem solving styles in education (e.g., Ge & Land, 2004). Mayo (2002) formulated a hypothetical case narrative which asked students to identify the theory that most closely fits with a provided case situation and provide a brief, explanatory rationale for their selection. Mayo's (2002) study found students who received case narrative problems improved their conceptual understandings more significantly than those who did not receive any. As the students engage in real-life situations, they are able to evaluate critically and generate as many alternatives as possible rather than process information primarily on emotional and intuitive levels (Kreber, 2001). However, these researchers have not yet addressed the issue of designing effective cases in terms of ill-structured problems to facilitate students' problem solving skills; rather than describe the process of solving the problems in their publications, researchers have focused on outcomes.

Literature Review

In case-based instruction, real or fictional problem situations are implemented for students' learning. Previously, case-based instruction has been found to encourage team work, facilitate the

development of reflective thinking and deeper conceptual understanding (Heath, 1999). Likewise, case-based instruction has been shown to facilitate meaningful learning by bridging the gap between theory and practice (Ertmer & Russell, 1995).

Osana, Tucker, and Bennett (2003) investigated the nature of adolescent reasoning on the issues of reform-oriented social studies through solving cases. In their study, eighteen participants from 10th grade were asked to allocate money to the candidates and to write their justifications for the allocations. Think-alouds and interviews were analyzed, and the results found that adolescents are more likely to engage in constructive or sense-making activity while reasoning through ill-structured problems.

Much research has focused on students' learning outcomes on problem-based instruction, little has yet been conducted on the effectiveness of the problem-based tutorial as an instructional strategy. Gallagher, Stepien, and Rosenthal (1992) studied the strategies that helped students problem solve. They found that problem finding during the problem solving steps was significantly increased and implied an increased recognition of problem finding is especially important since this is the component of problem solving considered critical for creative productivity. This increase in the presence of this problem solving step is a promising trend and justifies additional refinement as an instructional alternative for talented students. However, the participants in Gallagher et al's (1992) study were talented students, so their findings may not apply to other students if we use the same problem-based instruction as a technique. Therefore, problem based instruction is in need of additional research.

Researchers have investigated the approaches students use to solve problems. There are two common ones that have been offered to increase productions or generations of solutions to ill-structured problems: incubation (Wallas, 1926) and brainstorming (Osborn, 1953). In addition to incubation and brainstorming, the use of hierarchy is also a common approach with other researchers. Butler and Thomas (1999) conducted a study involving ninety-eight participants who were randomly assigned to one of the three experimental conditions (hierarchical, brainstorming, and incubation). The problem was given to a group of four or five people and they were given a brief description that varied according to the condition they were in. Their study found that the active methods of brainstorming and hierarchical generation produced more ideas than the passive technique of incubation (Butler & Thomas, 1999). However, the effectiveness of these strategies is inconsistent, and they can cause students to overlook some related solutions and associates.

In addition to research on various strategies for problem solving, researchers have been interested in the assessment of complex problem solving contexts. To find out whether skills required for solving well-structured and ill-structured problems generalize to each other, Wood (1983) discussed the issue of problem space. Problem space is a unit of human goal-oriented symbolic activity. Wood (1983) stated that with a problem space framework, different types of problem solving situations can be understood by outlining symbolic structures and then by describing the paths, goals, and rules for achieving the goal state. Furthermore, Wood (1983) claimed that the processes used to solve such problems are not the same as those used to solve well-structured problems. This has greatly influenced how the instructional designers should design cases for ill-structured problem solving.

Jonassen and Kwon (2001) hypothesised the functional content and patterns of communication would vary between well and ill-structured problems and by mode of communication. They presumed functional content and patterns during computer conferences would be more purposive and task-oriented than during face-to-face discussion, and ill-structured problems should require more complex and less predictable patterns of communication. The instruments of surveys of on Surveys of students' perceptions, and students' conversations were used in their study. In terms of problem solving functions, every communication act was classified as a problem definition, orientation, solution development, non-task, simple agreement, or simple disagreement. Students' problem solving patterns were classified and transformed into one of eight problem solving phases including problem analysis, problem critique, orientation, criteria development, solution

development, solution approval, solution critique, and non-task. They found learners in the computer-mediated communication group participated interactively in the group learning process, which reflected multiple perspectives by the greater number of agreements and disagreements.

From previous research, we know that the notions of well-structured and ill-structured problems are different (e.g., Simon, 1978; Wood, 1983); thus, the examination of the role of communication patterns while solving ill-structured problems becomes important.

Research Questions

This study examined the following questions which may help us to understand how to design effective ill-structured problems.

(1) What are the patterns for solving ill-structured problems?
(2) What are the implications of designing authentic case narratives that reflect real-world ill-structured problems?

Methodology

Participants and Procedure

The study took place in a medium-sized, southwestern university. Two voluntary graduate-level educational psychology students participated in this study. The researcher distributed a hypothetical case scenario about an instructional design related problem adapted from Ertmer and Quinn (1999). The participants were first instructed to perform think-aloud protocols using the think-aloud process developed by Ericsson and Simon (1993). During the problem solving, participants performed think-aloud protocols on solving the problem. The use of think-aloud methodology was efficient in this study because it provided a window for uncovering the psychological mechanisms and knowledge structures underlying human problem solving activities (Yang, 2003).

After the problem solving task, a semi-structured interview was conducted for an in-depth investigation of students' thinking processes. A one-on-one interview is practical for investigating the research questions because students are more likely to express their thoughts to open-ended questions asked in a private setting than in focus groups or other more exposed settings (Creswell, 1998). As a result, the more we can examine students' thinking processes, the more we know about how they solve ill-structured problems.

Design

Case study data analysis techniques (Miles & Huberman, 1994) were used to process data, generate emerging themes, and refine the existing framework. This study also intended to validate existing theories on ill-structured problem solving as the result of qualitative analysis.

Data Analysis

Data analysis was carried out at three primary levels: (1) initial data from think-aloud protocols and interviews were organized according to the research questions; (2) segments of the transcript data were coded and categorized in the transcript margins to index and cluster data; (3) schemes were generated and grouped for the research questions. The coding schemes developed were presented in Table 1. Peer review and member checking were also conducted to verify the reliability and validity of the qualitative findings.

Preliminary Findings

A summary of findings was reported below to answer the two research questions concerning how people solve ill-structured problems as well as the implications for designing them. The qualitative findings revealed that subjects presented general levels of problem solving skills. Subjects showed more or less organized responses in different problem solving stages, which affected how the subjects used different approaches on solving the problem. In the problem representation, participants selected or adjoined critical information needed and excluded superfluous distractions from the complicated problem situation so as to gain a clear representation

of the ill-structured problems. For example, Jenny identified the key issues (i.e., the web can provide students with various resources and historical background) that were critical to help her understand the case and further the analysis plan. In seeking information, participants made inferences from their prior experiences to explore a possible path for arriving at the solutions. They tried out different strategies to gauge information. In finding alternative solutions, participants chose solutions dependent on the differences among their domain knowledge and problem solving expertise. In the analysis, participants used strategies such as self-monitoring and self-evaluation to guide their plans of action. In the solution argument, participants performed metacognitive thinking to guide their reasoning and decision-making.

From the interview data, one of the subjects responded that the most difficult process while working on the problem was that there was not enough information for her to solve the case. She was tied up with limited existing information provided in the case and was aware of the gap between the presented information and problem solution. The second subject responded that she focused on trying to find out what her role was in the case so that she could provide better and more resources to the existing information.

Our qualitative data findings revealed important implications for the design of ill-structured problems. In the problem representation, more external instructional supports should be provided to help students clarify the problem statement. The ill-structured problems should include concepts, rules, and principles in specific domains, and represent associated premises from similar situations. In the seeking information and solution alternative, the ill-structured problems should devise different paths for primary solutions and alternative solutions. In the analysis and solution argument, the ill-structured problems should embed the opportunities for students to look back and justify their solutions to the problems they have identified.

Conclusion

Researchers have discussed the importance of ill-structured problems on promoting students' conceptual understanding and knowledge transfer (e.g., Ge & Land, 2004). This study investigated how people solve the ill-structured problem on the domain of instructional design. When solving the problems, students relied mostly on their prior experience and knowledge to guide their thinking and approaches in arriving at the solutions. This study provided in-depth investigation of the processes, such as problem representation, seeking alternative solutions and solution argument that learners used to solve problems. Domain knowledge and the use of cognitive strategies (i.e., self-evaluation and monitoring) are two critical components of successful problem solving.

Teachers who are interested in incorporating ill-structured problems into the curriculum should be cautious of the difficulties that our students will run into when no instructional supports are provided. This study offers criteria that teachers can use to guide the design and understanding of ill-structured problems. Although the design of the ill-structured problem for this study is on instructional design domain, future research examines other domains of problem should shed lights on the effectiveness of ill-structured problem solving.

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Table 1: Coding scheme, examples, and analysis from the data

Themes/Codes	Participants[1]	Examples	Analysis
Problem representation	*Jenny*	"She wants to have a website because there are some advantages. First, the web can provide students with various resources and historical background. Students can get more information than in the textbook. More and also current. I agree with that. Second, the web can provide students with easy access to various visuals, such as pictures, audio, and video clips, which students can study any time of the day. Yes, I agree with that."	Jenny reported and summarized the issues as described in the case. Her report toward the case is often verbatim. It appears that she paid little efforts to consider the extent to the heart of the case.
	Cathy	"I guess first thing we need to do is to find out what the exact objectives are. That would be kind of identify the problem, determine what the outcomes, goals, main goals and the specific objectives. That's always the good starting point."	Cathy identified and categorized the central issues in a case.
Seeking information	*Jenny*	"I need to know how much money we can use because if it is enough, she can hire someone for designing and developing the website in addition to me."	Jenny tended to focus on what she did not know and made the inferences from unknown information.
	Cathy	"Huh, need to know specifically what literature that she is going to teach. It says Shakespeare, but does that the only thing is going to be covered, or there are other topics. There always be a creditability issue"	Cathy took a more focused on what she already knew from the case.
Alternative solution	*Jenny*	"First of all, I need to know what Dr. Lou needs regard the content of the website. What students want to have or see for the website? What else? As I thought previously, it is very important, what is the role of the website for her instruction. Whether she wants to use it in her class like she wants to have students assign to work during the class or using the website as the textbook in addition to her regular instruction in the class. And after I get those information about the content, the type of website, the available facility, special software or hardware that we need. Then I can draw simple kind of design for website."	Jenny identified and proposed solutions to the case. She also considered for how the issues might be related to each other.
	Cathy	"She got the small grant, find how much the grant is for, and determine how many hours we estimate this is going to take. Make sure we have basic of hours to determine hours and costs may take. To make we have enough and then find out if we need more money from some other places or possibly cutting certain elements because you do not have enough funding to finish it."	Cathy identified several suggestions to the solutions and linked the suggestions in a more coherent way.
Analysis	*Jenny*	"Dr. Lou has to tell me the website. Do I just design one time or I need to update. It's very important otherwise I cannot estimate the labor of	Jenny addressed the different issues to help herself modify the solutions.

[1] Pseudonyms are used to protect the identities of the participants.

		time which is required for me to make a plan. If I want to create such a website, I also want to make it like very attractive. I also need to know about what students want. How to attract students? What kinds of stuff they want to know related to classical literature such pictures, hometown, stories, articles, or how to access some specific sites? Exactly what they want or what students want to see on the website. First, I have to talk to Dr. Lou. Then probably I will request her to have me interview students in her classroom. Then I can determine what they want. If it is not feasible, at least I will request Dr. Lou to provide the survey so students can quickly respond."	
	Cathy	"Because I think it's could make the experience richer as supposed to just sitting and reading and huh, the thing that might be good where they get more out of it would be have more interactive, say, discussion board, something on blackboard or something where they could discuss the themes and everything among other students."	Cathy proposed the solution in an advisory tone.
Solution argument	*Jenny*	"Once we make final plan, if it is possible before just starting to create the website. I am going to develop a kind of demonstration, like simple one to provide people brief idea of what the website looks like. I want to show it to Dr. Lou and some of her students. Like trial version. To see what they like, what they do not like, and what they need which is not in the website. Then after I get information, I can make a second plan for revision. And also during that time, I also revise the plan for cost. And go ahead make a final one. Once I complete final one, Dr. Lou can use it as the trail. If it is completed, there should be some problems that I can revise. Hum, I still need the feedback for that."	Jenny went beyond the focus on the case, and she also considered other issues that may be important.
	Cathy	"And of course running the evaluation, that is one of the important thing that I had when developing (when I did my master internship that I developed a series of labs. That's one of final and important step was the formative evaluation. We had some student go through it, try out, and give us feedback. Based on the feedback, we go back and change a few things to make it even better. That's pretty much it."	Cathy recalled her prior experience from the similar context.

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