It Is More about Telling Interesting Stories: Use Explicit Hints in Storytelling to Help College Students Solve Ill-defined Problems

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Abstract

A team consisting of three faculty members from Agricultural Economics, Agribusiness management, and Food Science with two research assistants at Penn State University has been working for three years on creating a food product case library for a problem-based learning and case-based instruction course. With the assistance of experts from the food manufacturing and retailing industries we collected approximately 110 stories related to food product development. These stories were organized and stored into a database (a Case Library) for faculty and students to use in a case-based instruction course.

An earlier research study conducted by our team members found evidence that a Case Library with stories did affect students' decisions of making multiple-choice tests concerning ill structured problems (Hernandez-Serrano, 2001). Then, we encountered that students had difficulty making on-point connections between stories and target problems at hand. Our goal is to help learners better understand the stories while enhancing their abilities to make analogies. This has raised the following questions: What should we do to achieve this goal? What kind of story-indexing strategies will help students understand the stories better? Will surface level indices (such as company name, product category, product name, and development process) help students recall similar features easier? Will a deeper level of indices (such as theme, goal, plan, results, and lesson) help students understand the stories better?

Problem Statement and Research Question

Given the importance of ill-structured/ill-defined problem solving in the workplace, instructional materials and activities should be situated in a contextual learning environment. An ill-structured problem may lack a clear initial state, a set of permissible operators, or a clear goal state (Chi & Glaser, 1985). In addition, there are no absolute correct answers, so this type of problem lends itself to multiple viable solutions making it difficult to teach students how to solve ill-structured problems. Research has shown that stories are more memorable, promote elaboration to personal experiences, and help in solving ill-structured problems (Swap, Leonard, Shields, and Abrams, 2001; Hernandez-Serrano, et al. 2002). However, research has not shown whether academic achievement of solving ill-structured problems is improved by using stories with pre-generated story indices developed by experts in the representative field.

Based on the research purpose stated above, answers to the following questions are sought:

Q_1: What are the effects of using different story-indexing strategies within a Case Library on college students' (novice learners') ability to solve ill-structured problems?

Q_2: How do novice learners make analogies between stories and targeted problems when they solve ill-structured problems? What processes are used when novice learners read, encode, retrieve, and adapt the source stories to the targeted problems?

Q_3: How do pre-selected indices help novice learners see similar features between the stories and the targeted problems?

Literature Review

Problem Solving: Experts classify/ index problems differently from novices

Chi & Glaser (1985) describe two factors influencing people's problem solving abilities: *the kind of knowledge brought to the problem by the solver* and *the nature of the task.* The knowledge brought to the problem by the solvers varies depending on the amount of their knowledge of specific domain content.

Identifying differences between experts and novices offers a key to understanding problem solving processes. Some studies show that novices tend to classify problems by their *surface structure*, focusing on the

words or subjects that are prominent in the problem statements; some studies indicate that experts appear to base their perceptions of problem relatedness upon problems' *deep structure*.

Case-based Reasoning and Story Index

The application of storytelling to problem-solving skill is supported by case-based reasoning (CBR), a learning theory focused on analogy in the context of solving real-world problems "... by encoding, retrieval, and adaptation in analogical reasoning process (Kolodner, 1997, p.57)." Suggested by CBR, a Case Library is built to provide the resources of cases by collecting stories from experts. A Case Library is a systematic collection and organization of a number of experts' experiences presented in the form of stories to the learner as they interact with a task environment (Edelson, 1993). See Figure 1 for an example of the Food Product Case Library.

Indexing is the process of assigning labels to stories based on specific rules or interpretations when putting stories into a Case Library (Kolodner 1993**.** Indexing consists of "labeling" an experience with the appropriate "title" and then "filing" it in the right place in memory, which is the process of organizing experiences so that people know where they can find relevant information when needed (Schank, Berman, and Macpherson, 1999).

Figure 1: Food Product Case Library

Explicit Story Indices and Problem Solving

Novices lack experience to draw on; even if they do have experience, they may have difficulties using these experiences well because they lack a good understanding of how to encode their experiences, are unable to make retrieval at appropriate times, and cannot reuse experiences (Kolodner, 1997). In contrast to novices, experts have many experiences in their areas of expertise stored in their "library" of memory, and they can retrieve the right story to solve new problems (Schank, Berman, and Macpherson, 1999). An expert is someone who has a great many stories to tell in one particular area of knowledge and who has those stories indexed well enough to find the right one at the right time (Schank, 1995). Schank (1995) tried three different methods of extracting stories from an expert who proved to be a repository of stories about various episodes in military history. He can see military stories in a variety of different ways because he has created for himself a set of complex indices about military history.

In the experimental study of Gick and Holyoak (1980, 1983) and Holyoak (1990), college students were asked to use the fortress problem to help solve an ill-defined radiation problem. The desired goal of the radiation problem is specified at an abstract level and the strategies used to achieve the goal are open ended.

Without the fortress problem as source analog, very few students proposed the idea of using low intensity rays. For those who received fortress problems as a resource analogy, they performed differently in generating solutions. When a hint to use the story is provided, most of the students came up with the idea of using convergent low intensity rays; when students are not told to apply the prior fortress story to help solve the radiation problem, their transfer performance of generating analogous solutions declined Why did most of the subjects fail to notice the relevance of a story analogy to a target problem? It wasconcluded that the difficulty may be related to the problem of identifying the optimal level of abstraction for representing the similar features.

Novices without enough domain knowledge and cases stored in memory only see the surface features when asked to solve problems and interpret problems but experts classify problems by principles and specific rules. How do we gather and organize expert stories to help novices learn? The application of storytelling to problem-solving skills is supported by case-based reasoning (CBR) and a Case Library is built to provide the resources of cases by collecting stories from experts.

If using cases as a resource analogy is such a natural and efficient way to help novice learners understand problem situations and propose solutions, how do we help novice learners see the relevance? How do we help them see more than surface features?

Our hypothesis is that using stories collected from experts and indexing them by deeper features/ thematic features can make these connections explicit for novice learners.

Method

This research is a mixed-method design with a quantitative design (control, comparable, and experimental group) and a qualitative design (think-aloud protocol). The different treatments for the three groups are listed below.

1. Control group: stories are not indexed with any labels or hints.
2. Comparable group: stories are indexed with surface indices (factual information, such as the name of the product, the name of the company, the category of the product, and the process of the product development).
3. Experimental group: stories are indexed with belief-based indices according to Schank's (1990). Belief- based indices include theme, goal, plan, result, and lesson.

See Figure 2 for an example of story with surface indices and Figure 3 for an example of story with thematic indices.

Figure 2: Story with surface indices

Company	PepsiCo
Product Category	Beverage
Product Name	AquaFina
Processes	Generate Product Idea/Concept

Just "bottled water"

Just a few years ago, when most people wanted to have a drink of water, most likely they turned to a water fountain in the school, work or home. Nowadays it is more common to see the upscale crowd carrying bottled water. This phenomenon seems to be driven by demographics. People are becoming more health conscious. The attitude seems to be "I don't drink tap water because is chlorinated and I don't trust it. It's not good for my health."

Trying to cash in on this craze around bottled water, the PepsiCo corporation launched its popular water product AquaFina. The marketing managers behind this product knew that this demographic group would be willing to pay a certain price for this product if it matched consumers' notions and expectations of health. That has been paired to powerful images of spring waters from Colorado and France further highlighting notions about health, freshness and purity. The product has been a success.

The AquaFina product has been well positioned against a demographic group. The PepsiCo corporation

has been successful by correctly applying demographic data to position a product in the consumer's mind, thus meeting the expectations of the more health conscious consumer of today.

Figure 3: Story with thematic indices

Theme	Generate Product Idea/ Concept
Goal	Generate and evaluate retail product concepts
Plan	Gather qualitative/ quantitative data on retail product concepts
Result	Successfully applying demographic data to position a product
Lesson	Evaluating demographic trends can develop new product concepts

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The main purpose of this quantitative design is to demonstrate the effect of using different story-indexing strategies within a Case Library on novice learners' abilities of solving ill-structured problems. By manipulating the variable of story-indexing strategy (grouping participants into control, comparable, and experimental groups and by allowing each group access to a Case Library with either no indices, surface indices, or thematic indices), we can gauge the effect on learners' performance scores on solving ill-structured problems. The main purpose of the qualitative design is to gather verbal reports from the novice learners when they are taking the open-ended test in order to investigate and understand the process of problem solving and analogy making.

All subjects were selected from university junior or senior students taking related courses in marketing management, food marketing management, or agriculture business. They took one training session and one open-ended test session in this study. Those participating in the think-aloud activity attended both sessions. The main difference is they have to talk aloud their thinking process while solve problems. The entire think-aloud process is video- and audio-taped and used as qualitative data. See Figure 4 for the flow chart of quantitative design; see Figure 5 for the flow chart of qualitative design.

For the open-ended test, a rubric with scoring rules was created by the first author and a professor of Agricultural Economics. Two raters used the rubric to assign scores for students' answers on those open-ended questions. The scores were treated as quantitative data. Therefore, each student has two scores from two raters. Average of the scores was used to see if there is any significant difference due to the treatment. For the qualitative data, the data were coded, categorized, and analyzed by following the method of verbal data analysis from Chi (1997).

Anticipated Outcomes

It is expected that the group with access to a number of stories with thematic-indexing strategy in a Case Library, will perform better on an open-ended test evaluating high-order thinking skills of solving ill-structured problems than a comparable group who have access to stories with surface-indexing strategy and a control group who has access to stories without indexing strategy. It is also expected that through the careful analysis of learners' verbal reports, the nature and process of analogical problem solving, the transferring process from experts' experiences/stories to novice learners, and the construction and function of personal indexing schema will be revealed.

Figure 4: A flow chart of the quantitative design

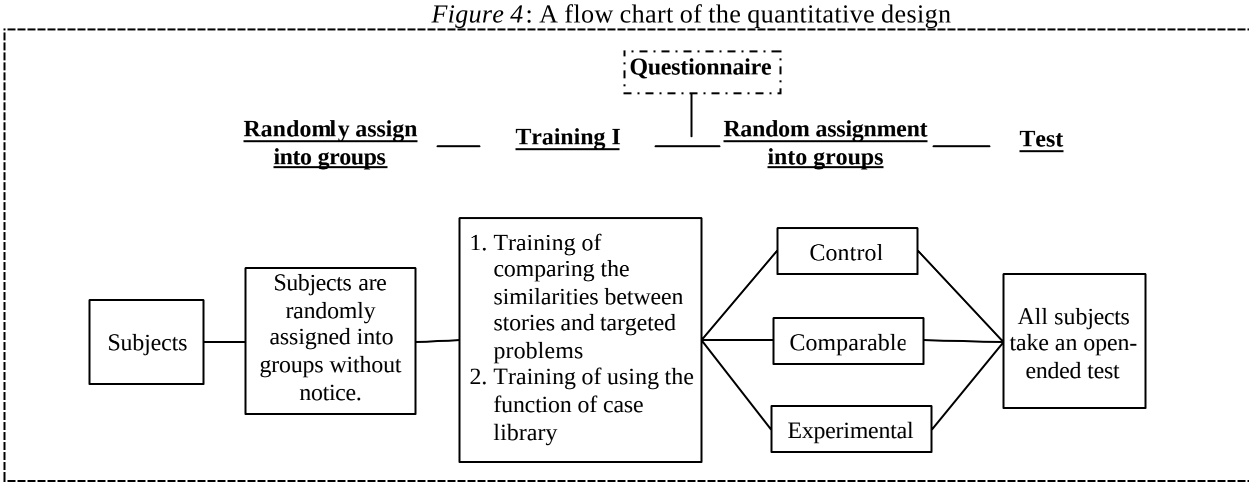
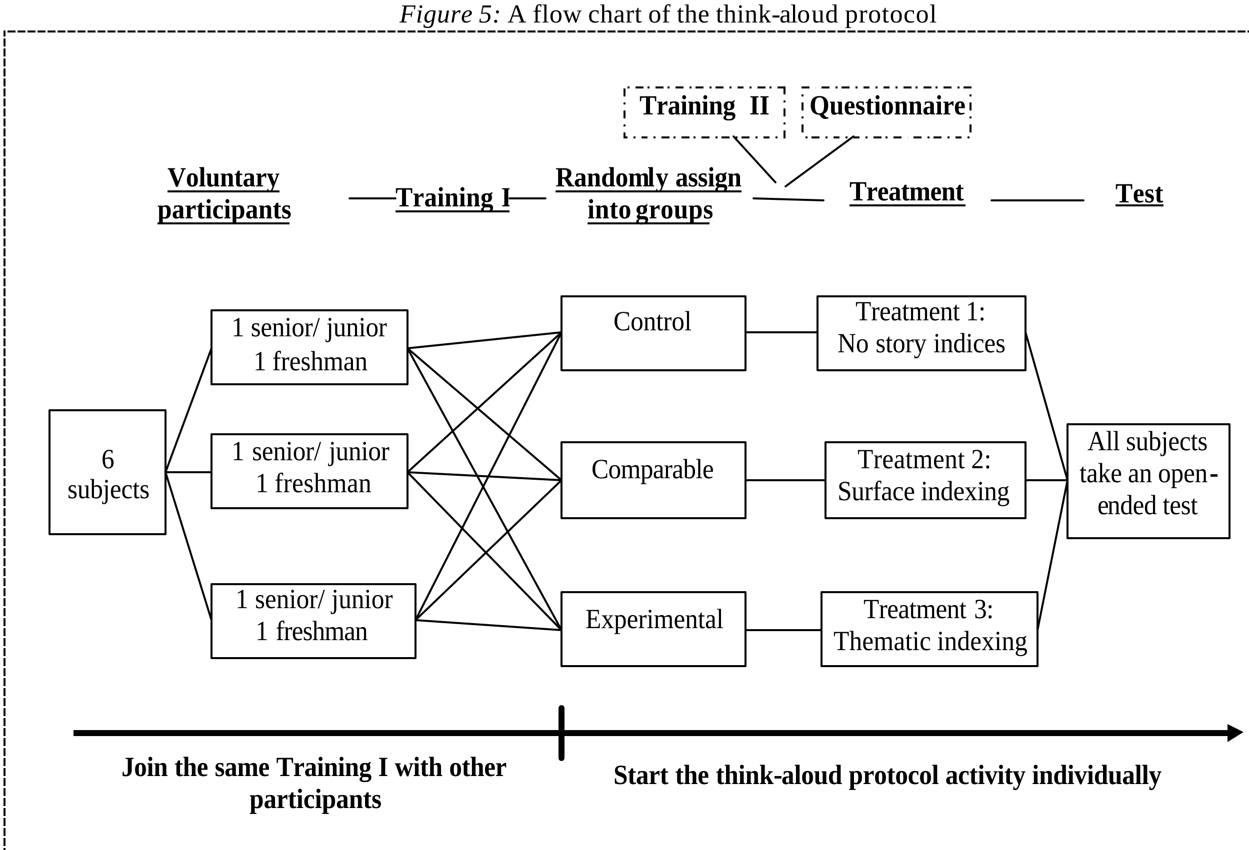


Figure 5: A flow chart of the think-aloud protocol



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