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ABSTRACT

The major purposes of this study are: (1) to investigate and compare the effectiveness of two instructional strategies, modeling and coaching on helping students to articulate and support their decisions in a case-based learning environment; (2) to compare the effectiveness of modeling and coaching on helping students address essential criteria in order to make sound decisions; and (3) to investigate how locus of control influences student performances. Fifty-five college students from two classes of School of Restaurant and Hotel Management at a large eastern university were randomly assigned to one of three groups: 17 students in modeling, 17 students in coaching, and 21 students in the control group. In a computer-based instructional lesson, students were asked to complete three case studies involving choosing equipment for purchase based on 12 criteria, and justifying their decision in a written report. In addition to core instructional materials, the modeling group was provided with a simulated case scenario with an expert's decisions and justifications. The coaching group was prompted with questions to focus the writing of their reports. Rotter's Locus of Control was administered after completion of the case study assignment to describe individuals' tendency to attribute successes and failures to internal or external sources. Students then used a five-point scale to indicate how comfortable they felt working with computers. Results showed that neither coaching nor modeling helped students to address more criteria. Internal students outperformed external students. However, there was some indication that modeling strategy can help reduce the performance difference in recall between internal and external students. Results are summarized in six tables. (Contains 21 references.) (Author/MAS)

Title:

Modeling vs. Coaching of Argumentation in a Case-Based Learning Environment

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Introduction

In recent years, the development of computer based learning environments has been influenced by the development of more powerful computer technologies and theoretical orientations . On the technology side, we have more and more powerful systems which are capable of delivering sophisticated multimedia (computer graphics, animation, audio and video) on the desktop. These systems afford instructional designers the capability to present a information, real problem situations, and real life experiences (Bransford, Sherwood, Hasselbring, Kinzer, & Williams, 1990). On the theory side, we have more situated models of meaning making. Contemporary approaches to instructional design are more concerned with students' abilities to use the knowledge they acquire to solve real life problems. Bransford and associates (Bransford, Sherwood, Hasselbring, Kinzer, & Williams, 1990; CTGV, 1990) note that in conventional teaching and learning, the students often fail to understand the value of new information for problem solving, because they do not experience the kind of problems that help them realize how information can be used to solve meaningful problems. Therefore, students too often treat new knowledge as something to be memorized which results in the acquisition of inert knowledge. Students often exhibit oversimplifications and compartmentalization (Spiro, Feltovich, Jacobson, & Coulson, 1992). Brown, Collins and Duguid (1989) also argue that in classroom teaching, teachers attempt to teach salient features to the students and dismiss the contextual and peripheral features of authentic tasks as "noise." This decontextualization does not enable learners to solve real life problems. "By ignoring the situated nature of cognition, education defeats its own goal of providing usable, robust knowledge."

A number of models for designing constructivist learning environments have been proposed. Most of them are case-based and try to present context-rich, information-rich and situated learning environments that are relevant to learners (Duffy & Jonassen, 1992.) A prime example of case-based learning is provided by anchored instruction (CTGV, 1992; CTGV, 1990; CTGV, 1993), which provides an authentic and generative learning environment in which students generate and combine sub-goals to meet the challenges afforded by the case. Students learn to use mathematics in solving the problems, rather than merely memorizing formulas. Very rich contextual information helps the project achieve this goal.

Brown, Collins and Duguid (1989) argue that learning is indexed by the experience and activities in which the learning happens. They argue that learning should be situated in authentic activities. For students to use tools in a way that they are used in real life, students must "enter the community and its culture," just like a craft apprentice learning skills from a master. They proposed a model of cognitive apprenticeship, which takes into account the situated nature of leaning. In cognitive apprenticeships, the emphasis is placed on teaching student to learn how experts solve problems and carry out tasks. Cognitive apprenticeship is a process of "learning-through-experience." (Collins, Brown, & Newman, 1989). Making coherent arguments has been identified as one important outcome of instruction in constructivist learning environments, because it reflects learners' understanding and internal organization of knowledge. Most constructivist approaches to learning, such as cognitive apprenticeships, emphasize a different set of instructional strategies including modeling, coaching, scaffolding, articulation, reflection, and exploration.

Modeling and Coaching of Performance

Of particular interest to this study are two support strategies, namely cognitive modeling and coaching. Bandura (1977) notes that by providing subjects with modeling, performance guidance, corrective feedback and self-directed mastery, we can foster learners' skill development and self-efficacy. With cognitive modeling, the teacher can expose learners to the expert's covert cognitive processes in problem solving. Usually the teacher will verbalize the internal information processing and reasoning while performing the procedures involved in a task. By experiencing teacher's cognitive process, students are better able to adopt the expert's mode of thinking (Gorrell & Capron, 1990).

The effectiveness of cognitive modeling has been demonstrated in many research studies. Bruch (1978) reported two experiments supporting the use of cognitive modeling. Denney (1975) investigated using cognitive modeling as a way of enhancing children's problem solving efficiency in a question-asking task. Three kinds of strategies were studied: cognitive modeling, watching people ask questions, and self-rehearsal of key strategies. Elder children benefited from all treatments, but cognitive modeling was the strategy that was used by most children from age 6 and up. In mathematics, students with difficulties also benefited from cognitive modeling and guided performance. Making the covert problem solving process observable for the learners by giving exemplary modeling and explanation of internal processes proved to be an effective way to scaffold students' performance. (Schunk, 1981, Welkowitz & Calkins, 1984).

Research conducted by Englert and Raphael (1988) indicate that cognitive modeling and coaching are also effective strategies for supporting expository writing. With their Cognitive Strategy Instruction in Writing program (CSIW), they taught special education students writing strategies through the use of think-alouds that model underlying writing process. In this program, they also used "think sheets" with prompting questions that help students focus on audience, purpose, background knowledge, organizations and steps of the writing. "Think sheets" also serve as a tool to help student think through the writing process reflectively. Evaluation results indicate positive results for using these strategies in teaching writing.

It is worth noticing that most implementations of cognitive modeling has been provided by think-aloud protocols. Students experience the covert and internal cognitive processes of the models through watching models' performance and listening to their speech explaining the process and strategies. With today's computer technology, we believe that it is possible to reveal model's cognitive process by providing explanatory descriptions of the process as learners attempt to solve problems. In this study, we explored an experimental implementation of coaching and modeling in a computer based, case-based learning environment. In this study, the instructional outcome is the ability to make an argument in support of purchasing decisions. In order to make sound argumentation, students not only need to assimilate the thinking process of the experts, but also need to articulate their own reasoning and thinking in a way that the expert would do. Cognitive modeling here serves as both model of reasoning process and model of desired behavior outcome.

Individual Differences in Using Modeling and Coaching

In this study, we attempted to investigate the interaction between the instructional treatments and the learning characteristic, locus of control. Locus of control describes an individual's generalized expectancy about how reinforcement is controlled, either by internal or external means. Individuals are internally oriented if they perceive a contingency between events in which they are involved and their own actions. Such individuals perceive events to be under personal control. Individuals who feel that they can influence the environment will actually seek ways to control the environment, when that control can be instrumental in attaining their goals. Externally oriented individuals perceive events as being unrelated to their behavior or characteristics, and thereby not under personal control. They tend to attribute the outcome of events to external factors (e.g., luck). Personal perceptions of causality have been demonstrated to be important mediators in many situations. As a psychological attribute, locus of control has been linked with the independent use and case-based learning environments.

Lefcourt (1982) identified some of the cognitive activities in that demonstrated differences between internals and externals such as information assimilation, attention, sensitivity to the meanings or reinforcement opportunities inherent in different tasks and situations, and concentration. He concluded that internals were found to be more perceptive to and ready to learn about their surrounds. They are more inquisitive; they are more curious and efficient processors of information than are externals. There is a trend of positive correlation between internality and academic achievement. Internals should be more adept at using learner-controlled, case-based learning environments.

Internal oriented individuals are more exploring, they tend to be more comfortable in the situation in which they need to make decisions. Internals should be better arguers. On the other hand, external individuals tend to believe that their effort does not make much difference in the outcome, therefore, they often rely on external lesson structures. They do not want to make decision because they believe that makes no difference. Therefore, it would be more beneficial to them if the lesson provides more supportive instructional strategies (Holloway, 1978; Carrier, Davidson and Williams, 1987).

Purpose and Hypotheses

The major purposes of the present study are

- To investigate and compare the effectiveness of two instructional strategies, modeling and coaching on helping students to articulate and support their decisions in a case-based learning environment.
- To compare the effectiveness of modeling and coaching on helping student address essential criteria in order to make sound decisions.
- To investigate how locus of control influences students performance.

This study tested the following hypotheses about modeling and coaching:

1. Students in the modeling treatment will write essays addressing more of the criteria than student in the control or coaching treatments.
2. Students in the coaching treatment will write essays addressing more of the criteria than student in the control treatment.
3. Students in the modeling treatment will write more integrated and coherent justifications than other students.
4. Students in the coaching treatment will write more integrated and coherent justifications than student in the control treatment.
5. External control students will benefit more from the modeling and prompting than internal control students.
6. Students who are more comfortable using computers perform better.

Method

Subjects

Fifty-five college students from two classes of School of Restaurant and Hotel Management at a large eastern university comprised the sample. Sample students ranged from the third to the fifth semester in college. Students were randomly assigned to three groups by their instructor. There were 17 students in the modeling group, 17 students in coaching group and 21 students in the control group. None of the students had any previous experience with the content or the instructional materials.

Instructional Materials

The instructional material was a computer-based instructional lesson (with three different versions) which consisted of three separate restaurant cases that required learners to select equipment for purchase and then justify their decision based upon the relevant information in the case. Each case was a restaurant under improvement. Students had access to and control of a variety of information in each case, such as the location of the restaurant, the requirements and expectation of the restaurant owner, the new menu structure and menu analysis, specifications of different pieces of equipment to choose from. They also could access a glossary of difficult terms and use a built-in calculator. Their task was to write a report describing and justifying the kinds of equipment to buy for each scenario. These decisions and justifications were recorded by the program.

There were 14 potential criteria that each student should think about before making the justification. These criteria were taught explicitly during the instruction.

Treatment 1: Modeling group. In addition to the core instructional materials, the modeling treatment provided students with a similar case scenario with think-aloud statements of the expert's decision on which pieces of equipment to purchase as well as the rationales and justifications for the decision. The modeling scenario was presented along with the articulated rationales and justifications in a field next to the window in which learners were required to write their justifications. In the expert's rationale, the reasoning processes were articulated and the criteria to be considered were addressed. This modeling section was available to the students while they were writing their own decisions and rationales.

Treatment 2: Coaching group. Students in coaching group also had the core instructional materials. Rather then a model of the performance, prompting questions were presented to focus their writing of the report. The questions prompted the students to think about the critical and relevant facts and the criteria when they are about to write the scenario. Sample questions are: "Have you gathered all the relevant facts from the case? " and "Can another piece of equipment perform this function equally well or better?"

Students in both treatments could return to the case scenarios and equipment specification database from the report writing section in order to obtain information to support their decisions. They were also permitted to revise their decisions later. The modeling and coaching were again available to each group respectively when they returned to the report writing section.

Treatment 3: Control group. Students in control group studied the core materials only without modeling and coaching in report writing section.

Procedure

Three groups of students used the software as an assignment for their class. All versions of courseware were stored on a university file server so that students had access to them. To help students to get the correct version of courseware, the three different versions were given different names and icons. Students finished the assignment in a one-week period and saved experimental data on floppy disks. The courseware saved version information, students ID and their reports. After finishing the program, data were collected by gathering data files recorded on students' disks.

Rotter's Locus of Control was administered after the assignment. After the Rotter's scale, the students were required to use a 5-point scale to indicate how comfortable they felt in working with computers.

Criterion Measures

Two readers scored students' justifications for all three scenarios on two scales. For each rater, the first scale is used to assess how many criteria were addressed in each scenario. This scale had 12 points that reflected the 12 criteria to be considered. Therefore, each student had 3 criteria scores. The average criteria score was calculated for each student. The second scale assessed how integrated and coherent the essays were in regard to the use of given information and the underlying reasoning process. This scale had 10 points and each student had 3 coherence scores for the 3 scenarios. The average coherence score was also calculated for each student. In judging the answers, we were more concerned with how well the students justify their decisions than with which piece of equipment they decide to purchase.

The inter-rater reliability was estimated. The correlation between average criteria scores was 0.75 and the correlation between average coherence scores was 0.77. In statistically analyzing the results, the average of two raters' scores were used as indicators for coherence scores and criteria scores.

Individual Difference Variable Measure

Rotter's Locus of Control Scale (1966) was administered to each subject after they finished the lesson as a measure of the locus of control. Locus of control describes individual's tendency to attribute successes and failures to internal sources such as effort and ability or external sources such as luck and fate.

Results

We use criteria scores to refer to the average scores obtained from the two raters on how many of the 12 criteria the students addressed in their reports and we use coherence scores to refer to the average scores obtained from the two raters on how integrated and coherent the students' reports were.

Table 1 presents the coherence scores achieved by the three groups, and Table 2 summarizes the analysis of variance (ANOVA). The ANOVA revealed statistically significant difference on coherence scores, F=46.49, P<.01.

Table 1
Coherence scores of three treatments

Treatment	N	Mean	SD
Coaching	17	8.15	0.51
Modeling	17	8.21	0.72
Control	21	6.06	1.01

Table 2
Analysis of variance for coherence score across three treatments

Source	SS	DF	Mean-Square	F-ratio	p
Treatment	58.71	2	29.35	46.49	.00
Error	32.83	52	0.63		

A Tukey post hoc test (p.< .01) indicated that students performed significantly better in both modeling and coaching groups when compared with the control group. However, there was no statistically significant difference in coherence scores between modeling and coaching groups occurred.

Table 3 presents the criteria scores across treatments, and Table 4 summarizes the ANOVA. No significant difference across treatments. F=0.148, P<.86

Measurement of locus of control was administered after the instructional treatments. Because some of the subjects did not turn in the questionnaire, we have 18,14, and 13 subjects' locus of control data for control, coaching and modeling group respectively. No significant differences among mean scores of locus of control occurred between the three treatments.

Table 3
Statistics of criteria scores of three treatments

Treatment	N	Mean	SD
Coaching	17	10.21	1.70
Modeling	17	9.86	1.60
Control	21	10.06	2.14

Table 4
Analysis of variance for criteria score across three treatments

Source	SS	DF	Mean-Square	F-ratio	p
Treatment	1.01	2	0.51	0.15	.86
Error	117.90	52	3.42		

There was no significant correlation between locus of control and coherence score. r=-0.12, p<.44. However, the correlation between locus of control and criteria score approached significant level. r=-0.29, p<.06. The correlation between locus of control and the criteria score led us to look more closely into these two measures. Modeling group had the least correlation between locus of control and criteria score. A linear regression of locus of control and criteria score for Coaching group showed a multiple R of 0.29.

Table 5
Analysis of variance for locus of control score across three treatments

Source	SS	DF	Mean-Square	F-ratio	p
Treatment	42.59	2	21.30	1.27	.29
Error	701.85	42	16.71		

Table 6
Correlation between criteria score and locus of control

Group Name	N	r	p
All groups	45	-0.29	.06
Coaching	14	-0.36	.21
Modeling	13	-0.11	.72
Control	18	-0.29	.23

No significant correlation between the self rating of comfort in using computers and criteria score and coherence scores occurred.

Discussion

Criteria scores indicated how many criteria students addressed. For a criterion to be judged as addressed, it only needed to be mentioned in the report. The fact that all of the 12 criteria were taught explicitly made criteria score a measure of recall of rules. The present study indicated that students performed equally well in all three groups. Providing additional prompting or coaching of selections criteria did not help students at the level of rule recall.

Coherence scores indicated how student analyzed the problem situation, applied the knowledge introduced in the courseware, and integrated and synthesized their solutions to the problem. Argumentation and articulation reflected higher level of thinking process and real life problem solving skills there would be needed in their future profession. By writing purchasing suggestions and rationale, they were trying to speak the language of the professionals in their field. The result of present study suggested that both coaching and modeling strategies enhanced students' performance in writing coherent and integrated rationales and argumentation. However, students in coaching and modeling group performed equally well, indicating that these two different scaffolding strategies were equally effective. Our current implementations of both strategies were not very sophisticated and still they enhanced performance significantly compared to that of the control group. However, we plan how students will perform with more sophisticated and more powerful implementations of coaching and modeling in an upcoming study.

Locus of control did not correlate to students' coherence scores. However, there was a negative correlation between externality of locus of control and criteria scores, and the correlation coefficient was approaching significance ($p<.06$). This confirms the result of past studies that internal student generally perform better than external students. However, initial data analysis indicates that in the modeling group the negative correlation between externality and coherence was least significant. The scaffolding afforded by modeling strategy might have helped external students keep up their performance with that of internal students. Because of the relatively small sample size, further study is needed to reach a more certain conclusion.

Conclusion

In a case based learning environment, students can make more coherent and integrated argumentation with either coaching strategies or modeling strategies as scaffolds of performance. Complex responses in case-based environments can be supported with a variety of strategies aimed at getting students to articulate their thinking. However, neither coaching nor modeling helped students to address more criteria (have better rule recall). Internal students outperformed external students. However, there was some indication that modeling strategy can help reduce the performance difference in rule recall between external and internal students.

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