WORKED EXAMPLES LEADS TO BETTER PERFORMANCE IN ANALYZING AND SOLVING REAL-LIFE DECISION CASES

By

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ABSTRACT

This study compared the impact of three types of case-based methods (worked example, faded worked example, and case-based reasoning) on pre-service teachers' (n=71) decision making and reasoning related to realistic classroom management situations. Participants in this study received a short-term implementation of one of these three major approaches to case-based learning. Specifically, this study focused on analyzing students' open-ended responses to classroom management problems presented during instruction using one of these methods. The results showed the worked example group, compared to the case-based reasoning and faded worked example groups, consistently performed better on analyzing cases and solving problem cases related to classroom management.

Keywords: Case-Based Learning, Worked Example, Decision Making, Classroom Management, Pre-Service Teacher Education.

INTRODUCTION

Studying teacher thinking and decision making has been an active research area in the field of education for over 50 years. Clark and Lampert (1986) advocated using the insights generated from this research to challenge pre-service teachers' taken for granted assumptions about teaching and to help them improve in learning how to teach. They further argued that research on teacher thinking and decision making "cannot describe the sorts of decisions teachers should be taught to make in any particular setting" (p. 29), instead research can provide guidance in designing methods of instruction to help pre-service teachers learn how to teach and experiment in making teaching decisions. One such method that has been successfully used in teacher education is the case-based method. Several researchers have suggested that cases representing a variety of classroom conditions be included in teacher education curricula in order to better prepare students for teaching (Merseth, 1996; Shulman, 1992; Sykes & Bird, 1992). There is an extensive body of research evidence demonstrating positive impacts of case methods on pre-service teachers' understanding of complex classroom situations, their ability to analyze these situations from multiple perspectives, their competence in using evidence to support their interpretations and decisions, and their skills to reflect on what they learned from cases (Beck, King, & Marshall, 2002; Bruning, Siwatu, Liu, PytlikZillig, Horn, Sic, & Carlson, 2008; Choi & Lee, 2009; Harrington, 1995; Rich & Hannafin, 2008; Schrader, Leu, Kinzer, Ataya, Teale, Labbo, & Cammack, 2003).

The popularity of the case method has resulted in multiple interpretations of how best to use cases to promote learning. Different forms of case use have been described in the literature (Doyle, 1990; Jonassen, 2006; Merseth, 1996). Two general approaches to teaching complex decision making or problem solving skills, currently being investigated in educational research, are Case-Based Reasoning (CBR) and worked examples. These two case methods have similarity in that both present students with descriptions of realistic exemplars of some complex problem solving or decision making domain and solutions or courses of reasoning and actions followed by an expert. Evidence suggests that from such descriptions, students sometimes can develop the conceptual and procedural knowledge and ability needed to solve problems or make more expert-like decisions in new related situations. Despite the considerable amount of interest in the explanation and improvement of teacher decision making, no study has

compared the effectiveness of different case methods on pre-service teachers' decision making. In addition, a recent review of literature on the field suggests that the case methods used in most studies of teacher decision making use the CBR approach (Demiraslan Çevik, 2011). There is no research in which worked examples were used to study teacher decision making. Therefore, there is a need for additional research to compare how different case methods (i.e., CBR and worked examples) affect pre-service teachers' learning and decision making and what factors influence the effectiveness of different case methods. This paper compares three case-based approaches in the context of teaching classroom management to pre-service teachers. These three approaches include (i) Worked Examples, (ii) Faded Worked examples which is a variant of worked examples approach, and (iii) Case-Based Reasoning.

The following section of the paper, briefly describes three approaches to the use of case based studies in education. A worked up study compares three case-based approaches to determine their relative impact on pre-service teachers' reasoning and decision making about classroom management.

Three Instructional Methods: Worked Examples, Faded Worked Examples, and Case-Based Reasoning

Cases as Exemplars-Worked Examples and Faded Worked Examples

Worked example refers to an instructional method based on the Cognitive Load Theory (CLT) as developed by Sweller (1988). The basic assumption of the CLT is that learning activities should be designed in a way that minimize cognitive load that is not relevant for learning to avoid straining the limited capacity of working memory (Paas, Renkl, & Sweller, 2003; Sweller, van Merrienboer, & Paas, 1998). The worked example effect occurs when novice students learn more from studying worked examples than from trying to solve the same problems by themselves. To explain the worked example effect, Sweller (1988) argues that novices generally do not have necessary experiences and cognitive structures that can help them function in complex situations; the complex situation produces high cognitive load. Thus learners need maximal guidance during initial stages of learning. Guidance in the form of worked examples reduces working memory demands and cognitive load and helps learners develop initial cognitive structures for problem solving in the complex situation. Extensive research over twenty-five years supports the worked example effect (Mwangi & Sweller, 1998; Paas, 1992; Sweller & Cooper, 1985).

The initial approach to using worked examples for instruction assumed that novices should receive a number of worked examples before solving problems by themselves. In controlled laboratory experiments, researchers found that students performed better when each worked example was paired with a practice problem than when a series of worked examples were followed by a series of practice problems (Sweller & Cooper, 1985; Trafton & Reiser, 1993; Ward & Sweller, 1990). Recently, Renkl and his colleagues (Renkl, Atkinson, Maier, & Staley, 2002; Renkl, Atkinson, & Große, 2004) suggested a fading approach in which there is a smooth transition from a worked example to an incomplete example and then to a problem solving task. Renkl et al. (2002) described two forms of fading; backward fading, which starts with omitting the last solution step, and forward fading which starts with omitting the first solution step. Across three controlled experiments with high school and college students, Renkl et al. (2002) compared the fading and the original worked examples approaches followed by problem approach. The results showed that the two fading conditions were superior to original worked examples approach. Additionally, performances on far transfer items were higher and time spent on learning was lower in backward condition. Studies by Atkinson, Renkl, and Merrill (2003) and Renkl et al. (2004) replicated the significant effects of backward fading.

Cases as Analogues-Case-Based Reasoning

Kolodner (1991) defined CBR as "reasoning from old cases or experiences in an effort to solve problems, critique solutions, explain anomalous situations, or interpret situations" (p. 53). The theory underlying CBR is Schank's (1982) theory of dynamic memory. Schank (1982, 1999) argued that human reasoning and learning is case-based, that is, humans solve problems by reusing or modifying

previous experiences stored in an evolving memory structure in which cases having similar properties are dynamically organized around a more general structure.

The goal of CBR approach is to provide learners with real world cases, similar to the current problem situation they are engaged in, to facilitate their understanding of how similar problems were solved before and to help them apply previously utilized case solutions or experiences to the current problem. Several researchers argue that CBR provides an authentic context intended to help learners acquire problem solving and decision making skills through engaging in the knowledge and experience of others embedded in cases (Hernandez-Serrano & Jonassen, 2003; Kolodner, 2006; Kolodner, Owensby, & Guzdial, 2004). Case-based learning thus is learning by experiencing.

CBR's theoretical principles about human memory, reasoning, and learning have been put into practice in classrooms by integrating CBR with Problem Based Learning (PBL) methodology (Kolodner, Hmelo, & Narayanan, 1996). Kolodner and her project team (Kolodner, Camp, Crismond, Fasse, Gray, Holbrook, & Puntembakar, 2003; Kolodner, Gray, & Fasse, 2003) used CBR and Problem-Based Learning (PBL) together in order to implement their learning by design (LBD) approach, a project-based inquiry approach to science learning in middle school science classrooms. Under the foundations of CBR and PBL, they designed curriculum units to allow students to learn by experiencing and designing as they engaged in solving problems in real-world cases. The results of several studies showed that the LBD classes consistently outperformed the non-LBD classes on multiple-choice tests of content knowledge and assessments of science and general process skills (Holbrook & Kolodner, 2000; Holbrook, Gray, Fasse, Camp, & Kolodner, 2001; Kolodner, Gray, & Fasse, 2003).

Comparison of Worked Examples and Case-Based Reasoning

Both the worked examples and CBR research traditions have yielded successful results on improving learners', especially novices', problem solving performances. Additionally, studies in cognitive psychology and education have indicated the benefits of using the CBR method to facilitate decision making process (Hernandez-Serrano & Jonassen, 2003; Wang, Moore, & Wedman, 2003). However, the theories underlying each method imply different principles for the design of learning environments. We highlight some of the key differences as well as similarities between the two methods in terms of the ways they imply that instruction should support learners.

These methods have similarity in that each presents students with descriptions of realistic exemplars of some complex problem solving or decision making domain and solutions or courses of reasoning and actions followed by an expert. Similarly, Clark (2009) argues that both CBR and worked example advocates agree on the use of instructional support called scaffolding. He further explains that both groups recommend the modeling of experts' solutions of the task, directing the learner's attention to important aspects of the task by denoting relevant task features, assessing learners' transfer skills, providing feedback on learning tasks, and gradually fading or eliminating practice and feedback as students gain more experience.

These methods, however, differ in some important ways. First, CBR's implications to designing instruction are similar to those entailed by constructivist approaches to teaching and learning (Jonassen, 1999; Kolodner, 2006; Kolodner et al., 2004). Accordingly, CBR implies that for effective learning, learners should be asked to make decisions about complex cases drawn from authentic situations. Cases in CBR often include detailed and rich descriptions of real-life situations to help students experience the complexity of the learning domain. In contrast, instructional design principles of the CLT, underlying worked example approaches, are based on information-processing descriptions of human cognitive architecture. The theory proposes that providing learners with worked examples during initial stages of learning minimizes distracting load on working memory, thus learners can devote their limited working memory capacity to task-related processes such as schema construction and proceduralization that are considered to be essential for skill acquisition. As a result, worked examples typically include a well-structured

problem specification and a description of the solution to this problem (Atkinson, Derry, Renkl, & Wortham, 2000; Paas et al., 2003) details are purposefully eliminated to allow learners more focus on relevant task features rather than details.

Second, CBR has often been applied in ill-structured domains while most of the research on worked example approaches has involved well-structured domains. Only recently, have a few studies applied worked examples in ill-structured domains including language, art education, and music. These studies showed college students' superior performances on general argumentation skills when studying worked examples with self-explanation prompts (Schworm & Renkl, 2006, 2007) and their learning about designers' styles in a design history course when studying worked examples compared to problem solving (Rourke & Sweller, 2009). However, more research evidence is needed on the design and implementation of worked examples in ill-structured domains. Spiro and DeSchryver (2009) argue that worked examples may be useful for well-structured domains, but are not effective in ill-structured domains in which problems have vaguely defined goals, multiple solutions, and multiple criteria for evaluating solutions. They claim that ill-structured domains, such as teaching, do not have a pre-specified set of rules and essential information that can be fully presented to learners. Therefore, they suggest that pre-service teachers develop better understanding of different teaching methods through the exposure to multiple contexts and perspectives, not by providing them with full explanations or exemplars related to the application of methods. As a result, it seems that the arguments and research results about whether worked examples can be applied in ill-structured domains are not conclusive. The present study compares the traditional and faded worked examples methods in an ill-structured domain.

Study Purposes

The purpose of this study is to compare and determine the impact of three types of online case-based learning environments on pre-service teachers' learning and decision making processes associated with classroom management issues. As part of an educational psychology class, students completed one of the three treatments above and were assessed subsequent to completing the treatment. The major research question guiding this study is: "Do the three conditions differ in terms of students' performance in analyzing and solving decision tasks related to classroom management?".

Method

Context

The study took place in 'Educational Psychology of Young Learners', a 3-credit hours course open only to majors in Early Childhood Education (ECE) or Elementary Education (ELED) offered in a large university in the Midwestern United States. The study was woven into computer-based activities designed to improve students' understanding of classroom management. Students had been assigned text on and had lectures and class activities on classroom management before completing the experimental materials. All students in the class were expected to complete these activities; students who completed the activities received class participation points.

Participants

The initial potential sample included 95 students who completed the demographics information and educational background questionnaires during the second week of the semester. Complete data were available for 71 students; students were lost through course drops (10), failure to complete an experimental activity (11), or because they did not give consent for their data to be used for research (3). The gender composition of the sample closely approximated that of the population of majors. Males represented a smaller proportion of the sample (14.1%; $n=10$) than females (85.9%; $n=61$). Similarly, the sample strongly represented the population of the ELED and ECE majors in the institution; 78.9% of the students ($n=56$) indicated their major as ELED and 21.1% of students ($n=15$) indicated it as ECE. Students completed two human development courses prior to this class, and most typically were sophomores (50.7%; $n=36$) or juniors (43.7%; $n=31$). Additionally, the compositions of the samples within each of the two majors closely matched in terms of a number of demographics and background information (i.e., gender,

age, GPA, ACT scores).

Study Design

A one factor, three group, between-subjects experimental study was conducted to investigate the effects of three instructional treatments on students' decision making. Students were randomly assigned into one of three conditions: (i) Case-based Reasoning, (ii) Traditional Worked-Examples, and (iii) Faded Worked-Examples. In each condition, students used an instructional computing system that presented cases or worked examples, dealing with conflict and classroom rules, to teach classroom management. Condition constituted the independent experimental variable in the study.

Instructional Materials

In each condition, students studied cases or worked examples related to classroom management issues such as dealing with conflict and classroom rules. Based on the principles and assumptions derived from each instructional method, different versions of the learning environment were designed and prepared as online learning environment using the tool called Drupal. Drupal is an open-source content management system used to design and develop online learning environments. It also records students' responses and time spent to complete the activities. The following paragraphs describe the design process for the cases and learning environments.

We used a set of questions adapted from (Bowers, Kenehan, Sale, & Doerr, 2000) as guidance in the process of designing cases and computer-based learning environments. The questions include; (i) Who are the learners? (ii) What is the content/topic about? (iii) What are the instructional goals of the case? (iv) What is the scope of the case? and (v) What multimedia features can be developed to best reach these goals?

We used the demographics and educational background questionnaire and the course instructor's (2nd author) observations to identify the general profile of the learners. The participants were mostly sophomore and junior students who had completed much of their general content requirements in academic subjects, but were early in their required sequence of teaching pedagogy courses. Most of the students had little experience in classrooms in a teaching role. The positive effects of cases and worked examples on novices' learning and skill development have been well established in the literature (Cherubini, 2009; Choi & Lee, 2009; Harrington, 1995; Kim & Hannafin, 2009). Therefore, we expected that students would benefit from the instructional approaches described here.

We selected 'dealing with classroom management issues' as the domain content to be learned as for the reason that it is one of the key areas of successful teaching on which pre-service teachers are not well prepared. In terms of identifying the instructional goals of the case we considered the skills we hope students to accomplish through the use of the cases. First, we created two general goals associated with each other; (i) understanding the complexity of real life classroom management, (ii) understanding teachers' decisions and reasons for and consequences of those decisions in the context of dealing with classroom management issues. Second, we reviewed a number of educational psychology and classroom management books and online resources (videos, case collections etc.) to collect cases related to the general goals. As we were reviewing the resources, we also specified the content of the cases which students were expected to comprehend. The domain content we decided on included classroom rules and routines, prevention strategies, control strategies, and guidance strategies. Then, we examined the vast number of resources to select the most appropriate cases which were relevant to the goals and the content and which were realistic, engaging, challenging, and instructional (e.g., involving teacher decision making, presenting methods that work and those that did not work, and describing lessons learned). However, we could not find enough cases that met the criteria indicated above. We thus either created new cases by combining information from different books or online materials or adapted some cases that would incorporate the content and goals we specified.

After elaborated discussions and revisions, we decided on the two sets of cases, each set including two study cases and a problem case to be used in the study. Then we sent each set of cases to two faculties experienced in

classroom management and teaching methods in elementary level. We also included a list of questions that we wanted them to consider while examining the cases. Soon after we received feedback from faculty, we finalized the cases. Therefore, the cases used in instruction consisted of six cases involving typical classroom management issues selected from instructional materials designed for pre-service teachers. Four cases were used as cases to be studied in the case based reasoning condition and as worked examples in the worked examples conditions. The remaining two cases were used as problem cases about which participants made decisions.

In terms of designing the computer-based learning environments, we considered specific implications of each method to instructional design. For the cases in the case-based reasoning condition, because of CBR's emphasis on realistic cases, we kept the contextual details and irrelevant information. For the cases in the worked and faded example conditions, because of their emphasis on minimizing cognitive load, we removed any irrelevant information that was not particularly related to experts' classroom management decisions, and we highlighted critical points to help students focus on the most relevant issues. Additionally, we employed backward fading in the faded worked example condition; omitted the last solution step in the first case and last two solution steps in the second case. With respect to the interface design, we considered design principles so that the interface was easy to navigate, had consistent structure, and provided students with guidance in the form of simple directions.

Furthermore, in this study, we adapted Owensby and Kolodner's (2002) *Case Interpretation* and *Case Application* tools to scaffold students' cognitive processing as they analyzed the expert cases and apply them to their challenge case. Figure 1 shows the *Case Interpretation Tool*. The left frame of the tool displays the case being analyzed and right frame displays scaffolds in the form of questions. Similarly, Figure 2 shows the *Case Application Tool*. In its left frame is the problem case to be solved and in its right frame are the scaffolding questions. We expected that these tools would scaffold students' reasoning and analysis as they use expert cases or worked examples to reason and help them develop

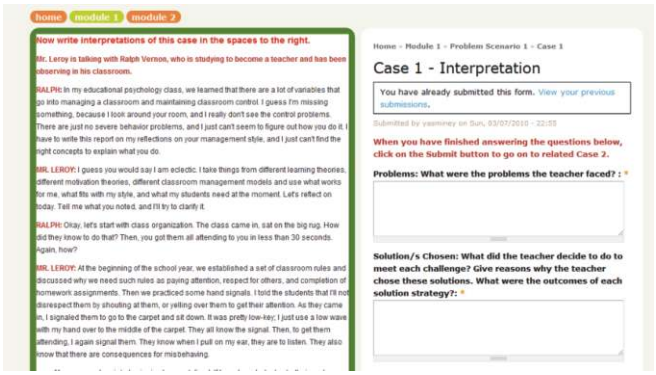

Figure 1. Case Interpretation Tool

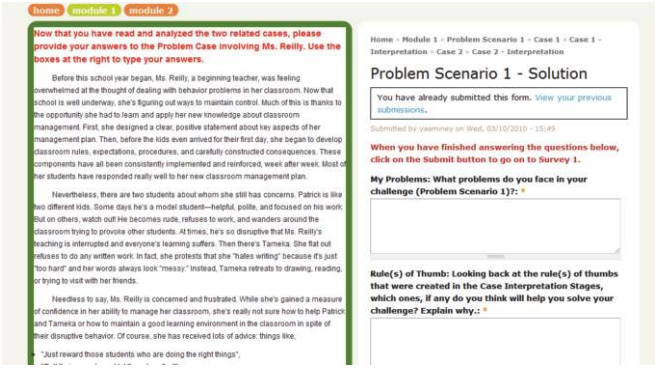

Figure 2. Case Application Tool

their ability to justify their decisions.

Procedure

Students completed questionnaires including demographics information and educational background questionnaires during the second week of the class. The computer experimental materials were integrated into the unit on the classroom management and were administered in the third and fourth weeks of March. On the day of intervention, all participants across all groups participated at the same time, but each group was assigned a different computer laboratory. According to their assigned condition, each student received an instruction sheet for the first session, which guided them through the specific tasks required for their condition. Students followed similar procedures during the second session of the intervention.

The activity steps students in each treatment group followed during the intervention are described below.

Case-Based Reasoning Condition

In the first session of the case-based reasoning condition

(module 1), students were provided with a problem case to solve. Two similar related cases were associated with each problem case. The students were asked to review these related cases before solving the problem case. After each related case, students were asked to answer a set of questions presented in the case interpretation tool. After reviewing and analyzing the two related cases, the students were referred back to the problem case and asked to solve it following the prompts provided in the case application tool. Specifically students were asked to use the information and knowledge in the reviewed cases to generate alternative solutions to the problem, evaluate the alternatives, make a decision, and generate an explanation justifying their decision. Students followed the same steps in the second session (module 2).

Traditional Worked Example Condition

In the first session (module 1), students first received two complete worked examples including explicit solution steps and annotations of the relevant principles for each step. After each worked example, students used the same case interpretation tool to answer a set of questions about teachers' decisions and the reasons for those decisions. Then the students solved the first problem and explained and justified their decisions using the case application tool. In the second session (module 2), they received fully worked examples 3 and 4 and analyzed them using the case interpretation tool. Next, they completed the second problem case and explained and justified their decisions using the case application tool.

Faded Worked Example Condition

The first two worked examples in the faded worked example condition and the procedures followed were the same as those in the first session of the traditional worked example condition. Students in the faded condition then received two partially worked examples in the first session (module 1). These third and fourth worked examples included incomplete sections and students were asked to fill in the incomplete information and provide justifications for their choices. In the second session (module 2), students received two problem cases in which they were asked to provide alternative solutions to the problem, evaluate the alternatives, make a decision, and provide an explanation justifying their decision by using the same case application tool.

Therefore, students in each condition interacted with a total of four study cases, in different forms based on the condition, and two problem cases that were the same across the conditions.

Dependent (Performance) Measures and Data Analysis

Dependent measures included students' responses to case interpretation and case application question prompts. We developed rubrics to analyze students' responses to these questions. While the same case application rubric was used for the two problem cases, the case interpretation rubrics included minor differences depending on the question prompts in each case or worked example. For instance, the case interpretation rubric for the first case or worked example included four main themes; (i) Identifying Problems, (ii) Describing Expert's (the teacher's) Solutions, (iii) Describing Experts' (the teacher's) Alternative Solutions, and (iv) Describing Lessons Learned/Rules of Thumb. The responses were given scores, varying between 0 and 3 for the first theme, between 0 and 6 for the second theme, between 0 and 4 for the third theme, and between 0 and 3 for the last theme, depending on the extent to which they represented coherent and well-developed arguments. The highest score students could get in case interpretation rubric was 16 for case 1, 16 for case 2, 12 for case 3, and 14 for case 4.

The description of scoring for a response related to identifying problems in the case or worked example is as follows

0: Mischaracterizes problems and/or overlook issues.

1: Accurately identifies some problems in a general way (e.g. student x is misbehaving), but does not describe specific details (e.g. nature of misbehavior).

2: Accurately identifies some problems and describes specific details about the nature of the problems (e.g. type of misbehavior, situations in which it occurs.)

3: Presents an accurate and detailed description of a variety of problems.

The rubric developed to analyze responses to case application questions included five themes: (i) Identifying Problems, (ii) Using Rules of Thumb, (iii) Describing own

Solutions, (iv) Describing Alternative Solutions, and (e) Describing Predictions. The responses were given scores, varying between 0 and 3 for the first and second themes, between 0 and 4 for the third and fourth themes, and between 0 and 3 for the last theme. The maximum score students could get in case application rubric was 17 for both problem case 1 and 2.

For testing the rubrics, we individually coded data from five students in group 1. The initial percentage of agreement between our coding results was 63% (50 agreements and 30 disagreements on the coding). Following the comparison of our coding, discussion on the reasons for the disagreements and the revision of the coding rules, the percentage of agreement increased to 85% (68 agreements and 12 disagreements on the coding). In order to examine if instructional treatment affected students' performances on analyzing study cases and solving problem cases, 10 students in each group were selected based on their GPA scores. Due to the low number of male participants in the sample (n=10), the selection included only female students. In each group, female students were rank ordered in regards to their GPA scores and five students in the lower GPA group and five from the higher GPA group were randomly identified for the further analysis. The first author completed coding the data from 30 students in three groups. Then the total score from four study cases and two problem cases (maximum total score a student can get is 92) was calculated for each student to examine if treatment group affected students' performance on analyzing and solving classroom management cases. Cronbach's alpha reliability coefficient was .90, which indicates a good reliability across the six performance measures.

Results

The research question asked if treatment group affected students' performance on analyzing and solving teaching cases related to classroom management. A one-way Analysis of Covariance (ANCOVA) was conducted to examine if students' performances on solving case problems differed with respect to treatment condition. The dependent variable was the total score that students received from their four case analyses and solving two case problems, and the covariate was the student's GPA. A preliminary analysis evaluating the homogeneity-of-regression (slopes) assumption indicated that the relationship between the covariate and the dependent variable did not differ significantly as a function of the independent variable, $F(6,18)= 1.80$, $p= .156$. The ANCOVA was significant. $F(2, 26)= 3.93$, $p< .05$. According to the results, 15% ($\omega^2= 0.15$) of the total variance in performance scores was accounted for by the treatment controlling for the effects of students' GPA, and 9.8% ($\omega^2= 0.10$) of the total variance in performance was accounted for by the students' GPA score (Table1).

Follow-up tests were conducted to evaluate pairwise differences among the adjusted means for the three groups. The Bonferroni procedure was used to control for Type I error across the three pairwise comparisons ($\alpha= .05/3 = .017$). The results showed that students in the worked example condition ($M= 61.91$, $SE= 3.63$) had higher performance scores, controlling for the effect of their GPA, than students who were in the case-based reasoning condition ($M= 49.11$, $SE= 3.63$). The Bonferroni pairwise comparison of the difference approached significance ($p= .019$). Based on the mean total performance score adjusted by students' GPA, students in the worked example group ($M= 61.91$, $SE= 3.63$) had higher scores compared to students in faded worked example group ($M= 49.76$, $SE= 3.65$). However, the Bonferroni pairwise comparison of the difference was not statistically significant ($p = .026$) Table 2.

Source	SS	df	MS	F	p
GPA	641.26	1	641.26	4.86	.036
Group	1036.50	2	518.25	3.93	.032
Error	3427.74	26	131.84		
Total	5023.20	30			

Table 1. A one-way Analysis of Covariance (ANCOVA) on Students' Performances on Analyzing and Solving Case Problems by Group

Group	Mean	Adjusted Mean	Adjusted Mean Differences		
			1	2	3
Case-based Reasoning	48.70	49.12a	--		
Worked Example	61.50	61.92a	12.80* (0.23)	--	
Faded Worked Example	50.60	49.76a	0.64	12.16	--

Table 2. Pairwise Comparisons on Students' Performances on Analyzing and Solving Case Problems

Conclusion and Discussion

This study compared the impact of three types of case-based methods (worked example, faded worked example, and CBR) on pre-service teachers' learning and decision making about classroom management. Specifically, this study focused on analyzing students open-ended responses to classroom management problems presented during instruction using one of these methods. Students analyzed four cases and solved two problem cases during the treatment.

The results showed the worked example group, compared to the case-based reasoning and faded worked example groups, consistently performed better on analyzing four cases and solving two problem cases related to classroom management. The superior performances of worked example group can be explained by the way the cases in this approach were designed. That is, worked example group received more scaffolding compared to the case-based reasoning and faded worked example groups. For the cases in the CBR condition, we kept the contextual details and irrelevant information; for the cases in the worked and faded example conditions we removed any irrelevant information that were not particularly related to experts' classroom management decisions and highlighted critical points to direct students' attention to important aspects of the cases. Several researchers have argued that novices, with limited experience, practical, or pedagogical content knowledge, focus more on the surface characteristics of classroom events (Berliner, 1994, 2001; Housner & Griffey, 1985; Leinhardt & Greeno, 1986; Swanson, O'Connor, & Cooney, 1990; Westerman, 1991). Similarly, Sweller (1988) argued that novices need maximal guidance during initial stages of learning because they generally do not have necessary schemas that can help them solve complex problems. A large body of research involving well-structured domains has shown positive effects of worked examples on novices' learning and skill acquisition (Atkinson et al., 2000; Mwangi & Sweller, 1998; Paas, 1992; Renkl, 1997; Renkl & Atkinson, 2007; Renkl et al., 2002; Sweller, Chandler, Tierney, & Cooper, 1990; Sweller & Cooper, 1985; Zhu & Simon, 1987). Considering preservice teachers' limited teaching experiences and their inability to notice significant features of classroom interactions, we speculate that scaffolding provided in worked examples helped students focus on the most relevant issues while the more complex details in the cases in the CBR condition may have diverted students' attention from important information to details or surface features thus impeded their schema construction. This present study, therefore, provides some evidence consistent with the worked example effect in an ill-structured domain.

However, the results of this study do not support the evidence found in several studies that students learn more from studying faded worked examples than worked examples (Atkinson et al., 2003; Renkl et al., 2002; Renkl et al., 2004). One reason for this could be the difference between the outcome measures and the study domain involved in earlier studies and in the present study. Earlier studies often used multiple-choice tests to assess students' near and far transfer performances in well-structured domains, whereas this study used realistic teaching cases to examine students' reasoning and decision making in an ill-structured domain. Additionally in this study, the worked example group studied four complete examples modeling experts' reasoning and decision making related to classroom management issues while faded worked example group studied only two complete examples in addition to two incomplete examples. Although the worked example literature suggests that presenting at least two worked examples for each problem would enhance transfer (Reed & Bolstad, 1991), this suggestion may be limited to well-structured domains. In an ill-structured domain such as classroom management novice students may need more worked examples to develop necessary cognitive structures that can help them function in complex situations. In addition, the nature of the problems may have varied more in the present study than in the research in well-structured domains.

Finally, the results of this study suggest that pre-service teachers lack in their ability to analyze authentic teaching cases beyond the information given in the cases. Even the mean performance score of the students in the worked example group was 61 out of 92. There is evidence in the literature that pre-service teachers often are unable to

notice significant features of classroom practices and analyze cases in a superficial manner (Abell, Bryan, & Anderson, 1998; van den Berg, 2001). However, research evidence (Choi & Lee, 2009; Harrington, 1995; Kim & Hannafin, 2009) showing that students make progress over multiple cases suggests that more fully incorporating the analysis of cases into teacher education potentially could lead to the development of more expert-like knowledge in graduates of teacher education programs. We argue, on the basis of underlying assumptions of each approach, worked examples can be particularly beneficial in pre-service teachers' early skill acquisition about teaching because pre-service teachers early in their teacher education program often do not have necessary experiences and cognitive structures that can help them solve complex real-life teaching problems. Guidance in the form of worked examples can allow pre-service teachers develop initial cognitive structures for solving and making decisions about teaching problems. As pre-service teachers gain more expertise, CBR can be used to help them experience in solving real-life teaching problems.

Limitations of the Study and Future Research Suggestions

This study, as other studies, has limitations. First, participants in this study received a short-term implementation of one of these three major approaches to case-based learning. While some short term studies might be useful in identifying the instructional features that could enhance learning; future studies that integrate improvement of pre-service teachers' instructional and management decision making skills across a substantial period of their teacher preparation are needed. Contrasting the use of case-based reasoning and worked example approaches should be over a long-term part of that research.

Second, this study reported results concerning students' case analyses and problem solving performances in the three case-based environments based on the data from ten students in each group ($n=30$). The results thus may not represent the general characteristics of students' responses in each group. Analysis of the complete data would provide more robust evidence to compare the relative effectiveness of each approach on students' reasoning and decision making related to classroom management.

Third, except for providing students with question prompts to guide them through their analyses of cases and solving problem cases, this study did not provide any additional scaffolding. There is evidence suggesting that structured scaffolding procedures and the discussion of cases in the classroom enhance students' learning and decision making about classroom management (Cherubini, 2009; Choi & Lee, 2009; Lee & Choi, 2008). Additionally, although not directly related to teacher education, Jonassen and Kim (2010) argued that designing authentic learning environments that invoke students' interest and induce them to engage in reasoning and argumentation leads to conceptual change and improvement in their decision making and problem solving skills. These authors further pointed out students, especially novices, are weak in argumentation and reasoning skills and suggested that students need scaffolding to improve in these crucial skills. Jonassen and Kim (2010) proposed a set of methods or tools to foster students' construction of arguments or reasons to justify their decisions. These tools include providing students with clear directions about creating supporting and opposing arguments or reasons for their positions, using question prompts to direct attention to the important aspects of tasks, and using graphical argumentation aids to facilitate better visualization of the connections or relationships between different concepts underlying students' arguments or reasons. Comparing these three case-based approaches with the combination of different scaffolding procedures would be a direction for a future study.

Finally, the exemplary and problem cases used in this study were presented in the written form. Although these cases included relevant details about the classroom situations described in the cases, they might not stimulate students' understanding of complex causal relationships that characterized teachers' interactive decisions related to classroom management as situated in a broader context. Video can capture more vivid and a wider variety of contextual information that would allow students better grasp the complexity of classroom interactions and teachers' interactive decisions (Bowers & Doerr, 2003; Moreno & Valdez, 2007). Using video cases of exemplary teaching practices or pedagogical problems and

designing instruction in a way that would enable students to examine these cases in a personalized and interactive manner can promote improvement on their critical reflection, reasoning, and decision making skills. Furthermore, examining the possibilities of applying worked example and faded worked example approaches to designing video cases would be a fruitful direction for future research.

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