2-2020

Asynchronous Discussion Forum Design to Support Cognition: Effects of Rubrics and Instructor Prompts on Learner's Critical Thinking, Achievement, and Satisfaction

Lisa A. Giacumo
Boise State University

Wilhelmina Savenye
Arizona State University

Asynchronous Discussion Forum Design to Support Cognition: Effects of Rubrics and Instructor Prompts on Learner's Critical Thinking, Achievement, and Satisfaction

Lisa A. Giacumo
College of Engineering
Boise State University

Wilhelmina Savenye
Mary Lou Fulton Teachers College
Arizona State University

Abstract

The purpose of this study was to test the effects of two metacognitive scaffolds on the effects on learners' cognition by evaluating student critical thinking skills performance in an asynchronous discussion board and achievement in a blended learning module. The two scaffolds included a systematic protocol for individualized facilitation prompts and an analytic rubric with three criteria (critical thinking, participation frequency, and writing quality) along with four levels of achievement for each criterion. This research study employed a quasi-experimental, two-by-two factorial design. The study participants (N = 257) were assigned to one of four different conditions. Those provided with the rubric scaffold demonstrated significant differences with respect to their performances. However, the combination of both metacognitive scaffolds had a detrimental effect on learner performance. Additionally, learners reported higher satisfaction levels with the module when presented only with the rubric scaffold. Based on these results, the implications are discussed for those who design, facilitate, and manage asynchronous discussions and blended learning environments.

Keywords: blended learning, metacognitive scaffolds, critical thinking, discussion board, assessment, grading rubrics

Introduction

The number of people pursuing online and blended learning opportunities continues to grow (Allen & Seaman, 2011; Allen & Seaman, 2016). A common tool used to promote academic interaction and learning found in learning management systems and online or blended learning environments are asynchronous discussion forums (ADF) (Li, Tang, Cao, & Hu, 2018). However, a problem exists in that instructors and researchers find that learners often do not demonstrate critical thinking skills within ADFs (Beckmann, & Weber, 2016; Klisc, McGill, & Hobbs, 2017; Novotny, Stapleton, & Hardy, 2016; Rodas, 2016). In addition, it can be challenging for instructors in online and asynchronous learning environments to measure and interpret students' learning outcomes and performance in a timely and accurate manner, which can limit their ability to provide effective feedback, which is also a problem for learners in ADFs (Chandrasekaran, Ragupathi, Kan, & Tan, 2015; Yang, Richardson, French, & Lehman, 2011).

A previous study documented the inherent complexity of facilitating students' performance within an ADF environment (Authors, 2013). The present study was designed to further investigate the effects instructors can have on improving student learning in discussions through the implementation of two commonly used types of metacognitive scaffolds: instructor response prompts and a rubric as treatment interventions. Instructors have used scaffolds to promote critical thinking skill demonstration in ADFs (Pattanapichet & Wichadee, 2015).

This study was conducted in a mostly online instructional context, coupled with a small amount of face-to-face classroom instruction. One of the two authors designed the instructional module to provide information and practice on the legal and ethical use of intellectual property (IP) integrated into the pre K–12 classroom, for junior- and senior-year undergraduate teacher preparation students at a large southwestern university.

Adult Online Learning and the 21st Century Workplace

To excel in the twenty-first century workplace, students should acquire creativity, communication, collaboration and critical thinking skills (Keane, Keane, & Blicblau, 2016) and be prepared to transfer what they've learned about specific theories, abstract principles, processes, and general rules into daily workplace tasks (Casner-Lotto &

Barrington, 2006). Decades ago, Flavell (1979) posited that when individuals monitor and reflect on their ability to articulate information, for example in writing, it can support their learning and critical thinking during school and real-life enterprises. Today, researchers advise that writing in ADFs can be used as an assignment to facilitate the demonstration of critical thinking (Lapadat 2002; Salter, Douglas, & Kember, 2017). Development of critical thinking skills, when defined as the ability to analyze, apply, and evaluate information (Duron, Limbach, & Waugh, 2006), may be best supported when learning activities include real-world scenarios, problem solving, analyzing arguments, and evaluating potential decisions (Bensley & Spero 2014; Dwyer, Hogan, & Stewart, 2014). However, Keane et al. (2016) remind us that using technology does not guarantee that learning will occur. Research shows that instructors, facilitators, and instructional designers need more guidelines regarding how to foster learners' critical thinking throughout the curriculum and in ADFs (Heijltjes, Van Gog, Leppink, & Paas, 2014; Authors, 2010).

Soft and Hard Scaffolds in Technology Enhanced Learning Environments

Higher education must both provide information access and support students in their gradual development of personal understanding and engagement with others (Laurillard, 2000). Vygotsky introduced the idea of scaffolding in his (1978) theory of the Zone of Proximal Development, arguing that social interactions with more advanced persons will benefit a learner by providing supportive assistance to achieve a desired performance the learner would not achieve individually. According to Sharma and Hannafin (2007), "while scaffolding refers to expert support, it is conceptually and operationally distinguishable from other types of assistance because it is faded (p. 29)." However, these authors also acknowledge the challenge of creating a computer-supported learning environment that recognizes when to fade scaffolding (Sharma & Hannafin, 2007). Saye and Brush suggest that the inclusion of both hard scaffolds, which are fixed, nonnegotiable, and technology mediated, and soft scaffolds, which are provided by an instructor, can be an alternative to complete individualized faded support (2002). Further, Puntambekar and Hübscher (2005) suggest that the redundancy afforded by distributed, multiple scaffold types, which support a specific desired performance, can provide beneficial opportunities for learners with diverse needs.

Soft Scaffolding Strategies to Support Metacognitive Skills and Learning

Oliver (2001) suggests instructors present cases or scenarios that require learners' critical thought to support the learning process, while Xie and Bradshaw (2008) build on this idea to suggest that instructors offer learners opportunities to strengthen their metacognitive thinking processes by prompting students to brainstorm solutions to cases and problem-solving activities. Dabbaugh (2003) offers instructional scaffolding strategies to support these metacognitive activities mentioned by Oliver (2001) and Xie and Bradshaw (2008), with recommendations for coaching learners who are struggling to demonstrate desired performance through questioning and providing timely individual feedback as a method to facilitate learning online.

However, several researchers describe situations in which students received little instructor facilitation of their virtual classroom discussions beyond one well-constructed discussion prompt (Christopher, Thomas, Tallent-Runnels, 2004; Daroszewski, Arrastia, Nelson, Cornille, & Liang, 2004; Kanuka & Anderson, 1998; Lee, 2009). Thus, investigation into the effects of different types of deliberate instructor guidance during discussions on the learners' demonstrated critical-thinking skills appears to be warranted. Specifically, this investigation focused on the effects of one type of metacognitive scaffolding, in the form of instructor coaching through questioning and timely feedback, to prompt novice teacher education students to reflect upon their knowledge of legal and ethical integration of intellectual property in classrooms and to determine appropriate decisions in case examples.

Rubric Use as a Hard Scaffold in Online Learning Environments

Several postsecondary researchers have suggested that rubrics can be effective tools when used to articulate expectations of student work via a set of evaluation criteria with a range of descriptive quality levels for each of the evaluation dimensions (Andrade, 2000; Goodwich, 1997; Osana & Seymour, 2004; Reitmeier, Svendsen, & Vrhota, 2004; Roblyer & Wienke, 2004; Schneider, 2006; Stetter, 2018). Further, Samuels, Ediger, Willcutt, and Palumbo (2006) state that one "method to promote the development of metacognition in students is to ask them to assess their own work (p. 55)." Several researchers have also found the use of grading rubrics to be associated with positive student attitudes (Rovai, 2007; Andrade & Du, 2005). However, a comprehensive literature review conducted by Reddy and Andrade (2010) on the use of rubrics used in postsecondary education indicated a need for more rigorous research with a clear focus on learning.

Common rubric characteristics include the quantity of an individual's contribution; the cognitive quality of an individual's contribution; meaningful connections made between course materials, abstract concepts, and real-world experiences; timeliness; collegiality; and expository writing mechanics (Ajayi, 2010; Gilbert & Dabbagh, 2005; Ho & Swan, 2007; Knowlton, 2003; Penny & Murphy, 2009; Topcu & Ubuz, 2008; Vitale, 2010). Each of these characteristics was represented in the rubric designed for this study.

Instructor Facilitation in Discussion Forums

Evidence shows that instructors can influence learners' interactions and performance in an asynchronous discussion forum environment (Dennen, 2005), and several researchers specifically studied CMC environments (Shea, Fredericksen, Pickett, & Pelz, 2003; Zhan & de Montes, 2007; Swan, 2001; Garrison, Anderson, & Archer, 2001). In particular, adding information or asking follow-up questions can help students demonstrate higher levels of critical thinking in their responses (Schrire, 2006; Christopher et al., 2004), and providing substantive and prompt feedback can enhance learning in an online environment (Gayton & McEwen, 2007). Nevertheless, other evidence suggests instructor facilitation may not contribute significantly to student participation or satisfaction (An, Shin, & Lim, 2009).

In many of the studies related to asynchronous instructor facilitation with adult learners, the facilitation protocols were not specified (Ajayi, 2010; Arend, 2009; Beuchota & Bullen, 2005; Garrison, 2007; Hough, Smithey, & Evertson, 2004; Jetton, 2004; Maher & Jacob, 2006) or only described a few specific response prompt facilitation actions (Curran, Kirby, Parsons, & Lockyer, 2003; Dennen, 2005; Garrison, 2007; Heejung, Shin, & Lim, 2009; Hemphill & Hemphill, 2007; Maher & Jacob, 2006; McKee, 2002). This study's preplanned instructor facilitation response prompt protocol incorporates elements from previous research that were found to generate and improve student participation (Dennen, 2005; Curran et al., 2003; Garrison, 2007; Jetton, 2004; Maher & Jacob, 2006; Hemphill & Hemphill, 2007; McKee, 2002).

Hypothesis and Defined Variables

To summarize, although the use of online discussion boards is prevalent, no studies were found to show empirical evidence that providing scaffolds designed to elicit higher order thinking skills, or multiple scaffold types simultaneously (i.e., both rubrics and instructor response prompts), would garner better critical thinking performance and learning achievement. Therefore, we endeavor to test the hypothesis that when instructors provide a rubric, or prompts, or both interventions, which are designed to support metacognitive abilities, learners are better able to demonstrate higher critical thinking skills and learning achievement. This should also result in more positive satisfaction ratings. Since these interventions have been shown to support learners' cognition, it is worthwhile to explore their effects in an online discussion context.

Purpose of the Current Study

The purpose of this study was to examine the effects of both predesigned instructor prompts and a rubric on the performance of adult learners in an asynchronous discussion forum. Aligned with the research on scaffold interventions previously summarized and the hypothesis, we investigated two different scaffold types as independent variables: instructor response prompts and rubrics. Also aligned with the research previous summarized, we identified the three dependent variables. The three dependent variables are defined as learners' online discussion forum performance (i.e., demonstration of critical thinking skills, amount of participation, and writing quality), learning achievement, and reported satisfaction.

To investigate online discussion forum performance, we used discussion messages posted by the learners in an LMS. To investigate learning achievement, the authors used scores from an objective-based learning quiz. The authors used an attitude survey to capture the participants' satisfaction ratings. We also investigated participant attitudes toward the module, as affected by the independent variables. Together, these three instruments ensured a triangulation of observations to inform the study results.

Evidence of the treatment effects of the two independent variables on discussion forum performance, learning achievement scores, and satisfaction ratings, is shown in the comparison of four groups. We organized these four groups in a 2x2 factorial design. The four groups consisted of a control group that did not receive either scaffold, a

group that received the instructor response prompts, a group that received the rubric, and a group that received both scaffolds. In short, this study showed how learners performed in online discussions and how the interventions affected performance, learning achievement, and satisfaction. This study addressed the following research questions:

1. Do students demonstrate a higher level of critical thinking, more contributions, and better writing quality, when receiving a rubric and/or, instructor response prompts in an online discussion?

2. What, if any, are the different effects of these approaches on subsequent learning achievement scores and satisfaction ratings?

Method

Participants interacted with a pretest, instruction, one of four versions of an ADF assignment, a posttest, and an attitude survey. The two treatment factors—rubric and facilitation response prompts—were implemented as between-subject independent variables. The dependent measures in this study were ADF performance, quiz performance, and participant attitudes.

Participants

A total of 317 undergraduate preservice teacher education students were recruited from a large public university located in the southwestern US. 80% of the participants self-identified as female and 20% of the participants self-identified as male. 93 % of the participants self-identified as under 30 years old, 5% self-identified as 30 to 39 years old and 1% self-identified as 40 to 49 years old. While field experience was not a demographic data point collected, the prescribed degree program curriculum first introduced learners to field work during the semester they participated in this study. Therefore, the large majority of the study participants would have had no prior field experience. A total of 257 complete data sets were collected. Participants were enrolled in a required junior-year course that introduces preservice teachers to how to plan for content-rich instruction, good pedagogy, and purposeful, value-added integration of technology tools for student and teacher use in K-12 classrooms.

Materials

A three-week blended module on copyright and fair use of IP for educators was presented using the Blackboard learning management system (LMS). Two objectives were taught in the unit: 1) classify the use of a creative work from a live performance, writing, or multimedia as either general legal use, defensible under fair-use exemptions for educators, or a copyright violation, and 2) identify appropriate ethical integration of intellectual property (IP) in the classroom.

The module was presented to all participants and covered each of Gagne's nine events of instruction (Gagne, Briggs, & Wager, 1992). Attention was gained by introducing the novel remake of the Disney classic films in a "Fair(y) Use Tale," created by Faden (2007) and through a simulated news article referring to a new teacher who surprisingly broke copyright law. Students were also informed of the required performance and criteria for performance with assignment instructions, a pretest, and a rubric. A discussion was facilitated to elicit prior learning about ethical and legal use of intellectual property in the classroom. Instruction in the form of a guided research activity, resources, and a case study. Performance was elicited in the discussion forum activity, which required students to explain how to integrate the conceptual lessons provided about ethical and legal use of intellectual property into their future classroom. Feedback was provided in the discussion forum in the form of responses by the facilitator and peers or the students' themselves when they assessed their work against a rubric. Performance was assessed of all students in the posttest quiz. Job-aids were created by the students to facilitate transfer to their future jobs as classroom teachers. All participating course-section instructors completed an individual training session conducted by the researcher that introduced them to the implicit and explicit curriculum design and unit activities, with which they later guided their students.

Objective-type pretest and posttest quizzes were given via the Blackboard LMS to assess each participant's prior knowledge and post-unit understanding, respectively. The 15-item multiple-choice quizzes were based on the unit learning goals and example questions are provided in Appendix A. Some of the items were adapted from a lecture given by Lewallen (2006). This instrument was also adapted from a 30-item measure used in a prior study (Authors, 2013).

Procedures

In this quasi-experimental study, students were assigned to the treatments based on their section enrollment in the course. All students received both face-to-face and online learning experiences that provided a foundational understanding of copyright and fair-use guidelines for educators. The face-to-face instruction was conducted during the first week of the module. The online portion occurred during the next two weeks and culminated in a learning quiz at the module's conclusion.

Each section was randomly assigned to one of the four treatment conditions. The ADF treatment groups featured four facilitation protocols: a) instructor response prompts and rubric, b) instructor response prompts and no rubric, c) no instructor response prompts and rubric, and d) no instructor response prompts and no rubric. Students completed the unit across three weeks of class meetings and at home.

The Logic-Based Critical Thought Discussion (LBCTD) grading rubric used in this study was adapted from the rubric first employed in the Authors (2013) study to investigate the presence of students' higher-order thinking skills. Researchers have generally divided the demonstration of critical thinking skills into low-, mid-, and high-level thinking skills (Christopher et al., 2004; Garrison et al., 2001; Kwon, Shin, & Park, 2018; Järvelä & Häkkinen, 2002; Veerman & Veldhuis-Diermanse, 2001). One of the authors originally designed the LBCTD rubric to evaluate critical thinking skills as conceived by Krathwohl's revised version of Bloom's Taxonomy (Bloom, 1977; Krathwohl, 2002).

As in the Christopher et al. (2004) study, the authors used the LBCTD rubric to assign point values to the depth of student contribution. This rubric extended the previous research and additionally documented both the breadth of the discussion contribution and the quality of writing. The breadth was considered important to facilitate increased social interaction. The quality of writing was considered important to reinforce the professional-level writing required of teachers. The LBCTD rubric also allows for the evaluation of correct and logical thought. This addition ensures that students do not receive credit when making use of illogic or misconceptions. The rubric is in Table 1.

Table 1
The Logic-Based Critical Thought Discussion (LBCTD) grading rubric.

	3 Points	2 Point	1 Point	0 Points
Depth of total contribution to collective understanding	Evaluate or Create; One or more entries assess the value of particular ideas or solutions, detect inconsistencies or fallacies within a process or product, critique, detect value, judge, extrapolate new opportunities extended from a complex relational understanding, hypothesize, plan, design procedure, construct a complex product (use complex relational understanding to design criteria to evaluate existing ideas or create new materials/environments).	Apply or Analyze; One or more entries execute, carry out, apply procedure to familiar task, implement, use, apply procedure to an unfamiliar task, differentiate, discriminate, distinguish, focus, select, organize, find coherence, integrate, outline, parse, structure, attribute, deconstruct, (group simple knowledge components to build new more complex relational systems understanding, and/or disassemble complex systems understanding into related but simple knowledge component parts, distinguish relevant from irrelevant, determine point of view, bias, values, or underlying intent).	Remember or Understand; One or more entries interpret, recognize, recall, identify, clarify, list, paraphrase, describe, define, represent, translate, exemplify, illustrate, instantiate, classify, categorize, subsume, summarize, abstract, generalize, infer, conclude, extrapolate, interpolate, predict, compare, contrast, map, match, explain, identify cause and effect model, show, restate, summarize, (emphasize recall and/or a literal understanding of knowledge components).	Student does NOT demonstrate correct logical thinking to address discussion prompt and/or course content
Breadth of total contribution to collective understanding	Apply or Analyze; One or more entries execute, carry out, apply procedure to familiar task, implement, use, apply procedure to an unfamiliar task, differentiate, discriminate, distinguish, focus, select, organize, find coherence, integrate, outline, parse, structure, attribute, deconstruct, (group simple knowledge components to build new more complex relational systems understanding, and/or disassemble complex systems understanding into related but simple knowledge component parts, distinguish relevant from irrelevant, determine point of view, bias, values, or underlying intent).	Student follows directions, posts two or three times; one response to discussion prompt, and at least one response to another student's thread.	Student posts once to discussion-board.	Student does NOT post to discussion-board.
Quality of writing	Student employs correct conventions of grammar and spelling, and is professional.	Two - three errors in conventions of grammar and/or spelling, and is professional.	Four or more errors in conventions of grammar and/or spelling, and/or is NOT professional.	Student does NOT post to discussion-board.

Week 1

To control for prior learning, students completed a computer-based pretest quiz on copyright law and fair-use exemptions for educators. Students then watched a short digital story called "A Fair(y) Use Tale," created by Faden (2007) and freely available on YouTube, after which they were assigned a guided research learning activity. The learning activity integrated informational Web resources and problem-solving exercises designed to support guided practice of the discrete verbal information introduced by the digital story.

Week 2

Following the learning activity, an instructor facilitated an in-person, whole-class discussion to ensure accurate understanding and application of the unit's content. Toward the end of the class meeting, readings and a graded ADF activity were assigned. A hard copy of the discussion forum rubric was distributed in class to students in the rubric treatment. All students had seen rubrics used to assess their assignments in the past and many students had created at least one rubric as part of their prior teacher preparation coursework. To ensure even implementation, the first author explained the rubric criteria for each dimension and gave examples of response content or frequencies that would be assessed in each of the nine-cell rubric during the in-person class for all course sections assigned to the rubric treatment as well as provided answers to any questions that arose subsequently. This concluded the face-to-face instructional portion of the module.

Week 3

During the next week, students read the assigned material and participated in the ADF assignment from home via Blackboard. The ADF assignment directed students to self-select one of five discussion-board question prompts and respond to it during the week. One example of a discussion-board question prompt asked students to describe how to use the four-factor test to evaluate the potential fair-use of a piece of copyright protected intellectual property that he/she would like to use in the classroom. Each of the five question prompts can be found in Appendix B Students in half of the assigned course sections were instructed to use the LBCTD rubric as they participated in the discussion. Students in half of the assigned course sections received discussion forum facilitation prompts for any participant who demonstrated low- or mid-level cognition.

To ensure even facilitation, the lead researcher observed the students' work in the ADF in Blackboard and provided response prompts to the half of the course sections that were assigned to the prompt treatments. In other words, the researcher used the same criteria and responded with the same types of prompts designed to elicit more critical thought. The researcher implemented the treatment response prompts in a Socratic style. In an attempt to guide demonstration of more complex thinking skills, these probing question prompts were designed to stimulate the demonstration of thinking skills at one level above the student's original performance. For example, if the researcher determined a discussion post to align with low critical thinking, the researcher prompted the student to apply their knowledge to a given context or analyze key idea statements by their component parts. If the researcher determined a discussion post to align with mid-level cognitive processes, the researcher prompted the student to critically evaluate their statements given the criteria for ethical and legal use of intellectual property or to create a new approach to ensure ethical and legal use of intellectual property in the classroom. See Appendix B for applications of these two examples.

Measures and Analyses

The resulting discussion forum postings were qualitatively evaluated by the researcher with the LBCTD rubric. Points were awarded for a student's depth of total contribution, breadth of total contribution, and quality of writing. Students could earn up to nine points for their overall discussion forum contribution: zero, one, two, or three points for each of the three areas. A sample of ten percent of students and their complete entries were examined by another researcher to confirm inter-rater reliability of the assessed scores. The correlations between the two raters were high for each score; .882 for depth, .856 for breadth, and .904 for quality of writing. Because we found the scores to be highly related and reliable, we used them to investigate the mean and the standard deviations for learners' performance in each area (i.e., total contribution, breadth of total contribution, and quality of writing). We then compared these quantified results for any potential significant statistical differences between the four treatment groups with a series of MANOVAs and ANOVAs. We share the results of these analyses in the discussion board performance section.

Additional quantitative measures included students' scores on the multiple-choice pretest and posttest quizzes. Many of the items for each objective on the pretest and posttest had similar root structures, whereas other items employed slightly different root structures. The questions are scenario-based and require participants to remember the guidelines presented for using IP in the classroom as well as to analyze, apply, or evaluate, the use of IP in different scenarios, to arrive at the correct answer. We compared the pretest scores to determine if there was any statistically significant difference in the prior knowledge of each treatment group with an ANCOVA. We compared the pretest and posttest quiz scores to determine if learners performed statistically significantly different, by treatment group with an ANCOVA. We share the results of these analyses in the pretest and posttest achievement score section.

We used students' responses to an attitude questionnaire to measure student interest, motivation, confidence, and enjoyment, adapted from the Palmer and Holt (2010) Experiences of Learning Online (ELO) instrument. The ELO instrument was adapted and modified for use in a previous study (Authors, 2013). Items from the earlier survey, which were not found to contribute to identifying student satisfaction differences in a blended learning modality, were omitted. In this study, 17 items were used to measure satisfaction on a Likert-type scale for elements, such as structure and organization, teaching staff, interaction, and technical aspects of online learning. Responses to three open-ended questions were also examined. The survey was conducted via Google Forms and Spreadsheets directly after students received the results of the learning quiz. We used learners' Likert-scale responses to investigate the survey item means and standard deviations. We then analyzed these findings for any potential significant statistical differences between the four treatment groups with a series of MANOVAs and ANOVAs. We used a content analysis approach to coding and aggregating learners' open-ended question responses into overarching themes. We share the results of these analyses in the attitude survey responses and open-ended question responses sections.

Results

The results of the participants' performance and attitudes, based on the differences in treatment conditions, are described in the following sections. Summaries of students' discussion forum performance assessed by the rubric, the pretest and posttest quiz scores, and finally the satisfaction survey, follow in sequence. Comparison of the outcome descriptions are included for each section and comparisons between the numerical differences are shown in tables presented below.

Discussion Forum Performance

The students' overall scores for discussion forum performance were used to calculate the total mean score of 5.24 out of 9.0 points. Each area of discussion forum performance including, critical thinking or depth, amount of participation or breadth, and quality of writing, was scored from 0.0 to 3.0 points, as noted previously in Table 1. As previously noted, to confirm that the scores were consistently assigned, an interrater reliability analysis was completed with a random sample of ten percent of students and their complete entries via a Pearson Correlation analysis. The analysis results indicate that the scores between raters were consistent. Table 2 presents the mean scores and standard deviations for the discussion forum performance represented by each treatment group. The results show differences between treatment groups. Figures 1, 2, and 3, illustrate the directional effects by treatment in learners' ADF performance.

Figure 1 shows an interaction effect in learners' critical thinking or depth performance; those in the rubric and no prompt treatment group did better than those in the rubric and prompt treatment group while those in the no rubric and no prompt treatment group did worse than those in the no rubric and prompt treatment group. Figure 2 shows that those in the no rubric and no prompt treatment or prompt treatment participated about the same amount, and they participated more so than those in the rubric and prompt treatment group while they participated less than those in the rubric and no prompt treatment group. Figure 3 shows a similar directional effect for writing quality, as figure 2. Those in the no rubric and no prompt treatment or prompt treatment demonstrated writing about the same quality level, and they demonstrated better writing quality than those in the rubric and prompt treatment group while they demonstrated a lower writing quality than those in the rubric and no prompt treatment group.

Table 2

Mean scores and Standard Deviations for ADF Performance by Rubric and Instructor Response Prompt Condition

		Rubric	No rubric	Total
Depth 3 points possible	Prompt	39: 1.31 (1.128)	77: 1.81 (1.101)	116: 1.64 (1.130)
	No prompt	88: 2.10 (1.073)	53: 1.40 (0.987)	141: 1.84 (1.093)
	Total	127: 1.86 (1.146)	130: 1.64 (1.071)	257: 1.75 (1.112)
Breadth 3 points possible	Prompt	39: 1.56 (1.252)	77: 1.92 (0.997)	116: 1.80 (1.097)
	No prompt	88: 2.26 (1.023)	53: 1.92 (0.958)	141: 2.13 (1.009)
	Total	127: 2.05 (1.140)	130: 1.92 (0.977)	257: 1.98 (1.061)
Quality of Writing 3 points possible	Prompt	39: 1.38 (1.161)	77: 1.44 (0.925)	116: 1.42 (1.006)
	No prompt	88: 1.61 (0.999)	53: 1.51 (1.012)	141: 1.57 (1.002)
	Total	127: 1.54 (1.052)	130: 1.47 (0.958)	257: 1.51 (1.004)
Total Score 9 points possible	Prompt	39: 4.26 (3.282)	77: 5.17 (2.577)	116: 4.86 (2.853)
	No prompt	88: 5.98 (2.649)	53: 4.83 (2.517)	141: 5.55 (2.650)
	Total	127: 5.45 (2.954)	130: 5.03 (2.549)	357: 5.24 (2.759)

Note. The values in the table above are organized by N: Mean (SD), e.g. 39: 1.31 (1.128). The maximum possible achievement score for the ADF activity was nine. The maximum possible achievement scores for the depth of discussion, breadth of discussion, and quality of writing were each three.

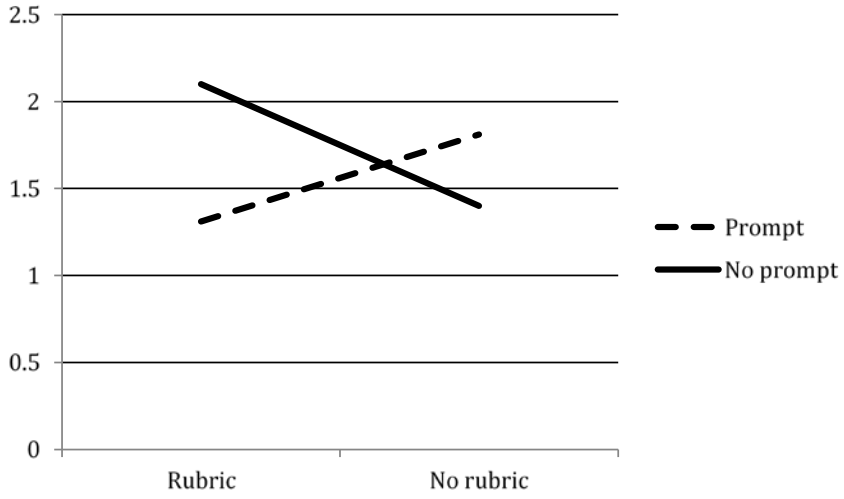

Figure 1. Direction of effects by treatment for the depth of ADF performance. The maximum possible achievement score for the depth of ADF performance was three.

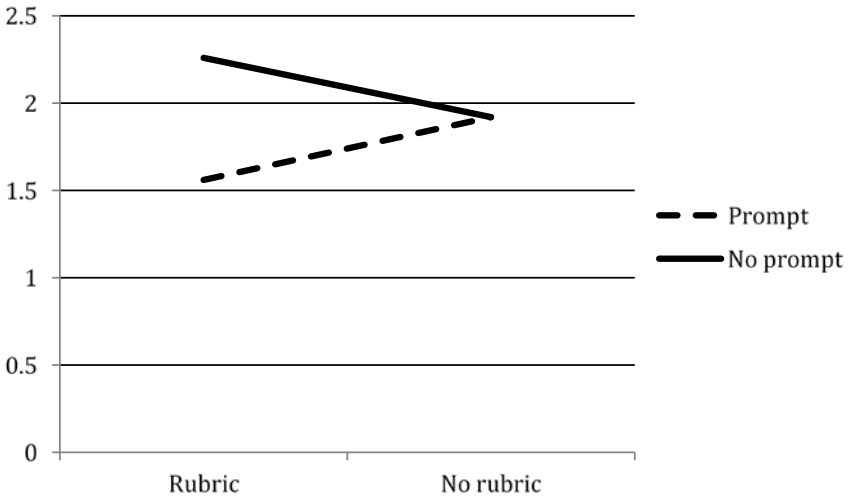

Figure 2. Direction of effects by treatment for breadth of ADF performance. The maximum possible achievement score for breadth of ADF performance was three.

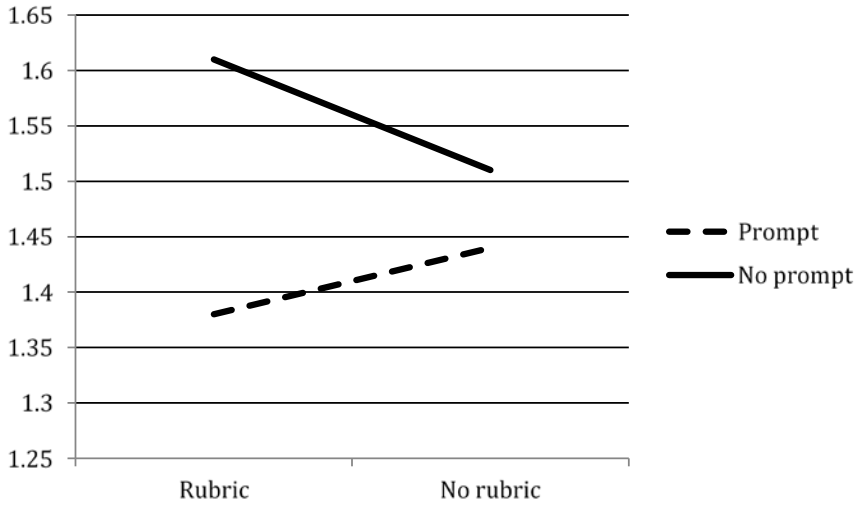

Figure 3. Direction of effects by treatment for the writing quality of ADF performance. The maximum possible achievement score for quality of writing in ADF performance was three.

A two-way multivariate analysis of variance (MANOVA) was conducted to determine the effect of the ADF treatment instructor response prompts (presence or absence) and rubrics (presence or absence) on the three dependent variables. Table 3 shows the MANOVA results for the ADF performance by treatment.

Table 3
MANOVA for Discussion Forum Performance by Treatment

Source	*df*	*F*	Partial η2	*P*
Prompt (*P*)	1	2.345	0.027	0.073
Rubric (*R*)	1	0.459	0.005	0.771
$P \times R$	1	2.345	0.089	0.000**
Error	251	(1.082)		

Note. Values enclosed in parentheses represent mean square errors.
*$p < 0.05$
**$p < 0.10$

An analysis of variance (ANOVA) was conducted on each of the three dependent variables as follow-up tests to the MANOVA. Statistically significant differences were found in the depth and breadth of students' contributions to the ADF. Table 4 shows the ANOVA results for ADF performance by treatment.

Table 4
ANOVA for ADF Performance by Treatment

	Source	*df*	*F*	Partial η2	*P*
Depth of Contribution	Prompt (*P*)	1	1.877	0.007	0.172
	Rubric (*R*)	1	0.549	0.002	0.459
	P × *R*	1	18.280	0.067	0.000**
	Error	253			
Breadth of Contribution	*P*	1	6.570	0.025	0.011*
	R	1	0.006	0.000	0.938
	P × *R*	1	6.478	0.025	0.012*
	Error	253			
Quality of Writing	*P*	1	1.263	0.005	0.262
	R	1	0.032	0.000	0.858
	P × *R*	1	0.372	0.001	0.542
	Error	253			

Note. Values enclosed in parentheses represent mean square errors.
*$p < 0.05$
**$p < 0.01$

The ANOVA test on the depth of contributions revealed that that no main effects were statistically significant. However, the follow-up test revealed a significant interaction. The Bonferoni method was used to control for a type 1 error in the follow-up test for simple main effects. When prompts were presented, participants who did not receive a rubric performed statistically significantly better than participants who did receive a rubric. Participants who did not receive any prompts scored statistically significantly better when they were provided with a rubric than those who were not provided with a rubric. When the rubric was presented, those who were provided with prompts scored statistically significantly lower than those who did not receive prompts. No other simple main effect comparisons were found to be statistically significantly different.

The ANOVA test used to investigate the breadth of students' contribution to the ADF revealed a statistically significant difference for the prompt main effect such that when students were presented with a prompt they tended to contribute less frequently to the discussion. The rubric main effect was not found to be statistically significantly different. The interaction was also found to be statistically significantly different and the Bonferoni method was used to control for a type 1 error in the follow-up test for simple main effects. When a rubric was presented, those without a prompt performed statistically significantly higher. No other simple main effect comparisons were found to be statistically significantly different.

Pretest and Posttest Achievement Scores

The means and standard deviations for the pretest and posttest learning performance by instructor prompt (presence or absence) and rubric (presence or absence) are presented in Table 5. The overall mean score for students' performance across the four treatment groups on the pretest was less than the overall mean score for students' performance across the four treatment groups on the posttest. The pretest mean score for students in the instructor prompt treatment was greater than the mean score of students who received no instructor prompt. The pretest mean score for students who later received a rubric was higher than for students who did not receive a rubric. Students who received instructor prompts obtained a greater mean score in the rubric treatment, as compared to a mean score of students in the no rubric treatment. In contrast, students who did not receive instructor prompts achieved a greater mean score in the rubric treatment as compared to students in the no rubric treatment.

Table 5
Means and Standard Deviations for Pretest and Posttest Achievement Scores by Rubric and Instructor Response Prompt Condition

		Rubric		No rubric		Total	
Instructor Response Prompt		Pretest	Posttest	Pretest	Posttest	Pretest	Posttest
Prompt	M	5.59	8.64	5.34	8.05	5.42	8.25
	SD	1.534	1.993	1.861	2.194	1.755	2.138
	n	39	39	77	77	116	116
No prompt	M	5.41	9.10	5.00	7.66	5.26	8.56
	SD	1.693	1.936	1.776	2.192	1.730	2.146
	n	88	88	53	53	141	141
Total	M	5.46	8.96	5.20	7.89	5.33	8.42
	SD	1.642	1.957	1.827	2.193	1.740	2.144
	n	127	127	130	130	257	257

Note. The maximum possible achievement scores for the pretest and posttest were each 12.

To verify that the assumptions of independence and normality underlying the ANCOVA, a test of homogeneity-of-regression (slopes) assumption was first conducted to evaluate any potential interaction between the covariate and the independent variable in the prediction of the dependent variable. No statistically significant interaction was found; meaning that the differences on the dependent variable pretest scores among groups did not vary as a function of the students' prior knowledge.

An ANCOVA was then conducted to assess differences among student achievement scores after completing the instructional unit by treatment variation. Results are presented in Table 6. Students' scores on the objective-type pretest were used as a covariate. The rubric main effect was found to be statistically significantly different and the scores of students who received a rubric were statistically significantly higher than the scores of students who did not. Students tended to achieve a higher mean score when they received the rubric as compared with students who did not receive the rubric treatment. There was no statistically significant difference in scores for those who were in the prompt treatment, and also no statistically significant difference was found for the interaction of the two factors.

Table 6
ANCOVA for Change in Pretest-Posttest Performance by Treatment

Source	*df*	*F*	Partial $\eta 2$	*P*
Prompt (P)	1	0.024	0.000	0.878
Rubric (R)	1	13.462	0.051	0.000*
P x R	1	0.024	0.009	0.122
Error	257	(4.334)		

Note. Values enclosed in parentheses represent mean square errors.
*$p < 0.05$

Attitude Survey Responses

The attitude survey contained 17 Likert-type items and three open-ended questions. A two-by-two MANOVA was conducted to test the effects of rubrics and instructor response prompts on student satisfaction levels. The scores on the attitude items ranged from one to five, where one denoted not satisfied and five denoted very satisfied. Mean scores for all the attitude items ranged from dissatisfied to satisfied. Table 7 shows the means and standard deviations for each satisfaction survey item.

Table 7

Means and Standard Deviations for Satisfaction Survey Items

Item			Rubric	No rubric	Overall
1	Being able to access online/ digital learning resources readily	Prompt	39: 3.79 (.894)	77: 3.97 (.827)	257: 3.96 (.777)
		No prompt	88: 3.95 (.741)	53: 3.95 (.741)	
2	Being able to partially learn with regular face-to-face contact	Prompt	39: 3.54 (.996)	77: 3.81 (.918)	257: 3.79 (.872)
		No prompt	88: 3.88 (.814)	53: 3.81 (.756)	
3	Being able to partially learn in an online format	Prompt	39: 3.38 (1.161)	77: 3.71 (.856)	257: 3.72 (.947)
		No prompt	88: 3.77 (.944)	53: 3.91 (.861)	
4	Being organized and responsible for my own learning	Prompt	39: 3.77 (.742)	77: 3.87 (.848)	257: 3.85 (.822)
		No prompt	88: 3.81 (.842)	53: 3.94 (.818)	
5	The amount of work that was required	Prompt	39: 2.31 (1.195)	77: 2.71 (1.037)	257: 2.71 (1.084)
		No prompt	88: 2.90 (1.125)	53: 2.70 (.932)	
6	Being given and/or pointed to enough current material	Prompt	39: 3.62 (.907)	77: 3.81 (.889)	257: 3.81 (.876)
		No prompt	88: 3.82 (.904)	53: 3.92 (.781)	
7	My ability to relate what is learnt to issues in the wider world	Prompt	39: 3.77 (.872)	77: 3.83 (.894)	257: 3.81 (.868)
		No prompt	88: 3.80 (.886)	53: 3.85 (.818)	
8	My ability to make connections to existing knowledge/experience	Prompt	39: 3.82 (.756)	77: 3.91 (.798)	257: 3.89 (.786)
		No prompt	88: 3.86 (.790)	53: 3.98 (.796)	
9	The assessable work, and its alignment with the learning goals	Prompt	39: 3.18 (1.023)	77: 3.58 (.978)	257: 3.53 (.935)
		No prompt	88: 3.59 (.853)	53: 3.60 (.906)	

Table 7 *(continued)*

Item			Rubric	No rubric	Overall
10	The feedback given on my assessable work, helping me clarify things I hadn't fully understood	Prompt No prompt	39: 3.18 (.914) 88: 3.31 (1.010)	77: 3.39 (.876) 53: 3.40 (.862)	257: 3.33 (.925)
11	The opportunity to develop/ practice online technical skills	Prompt No prompt	39: 3.62 (.907) 88: 3.78 (.780)	77: 3.75 (.710) 53: 3.85 (.770)	257: 3.76 (.777)
12	My ability to communicate knowledge and ideas effectively online	Prompt No prompt	39: 3.67 (.838) 88: 3.78 (.794)	77: 3.84 (.812) 53: 3.83 (.753)	257: 3.79 (.796)
13	Being encouraged to think about ideas and solve problems	Prompt No prompt	39: 3.51 (.854) 88: 3.70 (.911)	77: 3.77 (.826) 53: 3.83 (.753)	257: 3.72 (.847)
14	My ability to learn online	Prompt No prompt	39: 3.67 (.955) 88: 3.8 (.977)	77: 3.92 (.823) 53: 3.94 (.818)	257: 3.85 (.898)
15	The amount of teacher-student interaction in the discussion forum	Prompt No prompt	39: 3.13 (.864) 88: 3.35 (.872)	77: 3.27 (.805) 53: 3.34 (.919)	257: 3.29 (.859)
16	The amount of student-student interaction in the discussion forum	Prompt No prompt	39: 3.26 (.966) 88: 3.72 (.830)	77: 3.53 (.836) 53: 3.72 (.863)	257: 3.59 (.871)
17	The feedback about my discussion forum participation	Prompt No prompt	39: 3.13 (.894) 88: 3.4 (.843)	77: 3.27 (.821) 53: 3.3 (.814)	257: 3.33 (.841)

Note. The values in the table above are organized by N: Mean (SD), e.g. 39: 3.79 (.894). The mean scores and standard deviations were derived from the Likert-type scale ranging from 1 (strongly dissatisfied) to 5 (strongly satisfied).

The four items that received the most positive responses referred to the ability to access online/digital materials, how satisfied they were with their ability to make connections between existing knowledge, their satisfaction level with being able to learn online, and their satisfaction with being responsible for own learning.

Students had the most negative attitudes on the items pertaining to the students' satisfaction level with the amount of work required, the level of satisfaction with the amount of teacher-student interaction in the discussion forum, the feedback students received about their discussion forum participation, and the feedback students received on assessable work to clarify concepts.

An ANOVA was conducted on each of the individual survey items. Significant differences in the prompt main effect were found on items 3, 5, and 16. Table 8 shows the ANOVA for survey items by treatment.

Table 8
ANOVA for Survey Items by Treatment

Item		Source	*df*	*F*	Partial η2	*P*
3	Being able to partially learn in an online format	Prompt (*P*)	1	5.534	0.021	0.019*
		Rubric (*R*)	1	3.108	0.014	0.062
		P × *R*	1	0.638	0.003	0.425
5	The amount of work that was required	*P*	1	4.154	0.016	0.043*
		R	1	.540	0.002	0.463
		P × *R*	1	4.636	0.018	0.032*
16	The amount of student-student interaction in the discussion forum	*P*	1	8.138	0.031	0.005**
		R	1	1.507	0.006	0.221
		P × *R*	1	1.484	0.006	0.224

Note. Values enclosed in parentheses represent mean square errors.
*$p < 0.05$
**$p < 0.01$

Open-Ended Attitude Question Responses

Responses from participants (*N*= 257) were analyzed from the survey's three open-ended questions, which asked students what they liked best (item 18) and least about the module (item 19) and asked for suggestions for future improvements (item 20). All students responded to items 18 and 19, but not all responded to item 20 and many described more than one aspect for each item. The participants' responses were examined for recurring attitudinal themes.

Five major themes emerged from the question about what the participants liked best. The most common reaction to what was liked most (*n* = 181, 70%) referred to the value of learning about the content presented. Other prevalent reactions referred to the applicability of the content to real-world contexts (*n* = 93, 36%), the online learning component (*n* = 40, 16%), and the instructional approach of the module (*n* = 37, 14%). Students also noted their approval of the value of the practice assignments included in the module (*n* = 30, 12%).

Two major themes emerged from the question about what the participants liked least about the module. However, only a small percentage (*n*= 17, 7%) of participants responded with a positive attitude about either the entire module or certain characteristics of the module. The most common reactions to what was liked least referred to the workload (*n* = 146, 57%) and the guidance provided (*n* = 50, 19%).

Discussion

Results of the present study indicate that the scaffolds we designed and implemented can affect students' discussion performance, learning gains, and satisfaction ratings. The results, however, are complex, perhaps mirroring the complexity of instructor-led online learning environments. In the following sections, we discuss the implication of the study results on discussion performance, learning, and satisfaction, for instructors, instructional designers, and researchers.

Rubrics, Instructor Prompts, and Relationships Can Support or Hinder Discussion Performance

As noted in the findings, it would seem that incorporating a grading rubric and instructor response prompts as we did in this study result in similar effects on students' performance. However, once we consider the directional differences between the significant interactions for each level of treatment variable we see that those who received a rubric generally scored higher than those who did not, which is similar to the results presented by Szabo and Schwartz (2011) and Authors (2013). The positive performance trends found for the rubric condition support the previous findings reported by Authors (2013). While no significant difference for overall discussion forum performance was found

within the rubric treatment main effect, participants did perform better in the rubric treatment condition. These results suggest that the rubric is an effective form of explicit instructor guidance for online discussion environments, which other researchers have also found to be true for online learning environments (Lipnevich, McCallen, Miles, & Smith, 2014; Wyss, Freedman, & Siebert, 2014).

Further, the simple effects show that those who received both the instructor response prompts and rubric actually scored lower than those who received neither! The combination of the rubric with the instructor response prompts may not optimally support students' performance, which is a rejection of the hypothesis and blanket statement that multiple scaffolds will lead to better outcomes. The theoretical lens of cognitive load may explain the results of this study. While most of the previous research concerning cognitive load focuses on computer-based tutorials, the issue of information overload is likely to be relevant for this study as well. It is possible that the presence of both the rubric and prompts could have provided too much information for students who were already accustomed to participating in academic discourse within an ADF context (Deters, 2009; Pollock, Chandler, & Sweller, 2002; Paas & Van Merriënboer, 1994). Instructors and designers may do well to choose to present either rubrics or prompts, depending on the goal of discussion participation.

When the effects of the instructor response prompts were isolated from the effects of the rubric, the instructor response prompts positively affected students' overall performance. If the goal is to influence critical thinking skills and participation performance in the context of a graded assignment, one might choose to present a rubric. This aligns with earlier work that found that providing students with clear guidelines generated the greatest participation (Dennen, 2005). It also supports the findings that students interacted more when they were required to participate but when instructors refrained from posting themselves (Heejung et al., 2009).

However, if one does not present a rubric, then instructor prompting and training instructors to provide prompts becomes important when trying to influence students' critical thinking skills performance and the number of times they participate. This finding is important for those who would create online or blended learning environments for organizational trainers, instructors, teachers, and faculty. In that context, the inclusion of lead instructor input may be more important than the inclusion of a rubric. Many researchers have found that instructor and peer prompts support rich interaction and can even augment performance (Darabi, Arrastia, Nelson, Cornille, & Liang, 2011; Gao, Zhang, & Franklin, 2013; Zydney & Seo, 2012).

Finally, learners may respond better when receiving discussion prompts from their regular course instructors or peers, as they have an existing relationship with these individuals. The negative performance trends found for the prompt condition in this study where one of the researchers provided the prompts instead of the course instructor, contradict the findings of the earlier study where the participants in the prompt treatment performed significantly better than did those who did not receive a prompt from their course instructors (Authors, 2013). This corroborates findings from other researchers who have suggested that relationships between instructors and university students can affect students' performance and satisfaction (Eom & Ashill, 2016; Papathanasiou, Tsaras, & Sarafis, 2014).

Improve Module Learning Achievement: Consider Explaining the Rubric to Learners Before They Engage in Discussion Activities

When instructors and designers want to use online discussion components to promote learning achievement in blended module quizzes, we tentatively recommend the use of a rubric. The statistically significant differences found in the pretest-posttest gain scores suggest that providing a rubric to learners who understand it can positively affect learning. While we did not find these significant differences in the previous research study (Authors, 2013), we believe our improvements to the quiz items in this study likely allowed us to observe the differences between treatments. More research in this area would strengthen this recommendation.

Attitude Results: Rubrics and Prompts Also Satisfy Different Instructional Design Goals and Learner Experiences

Generally, students' ratings showed that they were satisfied with the blended learning module experience. We cannot suggest that one scaffold type or multiple scaffold types will influence their overall satisfaction, as students in all treatment conditions reported about the same levels of satisfaction. However, follow-up individual item analyses resulted in a few significant differences that seem to corroborate and clarify our recommendations to support blended learning environments, which incorporate an online discussion component.

If the goal is for instructors and instructional designers to encourage student participation and critical thinking, then rubrics can help students feel satisfied about being able to learn in a partially online format. Hartnett, St. George, and Dron (2011), also suggest students' high levels of outside incentives or external control can negatively affect motivation levels. We now contemplate whether students perceived the instructor prompts as external control.

We also tentatively recommend that instructors and instructional designers consider rubrics when the goal is to help students feel more satisfied when they are concerned about the workload required and the amount of student-to-student interaction. Responding to explicit prompts does require more effort and additional time spent on working, which could account for the observed decreased satisfaction levels with the workload in the prompt treatment. Researchers have previously found that student satisfaction with online ADFs can relate to the amount of interaction (Johnson, Hornik, & Salas, 2008; Sher, 2009; Swan, 2001). Thus, the results of this study introduce new insight into the relationship between learners' satisfaction ratings and levels of instructor discussion participation. Additional research in this area may strength our understanding of these outcomes.

Study Limitations

We did not consider the potential effects that gender, age, and experience, could have on our results as these were beyond the scope of this study. Limited robust empirical research and associated learning theory is available to show how these variables may affect learners' experiences in blended learning environments. Further study may show that these variables can affect the results we presented.

We implemented this study within one single subject domain (IP). We cannot separate the potential effects that the subject domain may have had on the results from the effects of the variables described and treatment design. That is to say, the extent to which the IP content could have affected the experience of learners in this study is unclear.

Due to the quasi-experimental design with a lack of randomization, we could not control for the other variables that may be of interest such as the time of day, time of semester, or student cohort. Assignment of participants for treatment groups by course section may have confounded the results. The mid-term period is typically more stressful for students who often have to balance reduced time for regular coursework with the increased time required to complete major project deliverables and, or tests. These students were only juniors, just starting their first semester of education coursework when we tasked them with understanding how to apply theoretical IP concepts to classroom practice.

Implications and Future Research

Instructors and instructional designers can implement instructor guidance in ADF activities to support students' demonstration of critical thinking skills which can result in learning achievement. However, they should use the different types of performance scaffolds presented in this study with caution because simultaneous use of several supports can negatively affect students' performance and satisfaction with their learning experience. Instructors and designers would do well to critically examine the learning context when deciding on which type of guidance to use, lest students become overwhelmed.

However, instructors and instructional designers should provide rubrics when the goal is to facilitate higher levels of critical thinking skill performance and a desired number of contributions per student. In addition, they can use rubrics in place of instructor prompts when the design goal is to foster student-to-student interaction or when the regular course instructor is not able to provide timely, individualized prompt responses in an ADF. They can also use instructor prompts for workplace training and development initiatives to support employee learning. However, facilitators should share the rubric with learners and explain how to use it before learners complete a corresponding assignment.

The results of the current study also suggest that directing students' attention to demonstrating critical thinking skills can effect retention of content material. Future research should continue to explore the use of rubrics, which emphasize the demonstration of critical thinking skills on a variety of learning activities and the effects on learning achievement on more objective achievement measures, such as multiple-choice tests.

We built this research study upon exploratory research conducted previously with IP as the only subject domain (Authors, 2013). It is likely that the slight treatment differences described between this study and the previous study had an influence on the outcome differences. Also, we cannot separate the potential effects of the subject domain from the treatment variables and design. Therefore, replication would help us better understand how each of the differences

may have affected the results and build confidence in our recommendations. Clearly, instructors and designers need to carefully apply the recommendations we made here with their own experience to best support learners and adjust for unique contexts.

In addition, further research on the types of, and intervention schedule for instructor prompts in order to develop more explicit guidelines for their use is warranted. The variations found between outcomes between the previous study (Authors, 2013) and the present study suggest that it is not yet possible to draw firm conclusions concerning effective facilitation principles and techniques. The prompt facilitation method and message content focus may have a differential effect on student performance. More work needs to be done before establishing a set of universal design principles underlying effective, explicit instructor guidance within ADFs.

Conclusion

Asynchronous discussion forums as used in this study represent a complex, social environment that can support students' demonstration of higher-level critical thinking skills when they incorporate the appropriate level of explicit guidance. As online and blended courses and ADFs become more common, educational technology researchers should continue to examine the relationship between a variety of such factors and their effects on student learning and performance.

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Informed consent was obtained from all individual participants included in the study.

References

Ajayi, L. (2010). How asynchronous discussion boards mediate learning literacy methods courses to enrich alternative-licensed teachers' learning experiences. *Journal of Research on Technology in Education, 43*(1), 1-28.

Allen, I. E., & Seaman, J. (2011). *Going the Distance: Online education in the United States, 2011*. Sloan Consortium. PO Box 1238, Newburyport, MA 01950. Retrieved February 26, 2015 from http://www.onlinelearningsurvey.com/reports/goingthedistance.pdf.

Allen, I. E., Seaman, J. (2016). *Online Report Card: Tracking online education in the United States.* Babson Survey Research Group.

An, H., Shin, S., & Lim, K. (2009). The effects of different instructor facilitation approaches on students' interactions during asynchronous online discussions. *Computers & Education, 53*(3), 749-760.

Andrade, H. (2000). Using rubrics to promote thinking and learning. *Educational Leadership, 57*(5), 13-18.

Andrade, H., & Du, Y. (2005). Student perspectives on rubric-referenced assessment. *Practical Assessment Research & Evaluation 10*(5), 1-11.

Arend, B. (2009). Encouraging critical thinking in online threaded discussions. *The Journal of Educators Online, 6*(1), 1-23.

Beckmann, J. & Weber, P. (2016). Cognitive presence in virtual collaborative learning: Assessing and improving critical thinking in online discussion forums. *Interactive Technology and Smart Education, 13*(1), 52-70.

Bensley, D. A., & Spero, R. A. (2014). Improving critical thinking skills and metacognitive monitoring through direct infusion. *Thinking Skills and Creativity, 12,* 55-68.

Beuchota, A., & Bullen, M. (2005). Interaction and interpersonality in online discussion forums. *Distance Education, 26*(1), 67-87.

Bloom, B. (1977). Behavioral objectives and their application to career education. *Journal of Career Development, 3*(4), 25-33.

Casner-Lotto, J., & Barrington, L. (2006). *Are They Really Ready to Work? Employers' Perspectives on the Basic Knowledge and Applied Skills of New Entrants to the 21st Century US Workforce*. Partnership for 21st Century Skills. 1 Massachusetts Avenue NW Suite 700, Washington, DC 20001.

Chandrasekaran, M., Ragupathi, K., Kan, M., & Tan, B. (2015). Towards Feasible Instructor Intervention in MOOC Discussion Forums. *Proceedings of the Thirty-Sixth International Conference on Information Science* (pp. 2483–2491). Fort Worth, TX, USA: Association for Information Systems.

Christopher, M., Thomas, J., & Tallent-Runnels, M. (2004). Raising the bar: Encouraging high level thinking in online discussion forums. *Roeper Review*, *26*(3), 166-171.

Curran, V., Kirby, F., Parsons, E., & Lockyer, J. (2003). Discourse analysis of computer-mediated conferencing in world wide web-based continuing medical education. *The Journal of Continuing Education in the Health Professions, 23*(1), 229-238.

Darabi, A., Arrastia, M. C., Nelson, D. W., Cornille, T., & Liang, X. (2011). Cognitive presence in asynchronous online learning: A comparison of four discussion strategies. *Journal of Computer Assisted Learning, 27*(3), 216-227.

Daroszewski, E. B., Kinser, A. G., & Lloyd, S. L. (2004). Socratic method and the Internet: Using tiered discussion to facilitate understanding in a graduate nursing theory course. *Nurse Educator, 29*(5), 189-191.

Dennen, V. P. (2005). From message posting to learning dialogues: Factors affecting learner participation in asynchronous discussion. *Distance Education, 26*(1), 127-148.

Deters, K. M. (2009). *Investigating a computerized scaffolding software for student designed science investigations* (Doctoral dissertation). Retrieved from ProQuest Dissertations and Theses. (Order No. 304942256).

Duron, R., Limbach, B., & Waugh, W. (2006). Critical thinking framework for any discipline. *International Journal of Teaching and Learning in Higher Education, 17*(2), 160-166.

Dwyer, C. P., Hogan, M. J., & Stewart, I. (2014). An integrated critical thinking framework for the 21st century. *Thinking Skills and Creativity, 12*, 43-52.

Eom, S. B., & Ashill, N. (2016). The Determinants of Students' Perceived Learning Outcomes and Satisfaction in University Online Education: An Update. *Decision Sciences Journal of Innovative Education,14*(2), 185-215.

Faden, E. (2007, March 1). *A Fair(y) Use Tale* [Video file]. Retrieved from http://cyberlaw.stanford.edu/blog/2007/03/fairy-use-tale.

Flavell, J. H. (1979). Metacognition and cognitive monitoring: A new area of cognitive–developmental inquiry. *American Psychologist, 34*(10), 906-911.

Gagne, R., Briggs, L., & Wager, W. (1992). *Principles of Instructional Design* (4th Ed.). Fort Worth, TX: HBJ College Publishers.

Gao, F., Zhang, T., & Franklin, T. (2013). Designing asynchronous online discussion environments: Recent progress and possible future directions. *British Journal of Educational Technology, 44*(3), 469-483.

Garrison, D. R. (2007). Online community of inquiry review: Social, cognitive, and teaching presence issues. *Journal of Asynchronous Learning Networks, 11*(1), 61-72.

Garrison, D. R., Anderson, T., & Archer, W. (2001). Critical thinking, cognitive presence, and computer conferencing in distance education. *The American Journal of Distance Education, 15*(1), 7-23.

Gayton, J. & McEwen, B. C. (2007). effective online instructional and assessment strategies. *The American Journal of Distance Education, 21*(3), 117-132.

Authors. (2013).

Gilbert, P., & Dabbagh, N. (2005). How to structure online discussions for meaningful discourse: A Case study. *British Journal of Educational Technology, 26*(1), 5-18.

Goodwich, H. (1997). Understanding rubrics. *Educational Leadership, 54*(4), 14-17.

Hartnett, M., George, A. S., & Dron, J. (2011). Examining motivation in online distance learning environments: Complex, multifaceted and situation-dependent. *The International Review of Research in Open and Distributed Learning, 12*(6), 20-38.

Heejung, A. Shin, S., & Lim, K., (2009). The effects of different instructor facilitation approaches on students' interactions during asynchronous online discussions. *Computers & Education, 53*(3), 749-760.

Heijltjes, A., Van Gog, T., Leppink, J., & Paas, F. (2014). Improving critical thinking: Effects of dispositions and instructions on economics students' reasoning skills. *Learning and Instruction, 29*, 31-42.

Hemphill, L., & Hemphill, H. (2007). Evaluating the impact of guest speaker postings in online discussions. *British Journal of Educational Technology, 38*(2), 287-293.

Ho, C. H., & Swan, K. (2007). Evaluating online conversation in an asynchronous learning environment: An application of Grice's Cooperative Principle. *The Internet and Higher Education, 10*(1), 3-14.

Hough, B., Smithey, M., & Evertson, C. (2004). Using computer-mediated communication to create virtual communities of practice for intern teachers. *Journal of Technology and Teacher Education, 12*(3), 361-386.

Järvelä, S., & Häkkinen, P. (2002). Web-based cases in teaching and learning—The quality of discussions and a stage of perspective taking in asynchronous communication. *Interactive Learning Environments, 10*(1), 1–22. https://doi.org/10.1076/ilee.10.1.1.3613.

Jetton, T. (2004). Using computer-mediated discussion to facilitate preservice teachers' understanding of literacy assessment and instruction. *Journal of Research on Technology in Education, 32*(2), 171-191.

Johnson, R. D., Hornik, S., Salas, E. (2008). An empirical examination of factors contributing to the creation of successful e-learning environments. *International Journal of Human-Computer Studies, 66*(5), 356-369.

Kanuka, H., & Anderson, T. (1998). Online social interchange, discord, and knowledge construction. *Journal of Distance Education, 13(*1), 57-74.

Keane, T., Keane, W. F., & Blicblau, A. S. (2016). Beyond traditional literacy: Learning and transformative practices using ICT. *Education and Information Technologies, 21*(4), 769-781.

Klisc, C., McGill, T., & Hobbs, V. (2017). Use of a post-asynchronous online discussion assessment to enhance student critical thinking. *Australasian Journal of Educational Technology, 33*(5), 63-76.

Knowlton, D. S. (2003). Evaluating college students' efforts in asynchronous discussion: A systematic process. *Quarterly Review of Distance Education, 4*(1), 31-41.

Krathwohl, D. (2002). A Revision of Bloom's Taxonomy: An Overview. *Teaching In Practice, 41*(4), 212-218.

Kwon, K., Shin, S., & Park, S. J. (2018). Effects of graphic organizers in online discussions: comparison between instructor-provided and student-generated. *Educational Technology Research and Development*, 1-25. https://doi.org/10.1007/s11423-018-9617-7

Lapadat, J. C. (2002). Writing interaction: A key component of online learning. *Journal of Computer Mediated Communication, 7*(4).

Laurillard, D. (2000). New Technologies and the Curriculum. In Scott, P. (Ed.), *Higher Education Re-formed* (pp. 133−153). London: Falmer Press.

Li, J., Tang, Y., Cao, M., & Hu, X. (2018). The moderating effects of discipline on the relationship between asynchronous discussion and satisfaction with MOOCs. *Journal of Computers in Education, 5*(3), 279-296.

Lipnevich, A. A., McCallen, L. N., Miles, K. P., & Smith, J. K. (2014). Mind the gap! Students' use of exemplars and detailed rubrics as formative assessment. *Instructional Science, 42*(4), 539-559.

Lee, L. (2009). Scaffolding collaborative exchanges between expert and novice language teachers in threaded discussions. *Foreign Language Annals, 42*(2), 212-228.

Lewallen, G. (2006). *Notes for a lecture on Fair Use scenarios.* Copy in Blackboard course shell.

Maher, M., & Jacob, E. (2006). Peer computer conferencing to support teachers' reflection during action research. *Journal of Technology and Teacher Education, 14*(1), 127-150.

McKee, H. (2002). "YOUR VIEWS SHOWED TRUE IGNORANCE!!!":(Mis) Communication in an online interracial discussion forum. *Computers and Composition, 19*(4), 411-434.

Novotny, N. L., Stapleton, S. J., & Hardy, E. C. (2016). Enhancing Critical Thinking in Graduate Nursing Online Asynchronous Discussions. *Journal of Nursing Education, 55*(9), 514-521.

Oliver, R. (2001). Seeking best practice in online learning: Flexible Learning Toolboxes in the Australian VET sector. *Australasian Journal of Educational Technology, 17*(2), 204-222.

Osana, H. P., & Seymour, J. R. (2004). Critical thinking in preservice teachers: A rubric for evaluating argumentation and statistical reasoning. *Educational Research and Evaluation, 10*(4-6), 473-498.

Paas, F. G., & Van Merriënboer, J. J. (1994). Instructional control of cognitive load in the training of complex cognitive tasks. *Educational Psychology Review, 6*(4), 351-371.

Palmer, S., & Holt, D. (2010). Students' perceptions of the value of the elements of an online learning environment: looking back in moving forward. *Interactive Learning Environments, 18*(2).

Pattanapichet, F., & Wichadee, S. (2015). Using Space in Social Media to Promote Undergraduate Students' Critical Thinking Skills. *Turkish Online Journal of Distance Education, 16*(4), 38-49.

Papathanasiou, I. V., Tsaras, K., & Sarafis, P. (2014). Views and perceptions of nursing students on their clinical learning environment: Teaching and learning. *Nurse Education Today, 34*(1), 57-60.

Puntambekar, S., & Hübscher, R. (2005). Tools for scaffolding students in a complex learning environment: What have we gained and what have we missed?. *Educational Psychologist, 40*(1), 1-12.

Penny, L., & Murphy, E. (2009). Rubrics for designing and evaluating online asynchronous discussions. *British Journal of Educational Technology, 40*(5), 804-820.

Pollock, E., Chandler, P., & Sweller, J. (2002). Assimilating complex information. *Learning and Instruction, (32)*1-2, 61-86.

Reddy, M., & Andrade, H. (2010). A Review of rubric use in higher education. *Assessment & Evaluation in Higher Education, 35*(4), 435-448.

Reitmeier, C. A., Svendsen, L. K., & Vrchota, D. A. (2004). Improving oral communication skills of students in food science courses. *Journal of Food Science Education, 3*(2), 15-20.

Roblyer, M. D., & Wiencke, W. R. (2004). Exploring the interaction equation: Validating a rubric to assess and encourage interaction in distance courses. *Journal of Asynchronous Learning Networks, 8*(4), 24-37.

Rodas, C. R. (2016). The Use of Online Tutoring to Promote Higher-Level Thinking Skills in English Language Learners using Asynchronous Discussion Boards in Teacher Preparation Programs. In G. Chamblee & L. Langub (Eds.), *Proceedings of Society for Information Technology & Teacher Education International Conference* (pp. 2286-2289). Savannah, GA, United States: Association for the Advancement of Computing in Education (AACE).

Rovai, A. P. (2007). Facilitating Online Discussions Effectively. *The Internet and Higher Education, 10*(1), 77-88.

Salter, S., Douglas, T., & Kember, D. (2017). Comparing face-to-face and asynchronous online communication as mechanisms for critical reflective dialogue. *Educational Action Research, 25*(5), 790-805.

Samuels, S. J., Ediger, K. A. M., Willcutt, J. R., & Palumbo, T. J. (2006). Role of automaticity in metacognition and literacy instruction. In S. E. Isreal, C. C. Block, K. L. Bauserman, & K. Kinnucan-Welsch (Eds.), *Metacognition in literacy learning* (pp. 63-82). Mahwah, New Jersey: Lawrence Erlbaum Associates.

Saye, J. W., & Brush, T. (2002). Scaffolding critical reasoning about history and social issues in multimedia-supported learning environments. *Educational Technology Research and Development, 50*(3), 77-96.

Schneider, F. J. (2006). Rubrics for teacher education in community college. *The Community College Enterprise, 12*(1), 39.

Schrire, S. (2006.) Knowledge Building in Asynchronous Discussion Groups: Going beyond quantitative analysis. *Computers & Education, 46*(1), 49-70.

Sharma, P., & Hannafin, M. J. (2007). Scaffolding in technology-enhanced learning environments. *Interactive Learning Environments, 15*(1), 27-46.

Shea, P. J., Fredericksen, E. E., Pickett, A. M., & Pelz, W. E. (2003). A preliminary investigation of "teaching presence" in the SUNY learning network. In J. Bourne & C. Moore (Eds.), *Elements of quality online education: Into the mainstream* (Vol. 4, pp. 279-312). Needham, MA: Sloan-C.

Sher, A. (2009). Assessing the relationship of student-instructor and student-student interaction to student learning and satisfaction in Web-based Online Learning Environment. *Journal of Interactive Online Learning, 8*(2), 102-120.

Authors. (2010).

Stetter, M. (2018). Best Practices in Asynchronous Online Instruction. In E. Langran & J. Borup (Eds.), *Proceedings of Society for Information Technology & Teacher Education International Conference* (pp. 245-247). Washington, D.C., United States: Association for the Advancement of Computing in Education (AACE).

Swan, K. (2001). Virtual interaction: Design factors affecting student satisfaction and perceived learning in asynchronous online courses. *Distance Education, 22*(2), 306-331.

Szabo, Z., & Schwartz, J. (2011). Learning methods for teacher education: The use of online discussions to improve critical thinking. *Technology, Pedagogy and Education, 20*(1), 79-94.

Topcu, A., & Ubuz, B. (2008). Effects of the asynchronous web-based course: Preservice teachers' achievement, metacognition, and attitudes towards the course. *Journal of Educational Technology & Society, 11*(3), 181-197.

Veerman, A., & Veldhuis-Diermanse, E. (2001). *Collaborative learning through computer-mediated communication in academic education*. Paper presented at the Euro CSCL 2001, Maastricht. McLuhan Institute, University of Maastricht.

Vitale, A. T. (2010). Faculty development and mentorship using selected online asynchronous teaching strategies. *Journal of Continuing Education in Nursing, 41*(12), 549-556.

Vygotsky, L. S. (1978). *Mind and Society: The development of higher mental processes.* Cambridge, MA: Harvard University Press.

Wyss, V. L., Freedman, D., & Siebert, C. J. (2014). The development of a discussion rubric for online courses: Standardizing expectations of graduate students in online scholarly discussions. *TechTrends, 58*(2), 99-107.

Yang, D. Richardson, J. C., French, B. F., & Lehman, J. D. (2011). The development of a content analysis model for assessing students' cognitive learning in asynchronous online discussions. *Educational Technology Research and Development, 59*(1), 43-70. DOI 10.1007/sl 1423-010-9166-1.

Xie, K. & Bradshaw, A. (2008). Using question prompts to support ill-structured problem solving in online peer collaborations. *International Journal of Technology in Teaching and Learning, 4*(2), 148-165.

Zhan, H., & de Montes, L. S. (2007). Is it a tale of woe?—An investigation of relationships of online teaching presence and learning. *International Journal of Technology in Teaching and Learning, 3*(2), 107-122.

Zydney, J. M., & Seo, K. K. J. (2012). Creating a community of inquiry in online environments: An exploratory study on the effect of a protocol on interactions within asynchronous discussions. *Computers & Education, 58*(1), 77-87.