International Journal of Education and Psychology in the Community
IJEPC
2011, 1(1), January, 32-51

TARGETED INSTRUCTION FOR PRESERVICE TEACHERS: DEVELOPING HIGHER ORDER THINKING SKILLS WITH ONLINE DISCUSSIONS

Jonathan Schwartz •
University of Hawaii, West O'ahu, USA

Zsuzsanna Szabo ••
Marist College, Poughkeepsie, NY, USA

Abstract
The purpose of this study was to develop higher order reflective thinking skills and application abilities in preservice teachers, through the use of online asynchronous discussions based on tasks that involve analyzing examples of teachers' in-class activity. Participants in the study were 46 preservice teacher education students at a small university in the state of Hawaii, US. Results show that teaching about Bloom's taxonomy and using reflective writing to analyze case studies, resulted in higher order thinking levels as demonstrated in asynchronous online discussions. Quantitative and qualitative analyses are presented along with implications for teaching and learning.

Keywords: higher order thinking, asynchronous online discussion, Bloom's Taxonomy, teacher education

Reflective writing and preservice teacher education

The effects of writing assignments on student performance is a topic for ongoing debate among researchers in the education field. More than three

Correspondence concerning this paper should be addressed to:
• Jonathan Schwartz, Ph.D., Division of Elementary Education, University of Hawaii, West O'ahu, U.S.A., 96-129 Ala Ike. Pearl City, Hawaii 96782; (808) 744- 4053. E-mail: *jonathan.schwartz@hawaii.edu*
•• Zsuzsanna Szabo, Ph.D., Department of Teacher Education, Marist College, Poughkeepsie, NY, U.S.A., E-mail: *zsuzsanna25@gmail.com*

decades ago Emig (1977) pointed out that despite the positive effect of writing on student performance results show mixed evidence. More recent research (Armstrong et al., 2008; Berthold et al., 2007; Kaplan et al., 2007) shows positive effects in student learning performance due to writing. Bangert-Downs and colleagues (2004) found that when writing tasks are focused on higher levels of thinking (cognitive and metacognitive processes), students' performance on text comprehension increased. Research on reflective journal writing shows even more promising results (Day, 1994; Kaplan et al. 2007). Reflective writing involves cognitive and metacognitive processes with positive effects on student performance and increased learning outcomes. Despite the mixed results of research it is evident that writing which involves higher order thinking processes is beneficial to learning.

In this study we show evidence that reflective writing improves not only the understanding of content, but also the use of higher order thinking (metacognition) and improves the ability to apply the learned content. These are of major importance in educating preservice teachers. Since most education programs only offer student teaching experience during senior year, we propose that preservice teachers could have a virtual student teaching experience much earlier than when they enter real classrooms. We believe that preservice teachers could gather valuable knowledge as part of virtual experiences, before they participate in student teaching, through reflective writing assignments that involve higher order thinking and open discussions on case studies, video analysis, and responses to targeted prompt questions. These could be done through asynchronous online discussions that complement in-class teaching and learning.

Technology in education

Koehler, Mishra, and Yahya (2007) argue that technology should be used in a purposeful way in order to generate high levels of learning. The authors write that, "effective technology integration for teaching subject matter requires knowledge not just of content, technology and pedagogy, but also of their relationship to each other (p. 746)." They have introduced the *Technological Pedagogical Content Knowledge* (TPCK) model. This model consists of four components: *Technology (T)*, encompassing standard technologies used in educational setting; *Pedagogy (P)*, includes the methods of teaching; *Content (C)*, concerns the subject matter that is to be taught and

learned; and *Knowledge (K),* the information acquired by the student. Koehler, Mishra, and Yahya (2007) stress that the TPCK model emphasizes the relationship between: content, pedagogy, and technology. Each subject area domain has its own TPCK. The use of technology as pedagogy, or in conjunction with pedagogy, must be used in a purposeful way in order to promote optimal learning. This idea is widely acknowledged in the literature and stressed by researchers including Lei and Zhao (2007).

Sivin-Kachala and Bialo (1993) presented the effects of use of technology in education in a synthesis based on 86 research reviews. They showed that the use of technology in teaching demonstrated a significant positive effect on achievement, on student attitudes toward learning, and on student self-concept. Along with effects on students, technology has influenced teachers also. Teachers employ more student-centered approaches to teaching when using technology, and the student-to-student and student-to-teacher interaction shows an increase when technology was used. The authors mention that "*it is not the technology that makes the difference but rather how teachers adapt and apply technology that makes the difference"* (pp. 389).

In the learning process as mentioned by Garrison and Anderson (2003) a community of inquiry integrates cognitive, social, and teaching elements that are not limited to social exchanges and are more than low-level cognitive interaction. Several researchers (Garrison, Anderson, and Archer 2000; Meyer 2003; Pawan et al. 2003) show that a community of inquiry is the integration of cognitive, social, and teaching presence. Garrison and Cleveland-Innes, (2005) talk about the fact that the "quantity of interaction does not reflect the quality of discourse" (pp. 135). On a similar line of thought Roblyer (2002) found that voluntary and required message posting that were pertinent to the purpose of the discussion created higher student engagement. Roblyer and Wiencke (2003) show that consistent interaction in courses that use technology is associated with higher achievement and student satisfaction.

Asynchronous discussions as a tool for teaching

One popular technology tool used by college faculty is asynchronous discussion (Biggs, 2003; Gilbert & Dabbagh, 2005). Online discussion forums offer a virtual environment available outside of classroom time where students reflect, discuss, and question topics learned during face-to-face class

time. This extended learning time can be structured in such a way that allows students to continue learning that takes place in classrooms. Recently, Szabo and Schwartz (in press) explored how virtual classroom environment along with face-to-face class time can be used to foster critical thinking skills. They report that the use of asynchronous discussion forums improved undergraduate preservice teachers' critical thinking skills. Using rubrics based on Bloom's Revised taxonomy (Anderson et al., 2001), the authors assessed preservice teachers' online discussions posted to asynchronous Blackboard discussion forums across the time of a semester. Change in critical thinking skills was measured by using the Ennis-Weir Test of Critical Thinking (1985). Results from their study show an increase in critical thinking skills among preservice teachers. These findings, along with results from other comparable studies (Bullen, 1998; Dennen, 2005) suggests that in order to create higher order thinking in asynchronous discussions, instructors must create appropriate conditions (Garrison & Cleveland-Innes, 2005). Instructors should use instructional methods, as well as assessment that can measure the process of development of reflective and higher order thinking skills. Recommended strategies are: the use of guidelines, rubrics, models, prompts, and feedback among others. Many researchers (Black, 2005; Ryan & Scott, 2008; Shana, 2009) confirm that adding an instructional assessment strategy is necessary to keep students accountable for their online contributions.

Bai (2009) specifies that explicit posting guidelines and models provided to the students beforehand, ensure higher levels of thinking in asynchronous online discussions. Comparing two groups of college students (one group guided and the other without any guidance), Bai emphasized critical analysis and higher order thinking in online discussion. Results from the study reveal that the group guided by the model demonstrated higher levels of thinking. This revealed the need to make students aware of expectations by providing a model of how to construct postings.

Golanics and Nussbaum (2008), looking at how to improve argumentation in asynchronous online discussion, found similar results, noting that explicit directions foster quality discussion. Analyzing undergraduate students' postings in an educational psychology course the authors found that goal instruction positively affected the development of arguments for students with extensive knowledge about the issue being discussed. Goal instructions are statements placed at the end of a discussion

prompt that convey the goal of discussion. For example, one of the goal instructions used by them was, "think of as many reasons as possible." Golanics and Nussbaum concluded that instructors improved the quality of discussion by providing more elaborate discussion prompts. They also suggest that instructors must use an overall instructional assessment strategy in order to elicit higher order thinking in asynchronous online discussion forums.

Higher order thinking and Bloom's taxonomy

Development of higher order thinking skills is of major importance in teacher education programs. Teacher education programs aim to help preservice teachers develop higher order thinking skills, able them to become researcher-practitioners who synthesize, analyze, and evaluate assessment data generated in the classroom to inform their teaching. Higher order thinking skills such as reflective thinking, metacognition, problem solving, application, analysis, evaluation, and creative thinking are skills that preservice teachers need as they become classroom teachers. In this study we propose that teaching preservice teachers how to use Bloom's taxonomy for instructional purposes, is one way to promote reflective and higher order thinking skills.

Bloom's Taxonomy and Bloom's Revised Taxonomy (Bloom, Krathwohl, & Masia, 1956; Anderson, Krathwohl, Airasian, Cruikshank, Mayer, Pintrich, Raths, & Wittrock, 2001) were developed based on the concept that thinking is a hierarchical process organized from low to high. Based on Bloom's original taxonomy (Bloom, Kratwohl, and Masia, 1956), Anderson, Krathwohl, et al. (2001) developed a two-dimensional taxonomy: cognitive processes dimension, and knowledge dimension. The cognitive processes dimension comprises the six thinking levels which are similar to the original levels of Bloom's taxonomy: remembering, understanding, applying, analyzing, evaluating, and creating (Anderson & Krathwohl, 2001, pp. 67-68). The other dimension "Knowledge dimension" has four levels: factual, conceptual, procedural, and metacognitive. The two-dimensional model offers a grid which is in fact a useful tool to plan teaching objectives and also to test students' learning at the different levels represented in the taxonomy. Using the revised Bloom's taxonomy teachers can measure if students' performance implies higher order thinking.

The present study is based on Szabo and Schwartz (in press), where it was found that the use of online discussion forums in face-to-face courses as instructional method increased critical thinking in preservice teachers. The current research study presents instructional methods for preservice teachers to develop higher levels of thinking through the use of reflective writing and online asynchronous discussions. After learning about Bloom's Revised Taxonomy, preservice teachers were required to analyze and discuss case studies of classroom situations that reflected the readings.

The research question addressed in this study was: Will teaching students Bloom's taxonomy, and informing them that the taxonomy will be used as a rubric for grading their online discussions, help students develop and use higher order thinking skills?

Methods

Participants

Participants in this study were 46 students enrolled in two upper division courses (see Table 1), as part of an elementary teacher preparation program at a small state university in Hawaii during Fall 2009.

Table 1. Participants by course and gender

Course	Females	Males	Total
300-level course	19	1	20
400-level course	23	3	26
Total	42	4	46

The courses

The two upper division courses in the study had a similar structure and were taught by the same instructor. Courses used a "blended" or "hybrid" approach where asynchronous online sessions were held along with face-to-face meetings (Groves & O'Donoghue, 2009). Each week, students completed a single module. As part of each module, students had a chapter to read, complete online discussion postings (comprised of a written reflection response to a question on the readings, and posted comments to other colleagues' reflection), complete a writing assignment, and took a quiz. In addition, students met face-to-face for 120 minutes where course topics were

discussed. Students in both courses completed 14 modules across the semester.

The first course meeting students received specific guidelines and models of discussion board posting, and requirements were explained (Holmes, 2004; Ryan & Scott, 2008). The first topic was also introduced, specifically, Bloom's Revised Taxonomy (Anderson, Krathwohl, et al., 2001). Students were assigned a reading (Krathwohl, 2002), and the instructor lectured on the topic. Instruction on Bloom's Revised Taxonomy included presentation, modeling, examples and non-examples, guided practice and independent practice. Research supports the use of models and good examples as part of effective practice (Bangert, 2004; Black, 2005). Good examples are necessary to set clear expectations. Lim and Moore (2002), mention that presenting examples "support[s] the development of cognitive schema that will help students evaluate future applications of their newly acquired knowledge and skills".

Each week, students were required to post a written reflection to a specific question based on analyzing a case study or making an analysis of a real-life classroom video-example. They had also to respond to at least two other students' postings. Students were required to use Bloom's taxonomy as they made their weekly postings. They were also presented with grading rubrics for online postings, from what they could draw on the guidelines of expected quality for their postings.

Since the majority of students were first-time users of Blackboard in the first two weeks postings were not graded. This strategy was used in order to allow students to become familiar with the course format as well as to practice reflective writing and online discussions. During this time, students were given feedback on postings. Starting with week three, weight (Doyle, 1988) was added.

Doyle (1988) defines the concept of "weight" as an element of academic tasks. Doyle suggests that weight is connected with the type of learning. For example, tasks that are high in risk combine with high degrees of ambiguity and result in higher order thinking (analysis and metacognition). In contrast, tasks that have less weight are low in risk, combine with low degrees of ambiguity, and result in lower order thinking (memorization). When tasks constitute a smaller portion of students' grades there is less of a possibility for failure. This is also confirmed by Gilbert and Dabbagh (2005)

who mention that "the increase in the overall grade percentage, positively influenced meaningful discourse in asynchronous online discussions".

The role of the instructor

The instructor posted the tasks for each module and monitored the discussions with minimal interference. In the first three weeks the instructor posted individual feedback providing explanatory messages when students seemed to stumble on concepts. As the semester progressed, and students developed discussion board skills, the role of the instructor became one of background monitor.

Measures

Canfield's Learning Style Inventory (CLSI). All students participating in the study completed CLSI at the beginning of the semester, to control for eventual learning style differences and predispositions of students to use the online asynchronous discussions. The CLSI determines which learning environments and which types of instructors are best for particular students (Canfield, 1992). Participants taking CLSI respond to a 30 questions inventory by ranking each response to questions on a scale of 1 to 4. A total score for each of the four scales was calculated.

A rubric based on *Bloom's revised taxonomy* (Anderson & Krathwohl, 2001) was used to score students' online postings. The tow-dimensional rubric measured levels of knowledge: factual, conceptual, procedural, and metacognitive for each posting, for the following cognitive levels: remembering, understanding, applying, analyzing, evaluating, and creating (see Appendix 1). One point was given on each category of the rubric if the student demonstrated that level. Scores were calculated by knowledge level (factual, conceptual, procedural, and metacognitive), and a total score also.

Analysis

Each student was given a numeric ID to protect for any personal identifiers. Numeric codes represented also the section and type of posting (reflection or comment). Because for all modules the tasks for reflection posted to the online discussion forum were quite similar, quantitative analysis, using the Bloom's taxonomy rubric, was performed on students'

online postings on six selected modules (two from each: beginning, mid, and end of semester; specifically Modules 2, 3, 7, 8, 13, and 14). It was expected that any differences in the level of reflections posted would show up in their comparison across the semester. Postings at the higher levels of Bloom's taxonomy were considered as higher levels of thinking, and evidence of use of reflective and metacognitive thinking. Two raters (high inter-rater correlation; r = .88), scored independently 824 discussion postings (reflections and comments), form students in the two courses. Qualitative analysis provided depth to our findings.

Results

Results from Canfield's Learning Style Inventory

Analysis of CLSI compared the students in the two groups in terms of instructional conditions, content to be learned, and learning style. Statistically significant results revealed that students in 300-level course, as compared with students in the 400-level course, appreciated more the interpersonal relationships with the faculty (t= .040; df=34), and ranked statistically significant higher the need for instructor authority in the classroom (t= .023; df=34).

Result from posted reflections

Results from the 300-level course, showed statistically significant increase in the overall level of thinking ($F_{5, 89} = 32.98$; $p = .001$), for reflections posted to the online discussions forums. Also, at each level of knowledge on Bloom's taxonomy rubric, there were statistically significant changes in the level of postings. The effect size at each level was medium or small (see Table 2). Post-hoc comparisons on reflections across the semester pointed us to specific differences in the level of posting for certain topics. Specifically, it was found an abrupt increase in the thinking quality for Module 3 (after adding weight), for Module 7 (reflection question was more specific), and Module 13 (very specific reflection question). For Module 13, students reached the highest scores with postings at the metacognitive knowledge level; and higher scores for analysis, evaluation, and creation at the cognitive level.

Results from the 400-level course, show statistically significant increase in the overall level of thinking for posted reflections across the

semester ($F_{5, 89} = 3.11$; $p = .011$). However, the effect size at each level was very small (see Table 2.). It is important to mention that postings at the factual and metacognitive levels of knowledge did not show statistically significant differences. One reason was that students in this course reached maximum scores for factual knowledge the at the beginning of the semester, and kept the same level all across (ceiling effect). Their reflections across the semester only sporadically reached metacognitive knowledge level. Also, unlike the students from 300-level, these students did not show a statistically significant increase in improving reflection postings. The only statistically significant differences in the level of postings were at the conceptual and procedural levels (see Table 2). Post-hoc comparisons show that for conceptual level of thinking as present in the written reflections, higher scores were on Module 8, and Module 13 (with more specific question for reflection). Also, statistically significant differences in thinking level were found on Module 3 (after weight was added), and Module 13 (with highest scores; very specific reflection question).

Table 2. ANOVA for reflections by course and by knowledge categories of Bloom's taxonomy

Knowledge categories	300-level course			400-level course		
	F	Sig.	Effect size	F	Sig.	Effect size
Total score	32.98	.001	.650	3.11	.011	.098
Factual knowledge score	7.78	.001	.304	.797	.554	.027
Conceptual knowledge score	36.98	.001	.675	2.72	.022	.087
Procedural knowledge score	23.83	.001	.572	3.49	.005	.109
Metacognitive knowledge score	3.02	.015	.145	1.32	.259	.044

Qualitative analysis on reflections

Based on the results from the quantitative analysis, we conducted a qualitative analysis on the same postings. As it was mentioned above, the quality of reflections posted to the asynchronous discussion forums, for the 300-level course were higher than those from the 400-level course. This difference was due to the nature of the course as well as the nature of the assigned questions for reflection in each week.

In Module 2, after students learned about Bloom's taxonomy, postings

tended to reflect factual and conceptual knowledge about theories and theorists; responses directly reflected the reading or video assigned as part of the module. For example, a reflection posted by Margy (all real names were changed in this paper) in Module 2, restates the question and demonstrates factual knowledge from the week's reading:

> According to our text under the social goals of schooling, education is a key to social improvement as people are being educated to improve home living. Instilling moral values in students through public schooling would reduce crimes and the number of police by society. For example, Hawaii Public Schools require a limited number community service hours in order to pass into the next grade level. These public school requirements also include a specific level of reading and writing skills. Reading and writing are the most important skills public schools teach because it would help anyone understand what is happing in the world through the media, especially via newspaper articles.

As students developed a better understanding of Bloom's Revised Taxonomy, and because weight was added starting Module 3, the quality of reflections improved, and students demonstrated higher levels of knowledge. In later modules, students showed more reflection on their own thinking (metacognition). They also showed more evidence of analysis, evaluation, and creation. For example, Maria's posting from Module 13 (module with highest scores), shows reflective thinking, recognizes applications, and reflects on her own learning:

> I was thinking that in Hawaii, we teach our students the Hawaiian culture because it is the roots of where we live. On the country side of O'ahu and other islands such as Molokai, students are taught to maintain the land through gardening, fishing, and taking care of the surrounding waters. Molokai students learn to build fishponds, cultivate kalo, and live off of the land. I have a niece who lives in Molokai and she speaks fluent Hawaiian and is immersed in the Hawaiian culture because her school teaches it. As a teacher I need to be constantly aware that my lesson plans need to be customized for out culture. In class when I will teach also I need to use examples that are specific to our environment and build a community in my classrooms.

Results from posted comments

Using the same rubric based on Bloom's taxonomy, we performed quantitative analysis by course and by modules, on comments posted by students to their colleagues.

Results from the 300-level course, show that there were statistically significant differences ($F_{5, 218} = 12.43$; $p = .001$) for overall comments posted across the semester. Specifically, there were statistically significant differences in the levels of posted comments for factual, conceptual, and procedural levels (see Table 3). However, all effect size values were small or very small. Looking across the six chosen modules used in the comparison across the semester, most of the comments were posted at factual and conceptual levels. Students obtained highest scores at factual knowledge, followed by scores on conceptual knowledge. However, procedural and metacognitive knowledge scores were very low compared to total scores for factual and conceptual levels. From the results we conclude that the level of comments posted (which in fact were the actual course asynchronous discussions), demonstrated only basic knowledge.

From all the post-hoc comparisons, only on Module 7 (very specific reflection question), results were statistically significant for conceptual and procedural levels. Only very few students in 300-level course demonstrated procedural knowledge and metacognition in their posted comments.

Results for the 400-level course, show that overall there were statistically significant differences across the four levels ($F_{5, 313} = 29.409$; $p=.001$). Again, the highest scores on comments were found at the factual level, which all students reached mostly from the beginning of the semester (demonstrates that they were able to discuss factual knowledge on the topics studied in each module). Scores progressively decreased on all other levels (with metacognition scores being the lowest). The effect size values for conceptual, procedural, and metacognitive levels were small or very small (see Table 3). For the 400-level course, looking across the semester at the six modules in study, the levels of posted comments are also limited to mostly factual and conceptual levels of thinking. Results from the post-hoc comparisons show that at factual and conceptual levels across the semester and modules, students did not demonstrate a large variability in their comments. As the semester progressed the comments became better at conceptual level. For procedural and metacognitive level of knowledge the

highest scores for comments were reached on Module 13 (a very specific question assigned for reflection).

Table 3. ANOVA for comments by course and by knowledge categories of Bloom's taxonomy

Knowledge categories	300-level course			400-level course		
	F	Sig.	Effect size	F	Sig.	Effect size
Total score	12.43	.001	.222	29.41	.001	.320
Factual knowledge score	6.58	.001	.131	1.89	.095	.029
Conceptual knowledge score	15.79	.001	.266	31.68	.001	.336
Procedural knowledge score	3.56	.004	.076	18.46	.001	.228
Metacognitive knowledge score	2.017	.077	.044	4.07	.001	.061

In conclusion from the above results, for both groups, the level of comments stayed at factual and conceptual levels, with sparingly examples of comments (only several students) going up to metacognitive levels (but overall not statistically significant increase in quality across the semester as it was found for reflections).

Qualitative analysis on comments

John was a student with highest scores on posted reflections; however, his comments reflect how the demonstrated level of discussions stayed mostly at the factual and conceptual levels. In Module 2, this student writes:

> I really enjoyed reading your response. I really liked that you took a look at the Hawai'i based standards to answer the question. I agree with your comments on technology that it is a new and important standard for students to be prepared for in their future jobs.

Similar comments made by John in Module 13 demonstrate factual and conceptual levels of knowledge:

> I enjoyed reading your ideas on child rearing practices because we work for the same company and to see the similarities in two different schools is an obvious clue that many parents are not preparing their children at home prior to

> entering their school years. I wholeheartedly agree with your topic of technology being a distraction and dependency for children.

Students learned about and used Bloom's taxonomy, and were aware that their written reflections and comments were graded using Bloom's taxonomy. Weight was added starting with Module 3, and their written reflections became better across the semester, however, the level of comments posted to their colleagues' reflections stayed at lower levels of thinking (factual and conceptual). This demonstrates that crafting assignments that require higher order thinking (to increase the level of posted reflections), will not necessarily be reflected in the quality of discussions on the questions (comments to each other on the reflections).

Discussions

Results from this study show that the level of thinking involved in a task and question for reflection, its specificity, as well as the importance of the response (weight), will determine the level of demonstrated thinking involved in written reflections on a given assignment. However, the level of discussions (comments posted to the reflections), is not affected by the level of the assignment.

Our results suggest that in order to elicit higher order thinking from students, reflection tasks should target higher order thinking skills. For example, in order to demonstrate procedural knowledge, in several modules, students were asked to view a video on classroom teaching. Then, they were asked to discuss "What was particularly innovative in the video? Giving it a personal twist, how would you apply the techniques in your classroom? "

Weight (Doyle, 1988), added in grading (higher order thinking is valued more), helped students use and demonstrate higher levels of thinking. In Module 3, weight was added and this made a statistically significant "jump" in the level of reflections and demonstrated reflective thinking.

Another finding in our study shows that intentional teaching and practice with Bloom's taxonomy could help students better understand and formulate higher order thinking reflections and responses. Practice and appropriately crafted assignment produced higher order thinking. Overall, our findings contradict results presented by Christopher, Thomas, and Tallent-Runnels (2004) who evaluated the thinking of graduate-level students using

Bloom's Taxonomy. Their results showed no relationship between the levels of the discussion prompt and the levels of the students' responses. Specifically, high-level prompts did not generate high-level responses. In contrary, our results show that the level of response is, at least in part, defined by the nature of the assigned question. It is very possible that the level of discussions (posted comments) would have been at higher levels if the instructor would have actively participate and facilitate the asynchronous online discussions. Results from a previous research on asynchronous online discussions (Szabo & Schwartz, in press), where the instructor monitored, participated, and facilitated, at least in part the discussions (more in the first one third of the semester), had as effect an increase in students' demonstrated levels of thinking. More research is needed to highlight the exact nature of influence that the level of a question or prompt for discussion, can have on the level of asynchronous discussions.

Limitations

A limitation of our findings is related to the nature of the courses involved in this study: undergraduate education courses, where teaching Bloom's taxonomy can be considered as an appropriate education topic. A second limitation is the reduced number of participants (46 preservice teacher students in only two courses). In consequence we cannot talk about generalizability of our results to other educational setting.

Conclusions

The nature of assigned question for reflection and discussion dictates the level of demonstrated thinking in posted asynchronous online discussions forums. Higher order thinking required by the assignment will generate higher levels of thinking as demonstrated in the reflections posted by students. However, the higher level of discourse is not carried through in the comments based on the posted reflections. As it was mentioned above, it is possible that a more active involvement from the instructor would produce higher order levels of posting in the comments as well.

Our results support the theory proposed by Doyle (1988) that weight is required to generate higher levels of thinking. Application of weight produced statistically significant higher levels of postings.

Despite the fact that our results contradict in part those presented by Christopher, Thomas, and Tallent-Runnels (2004), we all agree that the teaching process, assigned tasks, as well as the assessment procedures should help students create higher level of knowledge.

More research needs to be conducted to bring evidence on the proper level of instructor participation and facilitation of asynchronous online discussions, and ways to formulate class assignments that would produce evidence of higher order thinking in reflections and online asynchronous discussions.

References

Anderson. L. W. (Ed.), Krathwohl, D. R. (Ed.), Airsian, P. W., Cruikshank, K. A., Mayer, R. E., Pintrich, P. R., Raths, T., & Wittrock, M. C. (2001). *A taxonomy for learning, teaching and assessing: A revision of Bloom's Taxonomy of Educational Objectives*. Boston: Allyn & Bacon.

Armstrong, N. A., Wallace, C. S., & Chang, S. (2008). Learning from writing in college biology. *Research in Science Education, 38*, 483-499.

Bai, H. (2009) Facilitating students' critical thinking in online discussion: an instructor's experience. *Journal of Interactive Online Learning, 8*(2). Retrieved from http://www.ncolr.org/jiol/issues/PDF/8.2.4.pdf.

Bangert, A. (2004). The seven principles of good practice: A framework for evaluating on-line teaching. *The Internet and Higher Education, 7*(3), 217–232.

Bangert-Drowns, R., Hurley, M., & Wilkinson, B. (2004). The effects of school-based writing-to-learn interventions on academic achievement: A meta-analysis. *Review of Educational Research, 74*(1), 29-58. Retrieved from ERIC database.

Berthold, K., Nuckles, M., & Renkl, A. (2007). Do learning protocols support learning strategies and outcomes? The role of cognitive and metacognitive prompts. *Learning and Instruction, 17*, 564-577.

Biggs, J. B. (2003). *Teaching for quality learning at university* (2nd Ed.), Maidenhead, UK: Open University Press.

Black, A. (2005). The use of asynchronous discussion: Creating a text of talk. *Contemporary Issues in Technology and Teacher Education, 5*(1), 5-24.

Bloom, S. B., Krathwohl, D. R., & Masia, B. B. (1956). *Taxonomy of educational objectives; the classification of educational goals*. New York, NY: Longmans.

Bullen, M. (1998). Participation and critical thinking in online university distance education. *Journal of Distance Education, 13*(2), 1-32.

Canfield, A. A. (1992). *Canfield learning styles inventory (LSI) manual*. Los Angeles, CA: Western Psychological Services.

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

Day, S. (1994). Learning in large sociology classes: Journals and attendance. *Teaching Sociology, 22*, 151-165.

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

Doyle, W. (1988). Work in mathematics classes: the context of students' thinking during instruction. *Educational Psychologist, 23*, 167–80.

Emig, J. (1977). Writing as a model of learning. *College Composition and Communication, 28*, 122-128.

Ennis, R. H., & Weir, E. (1985). *The Ennis-Weir critical thinking essay test*. Pacific Grove, CA: Midwest Publications.

Garrison, D. R., & Anderson, T. (2003). *E-Learning in the 21st century: A framework for research and practice.* London: Routledge Falmer.

Garrison, D. R., Anderson, T., & Archer, W. (2000). Critical inquiry in a text-based environment: Computer conferencing in higher education. *The Internet and Higher Education, 2*(2–3), 87–105.

Garrison, D. R., & Cleveland-Innes, M. (2005). Facilitating cognitive presence in online learning: Interaction is not enough. *The American Journal of Distance Education, 19*(3), 133-148.

Gilbert, P. K., & Dabbagh, N. (2005). How to structure online discussion for meaningful discourse: a case study. *British Journal of Educational Technology, 36*, 5-18.

Golanics, J. D., & Nussbaum, E. M. (2008). Enhancing online collaborative argumentation through question elaboration and goal instructions. *Journal of Computer Assisted Learning, 24*(3), 167–80.

Groves, M., & O'Donoghue, J. (2009). Reflections of Students in Their Use of Asynchronous Online Seminars. *Educational Technology & Society, 12*(3), 143–149.

Holmes, K. (2004). Analysis of asynchronous online discussion using the SOLO Taxonomy. In: Jeffrey, P. L. (Ed.), *Conference papers of Association for Research in Education*, AARE 2004, 28 November–2 December 2004 [computer file]

Kaplan, D. S., Rupley, W. H., Sparks, J., & Holcomb, A. (2007). Comparing traditional journal writing with journal writing shared over e-mail list serves as tools for facilitating reflective thinking: A study of preservice teachers. *Journal of Literacy Research, 39*(3), 357-387.

Koehler, M. J., Mishra, P., & Yahya, K. (2007). Tracing the development of teacher Knowledge in a design seminar: Integrating content, pedagogy and technology. *Computers & Education, 49*(3), 740-762.

Krathwohl, D. R. (2002). A revision of bloom's taxonomy: An overview. *Theory into Practice, 41*(4), 212-218.

Lei, J., & Zhao, Y. (2007). Technology uses and students achievement: A longitudinal study. *Computers & Education, 49*(2), 284-296.

Lim, E. L., & Moore, D. W. (2002). Problem-solving in geometry: Comparing the effects of non-specific instruction and conventional worked examples. *Educational Psychology: An International Journal of Experimental Educational Psychology, 22*(5), 591–612.

Meyer, K. A. (2003). Face-to-face versus threaded discussions: The role of time and higher-order thinking. *Journal of Asynchronous Learning Networks, 7*(3), 55–65.

Pawan, F. T., Paulus, M., Yalcin, S., & Chang, C. (2003). Online learning: Patterns of engagement and interaction among in-service teachers. *Language Learning and Technology, 7*(3), 119–140.

Roblyer, M. (2002, March). A rubric to encourage and assess student engagement in online course conferences. Paper presented at the *Annual Conference of Society for Information Technology in Teacher Education (SITE),* Nashville, TN.

Roblyer, M. D., & Wiencke, W. R. (2003). Design and use of a rubric to assess and encourage interactive qualities in distance courses. *The American Journal of Distance Education, 17*(2), 77-98.

Ryan, J., & Scott, A. (2008). Integrating technology into teacher education: How online discussion can be used to develop informed and critical literacy teachers. *Teaching and Teacher Education, 24*, 1635-1644.

Shana, Z. (2009). Learning with Technology: Using Discussion Forums to Augment a Traditional-Style Class. *Educational Technology & Society, 12*(3), 214–228.

Sivin-Kachala, J., & Bialo, E. R. (1993). *The Report on the Effectiveness of Technology in Schools 1990–1992*. Washington DC: Software Publishers Association.

Szabo, Z., & Schwartz, J. (in press). Learning methods for teacher education: The use of Blackboard discussions improve critical thinking. *Technology, Pedagogy, and Education, 20*(1), 1-17.

Received January 2, 2011
Revision received January 17, 2011
Accepted January 22, 2011

Appendix

Rubric for scoring reflections and comments based on Bloom's taxonomy

Knowledge dimensions (types of using the knowledge)	**Cognitive processes** (different levels of thinking)					
	Remembering	**Understanding**	**Applying**	**Analyzing**	**Evaluating**	**Creating**
Factual						
Conceptual						
Procedural						
Metacognitive						