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Reflection: A Key Component to Thinking Critically

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Abstract

The ability to think critically is an important trait of all members of society. With today's multinational, multicultural, complex issues, citizens must be able to sift through large amounts of various data to make intelligent decisions. Thinking critically must be a focus of higher education in order to provide the intellectual training for its students to participate in this world. This qualitative study examined critical reflection through student writing as seen in three different college settings. Structured reflections were analyzed using Marzano's New Taxonomy of Educational Objectives (2001).

La capacité d'exercer son esprit critique est une caractéristique importante de tous les membres de la société. De nos jours, les enjeux sont multinationaux, multiculturels et complexes. Les citoyens doivent être capables de filtrer de grandes quantités de données diverses pour prendre des décisions intelligentes. L'enseignement supérieur doit être axé sur la pensée critique afin de procurer aux étudiants la formation intellectuelle qui leur permettra de participer au monde qui les entoure. La présente étude qualitative se penche sur la réflexion critique dans les écrits des étudiants de trois différents collèges. Les chercheurs ont analysé les réflexions structurées à l'aide de la nouvelle taxonomie des objectifs pédagogiques de Marzano (2001).

The ability to think critically is an important trait for all members of society. With today's multinational, multicultural, complex issues, citizens must be able to sift through large amounts of data to make intelligent decisions. Thinking critically must be a focus of higher education in order to provide the intellectual training for its students to participate in this world. According to Leibowitz (1997) "complex thinking, communication and collaboration will be among the essential process areas for the world as we will know it" (p. 50).

Critical thinking is a habit of mind characterized by the comprehensive exploration of issues, ideas, artifacts, and events before accepting or formulating an opinion or conclusion (Rhodes, 2010). Citizens in a democracy must be able to adapt to the changes as presented and this can be accomplished through the development of reflective skills. Brockbank and McGill (1998) identify the development of lifelong learning as an individual is one of the purposes of higher education. We posit that lifelong learning takes place through reflection. That is, learning begins with metacognition, knowing one's own thoughts and reflection, which allows the individual to identify the factors that influence one's own thinking.

Reflective writing focuses learners' attention on their thinking by asking them to delve into their thoughts about specific topics as well as their individual learning methods. The main purpose of this study was to investigate students' critical thinking by critically examining their reflective writing assignments.

Theoretical Framework

Vygotsky (1978) noted that for "the adolescent, to recall means to think" (p. 51). Kozulin recalled that in the introduction to *Thought and Language* (1986), Vygotsky "perceived psychological development as a dynamic process full of upheavals, sudden changes, and reversals" (p. xxix), a process that requires the learner to stop and think and reflect. We contend that for college students thinking should also mean reflection. According to Mezirow (1990) reflection is used "to examine the justification for one's beliefs … and to reassess the efficacy of the strategies and procedures used in problem solving" (p. xvi). Critical thinking is a result of reflecting on one's learning and developing a meta-awareness by "reflecting on one's thoughts, feelings and actions" (Taylor, 1992, p. 15). The students need to transform their learning through critical self-reflection (Mezirow, 1990), and learning should take place in an environment of thinking, reflecting, and connecting the old to the new. Reflection, Mewborn suggests, is "both an individual and shared experience" (1999), and this metacognitive relationship is developed through reflective writing that will enhance what Brockbank & McGill call the "conditions for critical reflective learning" (1998, p. 5). As educators, we chose to introduce the process of reflection into our different academic environments through reflective writing prompts.

Reflection, once learned, is a skill that crosses disciplines. If a student learns to reflect in a math class, the same set of reflective skills or concepts can be used in language arts. As we began to describe to each other the ways in which we were attempting to get students to move beyond the surface of a topic to deeper understanding, we realized we were all using reflective practices. It did not matter whether we were teaching math, occupational therapy, or educational foundations. The skills needed to think critically about the material presented, to reflect upon the information provided, were the same. The concept of reflection crossed disciplines in ways that resulted in our deeper understanding and reflection. This study describes how each of us saw reflection deepen students' ability to think critically. Reflection is content neutral.

Importance of the Study

Learning is enhanced by critical reflection, which involves the "creation of meaning and conceptualization from experience" (Brockbank & McGill, 1998, p. 56). As educators we need to facilitate critical reflection to enable students to move beyond a superficial understanding of their world. We agree with Mezirow (1990) that "reflection enables us to correct distortions in our beliefs and errors in problem solving. Critical reflection involves a critique of the presuppositions on which our beliefs have been built" (p.1). By creating a reflective environment for and with students, the educational experience will lay the foundations of a critically reflective member of the world community.

Inquiry Methods

The research methodology used in this study was classroom-based educational action research (Angelo, 1991; Elliott, 1991). Part of effective teaching is the ability to reflect on what is happening in the classroom, and to identify any differences in what was planned and what actually occurred. By conducting "systematic, intentional inquiry" within his/her own classroom, the instructor builds a better understanding of his/her own practice (Cochran-Smith & Lytle, 1993, p. 7). As this understanding develops, different teaching strategies may be suggested to better support student learning. Educational action research, as defined by Elliott (1991) is "the study of a social situation with a view to improving the quality of action with it" (p. 69), implying that a change in the situation under study develops out of the research itself by drawing together both research and practice (Carson, 1990). When pursuing an idea that arises from professional practice, the teacher is acting upon a personal theory that has been developed over time (McCutcheon & Jung, 1990).

This study took place in three cross-cultural contexts: (a) urban residential college with a diverse student population, (b) suburban residential college with traditional age students, and (c) state college with graduate and undergraduate students. In addition, the researchers represent both African American and white faculty who teach courses in mathematics, teacher education, or professional entry-level occupational therapy. We were already teaching these courses, and had independently included reflection in previous semesters. During our conversations as researchers, we realized that we were all using reflection in our teaching, and decided to study that process. We used a convenience sampling of those courses we happened to be assigned to teach.

In this study we used multiple prompts to foster students' reflection and to develop their understanding of themselves as learners. We used different learning environments and course content to answer similar questions about using reflective writing. The following research question guided this study: How do we, as course instructors in various disciplines, use reflection to facilitate students' learning and their thinking?

Participants

The study was approved by the Worcester State University Human Subject Review Board. Informed consent was obtained from all participants. Participants in this study, whose names were changed to protect their identity, were drawn from four classes in three different fields. Of the 76 students enrolled in College Algebra, 74 participated in the study. The majority

of these students were first-year college students, 18-19 years old, who had been placed into the course through an in-house placement exam or who had passed a non-credit introductory algebra course. They came to the class with a pre-existing knowledge of algebra that was incomplete and in some cases incorrect. They also had a self-image of themselves as students of mathematics. This self-image could be positive, leading to a more receptive view of their success, or, unfortunately, the more likely negative self-image of someone who "can't do math."

The students in the foundations course, Schools and Society, ranged from freshmen to juniors, 20-21 years old, with the majority at the first or second year of the undergraduate program. There were a total of 36 students and 32 participated in the study. This course was required for education students and also fulfilled a general education course requirement. As a result, half of the students were general education students and half were education majors. Reflection is a key element for pre-service teachers. The final portfolios require a detailed description of their reflection on their teaching and classroom experience.

Theories of Occupational Therapy was an undergraduate, online course taught in the summer for post baccalaureate students entering the program, junior transfer students, and sophomore students who were repeating the course. The 10 students, who all agreed to participate, ranged in age from 20-40. The course was scheduled over two six-week sessions. Most of the students in the course were also taking one or two other courses during each summer session.

The 12 students in Advanced Group Theories in the School of Occupational Therapy agreed to participate. They were in the graduate year of a five-year bachelors/masters occupational therapy program and ranged in age from 23-28 years old. Most of the cohort had been together for four years, while those who transferred had been in the cohort for three years. They were taking undergraduate courses as well as this graduate course. As future health care professionals, occupational therapy students must develop the habit of reflection. Whether they reflect on the underlying theories that provide the foundation for the interventions and assessments they use or on the group dynamics, interpersonal processes, or the intentional use of self during their interactions with clients, they need to engage in both reflection-on-action and reflection-in-action (Schön, 1984).

Data Sources

Data sources included students' writings in the following courses: College Algebra, School and Society, Theories of Occupational Therapy, and Advanced Group Theories. Writing can be used in two ways: as a means of communication and as a learning tool. Writing communicates one's thoughts, ideas, and knowledge to oneself as well as to others (Gage, 1986; Zinsser, 1988). As a learning tool, writing helps students make knowledge their own by putting concepts into their own words (Mayher & Lester, 1983). The written evidence becomes a tool that both the students and the teacher may use to understand the thought processes involved in understanding the new concepts presented in the lessons.

The writing assignments in each course varied in scope. For example, in College Algebra the writing focused student attention on their perceptions of themselves as learners and their progress through the course. The various prompts are presented in Appendix A. In School and Society, the writings focused on analysis of the readings presented during the semester and included writings and surveys (see Appendix B). In Theories of Occupational Therapy students were expected to answer specific questions about each week's readings (see Appendix C). In

Advanced Group Theories the reflections asked students to reflect on their own experiences, strengths, and weaknesses in relation to class content (see Appendix D).

Analysis

As our analysis began, we realized that we needed a model that would structure the process. Marzano's *New Taxonomy of Educational Objectives* (2001) provided a framework for our analysis of the data in order to identify the level of students' thinking through their reflective writing. While this taxonomy provides a two-dimensional model of thinking, knowledge and processing, we are using only the Level of Processing dimension in this paper. We selected the *New Taxonomy of Education Objectives* for the framework because it included self-system thinking and metacognitive thinking. The Level of Processing dimension of the New Taxonomy is hierarchical and incorporates three systems of thought or levels of processing: (a) the self-system, (b) the metacognitive system, and (c) the cognitive system. The self-system involves the interaction between a person's attitudes, beliefs, and emotions and influences a person's motivation and attention. Subcomponents include examination of importance, emotional response, efficacy, and overall motivation. It is this system that is important for student engagement, and through reflective processes that these components of self-system thought became apparent. The metacognitive system monitors, evaluates, and regulates other types of thinking, deals with learners' goals, and oversees process, clarity, and accuracy. The cognitive system consists of (a) knowledge utilization, (b) analysis (i.e., extending existing knowledge, producing new conclusions), (c) comprehension (i.e., organization of content for long term memory), and (d) retrieval (i.e., recall). This system includes synthesis and representation. It may incorporate matching, classification, error analysis, generalization, and specification. Knowledge utilization occurs when a person wants to accomplish a task or use knowledge in a specific situation. It can involve decision making, problem solving, experimental inquiry, or investigation.

Findings

The New Taxonomy (Marzano, 2001) provided us with an analytical tool to understand the changes in students' thinking that are the result of the reflections. Our findings are presented in the following three sections, each dealing with a different system of thought: (a) self, (b) metacognitive, and (c) cognitive. Examples have been drawn from the different classes and represent examples of individual and of common responses.

Self-System

Self-system thought is about attitudes, beliefs, and emotions. It motivates the student to the task of learning. As stated previously, students in College Algebra were expected to identify and change any misconceptions as well as increase their knowledge base in a short time. They needed to be highly motivated to stay engaged in this task. To this end, a series of reflective assignments (Appendix A) were created to focus the students on this difficult task of changing what had already been learned. Some of these assignments focused on self-system thinking.

The first writing assignment was a mathematical autobiography. The students were asked to reflect on their previous mathematical history and to identify their feelings about mathematics

and their beliefs about learning mathematics. Jimmy's reflection, an example of individual growth, exhibited self-system thinking. He identified why learning algebra was important when he stated:

> I believe that algebra is very important in order to become a pilot, engineer, or almost any other career choice that I may take on. On a broader scale, I hope to be able to balance my effort in mathematics throughout every other course I am taking this semester.

Jimmy identified the importance of the algebra class for himself thus providing the level of motivation that enabled him to persist throughout the semester. Through the reflective writing, Jimmy reflected on how he learns when he stated, "retaking algebra will give me a chance to catch up on anything that I may have struggled with or missed in previous algebra courses." Jimmy was able to delve more deeply into his reasons for learning algebra, thus beginning the process of critical reflection.

The New Taxonomy also calls for a "level of consciousness" (Marzano, 2001, p. 13) in the student in order to learn. Emotional responses are part of what we bring to every learning situation and should be brought to the surface and examined. One of the tasks in the autobiography is to relate both positive and negative stories. It is important for the students to identify how they feel about mathematics and take a look at how that interferes with their progress. Many students in the study see themselves as unable to learn mathematics. We discuss in class the way society accepts an ignorance of mathematical reasoning almost with pride. How many times have we heard "I can't do math" said on television or radio, or written in print materials? No one proudly announces "I can't read." These emotions, if allowed to remain, would provide a self-fulfilling prophecy of failure. One of the major goals of the autobiography assignment is to bring to light the students' emotional response to the subject so that the student may be more able to change these feelings through positive experiences with the subject. Comments on course evaluations over the next few years highlighted how some students were able to change their emotional response to mathematics. Many students commented "I finally like math," far more than had been seen in the past.

Self-system thinking was also evident in the reflection of students in Advanced Group Theories. At the end of the semester students were asked to reexamine themselves in relation to the goals from all the reflections during the semester (Appendix D). Typical of many, Susan reflected on her interactions with a classmate during one group assignment. She wrote:

> In regards to groups my goals were to become more assertive when dealing with difficult people, to pay attention to how I present myself to others, and to avoid shutting down during stressful group conflicts… The changes I saw were that for the most part I am now able to stick with the process even when the situation is intense as long as I remember to talk myself out of giving up and shutting down… I realize it sounds childish but as time goes on I am seeing more and more that adults have childish and pointless conflicts just as young people do. Knowing this and realizing how much stress the situation causes, I have tried to keep conflicts on the positive path and if that fails I do my best to keep my attitude optimistic.

Here we see Susan functioning at the self-system level. She is examining her efficacy, specifically the mental processes she uses to be effective in a situation. In addition, she is

examining her emotional responses. These understandings have enabled her to remain engaged in a less than optimal working relationship.

Metacognition

Metacognition monitors, evaluates, and regulates our thinking. People use metacognition to set goals and to monitor their progress in meeting those goals. Metacognition also allows people to monitor the clarity and accuracy of their knowledge. It is the metacognitive system that is "responsible for effective processing of the information that is essential to completion of the task" (Marzano, 2001, p. 12). In the mathematical autobiography College Algebra students were asked to set goals for the course. More importantly, they were asked to identify how they would achieve those goals, what steps they would take to ensure their success, thus signaling the metacognitive system to engage. Each subsequent writing assignment returned students to these goals and asked them to reflect on their progress. The students indicated they wanted to do well in the course and that they would work hard. As Marzano (2001) states, these broad goals are not sufficient to engage the metacognitive level. Setting goals is a difficult concept and many students do not on the first try. On Jimmy's first draft he did not set specific goals, but when asked, he did rewrite his essay and showed more depth of thought. He wrote,

> Some things I would like to achieve this semester in mathematics are that I would like to reinforce my basic algebra skills. I believe that retaking some of these lessons will make sure that I understand how to perform mathematics properly.… Another goal of mine is to achieve an A- as my grade for the semester. I will achieve this by answering as many JITT questions [1 minute quiz at the start of class], doing all of my homework, and studying more than enough to succeed on the exams. Finally, and easiest of all, I believe that attending every class is the first step in achieving this goal. Without being in class, it is much more difficult to learn what is going on.

Of the four writing assignments, it was on the second writing assignment (see Appendix A) that the students realized that they needed to take responsibility for their learning. After their first test was returned, the students were asked to reflect on their progress to date and whether they were doing what they said they would. Henry wrote,

> My goals are slowly taking effect but I need to give them a little boost so I can really kick it up a notch. I want to do better on tests and shoot for As, I want to understand the material better and study harder to achieve those As, and I want to do well in the class overall. … These are the goals I have set for myself, and as you can see I also made new goals for myself to strive for success. These goals will help me become a better student and also a better person in general.

Many students identified specific areas of difficulty they had. The most common included rushing through tests, not asking for help, and not doing homework. Typical of the majority of students, Harry wrote in his second essay:

I have just added a new goal though. This new goal is to check my work more carefully. All in all I need to break old habits by paying more attention to what I'm doing instead of concentrating on the problems first.

Others identified specific processes that they have had trouble with in the past. Jerry seemed to be thinking on this level when he wrote that "filling in these holes that may be big as the one that sank the Lusitanian [sic], are necessary before I return to calculus."

In Advanced Group Theories, students had frequent reflective writing assignments which asked them to first examine who they were in specific experiences and then to set goals and accompanying action plans. The reflections were related to material that was being used in classes so they had some information to organize their thinking. The first reflection asked students to examine themselves as someone who is part of a group, to look at a positive and a negative group experience, to set both personal and academic goals, and to identify specific actions to take to meet those goals. These reflections primarily revealed self-system and metacognitive thinking. Susan's reflection showed significant change in her metacognitive thinking when she wrote

> In a recent semester I had the opportunity to work with a particular classmate in almost every group I was in. This individual has a very strong personality and a habit of procrastinating. I on the other hand am only strong when forced and then I become almost uncompromising. In addition, I have a type one personality; therefore I like to work on projects right away so it does not seem so overwhelming. As one might guess, as the semester went on groups became stressful and difficult. Our personalities clashed and the friendship was affected. We had a hard time completing projects and I was not pleased with our results. From that group, I was able to discern that my assertiveness and communication skills need work and also that I need to present with less obsessive compulsive qualities. The group partnership has taught me some weaknesses that should be given attention.

Here we see a student monitoring both the group dynamics and her behavior, a metacognitive level of thinking. By the end of the course, she was thinking at the self-system level when she was examining her efficacy in the specific situation. These examinations allowed her to develop a sense of her motivation and then to activate the metacognitive processes that would identify goals and actions, which she also identified in the reflection.

Cognitive System

The cognitive system is "responsible for the effective processing of the information that is essential to the completion of a task" (Marzano, 2001, p. 12). Its processes include basic retrieval, comprehension, analysis, and utilization of knowledge. The reflective activities in School and Society, designed to focus on the cognitive system, were built into reading reflections, online discussion boards, and three learning surveys spaced every five weeks during the semester. The reading reflections asked students to respond to the same four prompts (see Appendix B) and to make connections to previous knowledge and experiences and also to the resources and information previously discussed in the course. Each discussion board thread was based on a reading or video and expanded upon during class discussions. Finally, in the learning

surveys (See Appendix B), students were given the opportunity to connect the resources to what they learned, what they already knew, and what they found helpful, especially in the use of a course management system. This process was put in place to help the students think about their own learning process (metacognition) and also to retain ideas in a way that allowed for those ideas to be used to guide new learning.

The first of six reflective activities focused on reading reflection where students responded to the prompts of observation, connections, surprises, and questions. Their questions were used as discussion in the class that followed, which again reinforced the reflective process. The observation comment is usually at the analysis level, or as Marzano (2001) states: "…it involves the 'reasoned' extension of knowledge" (p.38). In the following response, Margaret exhibited some error analysis which, as Marzano describes, "…involves (a) consciously judging the validity of knowledge based on explicit criteria and (b) identifying any errors in reasoning that have been presented" (p. 39). Margaret wrote,

> While other racial/ethnic groups were mentioned briefly in both the Kozol chapter and the article, I felt that more attention could have been paid to the integration of other minority groups. Neither inner city nor suburban schools consist entirely of Caucasian, African American and Latino students. Recent immigrants from countries across the world are experiencing similar disadvantage in the education system, and I am curious how that intersects with the problems being discussed in these readings.

The "error" identified was what Margaret saw as a failing of the readings to consider other variables. Her questions, based on the same reading moved her toward knowledge utilization. Here she is responding to the prompt for questions:

> What is the solution to a segregated education system? A large part of the problem is housing segregation, so to fully integrate it would require a majority of students to travel great distances to school each day. Kozol does address the fact that segregated schools cannot be entirely blamed on residential segregation, but I think that the housing issues must be addressed first.

In the above example of a writing reflection response, Margaret asked the question and then provided her own solution which was not only based on the reading, but also on what she has determined to be a rational response based on the information she had been given. Many students exhibited a similar synthesis of information and it was interesting when they completed the Learning Survey that the very subject they wrote about so clearly was the topic that was new to them. When asked to list information that was new to them, many of the responses were similar to the ones below:

> More in depth look at segregation.
> I knew about segregation, but I did not realize how segregated the schools in the U.S. were.
> I also learned how segregation still affects our school systems.
> The Kozol reading, especially regarding the extent to which public schools are still segregated.

Given the emotional content of the course reading represented here, it is important to add that there was an emotional level to the learning that had less to do with consciousness and development and more to do with internal feelings. Reading responses were neutral across the board, but the class discussion was heated and rules of engagement had to be agreed upon – built on the idea of respect. Through in-class discussion much of the anger, frustration, guilt and surprise was dissipated, which allowed for a more level response in the reading reflection. Feelings are part of the internal process that impact learning. Here is where Marzano's (2001) Taxonomy explains how the student moved beyond the emotional response and on to a flow of information through the other knowledge domains.

Working through this particular topic was made easier through the use of reflection on the readings, the discussion board, and the learning survey. Not all students responded positively to the questions, some ignored the topic discussed in the readings all together and focused on earlier readings. In general however, most of the students found the discussion board and class discussions helpful, especially since they were linked. This process allowed the students to build on previous reflection strategies, and also on information they already possessed and information they gained through discussion.

Students in the Occupational Therapy Theories course were expected to submit a guided reflection about each week's readings. They were to address the following four questions in each reflection:

1. What did you learn?
2. How does it fit with what you already knew?
3. How does it fit with occupational therapy?
4. What new questions did the reading generate?

The range of different levels of processing was evident even for individual students. For example, in the first reflection submitted, after reading material which examined what theory is, what it does, and how it is used in practice, Mary wrote:

> Before reading the assigned materials I knew that a theory was a concept that people base their future knowledge on. I did not know how often theories are really used and why they are so important. Professional identity in any field is based upon their founding theories and their up and coming ideas. This is why professional identity can be forever changing and why people under the same broad category can believe in two totally different ways of working.

Initially, her thinking was indicative of the retrieval level, specifically recall. She recalled information details but did not organize ideas. Her individual reflection continued to indicate this level of thinking until near its end where she wrote:

> A few key points that a therapist must always remember to use in [her] practice is always have the clients' well being in mind, address the problems that impact the client, and the therapist must use occupation as the primary source of therapy.

Here we see evidence of comprehension and, more specifically, synthesis. She organized key characteristics of the theory.

Over the next few weeks Mary's writing continued to indicate primarily retrieval and comprehension levels of processing. Yet, the questions she developed, as a result of reading the assigned course material, were often focused on a knowledge utilization level of processing. For example, the third week of class was focused on the organization of conceptual knowledge in the field of Occupational Therapy's. Readings had discussed paradigms, conceptual practice models or frames of reference, and related knowledge. Students struggle to understand these concepts and do not think about how they apply to practice. In contrast, Mary's questions were:

> How does the therapist transition from one paradigm to the next as they change? After practicing with one for so long I can't see how changing over to another would be an easy feat. The values of the client and the therapist probably are not the same. How does the therapist treat a person whose values totally contradict those of her own?

At this point in the reflection process, Mary was beginning to think at the knowledge utilization level, about determining how to use this knowledge in practice. "Knowledge utilization processes are those that individuals employ when they wish to accomplish a specific task" (Marzano, 2001, p. 45). While it is clear that Mary did not fully understand the information (i.e., the details and organizing ideas of the material presented in the readings) and most likely would have difficulty making decisions about how to solve specific problems when working with clients, her reflection indicated that she was starting to think about how therapists use their knowledge in real life settings.

Multilevel Processing

We have shared examples of the different levels of thinking that were evident in the reflections from our four undergraduate courses. Self-system thinking and metacognition were seen in the reflections from College Algebra and Advanced Group Theory. Cognitive thinking was seen in the reflections from School and Society and Theories of Occupational Therapy. Though we presented the different levels of thinking separately, at times students showed all three systems within a single reflection. Multilevel thinking, for example, was evident in Ellen's reflection on readings related to the organization of occupational therapy's knowledge and how the paradigm had changed over time and was continuing to change. Ellen wrote,

> …a major component of what I had learned about the mechanistic paradigm was enlightening, not necessarily in a good way. Even though I had already known that at some point in time the focus of occupational therapy had changed to a more medical perspective, I never imagined that this change was so dramatic, to the point of occupational therapy becoming nonexistent…I understand now how this change has proved to be of some help in shaping the contemporary paradigm, but the shock was more due to the fact that I cannot come to terms with how a field loses its primary focus for the sake of criticism.

In these comments Ellen was struggling with what she was learning through her analysis. "Analysis involves the 'reasoned' extension of knowledge" (Marzano, 2001, p. 38). She had examined the paradigms, matching what she was learning with what she knew, identifying

errors, and questioning the information's validity. She concluded the reflection with her questions:

> …knowing the impact that other disciplines have had on occupational therapy's paradigm, what is the likelihood that this may occur again and why? It terrifies me to think that my decision to want to become an occupational therapist is based on the contemporary paradigm and the fact that if it were to change as dramatically as it did in the past, I would be left with the question of "Where do I go from here?"

It is clear that at this point in the reflection process, Ellen was engaging in self-system thinking. She was examining her emotional response to the possibility that occupational therapy might become a profession in which she does not want to practice. It was unusual to see this type of thinking in the reflections from other students in this course because the questions tended to focus the students toward the cognitive levels of processing. Ellen's self-system thinking, however, resulted in her engagement in metacognitive thinking. She wrote,

> …knowing the path which occupational therapy has followed provides insight into the importance of making sure the field of occupational therapy will never again be jeopardized. It is essential to stay focused on who we are, what our goals are, and how we will get there.

In her reflection Ellen moved from cognitive processing to an examination of her emotional responses as well as other self-system thinking and finally to metacognitive thinking to identify goals.

Through the reflective writing assignments in all four courses, we saw changes in our students' thinking throughout the semester. By focusing reflection on their beliefs, students were asked to analyze their perceptions of themselves as mathematicians, as occupational therapists and as educators. In the Algebra course, for example, these perceptions changed over the semester for many students, they realized they "could do algebra" and could be successful in mathematics. In the occupational therapy course, the reflections similarly asked students to examine their development as a member of a group during the course helping them to realize that they could set goals and effect changes in their behavior and thus increasing their sense of self efficacy. After an initial broad reflection about who they were as group members they were asked to reflect on specific traits of group members and establish their individual goals to enhance their group participation. The different reflections challenged students to consider the many demands of being a successful group member. In the education course, students began to make connections among the assigned readings. Through reflective writing assignments students were able to achieve self-system, metacognitive, and cognitive thinking.

Discussion

In this study we asked the question: "How do we use reflection to facilitate students' learning and their thinking?" We found that we asked students to use reflection in three ways: (a) to set goals (self-system), (b) to monitor their progress (metacognition), and (c) to think at different levels of processing.

We were involved with students from various backgrounds and used different writing prompts to focus student attention on specific aspects of their learning.

The writings used in the College Algebra course revealed self-system thinking. The mathematical autobiography allowed the students to examine their beliefs, attitudes, and emotions towards mathematics. They could begin to understand why they felt the way they did. Students who feel they cannot do math will inevitably fulfill that prophecy, while students who will allow the door to open a crack and admit that they might be able to accomplish the tasks in the course will have more chance for success. Success in mathematics, as in many subject areas, is partly based on persistence (Lerch, 2000). Those students with a positive mathematical self-image are more likely to persist in their work than those with a negative mathematical self-image. In a very short time, approximately thirty class hours, students in our study both increased their knowledge and were introduced to the idea of reflecting on themselves as mathematicians. As Marzano (2001) states, "The self-system determines whether an individual will engage or disengage in a given task; it also determines how much energy the individual will bring to the task" (p. 50). The reflections cracked open the door.

The reflections in Advanced Group Theories were structured to increase students' self awareness. Like the students in College Algebra, the occupational therapy students were able to examine the underlying reasons for their behavior. By better understanding these reasons they were able to identify appropriate goals and ways to achieve those goals. The reflections allowed a level of consciousness to be achieved that fostered metacognitive thinking in the students and increased the likelihood of their success.

The reflections from School and Society, an education course, were used to further engage students in the content integral to the course. A discussion board was also used as a place for students to discuss their prior learning in relation to the new content. Brockbank and McGill (1998) stated that "the context of learning and what the learner perceives, consciously or not, as the ability to think, feel and act in any situation is critical to the means by which that person becomes a transformational learner" (p. 4). Identifying the emotional aspects of learning is done through reflection and self-thinking. Analysis of the writing reflections showed that students had begun to think at the taxonomy's level three, analysis, which involves "examining knowledge in fine detail and, as a result, generating new conclusions" (p. 71).

In Theories of Occupational Therapy the weekly questions were intended to have the students engage with the assigned readings and relate those readings to their previous knowledge. Analysis of the reflections revealed thinking at the retrieval, comprehension, and analysis levels, though some students demonstrated some knowledge utilization by the end of the course. As Brockbank and McGill (1998) would indicate, interactive dialogue moves students from a reliance on only their own thinking to a deeper level through the prompts given by the reader.

Implications

Today's undergraduate students are part of a rapidly changing world where knowledge is constantly evolving. They will need to have skills that will facilitate their success in that environment. We argue that reflection is one of those tools. It allows them to develop a realistic sense of efficacy and motivation. In addition it will develop their metacognition so they will be able to set and monitor the achievement of realistic goals. As educators challenged to develop

life-long learning skills in undergraduate students, we need to use reflection as a key pedagogical strategy.

Online and hybrid courses are now part of most college/university curricula. One of the disadvantages of those courses is the mechanical nature of responding online to course assignments and projects. In some online courses, students can correctly respond to certain guidelines or rubrics without demonstrating understanding. Having students reflect on their efforts as they move through the learning process presents the possibility of creating mindfulness during the learning process. If the approach to online learning is a "quick and dirty" strategy for getting through course material, reflection slows the process down and allows both the student and faculty an opportunity to build depth and breadth of knowledge as well as to develop higher levels of thinking.

Finally, working across disciplines, as was done in this study, creates an opportunity for faculty members and researchers in distant places to collaborate to resolve common challenges that they face implementing online learning. Cross-discipline collaboration can be difficult within institutions and our efforts overcame both the cross-discipline and long-distance challenges. Given that we have all become connected through improved communications and the Internet, our research stands as a model for working as educators without borders.

By examining students' reflections throughout one semester, we found all levels of thinking existed. Students would engage different levels of thinking within the same reflection. Future research is needed to determine how the prompts influence the level of thinking. In addition, studies are needed to determine the impact of reflection on student learning.

Today, faculty members are challenged to engage students in their learning. The use of reflective assignments facilitated student engagement in learning. This study found that a variety of reflective assignments engaged students' self-system, metacognitive, and knowledge systems of thinking.

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Appendix A

Writing # 1 - Mathematical Autobiography

Think about your mathematics courses over the years. Do particular people or incidents come to mind? Can you recall a positive experience concerning mathematics? How about a negative experience? How might these have had an effect on your approach to this course?

One purpose of this assignment is to open lines of communication between us that we will continue to build throughout the remainder of the semester. Another purpose is to ask you to reflect on how you feel about mathematics, and why you feel this way.

The assignment is also a record of your thoughts – something you can reflect on and learn from later. By reconstructing the events and processes by which you have arrived at this point, by identifying key events that have influenced you, you mat discover important aspects of your beliefs and skills, which could help you throughout the semester.

In this limited mathematical autobiography (2 to 3 pages), please include both a positive and a negative story. As part of your reflection, indicate how these events or people have influenced your perceptions of yourself as a mathematician.

Devote the final paragraph to a discussion of your goals for this course. Include the following: the reason you are taking this course, your personal goals that might be accomplished through this course, your academic goals for this course, and comments on how you will meet these goals. (We will return to these goals during the course of the semester.)

Writing #2 - Reflection Post First Test

Please look over your exam carefully. Pay careful attention to the errors you have made. Look for patterns on the types of errors – sign mistakes, copying incorrectly, concepts, wrong rules, etc. For instance, if you term chopped, is this something you have had trouble with in the past.

Think about how you prepared for this exam. Reread your autobiographies and comment on your stated goals and what you indicated you would do to reach those goals. Did you do what you said you needed to do? If not, reflect on why you did not do as you indicated and the impact, if any, your actions had on your test score. If you did not fulfill your goal for this test, but did what you indicated you should, what can you do next to insure a more successful result on the next test?

Reflection is the key to learning, especially to change mistaken processes. You were given a set of questions on the first day of class. How have you used these questions? Do they help focus your thoughts as you work on a problem? If you have not used them, discuss why not.

1. What (exactly) are you doing?
   - Can you describe it precisely?
2. Why are you doing it?
   - How does it fit into the solution?
3. How does it help you?
   - What will you do with the outcome when you obtain it?

Review your initial skill assessment. What errors did you make that are similar to the mistakes on the skills assessment? What errors did you correct from that assessment? What did you do to correct these errors?

Write a 2 page reflective essay.

The following are typical errors. Please add any others that are not listed. In your essay indicate which you made, then discuss what you will do to overcome these.

☐ Term chopping   ☐ Exponent errors
☐ Sign mistakes   ☐ Factoring
☐ Arithmetic errors ☐ Procedure errors
☐ Distribution sign error ☐ Order of operations
☐ Calculator errors ☐ Didn't check work
☐ Copying incorrectly ☐ Other errors - identify

Writing # 3 - Letter Home

Write a letter home to your parents explaining your grade at mid-semester. Please discuss how you are doing in College Algebra. Review your first essay and assess your progress toward your goals. Does your grade match your goals? If so, discuss what you have done to ensure your success. If not, discuss what you will do to improve your standing in this course. If you are receiving a warning, what would you say to your parents? [Your essay should be about 1 page.]

Writing # 4 - Semester End Preparation

The semester will be over soon. Reread your other 3 essays and think about how you have changed this semester. You set personal and academic goals that you were to work on during this course. It is time to reflect on your work toward both sets of goals. How has your approach to mathematics changed? How have you changed as a student? What new learning/study skills have you developed? What are your academic strengths? What are your academic weaknesses? How will you prepare for the final exam? Your essay should be 1-2 pages.

Appendix B

EDU – School and Society
Learning Survey

Please respond to the following questions regarding your learning in this course thus far.

1. Information that was new to me included the following:

2. I already knew the following, and this course offered a review or update on the topic:

3. Please list the [course management system] activities you found helpful in terms of your own learning and explain why or how they were helpful. If you found some [course management system] activities to not be helpful, list those and explain.

4. Please describe any strategies we might adopt that you think will improve the course.

5. Please list any criticisms you have – in a constructive way – that will allow for positive change.

Appendix C

Example of a Topic Related Reflection
Leadership/Controversy/Conflict Reflection

Think about your experiences as a group leader. What styles of leadership have you used? How did they work in the various situations? Describe your best experience, how you led and why your leadership worked in that situation. Describe your worst experience, how you led and why your leadership did not work as well in that situation.

Think about controversy and conflict. How do you handle those situations? What are your preferred patterns? Describe a situation that you think your preferred patterns worked well and why. Describe a situation that you think your preferred patterns did not work well and why. Describe a situation where you used a non-preferred pattern, how it worked and what you needed to do to use that pattern in the situation.

Identify some professional goals for your leadership, management of controversy, and resolution of conflict. Identify how you plan to work on those goals.

Appendix D

Group Autobiography

Think about your group experiences over the years. Do particular groups or incidents come to mind? Can you recall a positive experience involving groups? How about a negative experience? How might these have had an effect on your approach to this course?

One purpose of this assignment is to open lines of communication between us that we will continue to build throughout the remainder of the semester. Another purpose is to ask you to reflect on how you feel about groups, and why you feel this way.

The assignment is also a record of your thoughts – something you can reflect on and learn from later. By reconstructing the events and processes by which you have arrived at this point, by identifying key events that have influenced you, you may discover important aspects of your beliefs and skills, which could help you throughout the semester.

In this limited group autobiography (2 to 3 pages), please include both a positive and a negative story. As part of your reflection, indicate how these events or people have influenced your perceptions of yourself as a group person.

Devote the final paragraph to a discussion of your goals for this course. Include the following: the reason you are taking this course, your personal goals that might be accomplished through this course, your academic goals for this course, and comments on how you will meet these goals. (We will return to these goals during the course of the semester.)