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Capturing students' attention: An empirical study

Erik Rosegard[1] & Jackson Wilson[2]

Abstract: College students (n=846) enrolled in a general education course were randomly assigned to either an arousal (experimental) or no-arousal (control) group. The experimental group was exposed to a topic-relevant, 90-second external stimulus (a technique used to elevate arousal and focus attention). The control group listened to the instructor take roll. Both groups then listened to the same 30-minute lecture followed by an exam. An independent-samples t-test found a significant difference in exam scores measuring information retention between arousal (M=13.36, SD=1.5) and no-arousal (M=12.85, SD=1.4) conditions; t (844)=5.20, p < .001. Results suggest introducing a lecture with an external stimulus increases information retention.

Keywords: arousal, attention, memory, retention

I. Introduction.

Boredom is a significant issue in higher education (Craig, Graesser, Sullins, & Gholson, 2004; Pekrun, Goetz, Titz, & Perry, 2002; Shernoff & Csikszentmihalyi, 2003). In a series of five studies, Pekrun, Goetz, Daniels, Stupnisky, and Perry (2010) found a positive relationship between boredom and attentional problems while a negative relationship existed between boredom and academic performance. In a subsequent review, Pekrun, Goetz, Frenzel, Barchfeld, and Perry (2011) found that boredom was negatively related to motivation to learn, processing of information, and memory. Wallace, Kass, and Stanny (2002) and Wallace, Vodanovich, and Restino (2003) found a strong association between boredom and cognitive-based mistakes (e.g., attention deficits and memory failures). These academic related issues may lead to lower GPAs (Maroldo, 1986) and higher dropout rates (Farmer & Sundberg, 1986).

Boredom is also prevalent in higher education. Mann and Robinson (2009) found that 59.0% of university students experience boredom with 30.0% experiencing boredom most or all of the time. According to a 2010 Higher Education Research Institute (HERI) report, the weighted national norm for first-year students feeling bored in the classroom was 39.2% (Pryor, Hurtado, DeAngelo, Blake, & Tran, 2010). Pekrun et al. (2010) found boredom to be experienced significantly more than other negative emotions directly tied to learning and achievement (i.e., anxiety, anger, hopelessness). This academic emotion was one of the most cited reasons for dropping out of college (Farmer & Sundberg, 1986). Compared to other developed countries, "the United States now has the highest college dropout rate in the industrialized world" (Symonds, Schwartz, & Ferguson, 2011, p. 10).

Evidence supports the need to address the deleterious effects of this significant and widespread academic emotion. However, boredom involves motivational, cognitive, and physiological factors that are difficult to define and measure (Farmer & Sundberg, 1986; Mikulas & Vodanovich, 1993; O'Hanlon, 1981; Pekrun & Linnenbrink-Garcia, 2012). In developing a comprehensive definition of boredom based on a systematic, cross-disciplinary review, Vogel-

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Walcutt, Fiorella, Carper, and Schatz (2012) synthesized that "boredom occurs when an individual experiences both the (objective) neurological state of low arousal and the (subjective) psychological state of dissatisfaction, frustration, or disinterest in response to the low arousal" (p. 102). This aversive state and associated suboptimal arousal can negatively affect the motivation to learn.

One potential strategy to mitigate the negative effects of boredom is to increase arousal (Belton & Priyadharshini, 2007). A prevalent teaching strategy with prolific anecdotal evidence is the use of an external stimulus – a hook, trigger, attention getter/grabber, or anticipatory set (e.g., Feden & Vogel, 2002; Hidi & Renninger, 2006; Hunter, 1994; McCarty & Siccone, 2001; Moore, 1987; White, 2007; Willis, 2006). These external stimuli capture students' attention by touting the ability to increase arousal (decrease boredom), focus attention, and enhance learning and memory (Willis, 2006).

Although theoretically grounded in cognitive psychology and neuroscience, a paucity of empirical evidence exists on the efficacy of arousing techniques on attention and learning (Banas, Dunbar, Rodriguez, & Liu, 2011; Berk, 2011; Carlson, 2011). This is surprising given the widespread acceptance of attention getters used in the classroom and the recent contributions from "brain-based learning" – a neuroscience moniker used to describe the comprehensive and interdisciplinary approach to teaching and learning based on the science of nervous system structures and functions (Caine & Caine, 2004). Buskist and Groccia (2011) commented, "it is ironic that within higher education institutions dedicated to the discovery, transformation, and dissemination of knowledge, the choice of teaching strategies is based largely on experiential, commonsense, or anecdotal evidence" (p. 6).

The following review of literature will provide an overview of arousal, attention, and memory. Although the three concepts are interdependent, arousal is often identified as the precursor to attention (Posner & Peterson, 1990). If there is sufficient arousal, attention to the stimulus allows cognitive processing of the stimulus resulting in the forming and storing of a memory (Wei, Wang, & Klausner, 2012).

A. Arousal.

The use of an external stimulus is intended to heighten arousal. Difficult to define and complex in function, arousal in its basic form is a multifaceted, interdependent construct that "underlies all motivated behavioral responses, cognitive functions, and emotional expression" (Pfaff, Ribeiro, Matthews, & Kow, 2008, p. 11). Although a comprehensive understanding of arousal has yet to be established and is beyond the scope of this paper, arousal is often considered the primary mechanism of the central and autonomic nervous system, and is considered both a physiological and psychological state based on sensory excitability (Berlyne 1960; Eysenck, 1982; Loewenstein, 1994). This neural excitation originates from sensory input received by the Reticular Activating System (RAS), which then sends the information to the limbic system for processing (see Lieberman, 2011, for a review of this process). Arousal is responsible for activating and regulating numerous mechanisms (e.g., attention and memory), and can range from sleep to a state of alertness (Eysenck, 1982; Robbins & Everitt, 1995).

As a construct, arousal has been used in numerous learning theories. The earliest, most notable is the Yerkes-Dodson Law (Yerkes & Dodson, 1908). Although the inverted U-shaped function between arousal and performance (learning) has been mislabeled, widely criticized, and viewed as simplistic and unidimensional (Baumler, 1994, as cited in Hancock & Ganey, 2003;

Eysenck, 1982; Hanoch & Vitouch, 2004; Mandler, 1975), the basic premise of a curvilinear relationship has been replicated in studies with animals (Broadhurst, 1957) and humans (Dickman, 2002), with too much arousal leading to feelings of anxiety and too little arousal resulting in boredom (Apter, 1997; Belton & Priyadharshini, 2007; Csikszentmihalyi, 1975). Anderson (1990) argued that arousal and the inverted-U hypothesis could be pragmatically useful in exploring a wide range of behaviors and associated emotions. A moderate level of arousal has been purported to stimulate curiosity and interest (Berlyne 1960; Renninger & Hidi, 2011).

Jepma, Verdonschot, van Steenbergen, Rombouts, and Nieuwenhuis (2012) investigated the neural mechanisms underlying curiosity and argued that curiosity is a basic biological drive and motive for learning. According to Berlyne (1960), curiosity is a state of moderate arousal induced by external stimuli that presents conflict or uncertainty, and this motivated approach behavior seeks to resolve the conflict through the acquisition of knowledge. Through a number of experiments, Berlyne (1966, 1970) found that external stimuli comprised of collative properties (e.g., novelty, incongruity, ambiguity, surprise) evoked curiosity and exploratory behavior more than neutral forms of external stimuli (e.g., familiar, simple, clear, expected). Thus, beginning a class with a novel or unexpected question, puzzle, or poem would cause an increase in arousal followed by curiosity and the motivation to explore or seek information needed to answer the question, solve the puzzle, or appreciate the poem. Resolving this "information gap" through curiosity leads to positive affect and increased learning and memory (Loewenstein, 1994).

In a study using functional Magnetic Resonance Imaging (fMRI), Kang et al. (2009) showed a correlation between curiosity (stimulated by trivia questions) and cortical activity in brain regions associated with anticipated rewards. These results support Berlyne's (1966, 1970) earlier findings that external stimuli increases curiosity (interest) and the resulting motivated behavior to resolve the conflict. Jepma et al. (2012) also used fMRI to test predictions related to curiosity and found that learning and memory is enhanced when curiosity is reduced.

The term "interest" has been associated with curiosity. Hidi and Anderson (1992) and Izard (1977) noted Berlyne did not clearly differentiate between the two terms. However, Litman and Jimerson (2004) suggested that interest was one type of curiosity associated with positive affect rather than a deprivation state motivated to reduce an aversive condition. Hidi and colleagues (Hidi, 1990; Hidi & Anderson, 1992; Hidi & Harackiewicz, 2000) argued interest as well as curiosity is critical to learning and would benefit students who do not have a pre-existing interest in an academic topic or activity. Hidi and Renninger (2006) identified two types of interest (situational and individual). Whereas individual interest refers to one's preferences for certain activities, situational interest focuses on the characteristics of the activity and is more relevant to capturing students' attention (Hidi & Renninger, 2006).

Situational interest is a transitory affective response to a stimulus originating from a specific object, environment, activity, or event, which focuses an individual's attention. Individual interest refers to a more stable predisposition that evolves over time through continued cognitive and affective processing of a specific content area or activity. Situational interest is more closely associated with capturing students' attention (Hidi, Renninger, & Krapp, 2004) and can be evoked by novel, but meaningful stimuli. Turner and Silvia (2006) found that novel stimuli (i.e., visual art and poetry) triggered situational interest. However, Renninger and Hidi (2011) noted that the trigger or collative stimuli associated with situational interest needs to be relevant and meaningful. Mitchell (1993) found that novel stimuli (i.e., puzzle and computer

interaction) were more apt to stimulate situational interest whereas relevancy and meaningfulness of the trigger were more associated with maintaining situational interest. Chen, Darst, and Pangrazi (2001) observed not only an increase in situational interest from participants exposed to novelty and challenge, but also an increase in cognitive processing (e.g., attention). As with curiosity, situational interest should result from exposure to a novel and relevant external stimulus. This external stimulus is purported to elevate arousal, and in turn, focus and sustain attention (Anderson, 2005; Calvo & Lang, 2004).

B. Attention.

As the name implies, attention-getting devices are intended to focus the students' attention on class content (external stimulus). From a neural perspective, Norton and Pettegrew (1979), and Penner (1984) defined attention as receptive and cognitive processes that bring awareness to arousing stimuli entering consciousness. These processes involve "(a) orienting to sensory events, (b) detecting signals for focal (conscious) processing, and (c) maintaining a vigilant or alert state" (Posner & Peterson, 1990, p. 26). Berlyne (1960) supported the strong relationship between higher levels of arousal and the intensity (narrowing) of attention. Studies have established that arousal is positively related to a narrowing of attention and negatively related to the number of cues (details) utilized (Gable & Harmon-Jones, 2008; Riggs, McQuiggan, Farb, Anderson, & Ryan, 2011).

The "cue utilization hypothesis" (Easterbrook, 1959) provides an explanation of the inverted U-shaped relationship between arousal and performance (i.e., learning), and is based on selective attention. The basic tenet of the hypothesis is that arousal is inversely related to one's span of attention or cue utilization. An increase in arousal will lead to attention narrowing or a restriction of cues that can be processed, whereas a decrease in arousal will result in attention widening or a broadening of cues. Depending on the situation, this can be beneficial or detrimental. When attention is inadequate or inappropriate, learning is negatively affected (Easterbrook, 1959; Eastwood, Frischen, Fenske, & Smilek, 2012).

For example, if an instructor elevates students' arousal before a lecture, there is a higher probability that relevant, central details of the lecture material will be attended to and retained in memory. At the same time, less attention will be directed to irrelevant or peripheral details (e.g., an incoming text message from a friend, a novel noise originating from the back of the classroom, thoughts of what to eat for lunch after class). Excessive arousal results in students' attention being too focused/restricted that relevant elements of the lecture material are not processed or retained in memory, whereas the attention of under aroused students will wander and be easily distracted by competing stimuli.

Mather and Sutherland (2011) developed an Arousal-Biased Competition (ABC) theory to explain that arousal, whether elicited by stress hormones, external stimuli, or internal dialogue, narrows attention and stimulates the modulation of sensory processing, information encoding, and memory consolidation. The ABC theory proposes that arousal modulates attention by prioritizing competing stimuli. This bias leads to an enhanced memory processing and consolidation for high priority stimuli and decreased processing and consolidation for low priority stimuli. Prioritization occurs through interdependent "top-down" and "bottom-up" mechanisms that capture attention. Top-down influences tend to be cognitive based and goal relevant (e.g., class expectations, prior knowledge, explicitly stated learning outcomes). Bottom-

up influences are more emotionally based and perceptually salient (e.g., disturbing video, contradictory statement, powerful statistic).

Mather and Sutherland (2011) reviewed empirical evidence that exists for both top-down and bottom-up processes that prioritize stimuli, focus attention, and increase memory. For example, Zeelenberg and Bocanegra (2010) found that participants exposed to an arousing sound could recall a list of words significantly better than participants who were not exposed to an arousing sound. Liu, Graham, and Zorawski (2008) demonstrated that participants who viewed an arousing video recalled a set of pictures significantly better than participants who viewed a neutral video. Sarter and Lustig (2009) reviewed literature on arousal, attention, and memory, and concluded, "the assumption that attended stimuli are encoded more effectively into memory than less attended ones is straightforward and supported by substantial evidence" (p. 639).

In a classroom setting, top-down strategies may include explicitly stating the learning outcomes for the lecture (e.g., students will identify two consequences of drinking and driving) or asking questions pertaining to the lecture that elicit prior experience or knowledge of the subject area (e.g., how many of you have driven or been in a car with someone under the influence of alcohol). Bottom-up methods would include showing a disturbing picture of a video related to the lecture (e.g., consequences of drinking and driving). Just as arousal affects attention, attention affects learning and the ability for perceived stimuli to be encoded into short-term and long-term memory. Wei, Wang, and Klausner (2012) argued "because attention is the main gatekeeper to processing, storing, and retrieving information, learning cannot proceed in its absence" (p. 91). Learning and the process of working with information also involves memory.

C. Learning and Memory.

Learning and memory (LM) are two distinct, but interrelated processes. Learning is associated with information acquisition and subsequent behavior change, and memory is responsible for encoding, storage, and recall of information (Lieberman, 2011). Cowan (1997) explained that encoding information, a process that is modulated by arousal and attention, is the first step in forming a memory. Encoding involves the perception of an external stimulus, which is then converted into an engram (i.e., a hypothetical memory trace) by the brain region responsible for processing the stimulus (e.g., visual cortex, language area).

Storage or retention of information consists of an ongoing consolidation process (e.g., long-term potentiation). This process involves an increase in strength and frequency of neuronal communication – the firing between nerve cells synapses. Stronger communication leads to a more accurate memory and a greater likelihood of memory retention from short-term to long-term memory (Cowan, 1997). Substantial empirical evidence supports the basic notion that arousal and attention modulate and precedes learning and memory (see discussion in Craik & Lockhart, 1976; Kyndt, Cascallar, & Dochy, 2012; Posner & Petersen, 1990; Riggs, McQuiggan, Farb, Anderson, & Ryan, 2011; Risko, Anderson, Sarwal, Engelhardt, & Kingstone, 2012).

As discussed in the previous two headings, arousal and attention have been empirically linked to memory. Murty, Ritchey, Adcock, and LaBar (2011) conducted a meta-analysis of fMRI studies and found a positive relationship between arousal and memory. In addition, Murty et al. found that emotional stimuli were remembered better than neutral stimuli. In the context of teaching, a poem that evokes imagery or emotion would enhance memory more than a poem using neutral words. Given that a strong theoretical framework has been established, a review of research examining the effects of an external stimulus on arousal, attention, and learning will be

presented. The limited evidence that exists is primarily within the area of instructional communication (e.g., humor and multimedia).

D. Humor and Multi-media.

The definition of humor varies among scholars, but the following characteristics are widely accepted: (a) Verbal or nonverbal communication, (b) positive emotions, and (c) incongruous meanings (Martin, 2007). One theory used to explain the humor process that incorporates arousal and attention is the Instructional Humor Processing Theory (IHPT) (Wanzer, Frymier, & Irwin, 2010). Arousal is used to explain IHPT in that resolving incongruous meaning(s) is an interaction between physiological arousal and cognitive appraisal. The incongruity creates cortical conflict stimulating a physiological need to maintain homeostasis by resolving the incongruity. According to IHPT, an individual needs to perceive and resolve the incongruity within a humor message. This increased arousal (curiosity motivation) for resolution directs attention as long as the humor is relevant.

Further, Wanzer et al. (2010) suggested that the mental processing and elaboration resulting from the humorous message increases learning and recall. The IHPT predicts that instructor's use of humor in the classroom will enhance motivation, positive affect, and learning to the extent the humorous message captures students' attention, is relevant and appropriate, and resolution of the incongruity is successful. Martin (2007) stated "the novelty and emotionally arousing properties of humor may help to attract and sustain students' attention onto the lesson, thus facilitating acquisition of information" (p. 354). In determining the efficacy of humor on motivation and learning, Banas et al. (2011) reviewed forty years of research on humor in educational settings and found generally positive, but inconsistent results.

Ziv (1988) found positive effects of humor on cognitive learning in a classroom setting. Two groups were randomly assigned to a humor and no-humor condition. The same instructor delivered the information to both conditions with the humor group being presented with three to four concept-relevant jokes after presenting the concept and before an end-of-class review. The no-humor group was presented with the same information without jokes. The humor group performed significantly better on a post-lecture exam, and findings were replicated in another class using a different instructor in the following semester. Ziv cautioned that the majority of humor research has been conducted in artificial (experimental) settings and generalizing results to educational settings is limited. One study resulting in inconsistent results involved the effects of humor messages on learning. Kaplan and Pascoe (1977) examined three versions of a lecture used to deliver humorous messages to students before assessing information recall. One lecture presented humorous examples that were relevant to the topic; one lecture presented unrelated humor; and one lecture presented a mix of relevant and irrelevant humor. No significant results were found with immediate recall as measured by an 11-item quiz. However, after six weeks, students in the relevant humor lecture scored significantly better than the other two conditions on the same 11-item quiz. However, total quiz scores did not differ between conditions. Kaplan and Pascoe posited that inconsistent findings might be attributed to humor only improving information recall for those items related to the humorous messages, and concluded "general comprehension and retention of a classroom message is not significantly improved by the use of humor" (p. 64-65). Further, conceptual and methodological issues related to humor research create difficulty in understanding how humor functions in the classroom (Banas, et al., 2011). Teslow (1995) asserted that existing evidence is dated and study replication is scant. More

recent studies have investigated multimedia effects on learning and memory including some forms of humor (e.g., cartoons, humorous video).

Multimedia messages have been reported to act as an external stimulus that elevates arousal, focuses attention and enhances learning and memory (Berk, 2011). Research investigating the effects of multimedia on memory is often based on the cognitive theory of multimedia learning (Mayer, 1997). The theory proposes that auditory and visual processing occurs independently, but in parallel within working memory. This allows an individual to access more cognitive capacity to process information presented in text and pictures. Mayer (2003) reviewed research demonstrating that participants presented with information in two modes of representation (e.g., visually and verbally) learned significantly better than if presented with one mode of representation. This finding was demonstrated in text- and computer-based environments. For example, Mayer and Anderson (1991, 1992) found that participants listening to a narration on how a bike pump operates while watching an associated animation were able to generate significantly more solutions to subsequent problem-solving questions related to the topic. Eaton and Uskul (2004) examined a single mode of information delivery (i.e., film clip), and found that students scored significantly higher on test questions related to film clips than on questions unrelated to the film clip. This finding has been replicated in other studies (Kirsh, 1998; Mathis & Tanner, 1991). Studies examining multimedia messages in PowerPoint presentations have demonstrated similar results (Berk, 2011).

The above review of literature supports the framework that an external stimulus will evoke arousal, focus attention, and result in information retention. Moreover, the external stimulus needs to be germane to the course content, contain collative properties, and produce a moderate level of arousal. In addition, the review of literature also identifies the need to address the following observed deficits: (a) to examine information retention after exposure to an external stimulus, (b) to study the effects of external stimuli and arousal in a classroom setting, (c) to research other forms of external stimuli other than humor and multimedia, and (d) to provide empirical data for evidence based teaching strategies. Specifically, the purpose of this study was to examine the effects of arousal on information retention among college students in a classroom setting. The research question examined was whether student exposure to a 90-second external stimulus (i.e., attention grabber) would result in an increased retention of lecture information.

II. Methods.

The study was a randomized experimental design involving 846 students over a four-year period in a general education classroom at a large, urban university. The following methods will describe the variables, participants, instruments, procedure, and data analysis used in the study. It was hypothesized that participants exposed to an external stimulus will recall lecture information better than participants not exposed to an external stimulus.

A. Variables.

The dependent variable was information retention as measured by the response performance on a 15-point exam covering a 30-minute lecture on alcohol and leisure. It was hypothesized that students exposed to a pre-learning external stimulus (i.e., poem, game, puzzle) would retain information from a lecture significantly better than students who are not exposed to a pre-

learning stimulus. The independent variable arousal was operationalized as a 90-second external stimulus and was divided into arousal (experimental) and no-arousal (control) conditions. Three types of external stimuli (i.e., poem, game, puzzle) were used to increase arousal and were based on Berlyne's (1966) collative properties (e.g., novelty, ambiguity, surprise). In the first year, the experimental groups within both class sections listened to a poem related to alcohol and its consequences. The poem (external stimulus) was 90-seconds in duration and contained words designed to create visual imagery used to elicit an emotional response. The second year experimental group participated in a 90-second movement game called "no need for alcohol." The game consisted of paired students standing up, clapping their hands once, and pointing both thumbs in one direction. Without talking, the clapping and pointing would continue until both students pointed in the same direction, at which time, the first student to point to the other student saying "no need for alcohol" was the winner. Both students were then instructed to move quickly to another location (a minimum of 15 feet) and begin another round of the game. Instructions took 45 seconds while students were in a standing position and game play persisted for an additional 45 seconds. At the end of the 90-second attention activity, students were told to sit in their seats. In year three, the experimental group participated in a 90-second word search puzzle. Students were instructed to search for multiple occurrences of two words (alcohol and leisure) in a 15x15 letter grid. Two occurrences of each word were hidden within the puzzle. In year four, a different 90-second poem on alcohol was used in the experimental group. Similar to the first poem, the content addressed the antecedents, behaviors, and consequences of alcohol, and contained moderately graphic phrases to elevate arousal.

B. Participants.

Research participants consisted of students taking a one semester, upper-division course that fulfilled a university-wide general education (GE) requirement. Participants included students from 16 course sections (2 sections per semester over 4 consecutive years). Students taking the class represented a wide range of majors; however, the majority of students were pursuing a degree in Child and Adolescent Development or Recreation, Parks, and Tourism. The class roster showed that more than 90% of students were juniors or seniors at time of enrollment. Although no demographic information was collected, course enrollment of general education courses is an approximate representation of the university population (58% female; 30% White non-Latino, 26% Asian, 14% Chicano or Mexican American, 9% Latino, 9% Filipino, 6% African American; average age 22.7 years old – San Francisco State University, 2011). The eight semesters of data included responses from a total of 846 students. The duration of the course was 110 minutes and was divided into two, 55-minute sessions allowing 50 minutes for the arousal condition, 50 minutes for the no-arousal condition, and a 10-minute transition between conditions. The same instructor taught all 16 sections of the course. Class size averaged 53 students (range = 49-62).

C. Instruments.

Two instruments were used to collect data. One instrument (i.e., exam) measured the dependent variable, information retention. The purpose of the exam was to determine the retention of information immediately following a 30-minute lecture on alcohol and leisure. The exam consisted of 15 questions worth one point each. The questions ranged from true/false (4

questions) and multiple choice (4 questions) to matching (4 questions) and short-answer (3 questions). For example, one True/False question asked whether "*a 150-pound individual can detoxify two (2) ounces of alcohol in 30 minutes*."

The second instrument measured instructor enthusiasm. Instructor enthusiasm has been shown to impact learning (Lammers & Smith, 2008) and may have acted as a moderating variable. The instructor presented the lecture in both the arousal and no-arousal conditions for all 16 sections of the course and attempted to convey a uniform presentation to both conditions through an identical PowerPoint outline and associated script. A semantic differential scale (i.e., a 7-point rating scale using bipolar adjectives at each end) was used to measure instructor enthusiasm (enthusiastic – unenthusiastic) for all students.

D. Procedure.

One-week before the day of the experiment, students in each class section were randomly assigned to one of two groups (arousal or no-arousal condition). Each group attended either the first half of class or the second half of class depending on whether they were assigned to the arousal or no-arousal condition. The arousal (experimental) group was exposed to a 90-second external stimulus (i.e., poem, game, puzzle) while the no-arousal (control) group listened to a 90-second roll call where the instructor pronounced the first and last name of each student in the class. After completion of the 90-second activity (external stimulus or roll call), both groups listened to the same 30-minute lecture on the antecedents, behaviors, consequences (ABCs) of drinking alcohol, and alternative leisure activities.

At the end of the lecture, students were given an exam that included the enthusiasm scale. The 10-minute, 15-point exam covering the 30-minute lecture and discussion on alcohol and leisure was given to students in both groups. Students did not place their name or any demographic identifiers on the exam, and the exam was not used for course grading purposes. At the bottom of the page, students were instructed to rate the instructor's enthusiasm using a 7-point semantic differential. After 10 minutes, students were asked to stop writing and submit their exam to the instructor. Students were excused after they submitted their exam and exited through the east door. The second group of randomly assigned students entered from the west for the second half of class and the procedure was repeated. This process was reversed for each section.

For example, the experimental group was exposed to the 90-second external stimulus during the first half of class in section one while the experimental group of section two attended the second half of class. This procedure was reversed for the no-arousal condition. The control group listened to the 90-second roll during the second half of class in section one, while the no-arousal group of section two attended the first half of class. Each year of the study, the same procedure was followed for the experimental and control groups, except for the type of external stimuli used in the arousal condition.

E. Data Analysis.

Data were analyzed using IBM SPSS 19. Descriptive and inferential statistics were calculated in order to describe the sample and determine if there was a significant difference between the arousal and no-arousal conditions, and whether a significant difference existed within the four arousal conditions (i.e., poem1, game, puzzle, poem2).

III. Results.

The dependent variable was information retention as measured by the performance score on a 15-point exam. There were 846 individual test scores with a minimum score of 9 and a maximum of 15. The mean score for all tests was 13.11 and was slightly negatively skewed (-.482). There were 49 to 62 students (μ=52.88) that completed the exam in each of the 16 sections.

A Pearson correlation matrix was created to see if any bivariate correlations were significant (Table 1. Correlation Matrix for N = 846). As hypothesized, the only significant correlation (p<.000) was between the experimental group (0=control or 1=experimental) and the score on the 15-point exam (r=0.176).

Table 1. ***Correlation Matrix for N = 846.***

		15-pt Exam	7-pt Scale	Arousal Condition	Stimuli Type/Year	Semester	Section
15-pt exam (Information Retention)	Pearson Correlation	1	.026	.176**	-.022	.004	-.013
	Sig. (2-tailed)		.450	.000	.532	.916	.699
7-pt Scale (Instructor Enthusiasm)	Pearson Correlation	.026	1	-.022	.008	.025	-.039
	Sig. (2-tailed)	.450		.517	.812	.461	.255
Arousal Condition (Experimental Group)	Pearson Correlation	.176**	-.022	1	.001	.005	.003
	Sig. (2-tailed)	.000	.517		.968	.888	.935
Stimuli Type/Year (Poem1, Puzzle, Game, Poem2)	Pearson Correlation	-.022	.008	.001	1	-.020	-.021
	Sig. (2-tailed)	.532	.812	.968		.566	.551
Semester	Pearson Correlation	.004	.025	.005	-.020	1	-.005
	Sig. (2-tailed)	.916	.461	.888	.566		.889
Section	Pearson Correlation	-.013	-.039	.003	-.021	-.005	1
	Sig. (2-tailed)	.699	.255	.935	.551	.889	

** Correlation is significant at the 0.01 level (2-tailed).

An analysis of the 7-point enthusiasm score using an independent *t*-test found that there was no statistically significant difference between groups (p>.05). This provides some evidence that the moderating effect of instructor enthusiasm did not differ between the experimental and control group. An independent t-test on the 15-point exam measuring recall found that the mean score for the experimental group (μ=13.36, n=434) was significantly greater than the control group (μ=12.85, n=412) at p<.000. A calculation of the effect size (Cohen's d = 0.35) found that the number was between a small (.2) and medium (.5) effect size (Valentine, & Cooper, 2003). An ANOVA was performed to test if there were differences between external stimulus types (i.e., poem1, puzzle, game, poem2). The mean difference among each external stimulus was not statistically significant (p>.05).

A multivariate regression was conducted to test the relationship between the group membership (experimental or control) and the exam score. The overall model and predictor was significant (p<.000). The R^2 was 0.031 (3.10% of variance explained) for the single predictor of

group membership. None of the other variables were significant predictors (class, semester, year).

Data were collected during eight consecutive semesters, so a further analysis was done to see if time or the nesting structure had any impact on the data. A visual inspection of the mean scores across time showed no obvious changes between semesters or across years (Figure 1. Mean Scores across Time).

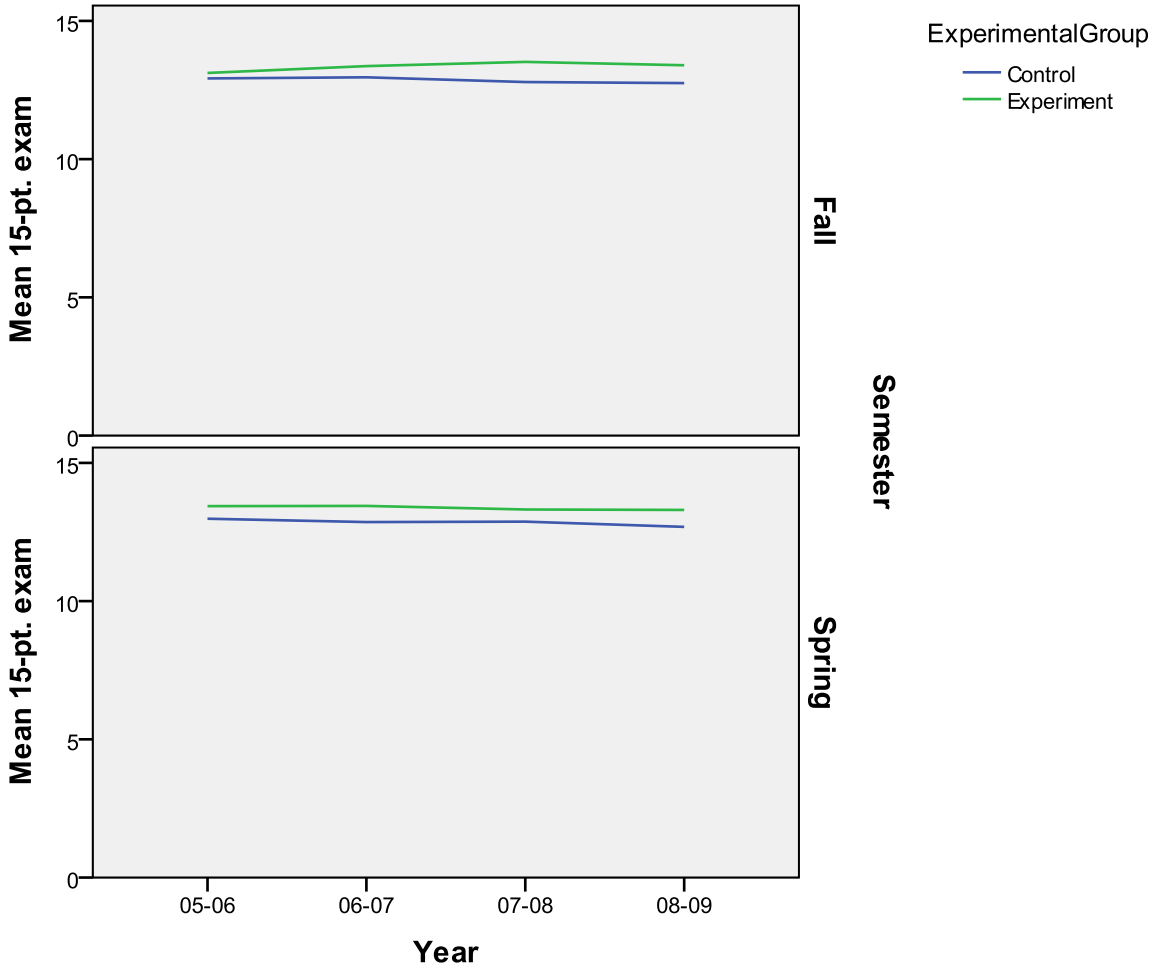

Figure 1. Mean Scores across Time**.**

A mixed effects model (i.e., hierarchical linear model or multi-level model) was conducted to further investigate whether there were any nesting effects. The model with only group membership as a fixed effect (independent variable) significantly increased the fit indices [both Akaike and Bayesian Information Criteria (AIC and BIC) decrease by 23.91] from the base-line model where only the intercept was allowed to vary (Burnham & Anderson, 2002). Entering additional terms to test if there was any nesting by class, semester, or year found that none of these significantly improved the fit of the model to the data. There were no nesting effects found in the data, but the difference between conditions (arousal versus no-arousal) continued to be evident.

An analysis of the exam scores found that there were no changes over time or differences between classes within the same group; however, there was a difference between the arousal and

no-arousal conditions. There was also no difference between types of external stimuli (i.e., poem1, game, puzzle, poem2). The exam score for the experimental group was statistically significantly higher than the mean exam score for the control group. The arousal condition explained a small percentage (3.1%) of variance in the overall scores ($R^2 = 0.031$), and a small size.

IV. Discussion.

The results of this study found that students exposed to a topic-relevant, 90-second external stimulus (i.e., poem, game, puzzle) before a 30-minute lecture demonstrated significantly better information retention, as measured by response performance on an exam, than students exposed to a neutral stimulus. Although the results were statistically significant, the measure of strength as calculated by Cohen's *d* was between a small and medium effect size. If looking at the mean differences between groups, the arousal group had less than a 1-point advantage on a 15-point exam. Although statistically significant, the practical significance of a ½-point or 3.3% grade differential is the determination of whether the incremental change is worth the time and effort of introducing students to an attention grabber. In determining the efficacy of attention grabbers, limitations will be identified and the importance of future research will be discussed.

A. Limitations.

One limitation of this study involved the researcher and instructor as the same individual. Although effort was made to deliver an identical presentation using the same PowerPoint slides and associated script, there is a possibility that some aspect of the lesson differed between the experimental and control group. While a videotaped lecture to both groups may have controlled for experimenter bias, the results may not be as generalizable to a face-to-face classroom setting. In addition, instructor enthusiasm may have been a limitation, but student reports showed no significant difference between the experimental and control groups.

A second limitation involved the operationalization of the constructs, arousal and memory. Although theory and limited research (Berlyne 1966, 1970; Mather & Sutherland, 2011) support the 90-second, topic relevant, external stimulus used in the experimental group (i.e., poem, game, puzzle), a physiological measure of arousal would have provided additional support and added validity. The dependent variable may also suffer from a measurement issue. For example, response performance on an exam may not accurately measure whether the information was retained. Students may have retained information that was not asked on the exam. In this study, if a student was able to recall information from the lecture, information was retained in long-term memory (Lieberman, 2011).

A third limitation may have resulted from the 90-second roll call used as the control equivalent to the 90-second external stimulus. Research has shown that hearing one's name increases arousal and shifts attention (Wood & Cowan, 1995). However, calling out 49 to 62 names for 90 seconds may have induced a baseline drop in arousal and thus, an inappropriate control. The methodological limitations of potential experimenter bias, instructor enthusiasm, variable measurement, and a questionable control lend themselves to future study.

B. Future Research.

This study only begins to address the dearth of empirical studies examining the learning effects of external stimuli. For example, in terms of arousal itself, how much arousal is needed to capture a student's attention? Evidence suggests that too much (anxiety) or too little (boredom) arousal can have deleterious effects on attention and memory (Berlyne, 1960; Cowan, 1997; Easterbrook, 1959), but no research was found identifying an optimal level arousal or range of intensity that results in improved learning or memory in a classroom setting.

What is the optimal duration of an external stimulus? Although a 90-second external stimulus in this study produced significant improvement in retention of information from a lecture, would the perception of a startling noise or disturbing picture, which can take milliseconds, be long enough to focus attention and enhance information retention? Would a 5-minute external stimulus result in positive gains or would the duration lead to desensitization and feelings of boredom?

In terms of timing, our study found a positive impact on retention from a pre-learning external stimulus; however, there is also evidence that providing post-learning arousal enhances memory recall (Liu, Graham, & Zorawski, 2008; Nielson & Powless, 2007). Research should compare pre- and post-learning arousal effects on memory as well as examine whether a pre- and post-learning external stimulus would have an additive effect on memory.

In addition, retention was measured immediately after a 30-minute lecture in this study. Measuring retention after longer delays (e.g., 1-2 weeks, end of semester) should be examined to determine durability of an external stimulus. Advances in neuroscience, PET scans, fMRIs, and other physiological indices of both central nervous and autonomic arousal may provide additional details of brain region activity as well as strengthen our understanding of cognitive processes. Future research should use these measurements for arousal as well as attention and memory rather than indirect measurements (i.e., external stimulus and post-lecture exam).

Finally, individual differences are an additional area of study that may provide insight into developing appropriate external stimuli. For example, Eysenck (1982) theorized that extroverts required higher levels of arousal to focus attention while introverts required less arousal. Although this study found no statistical difference between external stimuli types, this area needs further research. Bloom's (1956) three domains of learning (i.e., cognitive, affective, psychomotor) may be useful to investigate the salient features of different external stimuli types. Future studies should develop taxonomy for different external stimuli based on their functional differences.

C. Conclusion.

This study provided empirical support that implementing a hook, trigger, attention getter/grabber, and/or anticipatory set enhances learning and memory through increasing arousal (decreasing boredom) and focusing attention. Although results were statistically significant, a ½-point increase on a 15-point exam does not equate to anecdotal evidence and claims espoused by voluminous teaching improvement materials. In addition, due to a dearth of empirical evidence examining external stimuli and information retention in a classroom setting, generalizability is limited and further research is needed to validate current findings.

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Prevalence of mind mapping as a teaching and learning strategy in physical therapy curricula

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Abstract: Background and Purpose. Regardless of our discipline educators seek to create environments that actively engage students in their learning journey. One teaching and learning strategy that has emerged in higher education is mind mapping (MM). The purpose of this exploratory study was to determine the prevalence of MM usage in a health science professional curricula "physical therapy" and to determine if a relationship exists between faculty knowledge of mind maps and their use of the technique. Subjects/Methods. All Commission on Accreditation in Physical Therapy Education (CAPTE) accredited US physical therapist education program chairs (191) were emailed a request to participate in an on-line survey exploring the use of and knowledge of mind maps. The link to the survey was embedded in the email for direct access by the participants and was anonymous. Results. Of the 191 physical therapist program chairs surveyed, 55 completed responses were received. Of the 55 respondents only 10.9% (n=6) reported using MM within their curriculum while 89.1% (n=49) did not. For the 49 programs not using MM, 56.4% stated that their program faculty would be interested in using MM. Participants open ended responses support four major themes regarding faculty lack of MM utilization, with limited awareness identified as the greatest barrier. Discussion/Conclusion. The findings from this exploratory study support that MM is not used in many physical therapist education programs primarily due to faculty's lack of awareness. Interestingly, faculty would be interested in exploring its utility if they understood MMs tenets and relevance as a teaching and learning strategy.

Keywords: mind mapping, physical therapy, health sciences, teaching strategy

I. Introduction.

As educators, creating an environment that develops a students' critical thinking ability is one of our primary roles. One teaching and learning strategy that has recently emerged in higher education as a means to support student critical thinking is the nonlinear learning technique of mind mapping (MM) (Pudelko, 2012). Mind mapping, with its inter-related branching links information and is suggested to support a deeper level of thinking. While MM teaching and learning strategy has emerged in the literature, its use by physical therapist educators is unknown (Pudelko, 2012). The purpose of this exploratory study was to determine the prevalence of mind mapping usage in the education of physical therapist students. Research questions included: (1) Do faculty utilize mind maps in all CAPTE accredited physical therapist education programs?

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(2) If faculty do use mind maps, how are they used? (3) How does faculty define mind maps? (4) How does faculty define concept maps? and (5) Is there a relationship between faculty knowledge of mind maps and their use of the technique?

Review of literature. Mind maps are often confused with concept maps, which have been widely utilized in primary and secondary educational environments to promote critical thinking skills using a linear learning approach (Eppler, 2006). Concept maps have been used across the academic landscape including in the preparation of many health professionals including, nursing (Beitz, 1998) and medicine (Hoffman, Trott, & Neely, 2002). Numerous benefits resulting from the utilization of the concept map based upon its visual representation of information which fosters what Novak termed a "graphic re-construction of knowledge have been noted" (Novak & Canas, 2012). The tenets associated with concept mapping are supported by the cognitive learning theory that suggests that meaningful learning links new knowledge to prior knowledge (Ausubel, Novak, & Hanesian, 1986). Further supporting concept maps is the constructive theory of learning which suggests that in order to make sense of one's experiences "meaning" must be attached to the experience. In concept maps, "meaning" is associated to information through graphic reconstruction and representation (Vacek, 2009). Upon visual observation of concept maps a hierarchical process is noted which resembles the tightly structured format of an outline. It is through these connections that the concept map developer demonstrates a perceived relationship between ideas (Figure 1).

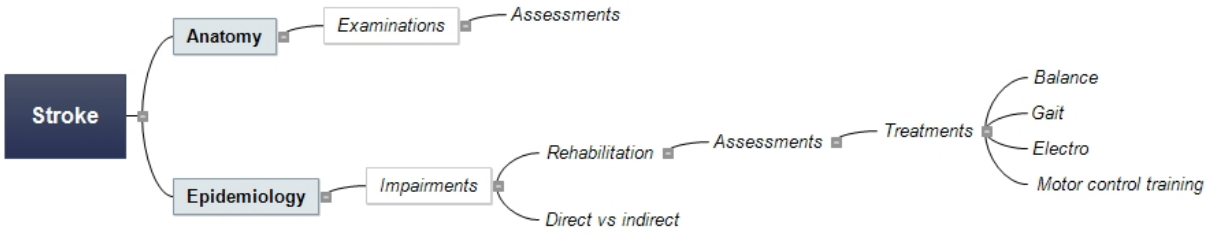

Figure 1. Illustrates a concept map on the assessment and treatment of stroke from a rehabilitative perspective. The map has two major themes presented in a linear fashion: theme 1 focuses on *epidemiology* and theme 2 on *anatomy*. Several sub themes are also presented in the map: *rehabilitation*, *examination* and *impairments*

Using the same underlying theoretical premise as that of concept maps is another teaching and learning strategy, "mind map". Mind mapping (MM) which is referred to as a "visual, non-linear learning technique" (Davis, Sumara, & Luce-Kaper, 2000) has only recently been investigated in the literature. This visually displayed non-linear approach to learning engages the learner in thinking and exploring concepts using visuospatial relationships and pictorial depictions in a non- linear manner. In mind mapping these relationships emerge from one central key theme by using peripheral branching. The number and location of these branches are reflective of the mappers understanding of important notions, ideas, and concepts associated with the central theme. Further inter-connecting of these notions, concepts and ideas result in cross connections across a radius of 360 degrees. It is this free flowing 360 degree radius that enables the mapper to seek and explore to the fullest the relationships associated with the material presented and thus make deeper and richer connections.

D'Antoni et al. (2011) further describes mind maps based upon the work of Buzan and Buzan (1993) who suggested that a mind map should be drawn on blank paper that is larger than standard 8 ½ by 11-inch paper allowing one to move outside the boundaries of conventional size paper. The use of multi-color and textured pens and pencils as writing implements are also encouraged as they afford the mapper a means by which to express themselves more creatively. The central positioning of the topic of interest allows the mapper the ability to develop and explore concepts and relationships using branches and sub-branches which contain pictures and key phrases (major themes presented). Pictures and phrases are key as they offer a mechanism to aid in information recall by creating a meaningful non-linear representation for oneself (Figure 2). This meaningful self-identified information representation supports a richer and deeper integration of information supporting both declarative (explicit) and non-declarative procedural (implicit) knowledge (Ambrose et al., 2010).

Several disciplines including Marketing (Erickson & Hauer, 2004), Economics (Nettleship, 1992), Finance (Biktimirov & Nilson, 2006), Executive Education (Mento, Martinelli, & Jones, 1999), Medicine (D'Antoni et al., 2010; Farrand, Hussain, & Hennessy, 2002), and Physical Therapy (Pinto Zipp, Maher, & D'Antoni, 2009) have begun to utilize mind mapping as a teaching and learning tool. Specifically in medical students Farrand et al. (2002) found both short term recall ($p=.016$) and long term ($p=.013$) factual recall was significantly better in their student group ($n=50$) using mind maps when compared to the traditional self-study group. Conversely, the work of Wickramasinghe et al. (2007) using mind mapping in medical students did not support Farrand's positive findings of MM on short-term memory.

Investigating if a relationship exists between mind mapping and critical thinking, D'Antoni et al. (2010) randomly assigned 131 first-year medical students to a standard note-taking (SNT) group or mind map (MM) group and found no significant differences in either critical thinking or content knowledge scores on the pre- and post-quizzes between the two types of note taking groups. The authors suggested that limited exposure to mind mapping did enable "novice" mind mappers the tools necessary to effectively grasp the material presented as they performed similarly to SNT subjects.

While the effectiveness of MM as a teaching and learning strategy has not been investigated in physical therapy students, Pinto Zipp et al. (2009) did explore physical therapy students' perceptions regarding the effectiveness of the mind mapping learning technique as a means to support their organization, prioritization, and integration of material course material. In this study, students perceived that mind mapping enabled them to organize material (38%), prioritize information (9.5%), and integrate course material (33.3%). Interestingly, the course faculty ($n=2$) did perceive that mind mapping improved student organization, prioritization, and integration of course material.

Although the authors have utilized mind mapping for over 6 years within a neurological rehabilitation course within a Physical Therapy program, objective measurement of MM supporting critical thinking has not been measured. Based upon the limited information on the utilization of MM in higher education and the presence of only several studies published specifically in the health professions literature (D'Antoni et al., 2010; Farrand, Hussain, & Hennessy, 2002; Pinto Zipp, Maher, & D'Antoni, 2009; Wickramasinghe et al., 2007; Pudelko, 2012) exploring mind mapping as a teaching and learning strategy in professional education the authors sought to first gain an awareness of the extent of its use specifically in physical therapist education programs.

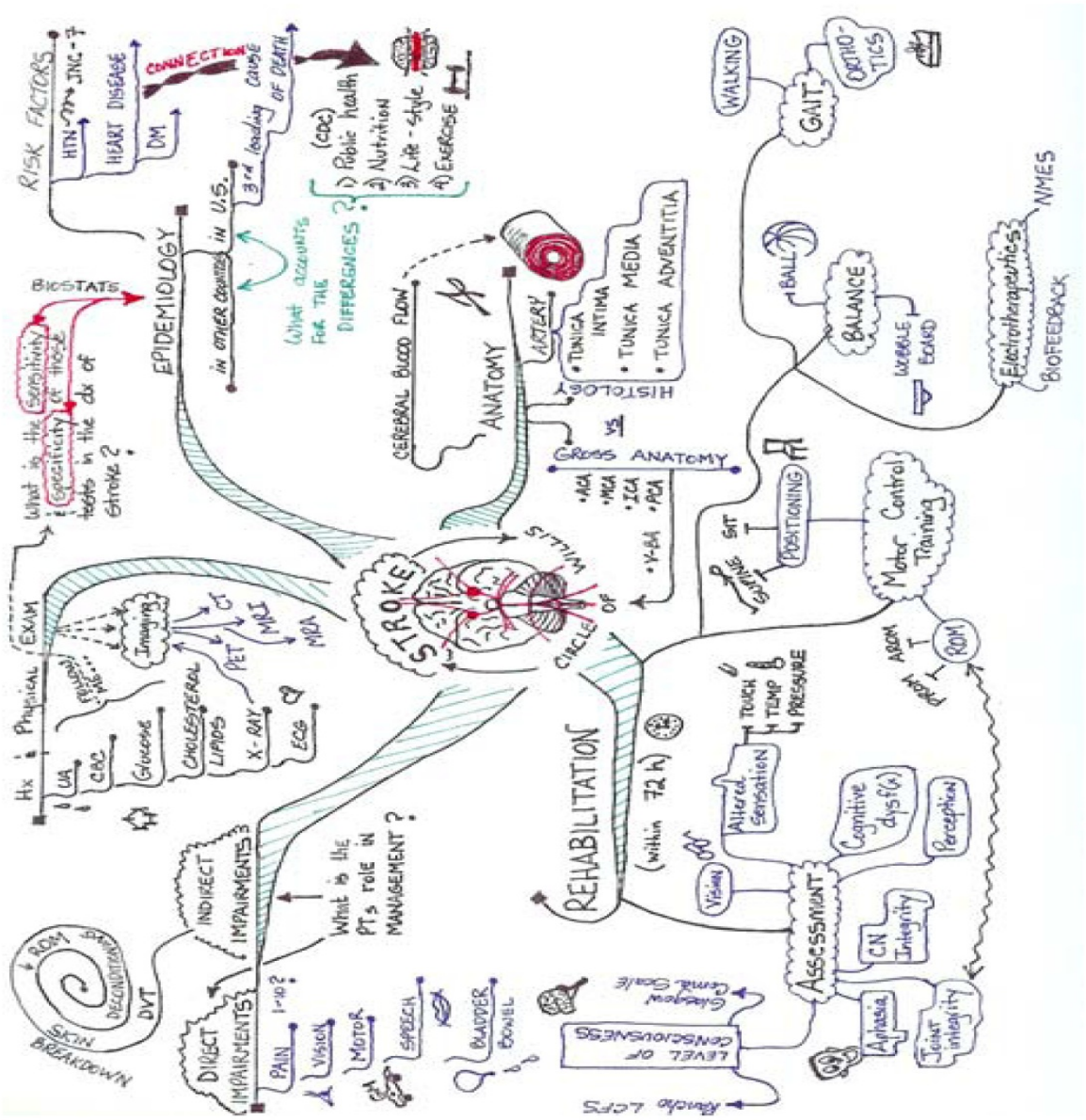

Figure 2. Illustrates one type of mind map on the assessment and treatment of stroke from a rehabilitative perspective. The map can be visualized as having four quadrants in a clockwise fashion: quadrant 1 focuses on *epidemiology*, quadrant 2 on *anatomy*, quadrant 3 on *rehabilitation*, and quadrant 4 on *history*, *physical examination*, and *impairments*. (Taken with permission from: D'Antoni, A. V., & Pinto Zipp, G. (2006). Applications of the mind map learning technique in chiropractic education: A pilot study and literature review. *Journal of Chiropractic Humanities, 13*, 2-11).

II. Methods.

A. Sample and Procedure.

The authors created a survey using ASSET, a university wide web-based survey tool. This study received approval from the Institutional Review Board at University. All CAPTE accredited PT academic program chairpersons received an email inviting them to participate in the study with instructions on how to access the survey via a hyperlink directed to the Seton Hall University Asset survey host. In 2010, all CAPTE accredited Physical Therapy programs chairpersons information (n= 191) was accessed via the APTA website. Participation in the study was completely voluntary and anonymous as the survey did not request participants to submit any personal or professional identifying characteristics. Physical Therapist program chairs were specifically surveyed given their responsibilities in overseeing curricular plans, syllabi, faculty assignments, and annual program review which would require explicit knowledge of all teaching strategies used by program faculty, thus enabling them to effectively respond to survey questions. The survey host (ASSET, SHU) stored the survey responses until they were downloaded by the researchers in aggregate format. Data from completed surveys were analyzed using SPSS Version 15.0.

B. Study Design.

The study utilized a descriptive, explorative survey research design. This descriptive, cross-sectional, survey design fit the aims of this study as it allowed the researchers to describe faculty utilization and knowledge of mind mapping in physical therapy curricula. Additionally, qualitative analyses of emergent themes from open ended questions posed within the survey were reviewed in order to provide greater insight into faculty perceptions regarding teaching and learning strategies specifically, mind mapping and concept maps. Participant's responses were coded for emerging themes and organized into sub-categories under each theme.

C. Survey Development.

To develop a valid survey questionnaire a modified Delphi consensus method was used consisting of five physical therapists with expertise in research design and survey development. Of the five Delphi panelists, four had used mind maps and concept maps in their teaching.

The Delphi technique has been used frequently in the literature to achieve consensus on an issue from a panel of experts, to collect an opinion on priorities in research or practice, to validate concepts or theoretical constructs (Bisset, Cusik, & Adamson, 2002), and to obtain content validity of survey items or measures on a researcher developed tool as was the case in this study (Biondo, et al., 2008; Falzarano, 2011; Falzarano & Pinto Zipp, 2012). Generally, the Delphi technique uses a series of questions seeking controlled feedback in attempt to seek the most reliable consensus among a group of experts in a specified area (Linstone & Turoff, 1975). For this study, the authors requested feedback on each question's appropriateness, clarity, and sequencing to the overall survey. Experts individually responded to the questions posed. In the literature it is suggested that survey developers using the Delphi approach review all expert responses and then modify the tool based upon the need to reach a pre-determined percent agreement. While the literature does not suggest a set percent agreement, many studies use 80%

(Keeney, Hasson, & McKenna, 2006) as was the case in this study. The revised survey is then sent out to the same experts for a second round of review on those survey questions, which required modifications in order to reach 80% agreement on question appropriateness, clarity, and or sequence. This process of review and revision is continued for several rounds until the set percent agreement has been met. In this study, the expert Delphi panel engaged in two rounds at which time 80% agreement was achieved on all individual questions. Lindeman (1981) suggested that the Delphi approach provides objectivity to the outcomes based upon the participant's lack of inhibition from the group process.

D. Survey Instrument.

Following an introductory statement on what a mind map is and a visual representation of a mind map, participants were asked to answer an initial question regarding the use of mind maps within their curriculum. If they responded "yes" to using mind maps they were directed via the electronic survey to complete 18 questions regarding the utlity of mind maps within their program (Section 1). The 18 questions required either a "yes" / "no" response or statements regarding their application of mind maps. Those participants who indicated that they did not use mind maps in their curriculum were asked to identify barriers as to why they did not use mind maps.

All participants were asked to complete the second section of the survey that contained demographic questions used to provide verification of the sample meeting the inclusion criteria. Only those respondents who used mind maps were asked to complete the third section of the survey which contained four open ended questions: how do you define mind maps?, how do you define concept maps?, does your program use concept maps?, and how does your program use mind maps?

III. Results.

A. Response Rate.

Of the 191 physical therapist education program chairs who were emailed a request to participate in the survey, 55 valid responses were return resulting in a 28.7% response rate. While there is no definitive required sample size for a survey (Kelly et al., 2003), the response rate obtained in this study represents approximately a third of all possible participants. The findings from this exploratory study, while offering insight, must be reviewed with caution as the sample who did respond that they used MM was much smaller than the group who responded that they did not use MM.

B. Demographic information.

Of the 55 respondents, the academic degrees awarded by institutions were the Doctor of Physical Therapy (n=53) and the Master of Physical Therapy (n=2). The physical therapist education programs were predominately three years in length (92.7%, n=51) with four programs being either four years (3.6%) or two years (3.6%) in length respectively. A majority of programs 58.2% (n=32) were not affiliated with a medical school. Potential regional differences were evaluated using the time zone of the program location. The time zone representing the largest

participant pool was eastern (67.3%) followed by central (20%), pacific (9.1%) and mountain 3.6% respectively (Table 1).

Table1. ***Demographics of Physical Therapy Program Respondents (n 55).***

Academic Degree Awarded	**Percentage**	**Number**
Master of Physical Therapy	3.6%)	2
Doctor of Physical Therapy	96.4%	53
Affiliated with Medical School		
Yes	41.8%	23
No	58.2%	32
Length of Academic Program		
2 years	3.6%	2
3 years	92.8%	51
4 year	3.6%	2
Location of Program by Time Zone		
Eastern	67.3%	37
Central	20.0%	11
Pacific	9.1%	5
Mountain	3.6%	2

Faculty Utilization of Mind Maps. Respondents were asked to identify if their faculty utilized Mind Maps (MM) in their programs over the past ten years and if so to identify when, where, and how it was infused within the curriculum. While current program chairs may not have been acting in that capacity during the entire ten year period, they would have explicit knowledge of teaching strategies during that time frame based upon their access to the program's accreditation documents and annual review reports. Of the 55 respondents, only 10.9% (n=6) reported using MM within their curriculum. Of the six programs using MM, 42.9% (n=3) reported using them for less than a year and 42.9% (n=3) reporting using MM for less than five years. Respondents were asked to designate the course category for which MM are used with 7.3% (n=4) identifying clinical coursework, 5.5% (n=3) foundational science, and 1.8 % (n=1) teaching and learning coursework. No respondents identified using MM in management coursework. When asked how their program utilizes MM within these identified areas, 16.7% (n=1) required MM after assigned readings but prior to class lectures, 33.3 % (n=2) required students to develop MM after class lectures and 50% (n=3) required students to develop MM as an assignment which added to their course grade (Table 2).

When asked if course instructors reviewed MM with individual students, 33.3% (n=2) stated that they did. Interestingly, only 16.7 % (n=1) formally assess students' perceptions regarding the use of mind maps in their program (Table 3).

Table 2. ***How Mind Maps are utilized within coursework (valid percent).***

	Yes	No
Require students develop mind maps after reading chapters but **prior to class lecture**	16.7% (n1)	83.3% (n5)
Require students develop mind maps **after class lectures**	33.3 % (n2)	66.7% (n 4)
Require students develop mind maps as **percentage of course grade**	50% (n3)	50% (n3)

Table 3. ***Faculty assessment of student developed mind maps (valid percent).***

	Yes	No
Formally assess student's perceptions of Mind Maps as a teaching/learning strategy	16.7% (n 1)	83.3% (n 4)
Course instructors review Mind Maps individually with a student in an attempt to develop the depth of their learning	33.3% (n 2)	66.7% (n 4)

To better understand faculty perception's regarding how students perceive and utilize MM as a learning strategy, several questions were posed to the faculty who use MM (Table 4).

Table 4. ***PT faculty utilizing Mind Maps perceptions' of student perceived utility of MM as a learning strategy (valid percent).***

Questions	Yes	No
Do students like the use of mind maps as a learning strategy?	60% (n3)	40% (n2)
Do students prefer mind maps over other educational strategies?	33.3% (n2)	66.7% (n4)
Students use their mind maps when reviewing for examinations and practical	100% (n6)	0.0%

The faculty respondents, who self-identified as not using mind maps within the PT curriculum, were asked to identify from a provided list of potential barriers which they perceived may have hampered their program's usage of MM. Of the 49 programs not using MM, 56.4% stated that their program faculty would be interested in using MM. Based upon the open ended responses from respondents not using MM, four themes emerged which may explain faculty lack of MM utilization, with limited awareness identified as the greatest barrier (Table 5).

Table 5. ***Barriers to mind mapping within Physical Therapy curriculum (percent agreement).***

	Percent	Number
Limited awareness of how to utilize MM in the existing coursework	72.7%	40
Lack of perceived usefulness of MM in developing student's critical thinking	43.6%	24
Lack of evidence to support MM in developing student's critical thinking	41.8%	23
Faculty time constraints	40.0%	22

For the programs currently using MM, three open-ended questions were posed to provide insight into how they are defining and incorporating MM as a teaching and learning strategy. The first open-ended question asked, "How does your program use MM?" Based upon the participants' responses, three major themes emerged: (a) as an adjunct to promote integration of knowledge, (b) to review concepts, and (c) to help students visualize interrelationships between variables (i.e., topics, structures, concepts). To determine the respondent's recognition of the subtle but important differences between concept and mind mapping techniques, the second question asked, "How would you define the term concept maps?" Upon reviewing the responses (Table 6), it was evident that faculty were aware that concept maps link information in linear fashion.

Table 6. ***PT Faculty Responses to define Concept Maps (most frequent themes).***

How would you define the term Concept Map?
• *Similar to mind mapping in that it is a graphical representation of the interrelationship between concepts; used to show linkages in the development of knowledge* • *Identification of interrelated concepts and the relationship between them – often related to one particular concept of idea* • *Directional flow/linking word to concepts* • *Linear concept integration flow chart*

The final open-ended question asked, "How would you define the term MM? Based upon the participants' responses, several themes emerged that support MM being viewed as diagrammatic interrelationships, interrelated concepts, and visual pictorial concepts (Table 7).

Table 7. ***PT Faculty response to define Mind Map (most frequent themes).***

How would you define the term Mind Map?
• *Visual representation of interrelated contextual processes* • *Diagrammatic representation of the interrelationships between certain variables and specific central ideas (tasks, structures or words)* • *Identification of interrelated concepts and the relationships between them- broad connections* • *Visual pictorial non-linear graphic integration of concepts*

IV. Discussion.

To develop critical thinking skills in students, faculty must continue to explore and evaluate the efficacy of various teaching and learning strategies. The findings from this study support that PT educators are not currently using mind maps as a mechanism for transmitting and integrating information in physical therapy education programs. This prevalence data is the first of its kind on MM utility in physical therapy education and can be used to explore strategies to address the perceived barriers. The authors infer that more important than understanding the prevalence of MM usage is the study finding that PT faculty would be interested in learning more about MM as a teaching and learning strategy and its usefulness in evidence-based teaching and learning.

Emerging literature in higher education recognizes the MM as a potential teaching and learning strategy that actively engages the mapper (learner) in synthesizing and integrating information in a meaningful non-linear manner (D'Antoni et al., 2010; Farrand, Hussain, &

Hennessy, 2002; Pinto Zipp, Maher, & D'Antoni, 2009; Wickramasinghe et al., 2007). The self-identified relationships that the mapper constructs may support a richer and deeper integration of information resulting in the fostering of both declarative (explicit) and non-declarative procedural (implicit) knowledge for the promotion of critical thinking for long-term learning (Ambrose et al., 2010). Clearly, reflective critical thinking is one of the key dimensions of clinical reasoning capability used in physical therapy practice (Christensen et al., 2008).

As academicians in the health sciences, creating rich learning experiences for the development of critical thinking is imperative as it supports students' ability to effectively practice their craft as evidenced based autonomous clinicians.

Clearly, much work is needed to further support MM as a teaching and learning strategy that can foster critical thinking skill. Yet, informing faculty about the MM strategy and the available evidence may promote the use of MM as a teaching and learning strategy within physical therapist education programs and higher education in the health sciences (Edwards & Cooper, 2010; Kerns, Bush, & McCleish, 2006; Michelini, 2000). As scholars of teaching and learning, educating others on innovative teaching and learning strategies is part of our role as scholars while also seeking evidence for their implementation.

V. Conclusion.

Mind mapping, which uses a multi-sensory learning approach, can support a student's ability to explore associations amongst information because it is a "free-form" learning technique in which creative thinking is fostered (Davis, Sumara, & Luce-Kaper, 2000). For the learner, exploring these relationships engages a "deep" approach to learning rather than a "superficial dive" (Biggs, 1987). The interconnection created by the branches in the MM also allows for "dual coding" (Kullay, Lee, & Caterino, 1985) of information which supports association and links to be made. While future work is warranted to assess if student critical thinking skills are benefited by this approach, the findings from this study suggest that mind mapping is not widely used in physical therapist education but that faculty are interested in learning more about the tenets associated with MM. As scholars of teaching and learning, we must explore and then inform others of diverse teaching and learning strategies that may support the academy's role to enlighten students not only with knowledge but with the ability to act upon that knowledge.

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Students' perceptions of plagiarism

Reva Fish[1] and Gerri Hura[2]

Abstract: While plagiarism by college students is a serious problem that must be addressed, students generally overestimate the frequency of plagiarism at their schools and blame students they do not know for the majority of incidents. This study looked at students' estimations of the frequency of plagiarism at a large urban college and explored how that varied over the full range of types of plagiarism, from using another author's ideas to submitting an entire document copied verbatim from another author's work. Analysis of student responses to survey items revealed they believe other students are far more likely than them to commit each type of plagiarism and they recognize that some types of plagiarism are more serious than others. The opportunity to reduce incidents of plagiarism by providing students with accurate information about plagiarism at their schools is discussed in the context of social norms theory.

Keywords: plagiarism, cheating, college, higher education, social norms theory

I. Introduction.

While plagiarism is a widespread problem, college instructors tend to overestimate its frequency (Hard, Conway, & Moran, 2006). Students also believe plagiarism occurs more often than it does, to an even greater extent than faculty, and they generally attribute the high rate of incidents to strangers rather than people they know or themselves (Engler, Landau, & Epstein, 2008).

It is important to understand students' beliefs about the frequency and nature of incidents of plagiarism at their schools. Even though students expect faculty to impose consequences for academic misconduct (Kuther, 2003; Brown, 2012), they also look to other students' behavior to determine how far they can push the boundaries of a professor's course policies (Feldman, 2001; McCabe, Trevino, & Butterfield, 2001; Hard et al., 2006; Rettinger & Kramer, 2009). Their opinion that some unidentified group of students at their school regularly submits work they did not do themselves can distort students' understandings of acceptable strategies they should use to complete assignments. Students who see some forms of plagiarism as less serious than others and who believe other students plagiarize frequently may become more likely to plagiarize themselves.

This study looked at students' estimations of the frequency of plagiarism at a large urban college and explored how that varied over the full range of types of plagiarism, from using another author's ideas to submitting an entire document copied verbatim from another author's work. It also looked at whether students believe some types of plagiarism are more serious than others. The consequences of students' beliefs that plagiarism is a common practice and how institutions should address that are discussed.

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A. Research Perspectives.

Plagiarism is a complex issue which has been studied using a variety of frameworks. Some research has focused on student characteristics that predict a greater likelihood of committing plagiarism, including levels of moral reasoning and self-esteem as well as achievement and motivation orientations (Angell, 2006; Rettinger & Kramer, 2009; Williams, Nathanson, & Paulhus, 2010). This perspective attributes the decision to plagiarize to characteristics of the students, discounting outside factors that might contribute to the choice to plagiarize.

Other research has regarded incidents of plagiarism as being the result of teaching style (Barnas, 2000) or classroom culture (Brown, 2012; Feldman, 2001) indicating the cause of plagiarism originates outside the student. From these perspectives, instructors are seen as contributing to students' beliefs that they can submit another author's work as their own by not providing an adequate level of rigor in their classrooms or by not checking student work for plagiarism.

Unintentional plagiarism has also been used as a framework for research (Belter & Du Pre, 2009; Blum, 2009; Colnerud & Rosander, 2009). This viewpoint often raises the question of whether students should be penalized when they are unaware they have plagiarized. While proof of intent to plagiarize is typically not believed to be necessary to support an accusation, whether students who are still learning to write academic papers should be expected to fully understand how to avoid plagiarism has been addressed in these studies.

Ethics, and in particular integrity, is another focus of the research on plagiarism (Conway & Groshek, 2009; Feldman, 2001; Kuther, 2003; McCabe et al., 2001; Hart & Morgan, 2010; Hudd, Apgar, Bronson, & Lee, 2009; Kwong, Ng, Mark, & Wong, 2010). That body of work examines plagiarism at the student, instructor, and institution levels, and emphasizes the need for institutions to convey the importance of honesty to students and for faculty to model ethical behavior for them.

More recently the focus of plagiarism research has been on technology-facilitated electronic access to text as a primary cause of the increase in the number of incidents of plagiarism (Jones, 2011; Trushell, Byrne, & Simpson, 2012; Wang, 2008). This method of plagiarism has become increasingly widespread through the effortless process of copying and pasting electronic text. Some studies have found that students may believe information on the internet does not belong to a particular author and, therefore, can legitimately be used by them in course assignments.

Engler et al. (2008), Hard et al. (2006), and the present study looked at plagiarism from the perspective of social/peer norms. According to social norms theory, individuals learn which behaviors are appropriate by observing the generally accepted behavior of others. For example, young adults have been found to overestimate the frequency of negative behaviors such as substance abuse by their peers, resulting in an inaccurate understanding of what is considered socially acceptable and an increase in those negative behaviors on their part (Berkowitz, 2004; Perkins, 2003; Perkins & Berkowitz, 1986). Based on this theory, if students have the misperception that acts of plagiarism are common among their classmates, and that consequences, if any, are minor, they are more likely to commit plagiarism themselves.

B. What is Plagiarism?

Many studies of plagiarism do not provide an operational definition of it, seeming to assume there is a one common understanding that does not need explication. Powers (2009) points out that this can affect research findings because students' self-reports of plagiarism are affected by an individual understanding of the practices that could be considered plagiarism. Further, faculty and students often disagree about exactly what constitutes plagiarism (Kwong et al., 2010). Definitions of plagiarism from several of the studies that provided one are listed in Table 1.

Table 1. Definitions of plagiarism.

Belter & DuPre (2009): "*One or more passages that was word-for-word the same as another source without appropriate citation and quotation marks*." p. 259
Colnerud & Rosander (2009): "*Using parts, or the whole, of a text written by another person without acknowledgement; submitting the same paper or parts of it, for credit in more than one course, falsification of information.*" p. 506
Hard, Conway, & Moran (2006): "*Presenting, as one's own, the ideas or words of another person or persons for academic evaluation without proper acknowledgement*." p. 1059
Park (2003): "*Plagiarism involves literary theft, stealing (by copying) the words or ideas of someone else and passing them off as one's own without crediting the source*." p. 472
Wang (2008): "*Us[ing] somebody else's work (words and thoughts) without attribution*." p. 743
Williams, Nathanson, & Paulhus (2010): "*Any nonzero percentage detected by Turn-It-In (after screening)*." p. 294

A common element across definitions is that plagiarism is the act of using another author's work without citation, thus portraying it as one's own work. Other common elements of definitions include descriptions of the length of the copied text, whether taking solely ideas from other authors is plagiarism, and the extent that the copied words were taken verbatim.
For the present study a definition of plagiarism was developed that addressed these elements: *Plagiarism is representing another author's ideas or words as your own in course documents or electronic postings. This would include submitting an entire document by another author as well as using a portion of text or ideas from another author's work and not citing the source. This would include information obtained from the internet, from other students, and from published and unpublished documents.* This definition was provided to the students on the survey they completed.

C. Plagiarism along a Continuum.

Incidents of plagiarism are viewed along a continuum, with some incidents regarded as more serious than others (Blum, 2009; Hudd et al., 2009; Jones, 2011; Kwong et al., 2010, Salmons, 2007). Studies of faculty and student understandings of plagiarism have found that faculty view most types of plagiarism as more serious than students view them (Kwong et al., 2010). Jones (2011) found that while all students recognized submitting an entire document written by another author as plagiarism, students saw copying a limited amount of text as less serious. Seventy-five percent of students saw purchasing a paper online as plagiarism, 67% thought copying text

verbatim without quotation marks was plagiarism, 50% saw paraphrasing text without citation as plagiarism, and 17% stated that students should not self-plagiarize by submitting the same work for assignments in different classes.

D. Student and Faculty Perceptions of Plagiarism Frequency.

Faculty and students tend to overestimate the frequency of student plagiarism (Engler et al., 2008; Hard et al., 2006; Wang, 2008). Students, in particular, see plagiarism as a common practice even though they report they have never plagiarized themselves (Wang, 2008). Students believe their friends are more likely to plagiarize than they are, but their friends are less likely to plagiarize than students they do not know (Engler et al., 2008; Kwong et al., 2010).

It is important to consider student overestimates of plagiarism by others because students' perceptions of peer behavior have a powerful effect on their own behavior (Hard et al., 2006; McCabe et al., 2001; Rettinger & Kramer, 2009). Both McCabe et al. (2001) and Rettinger and Kramer (2009) found that while there are a number of factors that predict cheating, knowing that other students have cheated has the greatest influence on a student's decision to cheat.

Even faculty, whose role it is to discover and address incidents of plagiarism, overestimate its occurrence, although to a lesser degree than students (Hard et al., 2006). An advantage to faculty overestimations of plagiarism is that it may make them more vigilant, benefitting students who do not plagiarize and who want it addressed (Kuther, 2003). Students generally appreciate instructors who can effectively monitor classroom learning and provide an appropriate level of rigor (Barnas, 2000). They want faculty to show respect for all students' efforts by not tolerating any form of cheating, including plagiarism – the most common form of cheating in higher education (Trost, 2009). Faculty can specifically mention in the course syllabus that submitting another author's work will not be tolerated, and the consequences if this happens, so students do not mistakenly believe that cheating will be ignored (Brown, 2012; Feldman, 2001). When incidents of plagiarism are uncovered, if faculty discuss the circumstances with the class, without disclosing the name of the student who plagiarized, they can show their vigilance when reviewing assignments and prevent additional incidents of plagiarism by students who thought it would be ignored (Feldman, 2001).

The research reported here is a part of a larger study that explored the scope and nature of plagiarism by students at a large urban college in order to determine the current extent of plagiarism there and how past institutional efforts to curb plagiarism were faring. These included implementation of an academic misconduct policy and use of plagiarism detection software.

The questions addressed in this report of the study are:

1. What is the frequency and nature of plagiarism admitted to by students?
2. What do students believe is the frequency and nature of plagiarism committed by other students?
3. Do students view some types of plagiarism as more serious than others?
4. Do students believe that the types of plagiarism they view as more serious are more likely to be committed by other students?

II. Method.

A. Participants.

A survey was conducted at a large urban public comprehensive college with over ten thousand students, undergraduate and graduate, enrolled each year. An email was sent to all students, inviting them to complete the anonymous electronic survey and providing them with an internet link to it. The number of emails sent varied by department, but all students received at least one email. Information about the survey was also posted on the home page of the campus library website and on the webpage students use to access email, check grades, register for courses, and so forth. The data collection process was reviewed and approved by the college's institutional review board.

Of the 626 students who responded to the survey, 334 students reported that they had been enrolled in classes which had assignments that could have been plagiarized and completed the survey items analyzed in the present study. Assignments which could be plagiarized were described in the survey as writing assignments that included information that could have been obtained from another source and misrepresented as the student's own work. The 334 students included 194 undergraduates and 131 graduate students. Nine students did not report their student level. Respondents ages ranged from 18 years to 62 years, and almost 52% of the students had a self-reported grade point average over 3.5, on a scale of 0.0 to 4.0. Table 2 provides full demographic information about the sample.

B. Instrument.

The student survey asked respondents about their views and experiences regarding plagiarism and was developed by reviewing published studies on plagiarism, examining efforts to address plagiarism at institutions across the country, and discussing current concerns with administrators and faculty at the institution where the study was conducted. This report of the research will focus on three questions from the survey.

In the first of these questions, the students were asked to rate four types of plagiarism as *not at all serious, somewhat serious*, or *very serious*. The four types of plagiarism they rated were:

- Using ideas from another author's work and not citing the source
- Using phrases from another author's work and not citing the source
- Using sentences/paragraphs from another author's work and not citing the source
- Submitting an entire document by another author as your own work

In the second question, students were asked to indicate how often they thought students committed each of the four types of plagiarism in writing assignments. The response choices were *Never, Once, Rarely (Few of them), Occasionally (Up to one-half of them), Regularly (More than half of them), Always (All of them).*

The third question was the same as the second question, but asked each student to indicate how often they had committed each of the four types of plagiarism. The response choices were the same as those in the second question.

Table 2. Student Demographics.

Student Characteristic	Percent (n)
Gender	
Male	32.6 (109)
Female	66.8 (223)
Gender not provided	0.6 (2)
Level	
Freshman	6.6 (22)
Sophomore	5.1 (17)
Junior	16.5 (55)
Senior	29.9 (100)
Graduate	39.2 (131)
Level not provided	2.7 (9)
Grade Point Average	
< 2.00	0.9 (3)
2.00 to 2.50	3.9 (13)
2.51 to 3.00	9.3 (31)
3.01 to 3.50	20.0 (67)
3.51 to 4.00	51.5 (172)
Grade point average not provided	14.4 (48)
Age	
< 20	75. (25)
20 to 25	51.2 (171)
26 to 30	13.1 (44)
> 30	18.9 (63)
Age not provided	9.3 (31)

C. Analysis.

Data analysis was carried out in two stages. In the first stage, descriptive statistics of the categorical and Likert-type scale survey responses were used to answer the first two research questions. In the second stage, the third and fourth research questions were answered using inferential *z* tests to determine if there were statistically significant differences in proportions of the sample who selected survey item responses. In each analysis the requirement of at least five cases for each of the two responses compared, to approximate a normal distribution, was met. A type-1 error rate of $\alpha = .05$ was used for all tests of significance. Odds ratios (OR) were used to determine the strength-of-effect for all significant results, with OR 1.50, 3.00, and 5.00 used to indicate small, medium, and large effect sizes, respectively (Chen, Cohen, & Chen, 2010). For ease of interpretation, all odds ratios were calculated so that a value greater than 1.00 would result (McHugh, 2009).

III. Results.

Table 3 shows the results for question 1: What is the frequency and nature of plagiarism admitted to by students? A majority of the respondents said they had *never* used another author's phrases (62.6%), sentences/paragraphs (82.3%), or entire piece of writing (96.4%). A majority of the students also reported that had either *never* or *once* used another author's idea and portrayed it as their own work (40.7% and 10.5%, respectively). As evident from the values in the table, there was a systematic decline in the admissions of plagiarism as the amount of text that was copied and the rate of occurrence increased. None of the students reported *always* committing plagiarism of any type and few to none reported plagiarizing *regularly* (0.0% to 3.9%).

Table 3. Survey question about how often respondent plagiarizes.

Question: How often have you done the following, without citing the source?	Never Percent(n)[a]	Once Percent(n)	Rarely Percent(n)	Occasionally Percent(n)	Regularly Percent(n)	Always Percent(n)
Used another author's ideas	40.7 (136)	10.5 (35)	32.6 (109)	12.3 (41)	3.9 (13)	0.0 (0)
Used another author's phrases	62.6 (209)	10.8 (36)	18.6 (62)	6.6 (22)	1.5 (5)	0.0 (0)
Used another author's sentences/paragraphs	82.3 (275)	6.6 (22)	7.2 (24)	3.0 (10)	0.9 (3)	0.0 (0)
Used entire document by another author	96.4 (322)	0.0 (0)	2.7 (9)	0.9 (3)	0.0 (0)	0.0 (0)

[a] Students significantly more likely to *never* commit each type of plagiarism than other students, $p < .05$. See Table 4.

Table 4 provides information about question 2: What do students believe is the frequency and nature of plagiarism committed by other students? The majority of respondents believe that other students are either *occasionally* or *regularly* plagiarizing ideas and phrases (39.8% and 40.1%, 48.5% and 22.8%, respectively), and that other students are *rarely* or *occasionally* plagiarizing sentences/paragraphs or entire documents by other authors (40.7% and 34.7%, 49.1% and 9.6%, respectively). A small proportion of respondents reported they believe other students *always* commit each of the four types of plagiarism (1.2% to 3.6%). Overall, respondent's reports of their beliefs about other students' plagiarism do not show the systematic decline seen in the students' reports of their own plagiarism as the amount of work that was copied and the frequency increased. In fact, almost half of the respondents (49.1%) reported that

they believe other students have submitted an entire document by another author a few times *(rarely)*.

Table 4. Survey question about how often other students plagiarize.

Question: How often do you think most students do the following, without citing the source?	Never Percent(n)[a]	Once Percent(n)	Rarely Percent(n)	Occasionally Percent(n)	Regularly Percent(n)	Always Percent(n)
Used another author's ideas	1.5 (5)	1.5 (5)	13.5 (45)	39.3 (133)	40.1 (134)	3.6 (12)
Used another author's phrases	2.7 (9)	2.4 (8)	22.2 (74)	48.5 (162)	22.8 (76)	1.5 (5)
Used another author's sentences/paragraphs	5.7 (19)	7.8 (26)	40.7 (136)	34.7 (116)	9.9 (33)	1.2 (4)
Used entire document by another author	19.2 (64)	18.0 (60)	49.1 (164)	9.6 (32)	3.0 (10)	1.2 (4)

[a] Students significantly more likely to *never* commit each type of plagiarism than other students, $p < .05$. See Table 3.

Information in Table 5 answers question 3: Do students view some types of plagiarism as more serious than others? The pattern of responses shows that students found plagiarism more serious as the amount of material taken from another author increased. Most of the students believed using another author's ideas is at least *somewhat serious.* A majority of the students indicated that using another author's phrases or sentences/paragraphs is *very serious* plagiarism (51.8%, 78.1%, respectively). Almost all of the students reported that copying an entire document written by another author was *very serious* (96.4%). To answer the research question, the proportions of students who chose each response – *not at all, somewhat, very* – for plagiarizing another author's ideas and for plagiarizing an entire document by another author were compared. There was a statistically significant difference at each of the three levels of seriousness. There was a significant difference between the proportion who indicated that using another author's ideas was not at all serious and the proportion who indicated copying an entire document by another author was not at all serious, $z = 7.736$, $p < .05$, with a very large odds ratio of 16.51. The odds of a student believing that using another author's idea is *not at all* serious is more than 16 times greater than the odds of a student believing that copying an entire document by another author is *not at all* serious. The proportion who responded that using another author's idea was *somewhat* serious was significantly different from the proportion that indicated copying an entire document by another author was *somewhat* serious, $z = 14.352$, $p < .05$, with a very large odds ratio of 49.01. The odds of a student reporting that using another author's idea is

somewhat serious is about 49 times greater than a student reporting copying an entire document by another author is *somewhat* serious. Finally, the difference in the proportion of students who said using another author's idea is *very serious* was significantly different from the proportion of students who said using an entire document by another author is *very serious,* $z = -18.069$ $p < .05$, with a very large odds ratio of 66.52. The odds of a student believing that copying an entire document is *very serious* is over 66 times greater than the odds of a student believing that using another author's idea is *very serious.* These findings indicate that students do believe that some types of plagiarism are more serious than others and that the level of seriousness of the plagiarism is based on the amount of information taken from another author. However, it should be noted the students reported they believed each type of plagiarism was serious in nature.

Table 5. Survey question about seriousness of types of plagiarism.

Question: How serious an incident is each of the following?	Not at all Percent(n)	Somewhat Percent(n)	Very Percent(n)
Using another author's ideas[a]	20.1 (67)	51.2 (171)	28.7 (96)
Using another author's phrases	4.5 (15)	43.7 (146)	51.8 (173)
Using another author's sentences/paragraphs	2.1 (7)	19.8 (66)	78.1 (261)
Using entire document by another author	1.5 (5)	2.1 (7)	96.4 (322)

[a]Using ideas significantly different from using entire document, at each level of seriousness, $p < .05$.

Question 4, whether students believe that the types of plagiarism they view as serious are more likely to be committed by other students than by them, was answered by comparing the proportion of students who indicated they had *never* committed each type of plagiarism and the proportion who indicated they believed other students had *never* committed that type of plagiarism. A statistically significant difference was found for each type of plagiarism, $p < .05$. Students' were more likely to report that they *never* plagiarized ideas, phrases, sentences/paragraphs, or an entire document than they were to report they believed that other students had *never* committed each of those four types of plagiarism, $z = 12.421$, 16.503, 19.953, 20.211, respectively. The odds ratios show that the difference in proportions increased as the amount of information plagiarized – the seriousness of the plagiarism – increased. The odds of a student reporting they would *never* plagiarize ideas, phrases, sentences/paragraphs, or an entire document compared to the odds they believed another student would *never* commit the same act were all very large – 45.20, 60.38, 77.27, and 113.20, respectively.

IV. Discussion.

This study surveyed students at a large urban college to explore their beliefs about plagiarism. Students were asked how often they commit plagiarism and how often then think other students commit plagiarism. They were also asked about how serious an incident they considered each of four types of plagiarism – using another author's ideas, phrases, sentences/paragraphs, and submitting an entire document written by another author. Most of the students in the sample reported never committing plagiarism of any type and there was a systematic decline in the admissions of plagiarism as the amount of text that was copied and the frequency of occurrence increased. The participants indicated they believe that some types of plagiarism are more serious than others, with taking larger sections of text from another author seen as the more serious incidents of plagiarism. Still, even using another author's ideas was believed to be at least somewhat serious by most students.

The pattern of students being less likely to commit the types of plagiarism they saw as more serious was not evident in their reports of the plagiarism they believe was committed by other students. Consistent with the findings from other research (Engler et al., 2008), the participants reported that other students were markedly more likely than them to commit each type of plagiarism. In fact, a small proportion of participants reported they believe some students always commit each of the four types of plagiarism.

The implications of these findings must be considered in relation to social norms theory (Berkowitz, 2004; Perkins, 2003; Perkins & Berkowitz, 1986) and the research by McCabe et al. (2001) and Rettinger and Kramer (2009) which found that when students believe others have cheated, they are more likely to choose to cheat. Students who overestimate the frequency of plagiarism by classmates may view plagiarizing as a norm and choose to plagiarize to complete an assignment. In particular, they may be more likely to think it is okay to use another author's ideas or text phrases – types of plagiarism, which they view as less serious. Therefore, it is critical that students have accurate information about the frequency and types of plagiarism committed by students in their classes and at their school. Institutions and course instructors must find ways to give students accurate information about the types of plagiarism that occur and number of incidents that are discovered. A campus-wide reporting system should be used to gather and distribute the information, and faculty can tell students the number and type of actual incidents they encounter semester to semester. Supplied with this information, students will be less likely to overestimate the number of incidents of plagiarism at their school and may, therefore, be less likely to plagiarize themselves.

Informing students that instructors look for plagiarism in assignments and that there are consequences if it is discovered can help to deter students from plagiarizing and create an environment where it is clear that ethical behavior is valued. Reducing plagiarism provides benefits beyond an ethical education environment; it can also improve student learning. When students do their own work, instead of copying it from another author, they learn research and writing skills, and they learn the topic content of the papers they write. The long-term benefits of an academic environment where integrity and learning are cultivated cannot be overestimated.

One limitation of this study is the possibility that the participants who chose to respond to the survey may have been those who actually were less likely to plagiarize than their classmates and therefore their claim that others are more likely to plagiarize was accurate. More than half of the respondents had a grade point average over 3.5, and studies have found that students with lower grade point averages are more likely to plagiarize (Belter & DuPre, 2009; Park, 2003).

Another limitation of this study is the reliance on student self-reports about their behavior. It is possible that some respondents were purposely untruthful or that they inaccurately reported they had not plagiarized. They may have viewed any plagiarism by them as justifiable behavior. Survey responses may also have been inaccurate if students did not fully understand the meaning of the questions asked.

It should be noted that the finding that students believe taking any amount of text is more serious than taking another author's idea may be due to the order that the types of plagiarism were listed in the survey -- with taking ideas listed first, followed by taking increasing amounts of text. While it is clear that an increased amount of copied text – from phrases/sentences to paragraphs to an entire document – indicates a more serious incident of plagiarism, it is not as clear whether copying another author's ideas is less or more serious than copying text. Course instructors, especially those who are published authors in their field, may believe that plagiarism of an original idea is more egregious. Students, who typically have no experience in professional writing, may not understand the value of developing a unique idea in a field of study and, therefore, see taking another author's idea as less important than copying text.

Even if instructors believe plagiarism of ideas is the most serious type of plagiarism by published scholars, they may believe the reverse when assessing student work – viewing copying of ideas as typical behavior in the process of developing writing skills. They may even believe that copying small amounts of text, such as phrases, are not serious incidents. While all incidents of plagiarism by students must be addressed, instructors should determine the appropriate consequences for each based on a student's writing skills and knowledge at the time the assignment is completed, the instructor's belief about whether the incident was intentional, and institution policies.

In conclusion, while the findings from this study cannot be generalized because they are based on a relatively small number of students' self-reports at one institution, the findings do provide information about a novel practice that may reduce the number of incidents of plagiarism. Publicizing the nature and frequency of plagiarism on a campus is a relatively cost-free and potentially effective way to not only reduce the time-consuming and emotionally difficult process of dealing with incidents of plagiarism, but to improve student learning as well. Additional studies should be conducted at schools to explore their students' understandings of plagiarism and to determine whether sharing accurate information about incidents of plagiarism will reduce the likelihood of incidents overall.

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Examining the silence of academic disappointment: A typology of students' reasons for not discussing disappointing grades with instructors

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Abstract: Although student-teacher interactions about disappointing grades can be beneficial, students do not always engage in them. The objective of this study was to explore the domain of reasons undergraduate students report for not discussing disappointing grades with their instructors. The data analysis yielded six main categories of reasons: utility of grade conversations, judgment of the evaluation, understanding of grade cause(s), instructor/relational considerations, student characteristics, and situational factors. This study advances the first typology of students' reasons for not discussing disappointing grades and offers implications for instructional practice, theory and research. Study limitations and future research directions are also discussed.

Keywords: students' communication with instructors, grades, feedback, student-teacher interaction

I. Introduction.

Although difficulties often characterize student-teacher interactions about grades (Goulden & Griffin, 1995; Wright, 2012), they can have important implications for students' educational experiences in areas including learning processes (Henningsen, Valde, Russell, & Russell, 2011), motivation (Kerssen-Griep, Hess, & Tress, 2003), and the quality of the student-teacher relationship (Docan-Morgan, 2011; Docan-Morgan & Manusov, 2009). Recent studies, however, suggest that students may often miss out on the academic, personal, and relational benefits potentially afforded by these interactions. Though academic disappointment is common and most students can easily recall earning a disappointing grade, many students are unlikely to discuss a disappointing grade with their instructor (Henningsen et al., 2011; Sabee & Wilson, 2005; Wright, 2012). Some scholars consider the silence of academic disappointment in the classroom problematic and assert that "a failure to discuss disappointing grades is a failure of education in some respects. The faculty member does not have the chance to clarify and teach…[and] the student does not have the opportunity to get additional feedback to improve future assignments" (Henningsen et al., 2011, p. 188). Thus, students' decisions not to initiate these discussions are worthy of further investigation.

Unfortunately, there has been little attention to the investigation of student-teacher interactions about grades and the relevant research that does exist privileges the experiences of students who initiate these discussions. Consequently, there is limited understanding of the experiences of academic disappointment that go unexpressed in the college classroom. Understanding of factors that may influence the silence of academic disappointment is important

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to the scholarship of teaching and learning, and may prove even more important to our understanding of student-teacher interactions about grades than the experiences of students who discuss disappointing grades with instructors (Wright, 2012). Therefore, in this study I directly examined student experiences of academic disappointment that were not discussed with instructors. My objective was to refine understanding of the diversity of students' reasons for not discussing disappointing grades with their instructors by developing the first typology of factors that hinder students from initiating a conversation with an instructor upon experiencing academic disappointment.

II. Literature Review.

Research identifies instances in which a student who would benefit from meeting with an instructor about a disappointing grade chooses not to do so. Instructor feedback can affect a student's self-concept in areas such as their self-esteem (Crocker, Karpinski, Quinn, & Chase, 2003) and perceptions of personal success (Sanders & Anderson, 2010). In these ways, negative feedback can create concerns about self-image (or face), which may influence a student's decision to meet with an instructor to discuss the evaluation. Individuals have desires to present a certain self-image (or face) to others and take steps to protect or maintain this image (Brown & Levinson, 1987). Some students may perceive a face-to-face discussion with an instructor as potentially face-threatening and consider not meeting with him or her as a method of protecting their face.

Due to the interpersonal nature of the student-teacher relationship (Frymier & Houser, 2000), relational factors also have implications for how students respond to feedback and their decisions to interact with instructors. Students' positive perceptions of instructor communication behaviors can enhance the quality of the student-teacher relationship and student academic achievement (Kerssen-Griep, Tress, & Hess, 2008). Immediacy (the perceived physical or psychological distance between communicators) and immediate behaviors (nonverbal/verbal behaviors that communicate liking, affect, and/or positive evaluation) have received significant attention in instructional communication research (e.g., Witt & Kerssen-Griep, 2011; Kerssen-Griep & Witt, 2012). An instructor's use of nonverbal (e.g., open body position, smiling, vocal variety) and verbal (e.g., self-disclosure, positive recognition, use of humor) immediacy behaviors can have implications for the student-teacher relationship, positively influencing students' perceptions of the instructor (e.g., credibility, liking) and willingness to interact with the instructor as a result. An instructor's (actual or perceived) abilities can also further affect student motivations to initiate conversations with instructors about grades. For example, an instructor's referential skills, or ability to effectively explain course material, are pertinent to students' educational experiences. Deficiencies in this area can inhibit an instructor's ability to effectively offer assistance, which can create feelings of uncertainty and frustration among students (Frymier & Houser, 2000). Thus, it is not surprising that students' perceptions of instructors as incompetent are negatively related to their out-of-class communication with them (Myers, 2004).

Although some students may not obtain useful insights into their performances without meeting with the instructor, not all disappointing grades warrant a follow-up conversation to provide the clarity and instruction that can enhance a student's subsequent performances. Research suggests an instructor's ability to communicate effective feedback can reduce a student's need to discuss a disappointing grade. Critical feedback that is effective should cause

students to develop understanding of what they did incorrectly and how to improve in the future, consequently affecting student learning and motivation (Husman, Brem, & Duggan, 2005). Feedback intervention theory (FIT) indicates that the focus of feedback affects its impact on the target's learning. Learning improves when feedback is objective and directly focused on the assessment, but is reduced when feedback offers subjective, indirect, and emotional judgments (Kluger & DeNisi, 1996). To this point, students prefer detailed feedback (Lizzio & Wilson, 2008), which enhances student learning. Detailed feedback can also limit the face-threat students perceive in the feedback when instructors provide justifications for them (Butler & Winne, 1995). Furthermore, detailed feedback can reduce a student's ambiguity and/or questions about an evaluative decision (i.e., grade) (Svinicki, 1998). Since such uncertainty has been thought to influence students' challenging behaviors and inquiries about their evaluations (Simonds, 1997), detailed feedback may also reduce student displays of aggression and resistance in the classroom.

The above demonstrates the diverse factors that may affect students' responses to disappointing grades and their decisions to discuss them with an instructor. Though a potential failure of the education process exists when students who would benefit from meeting with the instructor are dissuaded from doing so by destructive factors (e.g., instructor communication face management concerns, instructor incompetence), research demonstrates this is not always the case. There are factors that can enhance students' learning experiences following a disappointing grade without a meeting with the instructor (e.g., detailed feedback). When considering the various factors that can influence students' decisions in this regard, instructors likely encounter unique challenges in their efforts to evaluate a student's academic disappointment and intervene appropriately. Therefore, it is important that research identifies factors that influence students to withhold academic disappointment from instructors, rather than initiate potentially beneficial discussions about grades with them. The following research question guided this investigation:

RQ: What reasons do students report for choosing not to discuss a disappointing grade with their instructors?

III. Method.

A. Participants and Procedures.

Upon receiving human subject's board approval, undergraduate students from the Communication Studies research pools at two universities were recruited to participate in this study. The 586 students who chose to participate completed an online consent form and a questionnaire in which they were asked to recall a disappointing grade they recently earned in a course. Only the data for the 261 students who reported that they did not discuss the disappointing grade with the instructor were pertinent to the objective of the present study. These students were then asked to respond to open-ended questions about why they chose not to discuss it with the instructor. Among them, two students reported that they had meetings set up with their instructor, which had not yet taken place, and two other students reported that they had yet to receive a disappointing grade. The data for these subjects were not included in the analysis. Thus, the data for the 257 undergraduates who indicated that they did not discuss the grade were analyzed in this study. The sample was primarily Caucasian (n = 193, 75%) and female (n = 173, 67%); one respondent did not provide this information. The average age of respondents was 19.90 years (SD = 2.06); however, 13 respondents did not report their age. The sample was comprised of 37 freshmen, 106 sophomores, 72 juniors, and 42 seniors.

B. Data Analysis.

The participants who indicated they did not discuss the disappointing grade with their instructor were asked to report why they had not done so. Although some responses contained multiple and varied reasons, the entire response served as the unit of analysis because the majority of participants wrote very brief responses (one to three sentences). A trained student coder examined each response and organized the reason(s) reported within them into thematic categories containing definitions that emerged from the data (e.g., Baxter & Wilmot, 1984). These categories and their structural definitions were used to develop coding instructions in which a definition and exemplar for each category was presented. A miscellany category was also included to account for any reasons reported that did not fit into the identified categories.

Using a sample of responses, two other students were trained to use the instructional codebook and analyze the data accordingly. The coding was not mutually exclusive and hence, coders indicated the presence or absence of all categories of reasons. Every analyzed response contained at least one reason. During training, any disagreements were resolved through the discussion of the codebook definitions and the response in question until an agreement on the appropriate code(s) was reached. After completing the training, the coders independently placed the remaining data into at least one of the supra-categories and where relevant, the appropriate sublevel category(ies) using the codebook. Any disagreements that occurred during this time were resolved by the author who considered which category seemed to be most consistent with the way the coders categorized the other units.

IV. Results.

Results indicated students consider evaluation, individual, instructor/relational, and situational factors in their decisions not to discuss a disappointing grade with an instructor. A total of 343[2] reasons were identified in the responses provided by the 257 participants in this study. The data analysis revealed seven supra-categories, and in some instances lower level categories, that were labeled as follows: utility of the grade conversation, understanding of grade cause(s) (3 sublevels: insufficient preparation, instructor feedback, and general understanding), judgment of the evaluation (3 sublevels: grade impact, fairness perceived, evaluation/course unimportant), instructor/relational considerations (4 sublevels: approachability, competence, legitimate authority, and relational concerns), student characteristics, situational factors, and miscellany.

The miscellany category contained seven reasons that did not fit in the supra-categories that emerged from the data. Two respondents indicated they did not know why they did not discuss the grade with the instructor. Two others stated they did not feel the need to discuss the grade but provided no additional explanation of whether this reflected their personal preference, judgment of the evaluation, awareness of the cause(s) of the grade, or other reason. Another response stated the student preferred to go over the instructor's head rather than talk directly with him/her. And in two cases, grade conversations and the opportunity to make corrections and resubmit the assignment were initiated by the instructor.

Table 1 contains definitions of each code, exemplars, the proportion of units in each code, and their individual Cohen's kappa (κ). Cohen's kappa measures the inter-coder

[2] The sum of the frequencies for (1) the sublevels within judgment of the evaluation, understanding of grade causes, and instructor/relational considerations and (2) the supra-categories: utility of the grade conversation, student characteristics, situational factors, and miscellany.

agreement. Results indicated acceptable levels of agreement for each supra-category (all $\kappa \geq .80$) and that all, but one sublevel category (i.e., instructor competence) met or exceeded a moderate level of agreement (e.g., $\kappa > .70$).

Table 1. Explanation of Codes Used to Analyze Students' Reasons for Not Discussing Disappointing Grades with Instructors.

Category	Definition	Exemplars	Cohen's *kappa*	Proportion
UTILITY OF THE GRADE CONVERSATION	Reasons citing perceptions that a grade conversation was unlikely to produce any benefits and/or change the outcome	"I didn't think I would gain anything from it" "There didn't seem to be a chance that anything would help."	.92	.27 (n = 70)
UNDERSTANDING OF GRADE CAUSE(S) (includes three subcategories)	Reasons citing one's understanding of the cause(s) for the disappointing grade through:		.89	.22 (n= 57)
	1) *Insufficient Preparation* - the student's own behavior contributed to the grade (e.g., quality of preparation, attention, personal situations, etc.)	"I felt that it was mostly my own fault for not studying well enough; talking to the professor wouldn't really give me any new insights" (*Insufficient Preparation*)	*.94*	*.11 (n = 29)*
	2*) Instructor Feedback* - a clarity and understanding regarding the instructor's assessment of their work	"I understood where my failings were, the notation/comments on the paper were pretty extensive" (*Instructor Feedback*)	*.79*	*.05 (n = 12)*
	3) *General Understanding* - "other" causes or the absence of any details regarding the specific cause(s) for the grade	"It was the first test, and I was getting to know her style of exam." "I knew why I got the disappointing grade and didn't feel it was necessary" (*General Understanding*)	*.75*	*.07 (n = 18)*
INSTRUCTOR/ RELATIONAL CONSIDERATIONS (includes four subcategories)	Reasons citing the instructor's characteristics and/or the anticipated consequences for the student-teacher relationship:		.84	.22 (n = 57)
	1) *Approachability* – statements indicating it would not be pleasant or easy to discuss the grade with the instructor.	"He is extremely intimidating;" "I did not talk to her because she is always rude and never lets you get a word in edgewise." (*Approachability*)	*.78*	*.16 (n = 42)*
	2) *Competence* – concerns about the instructor's ability to adequately	"I was not convinced that she could adequately	*.68*	*.04 (n = 11)*

	fulfill the responsibilities of their position, engage in the discussion, behave ethically, and/or address their questions/concerns.	explain it to anyone else but herself." "I wrote the instructor several emails but she never responded." "He had failed at explaining [the material] to me when I had gone to office hours." (*Competence*)		
	3) *Legitimate Authority*- the instructor's general power and authority to evaluating their work	"I decided he must know something I didn't because he was the T.A." (*Legitimate Authority*)	*.72*	*.03 (n = 7)*
	4) *Relational Concerns*- concerns about the relationship with the instructor and the potential adverse consequences of the conversation on it (e.g., retaliation, backlash, etc.).	"Because I do not think my instructor likes me and any attempt to dispute my grade would cause her to like me even less." "I believe this professor was biased toward female students. Therefore, discussing the grade with him likely would have resulted in additional backlash." (*Relational Concerns*)	*.80*	*.03 (n = 7)*
JUDGMENT OF THE EVALUATION (includes three subcategories)	Reasons citing the perceived severity, importance, and/or fairness attributed to the grade.		.81	.21 (n = 54)
	1) *Grade Impact* - responses imply that the impact of the grade on their academic performance, in comparison to classmates, etc. was not significant enough to warrant talking to the instructor and/or that there were sufficient opportunities remaining to raise the grade	"While the grade was less than I expected, it still wasn't terrible, and it didn't affect my overall grade very much." (*Grade Impact*)	*.72*	*.11 (n = 27)*
	2) *Fairness Perceived* - cited directly or indirectly that they perceived the grade as fair	"I deserved the grade;" "The grade reflected my abilities/effort." (*Fairness Perceived)*	*.74*	*.09 (n = 23)*
	3) *Grade/Course Unimportant* - responses noting that the student did not care about or were not interested enough in the grade and/or course.	"Primarily the grade wasn't that important to me." (*Grade/Course Unimportant)*	*.87*	*.05 (n = 12)*

STUDENT CHARACTERISTICS	Reasons citing the student's personal perspectives, emotional reactions, and/or traits as hindrances from discussing the disappointing grade. Responses in this category also stated concerns related to face management, self-efficacy, and social appropriateness.	"Embarrassed and too lazy." "…I am not comfortable enough to go up and explain my stance whether I'm right or not."	.84	.16 (n = 41)
SITUATIONAL FACTORS	Reasons citing scheduling conflicts, inconveniences, and/or changes in circumstances that caused them not to discuss the grade with the instructor.	"The lines were always very long. There were a lot of disappointing grades in that class." "I was busy with other work getting ready for finals…." "The grade was on a final exam and the procedures for changing a final grade are tedious." "I dropped the class."	.87	.14 (n = 37)
MISC	Any response that does not fit within the supra-categories identified in the data analysis.	"I don't know why I didn't talk to the instructor." "I did not feel the need" (void of any further explanation for why not)	.90	.03 (n = 7)

V. Limitations and Discussion.

This study answers calls for further investigation of students' decisions regarding grade conversations (Henningsen et al., 2011), in particular, their decisions against discussing academically disappointing experiences with instructors (Wright, 2012). Appropriately, the objective of this study was to advance the first typology of students' reasons for not discussing disappointing grades with instructors (see Table 1). The method used to identify the domain of reasons reported, however, assumes that a student's decision against discussing a disappointing grade results from a rational process that one can coherently express. Consequently, the typology advanced by this study may, at best, capture students' reflections and sense-making processes for not discussing disappointing grades with instructors.

Although participants were instructed to report a recent event in which they earned a disappointing grade, the frequency of the themes reflected in the reasons reported may have been confounded by other variables such as the degree of negative outcomes elicited by the grade (e.g., emotional responses, adverse consequences), the type of assessment on which they received the disappointing feedback (e.g., essay vs. multiple-choice, paper vs. exam, major vs. minor grade, individual vs. group), and individual difference variables (e.g., race/ethnicity, gender, goal motivation). The influence of these and other potential confounds on students' reasons for not discussing disappointing grades deserve further investigation. Social desirability biases may have also influenced the results such that students underreported (or withheld) reasons thought to reflect negatively upon them (e.g., perceived the grade as unimportant, student characteristics) and over-reported those which were less likely to do so (e.g., utility of the

grade conversation, instructor/relational considerations, situational factors). As a result, the reasons observed in this study may not account for all existing reasons for students' decisions against discussing disappointing grades. Furthermore, though the students in this study reflected upon experiences in which they earned a disappointing grade, the factors that determine a student's assessment of academic disappointment are relatively unknown and require further research.

A. Possible Explanations for Students' Unexpressed Academic Disappointment.

Despite these limitations, this study refines understanding of why some experiences of academic disappointment are not shared with instructors. The typology indicates that the reasons students report for not discussing disappointing grades with instructors are diverse and reveals five areas students consider when making these decisions: utility, the evaluation, and relational, individual, and situational factors.

First, perceptions of the benefits of discussing disappointing grades framed students' reasons related to the utility of the grade conversation (27%). Most common responses attributed the lack of utility in initiating a grade conversation to the unlikelihood of obtaining a higher grade as a result. This emphasis provides further evidence of the prevalence of social influence and students' desires to use grade conversations to obtain a higher grade (e.g., Henningsen et al., 2011; Sabee & Wilson, 2005; Svinicki, 1998; Wright, 2012).

Second, there were two distinct ways through which students' consideration of the evaluation manifested in their reasons for not discussing a disappointing grade. The first reflects the use of student-teacher interactions about grades to seek information to enhance student understanding and abilities to improve in the future [i.e., understanding of grade cause(s) (22%)]. Some students did not need to meet with their instructors in order to achieve these learning goals because they acquired the desired clarity and insights through their own understanding of the cause(s) of the disappointing grade. Primarily, students reported gaining this understanding from the instructor's feedback on the assessment and/or the awareness that they were insufficiently prepared for the assessment (e.g., poor study habits). The second way in which students' perceptions of the evaluation influenced their decisions against meeting with the instructor was in their judgments of the impact, fairness, and importance of the evaluation (and/or course) [i.e., judgment of the evaluation (21%)]. Specifically, some students avoided grade conversations because they perceived that the grade produced limited adverse effects, resulted from fair grading practices, and/or was generally unimportant to them. These factors may function as important criteria some students use to help them decide whether to discuss a disappointing grade with instructors. Students' considerations of fairness support previous findings that grades are often the topic of classroom justice issues (Horan, Chory, & Goodboy, 2010), which may motivate some students to interact with instructors aggressively (Chory-Assad & Paulsel, 2004).

Third, students' considerations of the instructor and/or the student-teacher relationship (22%) demonstrate the interpersonal nature of the student-teacher relationship (see Frymier & Houser, 2000). Perceptions of an instructor's approachability [or lack thereof] and professional characteristics such as their incompetence (e.g., inability to fulfill responsibilities of their position, possess knowledge of course content, etc.) and legitimate power to evaluate their performance were often reflected in students' reasons for not discussing disappointing grades. The consideration of instructor power is also relational as it takes into account the social appropriateness of discussing one's academic disappointment with a superior. Considerations of

the student-teacher relationship also included concerns regarding the affinity between them and the potential for the discussion to adversely affect their relationship as hindrances to sharing academic disappointment. This indicates some students are aware that student-teacher interactions about grades can serve as relational turning point events (e.g., Docan-Morgan & Manusov, 2009). Interestingly, the data also suggest that relational turning points may be experienced secondhand as some students determined the instructor was unapproachable or incompetent based upon the experiences of classmates.

Fourth, students reported considerations of self in their reasons for not discussing disappointing grades with instructors [i.e., student characteristics (16%)]. These reasons reflected students' perceptions of their abilities to engage in, and construct cogent arguments during, a grade conversation and to do so with emotional control. This focus upon self-efficacy suggests that some students perceive grade conversations as effortful interactions requiring certain skill sets and emotional intelligence. Just as earning a disappointing grade can elicit negative emotions so, too, can the prospect of discussing academic disappointment with an instructor. Indeed, some students cited feelings of fear and anxiety as deterrents to discussing the disappointing grade. These negative emotional responses suggest students who are sensitive to the face threatening potential of a grade conversation may withhold their academic disappointment as a means of protecting their face (e.g., Brown & Levinson, 1978).

The fifth and final area of consideration pertained to situational factors (14%). Scheduling conflicts, timing of the assessment (e.g., end of the academic year), and tedious procedures were frequently reported barriers to students sharing their academic disappointment. Because these issues are often specific to particular circumstances rather than permanent conditions, the students who were hindered by them may not be predisposed against initiating grade conversations.

B. Study Contributions, Implications for Theory, and Future Research.

As the initial effort to develop a typology of students' reasons for not discussing academically disappointing experiences with instructors, this study makes several contributions to research on student-teacher interactions about grades and offers directions for future research. First, though previous research has examined the utility of communication theory to predict students' decisions to initiate grade conversations (e.g., goals-plans-action model and theory of planned behavior, Henningsen et al., 2011), the present findings suggest additional theoretical perspectives for refining understanding of students' decisions against sharing academic disappointing experiences with instructors. Social exchange theories assume individuals base their decisions and actions on perceptions of costs and rewards and make decisions and engage in behaviors perceived to be rewarding (Thibaut & Kelley, 1959). With regard to the present findings, some students' calculations of the perceived costs (e.g., relational damage, loss of valuable resources (time)) and benefits of initiating grade conversations influenced their decisions against doing so. Although such cost-benefit analyses could explain many of the considerations in students' reasons, these calculations were explicit in the supra-category, utility of the grade conversation. As previously noted, students tended to focus on the grade-centered benefits of discussing disappointing grades with instructors (i.e., to get a higher grade). This narrowed focus likely inhibits their abilities to recognize and take advantage of the many learning-centered and relational benefits of these interactions. It is important that research further examines the factors that affect students' perceptions of the costs and rewards of discussing

disappointing grades with instructors. However, it seems likely that these beliefs stem broadly from personal experiences discussing grades with instructors, observations/experiences of classmates who engaged in grade conversations, instructor communication behaviors, and/or from the advice of others (e.g., parents) about discussing grades with instructors.

Theories pertaining to the influence of uncertainty on communication may also be useful to future examinations of students' decisions regarding discussing disappointing grades. Uncertainty Reduction Theory (URT) assumes individuals use communication to reduce their uncertainty (Berger & Calabrese, 1975). The heurism of URT to research of student-teacher interactions about grades is evident in the influences of uncertainty about course content, grading practices, and/or of how to improve in the future on students' decisions against discussing disappointing grades with instructors. The Theory of Motivated Information Management (TMIM) is another theoretical perspective of uncertainty, which explains how individuals use cognitive abilities and other resources to manage information in interpersonal settings (Afifi & Weiner, 2004). Specifically, TMIM focuses upon situations in which individuals are motivated to manage their uncertainty and examines the influence of efficacy perceptions and the information provider on the management processes. TMIM would enhance understanding of how students' considerations of issue importance (labeled as "judgment of the evaluation"), communication efficacy (labeled as "student characteristics"), and the information provider (labeled as "instructor characteristics," sublevel-competence) influence how students manage uncertainty regarding academically disappointing experiences. In the case of the present findings, TMIM suggests that students may choose not to seek information from the instructor if they perceive the evaluation as unimportant, have doubts about their ability to engage in the conversation, and/or question the ability of the instructor to effectively provide the desired information.

Second, the reasons students report for not discussing disappointing grades with instructors reflect their considerations of factors related to research on students' motives for communicating with instructors (Martin, Myers, & Mottet, 1999). This association is most evident in students' motives to offer excuses (i.e., challenge a grade), to relate (i.e., relational development and maintenance), for participation (i.e., demonstrate interest in the course and learning), to obtain favorable impressions of the instructor (i.e., sycophancy), and those regarding functional reasons (i.e., increase understanding of content or assignment). In the case of the present study, students' negative perceptions of these personal, relational, and academic areas dissuaded them from discussing disappointing grades with instructors. Considering some students' motives for communicating with instructors have strong implications for their cognitive learning (Martin et al., 1999), students' reasons for not discussing disappointing grades may have similar implications for motivation and cognitive learning outcomes. If so, students who reported instructor characteristics as deterrents to initiating a grade conversation may have lower motivation to learn and experience lower levels of cognitive learning than do students whose reasons pertained to their understanding of the cause(s) for the grade. Although these relationships were beyond the scope of the present investigation, the implications of students' reasons for not discussing disappointing grades for their educational outcomes warrants empirical support. When considering the similarities observed with the present findings, the similarities between students' motives to communicate with instructors and the reasons students report *for* discussing disappointing grades with instructors should also be examined. Though the present typology identifies factors that reasonably influence students' decisions regarding grade conversations, it is possible that students who choose to discuss disappointing grades do so for

reasons not identified in this study. Therefore, future research should explore the similarities and differences in the factors that influence students' decisions toward and against discussing academic disappointment with instructors.

Third, and unexpectedly, students' reasons for not discussing disappointing grades share similarities with reasons reported for withholding complaints and engaging in conflict avoidance in close relationships. Just as some students considered the utility of a grade conversation [or lack thereof] in their decisions against discussing disappointing grades with instructors, individuals may avoid conflict because they believe the confrontation will not produce the desired change in one's partner and/or the situation (Cloven & Roloff, 1994; Makoul & Roloff, 1998). Students' considerations of the severity, fairness, and importance of the evaluation (i.e., judgment of the evaluation) are also similar to those regarding issue importance in individuals' decisions to withhold complaints and avoid conflict in close relationships (Cloven & Roloff, 1994; Roloff & Solomon, 2002). In both cases, these considerations serve as thresholds that aid individuals in making decisions of whether or not to initiate a discussion about the issue (i.e., a disappointing grade or complaint). It is possible that students perceive grade conversations as effortful interactions that, like conflict, require spending one's valuable resources, and can leave one exhausted if it is prolonged (Vuchinich & Teachman, 1993). Thus, students, like relational partners, strive to "pick their battles" with regard to the potentially conflict-inducing issues they choose to discuss with instructors and these thresholds assist them in doing so. Also, an instructor's perceived unapproachability and potential retaliation can serve as a type of "chilling effect" (Cloven & Roloff, 1993) that decreases students' willingness to discuss disappointing grades with instructors. The similarities between students' reasons for not discussing disappointing grades and those identified for withholding complaints and avoiding conflict suggest that some students (and teachers) may perceive and respond to grade conversations as one might respond to a conflict situation or social confrontation episode. This is reasonable when considering the intensity and strong emotions often attributed to interactions about grades (Goulden & Griffin, 1995). In consideration of this, conflict management and avoidance research may benefit future research on student-teacher interactions about grades and initiatives to increase the willingness of students and teachers to discuss them.

C. Implications for Instructional Practice.

The findings from this study identify several areas where instructors may positively influence students to discuss disappointing grades with them. First, an unfortunate challenge to an instructor's ability to appropriately intervene in students' experiences of academic disappointment is that some students do *not* believe discussing a disappointing grade with an instructor is useful. The limited perceptions of utility in grade conversations is likely influenced by students' narrow perceptions of the benefits of these discussions (i.e., to get a higher grade). This narrow focus may cause some students to misjudge the utility of meeting with an instructor, missing out on the many potential benefits afforded from doing so. To address these issues, instructors can use direct (e.g., classroom instruction) and indirect (e.g., syllabus content) methods to expand and reframe students' perceptions of the benefits of student-teacher interactions about grades, with special attention given to learning-centered benefits (Wright, 2013). However, future research is warranted to identify the most effective instructor practices to address this issue because research does not completely inform us as to the origin of students' beliefs about the utility of grade conversations.

Second, since subordinates may have difficulties initiating discussions with their superiors, instructors should be aware that perceptions of their legitimate authority can hinder students from discussing disappointing grades. Therefore, instructors must not abuse their power or influence students to perceive constructive conversations about grades as illegitimate or socially inappropriate. An instructor's efforts in these areas can also address students' concerns about self-efficacy and impression management that can deter them from initiating grade conversations.

Third, instructors must enhance students' perceptions of them as competent and approachable. Therefore, it is important that instructors are diligent in fulfilling the responsibilities of their position (e.g., responding to email, clear explanations of course content) as incompetencies in these areas can discourage students from meeting with them about disappointing grades. Instructors' uses of verbal and nonverbal immediacy behavior can enhance liking and student perceptions of a supportive classroom environment (Myers, 1995), which can increase perceptions of approachability. Teacher training initiatives in the areas of instructional communication face management and feedback interventions (Kerssen-Griep et al., 2003; Kerssen-Griep & Witt, 2012) can also equip instructors to provide the face support and ego support that can encourage students to initiate grade conversations.

Furthermore, course policies may also influence students' perceptions of an instructor's approachability. For example, rigid and impersonal classroom policies that control when and how students can initiate conversations about grades (e.g., 24-hour waiting period before discussing a grade, require written documentation of students' questions or concerns about the grade) can make these interactions seem more akin to a legal dispute than an educational conversation. Although strict guidelines may minimize the unpleasantness of grade conversations, they may also influence students to perceive that the instructor does not welcome discussions about academically disappointing experiences. By giving greater attention to facilitating grade conversations instead of regulating grade disputes, instructors can enhance students' understanding of the diverse benefits of discussing disappointing grades and their legitimate right to initiate them.

VI. Conclusion.

The present findings suggest that (1) the diversity of reasons students have for not discussing disappointing grades with instructors and (2) the possible implications of these reasons for students' educational experiences may contribute to the challenges instructors encounter determining how to appropriately intervene in students' experiences of academic disappointment. The constructive reasons students reported [e.g., understanding of grade cause(s)] indicate positive consequences for their educational experiences. Specifically, that some students can gain an awareness of the cause(s) for disappointing academic performances and acquire strategies for improving through means other than meeting with the instructor. Two important conclusions should be drawn from this observation. First, instructors need not always intervene in students' experiences of academic disappointment and second, students' decisions against discussing disappointing grades with instructors do not always reflect a failure of education as some scholars previously suggested (see Henningsen et al., 2011). These conclusions, however, do not justify efforts to inhibit student-teacher interactions about grades. Rather, readers should utilize the findings from this study to enhance their abilities to ensure that

students who would benefit from discussing their academically disappointing experiences are not hindered from doing so by factors within an instructor's influence.

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From rationalization to reflection: One teacher education law class

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Abstract: This paper describes the struggles of a teacher educator to acknowledge and honor her own liberal bias along with her students' more conservative perspectives as these emerge in an education law class for preservice teachers. It illustrates the author's ongoing transition from rationalization to reflection, as she considers both her students' responses to class assignments on speech and expression rights and end-of-course evaluations, and reflects on the possibility that generational and experiential differences, rather than "resistance," may be behind students' reactions. The author concludes that transparency on the part of the teacher educator is critical to allow (re)consideration of our beliefs in more reflective ways.

Keywords: teacher education, reflective practice, education law

It is probably typical for many university faculty, especially newer professors, to struggle with how far they should go in "encouraging" students to reconsider strongly held beliefs, and to wonder whether there is a slippery slide towards turning students off entirely or blurring the lines between *inculcative* (socializing students into existing norms and values) and *liberal* (fostering self-determination) frameworks for teaching (Warnick, 2009). After more than three years of teaching required social foundations classes for teacher candidates at a rural Midwestern university, I find myself routinely struggling with questions about how to encourage them to contemplate the implications of their beliefs and to promote critical thinking about education-related issues without "push[ing] them to the point of resistance" (Ahlquist, 1991, p. 164).

I am a child of the sixties, raised in an era when challenging authority was the coin of the realm. In second grade, I questioned a nun who loaned my show-and-tell book to another student without asking. I remember as an eleven year-old hearing a teacher's description of being in Chicago during the 1968 Democratic National Convention and desperately wanting to see the protests for myself. In high school, I seriously considered investigative journalism as a career, inspired—no doubt as many others were—by Carl Bernstein and Bob Woodward and their Watergate reporting. For better or worse, I remain strongly "liberal" when it comes to rights and freedoms, while students today are shaped by September 11, 2001 and other threats; the limitations many Americans are willing to accept in exchange for a feeling of safety often make sense to them.

Despite, or perhaps because, of this, I believe it is important to challenge students who have grown up in different times to consider the shift that has occurred. I believe it is crucial for students to understand the implications of legal and policy decisions that affect K-12 students' rights, especially through a historical context, particularly because it is very difficult to reclaim rights once they have been restricted.

Research focusing specifically on young adults' beliefs about speech and expression rights after the September 11 attacks is lacking, but there have been survey data reporting that this group expresses less willingness than earlier generations to give up civil liberties to achieve

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security from terrorism (American Pew Research Center, 2011; Halpin & Agne, 2009). It should be noted, however, that Pew and Halpin/Agne reported 37% and 25% of respondents, respectively, *did* agree that restricting civil liberties was an appropriate tool to achieve security. The Knight Foundation found that three-quarters of surveyed high school students in 2004, 2006, 2007 and 2011 either didn't know what they thought about the First Amendment or took it for granted; almost half the 2006 and a quarter of the 2011 respondents thought the First Amendment overall went too far in the rights it guaranteed (Dautrich, 2011).

Imber (2008) reported that less than half of the teachers in his education law classes were able to correctly answer questions about student rights, concluding that "teachers are not only uninformed about student rights but burdened with a great deal of misinformation" (p. 93). In particular, he believes that many teachers do not support or understand constitutional rights for K-12 students (see also Dautrich, 2011). Significantly, Imber suggests that teachers tend to see themselves more as "surrogate parents, entitled to act with broad authority based on their judgment of how best to promote the educational interests of their students and school" (p. 93), rather than as representatives of the state, subject to the limitations the Constitution places on government actors in their interactions with citizens.

And so, my approach to the topic of student speech and expression rights in the education law class I teach seemed clear: It was critical to encourage my future teachers to support *their* future students in understanding and practicing their rights, especially in light of the increasing limits being imposed by courts on student expression.

It is unclear, however, whether my efforts have resulted in the desired outcome.

As an essential aspect of my class, I ask my students to consider their own beliefs about speech and expression rights in the context of current and historical trends. I encourage them to express their ideas verbally and in written assignments, acknowledging that some topics we explore (e.g., religious expression in the classroom) can provoke strong feelings. The tension between my own desire to prepare teachers to advocate for speech and expression rights—and indeed to practice these rights themselves—bumps up against my concerns that "demanding a certain degree of open-mindedness can be equated to pushing a liberal agenda" (James, 2010, p. 626). My dilemma: How do I sustain my commitment to demonstrating the importance of the "marketplace of ideas" while avoiding coercive pedagogy? Is such a thing possible? Alternatively, are identification of and transparency about the pedagogy choices we make as teacher educators perhaps the best we can do, as Hess (2005) suggests?

This paper is an account of the path I have taken, as I have slowly come to learn through reflection that I must own my own liberal bias, honor my students' differing values, and continue to work to find productive room for both in the classroom, honestly and respectfully. It is based on my reflections on three plus years of teaching a ten-week education law class to teacher candidates, prompted by student responses to course assignments and to the course itself via end-of-semester evaluations. These data will illustrate the challenges that have surfaced for me in trying to engage and challenge students while wrestling with the complicated feelings these efforts seem to provoke for both of us.

I. Struggling with Disclosure.

Before turning to my own reflection, it is helpful to have some sense of the context of the role of the teacher educator vis-à-vis his or her students' beliefs and values. Hess (2009), among others (Kahne & Westheimer, 2003; James, 2010; Parker, 2003), argues that schools are critical sites

for developing civic awareness and providing opportunities for students to engage in "dialogue, debate, and action" (Feinberg, 2008). Teacher educators, to her, have a particular responsibility to develop K-12 educators who help their students "to encounter, to speak, to hear, to critically evaluate" (Hess, 2009, p. 173). It seems logical that it would be difficult to encourage such responsibility without teacher candidates themselves reflecting deeply about their *own* assumptions and beliefs.

While the American Association of Colleges and Universities argues that students' "ethical, civic and moral development" should go hand-in-hand with intellectual development (AACU, 2009), "The goal of producing ethical, moral graduates raises legitimate questions about the role of college professors in […] shaping students' values" (Woessner & Kelly-Woessner, 2009, p. 343). DelFattore (2010, pp. 23-24) notes, "Students […] have no constitutional right never to hear ideas that they do not like […] [but] the students' obligation to learn the course material does not extend to sharing the instructor's view of it." A large body of literature examines the resistance of teacher candidates to multicultural classes (see Vavrus, 2010); no such literature exists for education law classes, despite controversy (religion, segregation, ethics) being an undercurrent throughout. These types of foundational classes pose special challenges that methods and content classes do not; by their very nature they ask students to "learn from viewpoints that may be starkly *different* from what they hear elsewhere" (Hess, 2009, p. 173).

A. Teacher Stance.

The tension, for me, comes out of how hard to push students to consider the implications of their views on constitutional rights for their future students and for our society. I am aware of the perception that "liberal" college professors seek to sway their students on social and political issues (Gross, 2012), though recent studies have shown that this perception is not well grounded in reality (Gross, 2012; Smith, Mayer, & Fritschler, 2008; Woessner & Kelly-Woessner, 2009). Especially in teacher education programs, there is ongoing controversy over the idea of compelling particular "dispositions," including inclinations for "societal transformation" and social justice (Cunningham, 2009; Misco & Shiveley, 2007; Will, 2006; Wilson, 2005).

There are differing perspectives regarding what, if anything, a teacher should reveal to students about his or her own beliefs in class environments where opinion is relevant (as opposed to, say, lecturing students about presidential candidates in a physics class). While the National Council for the Social Studies' (NCSS) teacher standards are written for K-12 teachers, they provide a perspective on teacher stance that leans towards discretion. These standards encourage teachers to avoid "promulgating personal, sectarian, or political views" and to "encourage recognition of opposing points of view" (NCSS, 2002, p. 13). Clearly the notion of academic freedom on college campuses allows for much more latitude on the part of instructors, though there *is* evidence that faculty overall skew liberal (Gross, 2013), and legitimate concerns can be raised about the possibility that true debate and dialogue cannot be achieved if there is not enough diversity to support them (Long, 2013).

Kelly (1986) and Hess (2005) describe teacher "stances" that are similar in terms of approaches to controversial issues. They both argue that controversy, handled appropriately, is critical for student development. Kelly (1986) goes further in arguing that we are fooling ourselves if we believe true neutrality is possible; that teacher perspectives should not be excluded from the classroom; and that students can benefit from observing an adult role model

addressing issues thoughtfully and responsibly while encouraging critical thinking. This preferred approach to controversial issues is called *committed impartiality*:

> First, teachers should state rather than conceal their own views on controversial issues. Second, they should foster the pursuit of truth by insuring that competing perspectives receive a fair hearing through critical discourse (Kelly, 1986, p. 130).

This is a challenging stance and one that takes practice, skill, and time to hone. Whether this stance, practiced well, is enough to mitigate the possibility entirely of students feeling pressured or coerced is an open question.

II. Reflection Framework.

Day (1999) and Hess (2005) both argue that without engaging in deliberate and systematic reflection, educators cannot fully identify and monitor their own taken-for-granted assumptions and motivations infusing their work. "Reflective practice" and "self study" are two frameworks that can be utilized to organize such efforts. Loughran (2002) notes that reflective practice can mean different things, from the simple act of thinking about something, to a more formalized practice that has associated activities and data collection techniques geared to promote insight. Either way, he maintains that "Reflection is effective when it leads the teacher to make meaning from the situation in ways that enhance understanding so that she or he comes to see and understand the practice setting from a variety of viewpoints" (p. 36).

Self-study approaches call for sustained and critical reflection as a means of professional growth, and as a field has increasingly grown more rigorous in terms of methodology (LaBoskey, 2012). It should be acknowledged that self-study is not always deliberately anticipated and planned. As Berry (2008, p. 18) writes, "[Learning] problems may present themselves as "surprises" encountered in the course of [teachers'] work, or they may be the result of a teacher educator's deliberate decision to investigate a particular area of practice." She reminds us "Self-study is not a straightforward process" (p. 20).

Sharing one's self-study can mitigate professional vulnerability by publicly inviting others to become part of the reflective process. In this case, my struggle has become the basis for a series of conference proposals, presentations, and manuscript drafts over the last few years. The reflection and revisions for these, along with the critical feedback I have received, have resulted in an evolution—from work that targeted the limitations of my students and in hindsight was a "rationalization" (Loughran, 2002, p. 35) for seeing the problem outside myself, to this current paper that puts the onus more squarely on me. My focus, as well, has evolved from an emphasis on speech rights in a democracy to an examination of my own reactions to student responses and the evolution of these reactions over time (fueled, for example, by journal reviewers who pointed out that my work was better suited as self-study—at the time, something of a revelation). As it turned out, the sharing of a new paper revision with a colleague ultimately pushed me to deeper understanding and a reframing of the dynamics of the dilemma, as I will discuss later.

While accelerated by the scholarly work above, my thoughts were also captured in my own notes to myself, recollections, and formal reflections for tenure and promotion documents (referred to as "formal reflections") required by the university for each semester of teaching. As I struggled with my initial belief that the goal was to get students to understand why they should perceive things as I did, and I tried to move past this uncomfortable realization, my emphasis evolved from rationalization to reflection (Loughran, 2002). Thus, this is not a textbook example

of self-study, particularly as such research is conceptualized today, and is not meant to be taken as such—though it does authentically reflect the sometimes sloppy, meandering nature of examining practice.

A. Student Data as Trigger.

The impetus for examining the classroom dynamic was prompted initially by student comments in my end-of-semester evaluations. These evaluations always trigger comments from students that refer to my bias. Despite my assurances—spelled out in the syllabus and reiterated frequently in class—that all perspectives are welcome if thoughtfully defended, students' end-of-semester evaluations, while favorable on the whole, always feature comments that target my "personal bias" ("She gives out bad grades becase [*sic*] she is so biased and only likes to hear what pleases her").

As is typical, evaluations are collected during the last weeks of class and are anonymous. Professors in my department are rated on seventeen criteria (ranging from quality of oral and written communication skills to availability to students to preparation for class) using a Likert scale, and there are three open-ended questions asking for feedback about the most and least valuable aspects of the course and suggested improvements. The comments about bias may be a minority perspective (ranging from 5-15% of students, but typically about 10% each semester) but they are offered with heartfelt conviction, and their appearance has remained consistent over time.

After the first semester of teaching the law class, I began to look more closely at topics (e.g., the teaching of evolution, the rights of the minority) and assignments that seemed to elicit, however subtle, viewpoints that differed from mine. I have asked students to respond to varied prompts, including a case featuring a student wearing a provocative political t-shirt to school (the "terrorist t-shirt" vignette) and a journal question about schools' jurisdiction regarding student rights ("How much/what kind of control, in terms of speech and expression rights, should schools have over students?"). Though I cannot definitively link student responses and the beliefs I assume they represent with course evaluation responses, such a connection does not seem implausible.

III. The Education Policy and Law Class.

My university is located in a rural, economically stressed area of the Midwest. Its teacher candidates are primarily white females who are majority Christian, mirroring national demographics (U.S. Department of Education, 2007), coming mostly from rural towns or suburban areas. The program requires all candidates to take an education law class; the course description notes that we seek to "allow students to critique contemporary debates concerning educational policy, law, and ethics [and] examine the tension between competing philosophical theories and the construction and function of educational policy in a democratic state." The vast majority of students are seniors moving on to student teaching. A significant section of class is devoted to the Constitutional rights of K-12 students (and teachers as well). As resources, we utilize case studies, videos, and scholarly and mainstream media articles that describe iconic Supreme Court cases and contemporary dilemmas, so as to consider education law and policy from multiple perspectives.

Many of my students struggle with my expectations for critical thinking and reflection about education-related issues. There is palpable discomfort about these expectations, which tends to emerge most strongly after they review my written comments on drafts of written work. The discomfort may have something to do with the homogeneity many grew up with (often revealed as they share perspectives about educational issues based on their own schooling experiences), or with their thwarted anticipation of less ambiguous assessments, such as quizzes (reported as more typical in other courses).

As a prelude to exploring student speech and expression rights, we discuss ethical and moral thinking in the contexts of school and society; we use a school law text, lecture materials, and relevant readings to examine the complexities of educational dilemmas in both policy and practice. For the student rights section, we trace the trajectory of legal rulings from the Tinkers' black armbands (1969) to the 2007 *Morse v. Frederick* "Bong Hits 4 Jesus" case,[2] examining how speech and expression rights have been narrowed over the years (Strossen, 2000/2006).

The faculty who teach this class have agreed on the importance of case studies/vignettes and reflection (Warnick & Silverman, 2011) as avenues for assessing students' understanding of the theory and application of ethical, moral, and legal thinking in education. We transitioned the course's capstone project from a personal philosophy of education to a paper that incorporated reflections on education policies and dilemmas. After this change, I noted in my formal promotion/tenure reflections:

> This transition may have contributed to some uncertainty about the difference between opinions and reflections again; I know some students had a difficult time understanding why they were being pushed to go beyond immediate reactions to think more deeply (for example, asking students to reflect on what responsibility they had to the profession at large was a difficult question for many). (September, 2011)

The tension regarding my role as teacher has been prompted by student work on the speech and expression rights of K-12 public school students. It appears that for many, the marketplace of ideas is less compelling than maintaining civility and security. The first time I used the t-shirt vignette as an assignment, I informally coded student responses and found overwhelmingly strong themes around avoiding offensiveness and around safety concerns, both offered as a rationale for limiting students' rights in public school classrooms. I have continued to find these themes through subsequent coding for both assignments, in approximately 200 responses to the t-shirt vignette and approximately 375 responses to the student rights prompt, over three plus years of teaching. While not specifically examined here, support for the right to privacy for K-12 students also appears to be qualified; there is consistently a defense of drug testing and random searching of public school students by a significant number of my students, primarily as a means of keeping schools safe. The belief that "If students have nothing to hide, they shouldn't get upset about searches or drug tests" is very common.

A. The Terrorist T-Shirt Vignette.

The first semester I taught at the university, as a temporary instructor, I used a student t-shirt vignette as an essay question, and asked how a public school student who refused to remove a

[2] *Tinker v. Des Moines Independent Community School District*, 393 U.S. 503 (1969) led to the Supreme Court reinforcing students' constitutional rights in public schools after Mary Beth and John Tinker wore black armbands to protest the Vietnam War. *Morse v. Frederick*, 551 U.S. 393 (2007) expanded schools' rights to suppress student speech that appeared to promote drug use.

politically charged shirt should be handled. The answers alarmed me. The vignette was based on the case of *Bretton Barber v. Dearborn Public Schools*. Barber was a high school junior in Dearborn Heights, Michigan (a community with a large Muslim population) who in 2003 wore a t-shirt to school that bore then-President George W. Bush's picture and the words "International Terrorist." He was ordered by a school administrator to take it off, refused, and was sent home despite no evidence of any disruption to the school day. He contacted the American Civil Liberties Union (ACLU), which sued on his behalf, alleging violation of his First Amendment rights, and won his case in the U.S. District Court for the Eastern District of Michigan.

The scenario given to my students changed some of the details (e.g., a teacher reported a few minutes discussion about the shirt in a calculus class; an administrator is told by a student that he needed to "do something" or there would be a problem). My students were asked to describe what they thought the ethical and legal issues were, and how they might handle the situation if they were the decision maker.

The first time I used this vignette, I had no expectations of students returning anything resembling sophisticated legal analysis. I did have expectations that the *Tinker* decision (which held that even unpopular student speech that did not cause substantial disruption was protected) had made at least some impression, along with, perhaps, our discussions around what constituted disruption and what might present "teachable moments." However, students then—and afterwards—tended to focus on the need to maintain control and order.

Student responses. Close to two-thirds of students, over the semesters, have indicated that the "International Terrorist" t-shirt was disruptive simply in the wearing; many of them identified the offensiveness of the t-shirt's sentiment as a rationale for forcing its removal. Students have had two main reasons why the student should take off the shirt or face stiff punishment. Some simply argued that if an article of clothing offended someone, the wearer should be compelled to remove it.

> What I have concluded from these pieces of information is that although student free speech is protected, the second somebody else is affected by the conduct, it becomes an issue […] He should understand that […] he should not bring things into the learning environment that can be considered controversial and/or cause a problem with other students and their learning environments.

Other felt safety concerns were a legitimate reason for forcing removal of the shirt. Roughly half of my students have indicated that the possibility of danger—some concerned about an escalation into "chaos," "anarchy," or "terrible consequences"—justify asking the vignette's high school student to remove a t-shirt labeling then-president George W. Bush a terrorist. A few students have expressed concerns for the t-shirt wearer; one student wrote, "[The student's] safety is an equal right to his right to free speech." Another described a broader concern, echoed by many:

> Also, the shirt can cause a great deal of violence. The school is racially divided. It is more than likely that the Arab population of the school agrees with the t-shirt. However, there may be Bush supporters in the school as well. This can potentially start conflict.

Many students clearly absorbed, on some level, the finding of the *Tinker* Supreme Court decision that "substantial disruption of or material interference with school activities" (393 U.S. at 514, 89 S.Ct. at 740) needed to be evident or reasonably forecast to limit speech or expression, and concluded that the t-shirt had disrupted the school environment. The brief discussion in the calculus class provoked misgivings:

> […] it is clear from the description of the Calculus class that the shirt sparked a debate, which interrupted the lesson that was planned for that day.
>
> The t-shirt was obviously causing a disturbance in many classes and with many students.

Reflections. The first semester I used this case study, I scuttled the scheduled topic for the day when I returned papers and initiated (perhaps demanded) conversation about the responses. I referenced *Tinker* and again described how "disruption" has been interpreted by the courts. I expressed concern that many students seemed to feel that as soon as someone is (or might be) offended, speech protection went by the wayside. I questioned the perception that "many" students at the fictional high school were offended, upset, or otherwise actively or negatively impacted by the t-shirt in a way that disrupted the educational process. I later jotted down on my working syllabus that "students think ACLU is great to help them when teachers screw up on Facebook, but not for kids' political views."

It is hard to know whether my comments had much impact; I remember the discussions as perfunctory, and student evaluations at the end of the classes were not required as I was a temporary instructor that semester. In retrospect, it is safe to assume that students felt scolded rather than enlightened. I am reminded of what one of my colleagues wrote after I later shared this experience and sought advice about channeling my impatience in more productive ways:

> I can still remember the first semester: I came into the classroom like a bulldozer with all my baggage of leftist righteous theories hammering students about social justice…and they hammered me back. In that particular moment, I did not engage in conversation with my students, but I engaged in confrontation, trying to convince them of my position. (personal communication, August 12, 2009)

My next few formal reflections continued to position students as somewhat resistant, however; for example:

> It is important to strike a balance between appropriately challenging students and making accommodations that result in stronger engagement and understanding of the material. I believe that students come in expecting […] assessments that involve their responding to short response or multiple-choice questions about particular laws, and instead they are asked to think about ethical and political issues related to education law and policy, using cases and critical thinking. (January 2010)

I used the t-shirt case for four semesters and eventually moved on to other assessment options, including a newly required reflective journal, which I turn to now.

B. The Student Rights Prompt.

Class assessments include varied journal prompts meant to elicit students' reflections on educational policies and challenges. It is unusual to have students who have much knowledge of areas like school funding, school choice, teacher evaluation, or tenure, based on the responses I get to my initial inquiries. Half my classes, therefore, introduce students to these topics and related policy choices and implication, and are more lecture-based than interactive. I am left to conclude that it is the discussions of student rights (due process, drug testing and privacy, religious and political expression) that trigger stronger feelings, and that these feelings remain on the front burner since these topics figure significantly in final papers. One reflective prompt focuses on these rights, asking my students to consider what sort of control public schools should exercise over students' speech and expression. Students write drafts, I supply feedback, and they turn in their final reflective journals after the class is over.

Student responses. Again, while there are students who describe schools as important places to learn about the responsibilities of citizenship in a safe and orderly environment, over half of my students each semester responded to the prompt with an endorsement of the school's right to maintain strong control over student speech and expression on school grounds. Safety and offensiveness remain the primary concerns:

> It is a hard thing for schools to try and keep order and safety with all of its students without stepping on the toes of the students Amendment Rights. I feel however schools should be obligated to break some of these rights in order to keep the school a safe learning environment.
>
> Because of what happened on 911 [*sic*], the schools need to do a better job of regulating and documenting what students wear and what behavior is expected of them when at school during school hours.

Some drew boundaries around where and when students had more or less rights; many noted that once outside the school students could do as they pleased:

> I do believe that students should be able to express themselves, however if it is offensive in any way, then it should not be done on school property. When students are outside of school they can express themselves all they want.

Others felt that the adult world imposed restrictions similar to the ones mandated by court rulings, and they argued that learning to adapt to such restrictions would ultimately serve students well:

> Our jobs are to educate students so they grow up to be responsible adults in which they need to act accordingly so I don't think it's to [*sic*] much to ask of them to follow a few simple rules in school. In the future, most will be told how to dress and act so we are really just setting them up for what they will experience down the road.

Reflections. My primary opportunities to provide feedback present as either verbal prompts in class about relevant information or resources or via written comments to individual students on their drafts. For example, I might remind students in class that the article we read about a science teacher struggling to teach evolution in a class of evangelical students is a good reading to keep in mind when considering religious rights and ethical teaching. On papers, I might ask a student who suggests that teachers should always remain "neutral" how they might handle a student who walks into class wearing a Confederate flag t-shirt, or how they would respond to a student who asks why it is necessary to take a drug test to play tuba in the school band. It is difficult to tell, though, if these generalized in-class comments or the more private individual feedback come across to students judgmentally or not. I noted in another formal reflection:

> There is feedback from some students about their opinions not being valued, which is not a new complaint but one I continue to try to figure out how to address. Like the multicultural class, ed law has as its focus real-world issues and dilemmas […] and as a result there are going to be strong feelings […] One goal is to be more conscious of the written feedback I provide to students on their journals; to be aware that my comments may seem appropriate to me but may feel more critical to students and to figure out ways to challenge them without discouraging them. … (September 2011)

C. End-of-course Evaluations.

In reviewing evaluations, I focused on one of the Likert scale items, along with the comments. The item (*The instructor was respectful of all students*) is the most relevant for self-examination. Over eighteen sections of the education law class, on a 5.00 scale, the lowest mean for this item has been 3.38 and the highest 4.82. The vast majority of students rate me, on average, between 4.25 and 4.75. As noted, the percentage of comments that focus on my perceived bias in some way average out at about ten percent of students over the semesters.

Comments like "she pushed her opinions on us a little too much" leave me wondering whether this particular writer really *is* expressing the viewpoints of multiple students. Comments that reflected an emotional reaction to perceived pressure, such as "I was honestly scared to share my opinion and thoughts because of how much of a complete dictator she is," while rare, are disconcerting. The belief that work is assessed based on how closely it aligns with my perceived opinions leaves me troubled, trying to understand what triggered students to write, "I belive [*sic*] you cannot ask someone for their opinion and the [*sic*] look for a specific answer that matches your specific opinion" and "if you didn't give her opinion, then you're wrong."

Reflections. While student evaluations at my university may not have as much weight for promotion and tenure decisions as they can at other colleges and universities (Franklin, 2001), they *are* collected and submitted; if for that reason only, it is difficult not to ruminate on the less positive perspectives that are offered. Despite the fact that the vast majority of comments are positive, these opinions leave me wondering: How many students felt coerced and simply didn't write that down? Did I make a difference in terms of encouraging students to re-consider long-held beliefs, or did I force them to go underground?

I have frequently taken suggestions and critique from students' evaluations and used these to make changes, but it is easier to adjust the number of quizzes than it is to intuit students' reasons for feeling pressured. Sometimes it seems that regardless of how carefully I choose my words or tone of voice, there is no avoiding some pushback from students. The formal reflection done in September 2011 suggests this:

> I reflect each semester about how to teach more effectively and find ways to make connections between students' lives and experiences in order to make the courses more meaningful for them. I do not want to revert to a quiz a week or two tests a semester to determine students' grades, so I am somewhat resigned to the fact that evaluations are always going to be likely to reflect at least some student frustration. However, this does not let me off the hook for continuing to search for ways to mitigate that as I can.

IV. Self-Critique: I *am* Pushing a Liberal Agenda.

Truth be told, it was not until I shared an earlier draft of this paper with a younger colleague, Susan (a pseudonym), that I began to feel like I could really step outside of the dialogue in my own head and think about this tension in a more productive and hopeful way. For quite a while, my reactions were framed by an education law lens—meaning, alarm at how often students were endorsing the limitation of rights for reasons that seemed overblown. I even presented a paper at a law conference that illustrated my struggle with developing "teachers who understand just how critical their role is in preparing future citizens and in maintaining essential liberties" (Feinberg, 2008).

What I discovered was that I could not see the forest for the trees. I was guilty of what I had always cautioned my students to avoid—assuming that everybody else saw the world through the same lenses as they did. Ironically, I was playing the role of surrogate parent that Imber (2008) discussed, although in service of activism, rather than caution. After all, I had written in my very first formal reflection (and espoused in my syllabi):

> I try hard to remind my students that they can and should play roles beyond simply "teacher." They are citizens, potential future parents, and certainly taxpayers, and will be *activists* and policymakers by virtue of the choices they make as educators. (January 2009, emphasis added)

A. Competing Values.

What are teachers supposed to be, in terms of their roles as educators in a democratic society? My bias is grounded in a scholarly perspective (Hess, 2009; Kahne & Westheimer, 2003; Parker, 2003) that positions teachers as role models who create democratic classrooms and foster the kinds of discourse that reflects a marketplace of ideas. Others, however, believe that teachers overstep their boundaries when they go beyond teaching the content they are responsible for (Fish, 2008, is the most articulate spokesman for this stance but focuses on higher education; the argument is relevant nonetheless) and/or encourage dispositions beyond character traits such as respect, responsibility, and the ability to get along with others.

I would not have wanted my own children to attend a school that would suspend a student for a politically oriented t-shirt, and as a parent I would have been thrilled to hear more often of moments that allowed them and their classmates the opportunity to debate, discuss, and honor diverse opinions about varied issues. That is *my* perspective, however—and I wonder, does this perspective make it more difficult to tolerate students' differing outlooks? Given research that has shown college professors as more critical of colleagues' work that contradicts their own beliefs (Kelly-Woessner & Woessner, 2006), it is not a stretch to presume that the same dynamic could be in play with students.

As Susan helped me to recognize, there is value in both my students' and my perspectives. She pointed out, "You are getting push back from students not because they don't believe in our essential liberties but because they have learned a different set of values growing up. More conservative values" (personal communication, September 24, 2012). This is really not surprising; as inexperienced educators, teacher candidates are particularly concerned with classroom management and maintaining control of students; for them, "fair" often means no one gets hurt, and "safe" means no one is offended. There is nothing inherently wrong with being worried about student safety; everyone is entitled to learn in a safe environment. There is nothing inherently wrong with being worried about offending someone; it could be argued that the pendulum has swung too far in the other direction when we consider the current level of discourse in our politics and media. These were the values taught to Susan, who grew up in a rural community very much like the ones surrounding our university. They are values that have taken on added importance for many after September 11—despite the potential for unintended consequences around the surrender of rights (Walsh, 2006).

It is hard to believe that students born in 1990 or later would have an understanding of how things "used to be" (for example, boarding a plane without going through a scanner—let alone walking a traveler to their departure gate!) unless their families or teachers went out of their way to engage them in discussion about American civil liberties. So, really, why would they

recognize the slippery slope I worry we embark upon when we banish a student's political t-shirt or mandate drug testing for any student who wants to participate in extracurricular activities? As I peel off the cloak of rationalization, I have begun to understand that students' perspectives may reflect profound generational or experiential differences, rather than resistance.

B. Where to Go From Here?

While is can be argued that the importance of recognizing students' values and life experiences should have been obvious earlier, it appears that rationalization (Loughran, 2002) is alive and well in teacher education, especially in social foundations courses. Lowenstein (2009) writes persuasively about the preponderance of "deficit views of White preservice teachers" (p. 164) she uncovered in her comprehensive review of the literature on multicultural teacher education, and caustically concludes that "teacher educators face the task of somehow rescuing teacher candidates from their lack of knowledge or from their misconceptions" (p. 178). As an alternative, she argues that these students be seen as active learners, who bring useful resources to their learning experiences.

What I can do to help that along is publicly acknowledge that perspectives—including mine—are filtered through one's personal historical contexts, and that understanding those contexts allow us to (re)consider our beliefs in more reflective ways. If I own my experiences—and the biases they have helped create—I give students permission to own theirs. A "good grade," it must be made clear, is not based on students' parroting my positions—that is not education, after all. But it is important to help students understand how experiences and contexts shape our perspectives and help or hinder our ability to reflect and deliberate about issues big and small—and I cannot do that with them, if I am not willing to do that in front of them. Is this "committed impartiality" (Kelly, 1986)? I believe it is at least an important part of its foundation.

This being said, it must be considered that it is impossible to avoid negative reactions in a class that is meant to encourage critical thinking and discussion. Sherman & Cohen (2002), among others, found that people who do not have a solid sense of self-worth are more likely to "allow their beliefs to bias their evaluation of new information" (p. 119) and adopt a defensive posture in response to such experiences. Students, particularly traditional undergraduates, are certainly more likely to be in the process of navigating challenging experiences and forming identities as they move through their teacher education programs, and may be more likely to dismiss alternative perspectives as agenda-laden or biased. While it is important to keep this in mind, it is not enough to abandon discussion of controversial topics.

It is ironic, of course, that my belief in the "marketplace" of the classroom could end up persuading students of an agenda meant to trump their values and beliefs. James (2010, p. 619), in her account of theological certainty and its effects on discussion in the university classroom, argues

> One consequence of [the] lack of public political discourse and engagement is increasing partisanship–certainty if you will—about the rightness of one's position, and less desire (or ability) to find common ground (Schkade, Sunstein, & Hastie, 2006) […] In such a political climate, teachers who are committed to and capable of preparing students for democratic citizenship are vitally important. It follows, then, that teacher educators who can help prepare teachers for their roles as democratic educators are equally important.

How easy it is to fall into the trap of rationalizing one's own position via the "student resistance" lens, inadvertently reinforcing the partisanship James speaks of in the classroom. The

opportunity for a marketplace of ideas in our schools via exposure to multiple perspectives has always been crucial; it is even more crucial now; and teacher educators have a special responsibility to help teacher candidates become comfortable with this framework. This cannot be accomplished, however, without acceptance of how past experience shapes all of us, as well as recognition of how current experience has the power to do the same. It is my hope that this reflection illustrates a transparency (Hess, 2005) about pedagogical perceptions, choices, and tensions that helps other educators consider their own practice and the choices they make as well.

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A comparison of student academic motivations across three course disciplines

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Abstract: Intrinsic and extrinsic motivations of undergraduate students enrolled in human anatomy and physiology, physics, and nutrition courses were explored with course discipline-specific adapted versions of the Academic Motivation Scale. Information on students' study habits and efforts, and final course grades were also collected. Results revealed the adapted versions of the Academic Motivation Scale had comparable reliabilities to previous investigations, significant differences in motivations across the students enrolled in the three courses and significant influences of motivation on academic behaviors and course performance.

Keywords: academic performance, self-determination theory, academic motivation scale

I. Introduction.

In an attempt to understand what factors are related to the motivation of undergraduate students, how students' motivation may contribute to their success or failure in individual courses, as well as what can be done to increase their motivation, we undertook the current study. This project investigated students' intrinsic and extrinsic motivations, as well as amotivation, while enrolled in human anatomy and physiology (HAP), physics, and nutrition courses. These three classes enroll students across many different majors, which require these courses be taken as part of the curriculum. This provides an excellent opportunity to study differential student motivation and the impact of those differences on student academic behaviors and performance.

Student motivation is a vital determinant of academic performance and achievement. It has been extensively studied in the context of global higher education. Deci and Ryan's (1985) self-determination theory (SDT) provides a theoretical framework for explaining student behavior through the understanding of student motivation. According to SDT, motivation should not be viewed as a unitary concept. Instead, SDT proposes a continuum composed of three types of motivation: intrinsic motivation (IM), extrinsic motivation (EM), and amotivation. Motivations along the continuum differ in the extent in which they are self-determined.

Intrinsic motivation represents the most self-determined type of motivation, in which activities are accomplished for the sake of enjoyment. There are three subfactors within intrinsic motivation: intrinsic motivation to know (IM-To Know), intrinsic motivation toward accomplishments (IM-To Accomplish), and intrinsic motivation to experience stimulation (IM-Stimulation). IM-To Know arises when an individual engages in a behavior for the satisfaction

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experienced while learning or trying to understand something new. IM-To Accomplish occurs when an individual engages in a behavior for the pleasure experienced while trying to accomplish a task or create something. IM-Stimulation transpires when an individual engages in a behavior in order to experience stimulating or exciting sensations.

Extrinsic motivation lies along the center of the continuum of self-determination. Extrinsic motivation represents actions taken to achieve a goal or reward beyond the activity itself. There are three subfactors included in the extrinsic motivation, listed in order here from most to least self-determined: extrinsic motivation identified (EM-Identified), extrinsic motivation introjected (EM-Introjected), and extrinsic motivation external (EM-External) forms of regulation. EM-Identified is when an individual truly values a behavior even though they are not doing it because they like it. EM-Introjected is when one engages in a behavior to maintain personal expectations or avoid guilt. EM-External is when an individual participates in an activity solely as a means to obtain an external reward or to avoid punishment.

Amotivation lies at the opposite end of the self-determination continuum from intrinsic motivation. Amotivation refers to the absence of intention and motivation.

When applied to the realm of education, SDT is primarily concerned with promoting in students a confidence in their own capacities and attributes, a valuing of education, and an interest in learning. Self-determined motivation has been linked to various education outcomes across the age span, from early elementary school to college students. Pintrich and De Groot (1990) linked intrinsic motivation and autonomous forms of extrinsic motivation to positive academic performance. Student motivation has been found to be a predictor of positive academic performance in areas including course attendance (Moore et al., 2008), course grades (Wilson & Wilson, 2007), and persistence in their program of study (Dodge et al., 2009).

Unfortunately, students are increasingly taking a consumerist approach to higher education, suggesting a shift from intrinsic to extrinsic motivations (Labaree, 1997). This is potentially problematic because students whose motivations are more intrinsic do better in school, have lower rates of withdrawal, absenteeism, and dropout, and have lower feelings of anxiety about school and higher levels of academic performance (Prospero & Vohra-Gupta, 2007). Griffin et al. (2013) recently reported the single most influential learning and study skill promoting positive academic performance is students' level of intrinsic motivation. These studies suggest examining students' motivations may be important to predicting their performance in college courses.

Considering student motivation is vital for success in college, faculties place more emphasis on motivation and attitudes towards learning as central to learning than students themselves (Lammers & Smith, 2008). Furthermore, studies have acknowledged that motivational factors are discipline-specific, and what leads to success in one field may not necessarily do so in another. Academic achievement of biology, history, computing, planning, anthropology, geology, food science and nutrition, and education students measured using a motivation questionnaire revealed that factors motivating students are specific within a discipline, and do not extend uniformly across all disciplines (Breen & Lindsay, 2002). Disciplinary differences in self-regulated learning were also noted among college students taking humanities, social science, and natural science courses (Vanderstoep et al., 1996).

In this study, we have chosen to investigate student motivation in three courses: HAP , physics, and nutrition. Few studies have researched motivations of the allied health student population, who are required to take HAP. Considering the important role of allied health professionals in society, it becomes crucial to identify these students' motivations, as they will

work directly with clients in the health field (Ballman & Mueller, 2008). In addition, examining students' motivations will be important to predicting their performance in HAP courses.

HAP courses are considered "difficult" by both faculty and students (Michael, 2007). At our institution, HAP courses are required of all allied health majors. Most students taking the classes at our institution are pre-nursing majors, although we have also noted an increase in exercise science and nutrition majors. Students taking these courses need to earn a grade of "C" or better to progress in their degree program. As more and more students enter the allied health field, the enrollment in these courses is skyrocketing. Attrition is an issue to be addressed as well: as many as 50% of the students enrolled in the class fail to earn at least a "C", and must either retake the course, change their major, or drop out.

It has been reported previously that nursing students traditionally experience difficulties with the science subjects in nursing curricula (Andrew, 1998). Nilsson and Stomberg (2008) also found that the degree of difficulty/heavy demand on studies is one of the factors in explaining low motivations of nursing students. Salamonson et al. (2009) observed a shift from intrinsic goal orientations to extrinsic goal orientations in nursing students, including high achieving nursing students. These findings suggest that students in HAP courses may be more extrinsically motivated.

Few studies have researched the motivations of students studying physics. In one study, the Self-Determination Theory was applied to the motivational orientations of 9th grade students studying physics in Finnish-speaking comprehensive schools in Finland (Byman et al., 2012). According to this study, both IM and EM-Identified seemed to be optimal motivational orientations to physics learning. Even fewer studies have focused on the motivations of students taking physics courses at the university level. Recently, Bodin and Winberg (2012) reported on the role of beliefs and emotions in numerical problem solving in university physics education. They discovered that intrinsic motivation together with students' personal interest and utility value beliefs did not predict the quality of performance on task with many degrees of freedom. However, feelings corresponding to control and concentration, emotions that are expected to trigger students' intrinsic motivation, were important in predicting performance.

Similar to HAP courses, physics courses are considered difficult by students. At our institution, Introductory Physics courses are required for multiple majors. The student population in the Introductory Physics course is composed of approximately 50% exercise science majors, 30% construction management majors, 10% biology majors, and 10% of other majors. Also similar to HAP, attrition is an issue to be addressed, as approximately 30-40% of the students enrolled in the class fail to earn at least a "C", with the same consequences as noted above for students taking HAP courses. Given the required nature of these courses, additional studies on the motivation of students taking these courses would be beneficial in improving student success in their major.

Research on the motivations of students in nutrition courses is even more limited and suggests these students may have different motivations from students in other majors (Breen & Lindsay, 2002). More specifically, this research reports that students taking nutrition courses seem to have primary motivations that focus on the enjoyment derived from academic activities. Although the Breen and Lindsay conceptualization of motivation does not fully overlap with the SDT model, the motivations described are definitely intrinsic, and most closely resemble IM-To Know and IM-To Accomplish.

Unlike the HAP and physics courses describe above, the nutrition courses used in this investigation are not required, are not perceived as "difficult," and do not typically have a high

percentage of students who earn less than a "C". If the same was true of the classes used in the Breen and Lindsay investigation, that may explain why intrinsic motivations appeared to more strongly influence student performance.

Based on this prior literature, we hypothesize:

H1: The Academic Motivation Scale used in prior research can be applied to specific courses, not just higher education globally. Specifically, reliabilities for subscales will be comparable with reported reliabilities.

H2: The Academic Motivation Scale subscales will differ significantly between students enrolled in the three course disciplines in this investigation (HAP, physics, and nutrition). Specifically, students in nutrition courses will report higher levels of intrinsic motivations and lower levels of extrinsic motivations than students in HAP and physics courses.

H3: Student motivation will influence study habits and efforts (e.g., class attendance, completion of assignments, and hours spent studying) and final course grade. Specifically, higher levels of intrinsic and extrinsic motivations will be associated with higher levels of study habits, efforts, and final grades. Conversely, higher levels of amotivation will be associated with lower levels of study habits, efforts, and final grades.

II. Method.

A. Participants.

Participants were recruited from a population of students enrolled in one of 11 sections of six different undergraduate courses at a large public southeastern university: four sections of Human Anatomy & Physiology I [HAP I], two sections of Human Anatomy & Physiology II [HAP II] and Nutrition & Health, and one section each of Physics I, Physics II, and Nutrition & Diet Therapy. A total of 806 students participated and 775 (96.2%) completed the full questionnaire: 369 in HAP I, 152 in HAP II, 79 in Nutrition & Health, 106 in Physics I, 26 in Physics II, and 43 in Nutrition & Diet Therapy. We were able to obtain final course grades for 663 (grades for both sections of Nutrition & Health were unavailable), representing 85.5% of those who completed the questionnaire.

With respect to demographic data, 67.5% of the participants (N=523) were female, 32.4% (N=251) were male, and 0.1% (N=1) did not report their gender. The majority of participants (66.2%) were White (N=513), with 26.5% (N=205) African-American, 1.9% (N=15) Hispanic, 2.2% (N=17) Asian-American, 3.0% (N=23) "Other," and 0.3% (N=2) not reporting ethnicity. In terms of class standing, 5.2% (N=40) were freshmen, 48.5% (N=376) were sophomores, 31.0% (N=240) were juniors, 14.5% (N=112) were seniors, 0.1% (N=1) were grad students, and 0.8% (N=6) were "other." Data for student majors is listed by course discipline in Table 1.

B. Materials.

Participants received a 42-item questionnaire. The first six questions were demographic questions. The next eight questions were dependent variables and queried students about their likelihood of continuing with their major [Continue], grade point average [GPA], class attendance [Attendance], class preparation [Preparation], study time [Hours Studying], perceived level of difficulty of the class [Perceived Difficulty], overall level of motivation [Motivated], and anticipated grade in the class [Expected Grade]. These eight questions were identical to those

used in Maurer, Allen, Gatch, Shankar, and Sturges (2012). Due to IRB restrictions, it was not possible to reconcile self-reported GPA with official university records.

Table 1. Student major by course discipline.

	Course discipline					
	HAP		Physics		Nutrition	
Major	*N = 520*	%	*N = 132*	%	*N = 122*	%
Nursing	227	43.65%	0	0.00%	101	82.79%
Athletic Training	29	5.58%	2	1.51%	0	0.00%
Exercise Science	113	21.73%	57	43.18%	0	0.00%
Nutrition	32	6.15%	0	0.00%	0	0.00%
Health Education & Promotion; Community Health	20	3.85%	0	0.00%	4	3.29%
Health and Physical Education	16	2.31%	0	0.00%	0	0.00%
Biology/pre-med	28	5.38%	22	16.67%	2	1.64%
Chemistry	0	0.00%	2	1.52%	0	0.00%
Geology	0	0.00%	2	1.52%	0	0.00%
Computer Science	0	0.00%	6	4.54%	0	0.00%
Construction Management	0	0.00%	31	23.48%	0	0.00%
Other	59	11.35%	10	7.58%	15	12.30%

The remaining 28 questions were adapted from Vallerand et al.'s (1992) Academic Motivation Scale (AMS) following the protocol developed by Maurer et al. (2012). The AMS operationalizes SDT by measuring degrees of self-determined motivation in academic contexts. Vallerand and colleagues (1989) developed and validated the AMS for the purpose of assessing three types of intrinsic motivation (IM-To Know, IM-To Accomplish, and IM-Stimulation), three types of extrinsic motivation (EM-Identified, EM-Introjected, and EM-External), and amotivation. The AMS has been shown by Grouzet, Otis, and Pelletier (2006) to be time- and gender-invariant.

Prior investigations with the AMS have all operationalized it at the global level, referencing higher education and college attendance more generally. In this study, the AMS was adapted to apply specifically to the three course disciplines: HAP, physics, and nutrition. The AMS consists of seven subscales, each of which is assessed with four items on a seven-point Likert scale: Amotivation, EM-External, EM-Introjected, EM-Identified, IM-Stimulation, IM-To Accomplish, and IM-To Know. Reliabilities for the seven subscales in the original AMS, expressed as Chronbach's alpha, are presented in Table 2 as "Reported alpha."

To adapt the AMS to the three course disciplines, each of the 28 items were reworded to focus the meaning of the item on the course selected. In the original AMS, participants were instructed, "Using the scale below, indicate to what extent each of the following items presently corresponds to one of the reasons why you go to college", with response options from *Does not correspond at all* to *Corresponds exactly*. For the present study, the instructions were reworded by replacing the phrase "go to college" with the phrase "are taking this class." A sample IM-To Know item from the original AMS read, "For the pleasure I experience when I discover new things never seen before." In the present study, the item was reworded by replacing the phrase "never seen before" with the phrase "about the human body I've never seen before" (HAP), "about how the physical world works that I've never seen before" (physics), and "about nutrition and health that I've never seen before" (nutrition).

C. Procedure.

The project used a non-experimental design with a convenience sample. Students in the 11 course sections were invited to participate in an in-class survey. They were given 15 minutes to complete the survey and enter their responses via clickers (i.e., classroom electronic response systems) or on special scantrons. No incentives for participation were offered and all students were free to decline participation. Final course grades were collected from course instructors after the end of the term.

III. Results.

A. Hypothesis One.

Reliability analyses indicated that all seven subscales of the adapted AMS had adequate internal reliability, as measured by Chronbach's alpha, for all three course disciplines. Reliabilities were comparable to those reported for the global AMS by Vallerand et al. (1992) and to those reported for the previously adapted allied health AMS by Maurer et al. (2012) (see Table 2).

B. Hypothesis Two.

Correlational analyses revealed significant correlations between the AMS subscales, so a Multivariate Analysis of Variance [MANOVA] with the three course disciplines as the categorical independent variable and the seven AMS subscales as the dependent variables was computed. A significant multivariate main effect for course discipline emerged, Pillai's Trace = .24, F (14, 1534) = 15.04, $p < .001$, partial $\eta^2 = .12$. Follow-up univariate ANOVAs yielded significant models for all seven AMS subscales (see Table 3). For the IM-To Know and IM-To Accomplish subscales, all three course disciplines were significantly different from one another. For IM-To Know, students in nutrition classes reported higher scores than students in HAP classes who reported higher scores than students in physics classes. For IM-To Accomplish, students in physics classes again reported the lowest scores, but this time students in HAP classes reported the highest scores. For the IM-Stimulation subscale, physics was significantly different (lower) from the other two course disciplines which were not significantly different from one another. For the remaining four subscales, HAP was significantly different from the other two courses disciplines (higher in all cases except amotivation) which were not significantly different from one another. Higher scores indicate higher levels of that type of motivation, with 16 representing the midpoint for each subscale.

Table 2. AMS subscale reliabilities by course .

		Course					
		HAP I	HAP II	Physics I	Physics II	Nutrition & Diet Therapy	Nutrition & Health
AMS Subscale	Vallerand et al.'s Reported Alpha	HAP		Physics		Nutrition	
IM-To Know	.84	.89		.88		.89	
IM-To Accomplish	.85	.84		.87		.84	
IM-Stimulation	.86	.87		.85		.86	
EM-Identified	.62	.80		.77		.86	
EM-Introjected	.84	.84		.91		.88	
EM-External	.83	.85		.83		.82	
Amotivation	.85	.81		.80		.79	

Note. Alpha is Chronbach's alpha.

Table 3. AMS subscale differences by course discipline.

			Means		
AMS Subscale	F (2, 772)	Partial η^2	HAP	Physics	Nutrition
IM-To Know	56.67**	.13	18.82_a	12.48_b	19.96
IM-To Accomplish	24.47**	.06	16.94_a	12.90_b	15.28
IM-Stimulation	29.21**	.07	14.50_a	9.92_b	13.79_a
EM-Identified	73.18**	.16	21.83_a	15.99_b	17.34_b
EM-Introjected	16.44**	.04	18.21_a	15.13_b	15.80_b
EM-External	11.99**	.03	21.23_a	19.13_b	18.73_b
Amotivation	6.04*	.02	8.11_a	9.52_b	9.61_b

* $p < .01$, ** $p < .001$

Note. Means in the same row with different subscripts are different at the $p < .01$ level. Subscale range: 4-28.

C. Hypothesis Three.

In addition to the correlations between the seven AMS subscales, significant correlations emerged between the nine dependent variables. As a result, a multivariate multiple regression (Generalized Linear Model) with the seven AMS subscales as independent variables and all nine

dependent variables was conducted. To facilitate data interpretation and presentation, separate models were computed for each of the three disciplines.

HAP. Three subscales yielded significant models: EM-Identified (Pillai's Trace = .04, F (9, 459) = 1.92, $p < .05$, partial $\eta^2 = .04$), EM-External (Pillai's Trace = .05, F (9, 459) = 2.57, $p < .01$, partial $\eta^2 = .05$), and amotivation (Pillai's Trace = .09, F (9, 459) = 5.32, $p < .001$, partial $\eta^2 = .09$). Seven dependent variables yielded significant models: Continue (F (7, 475) = 2.41, $p < .05$, partial $\eta^2 = .04$), GPA (F (7, 475) = 8.59, $p < .001$, partial $\eta^2 = .11$), Attendance (F (7, 475) = 3.18, $p < .01$, partial $\eta^2 = .05$), Hours Studying (F (7, 475) = 4.77, $p < .001$, partial $\eta^2 = .07$), Motivated (F (7, 475) = 7.79, $p < .001$, partial $\eta^2 = .11$), Expected Grade (F (7, 475) = 12.82, $p < .001$, partial $\eta^2 = .16$), and Final Grade (F (7, 475) = 7.88, $p < .001$, partial $\eta^2 = .11$).

EM-Identified significantly influenced likelihood of continuing with major (F (1, 475) = 4.58, $p < .05$, partial $\eta^2 = .01$), GPA (F (1, 475) = 11.26, $p < .01$, partial $\eta^2 = .02$), Expected Grade (F (1, 475) = 7.30, $p < .01$, partial $\eta^2 = .02$), and Final Grade (F (1, 475) = 8.09, $p < .01$, partial $\eta^2 = .02$). Visual inspection of means confirmed that all effects were positive linear effects such that higher levels on EM-Identified were associated with higher levels on the dependent variables (see Table 4).

EM-External significantly influenced likelihood of continuing with major (F (1, 475) = 4.23, $p < .05$, partial $\eta^2 = .01$), GPA (F (1, 475) = 5.63, $p < .05$, partial $\eta^2 = .01$), Attendance (F (1, 475) = 4.23, $p < .05$, partial $\eta^2 = .01$), Hours Studying (F (1, 475) = 6.64, $p < .05$, partial $\eta^2 = .01$), Motivated (F (1, 475) = 3.93, $p < .05$, partial $\eta^2 = .01$), Expected Grade (F (1, 475) = 8.96, $p < .01$, partial $\eta^2 = .02$), and Final Grade (F (1, 475) = 5.79, $p < .05$, partial $\eta^2 = .01$). With the exception of continuing with the major and hours studying, visual inspection of means again confirmed positive linear effects. For hours studying, a curvilinear effect was revealed such that those who reported the smallest and largest number of hours studying reported lower levels of this type of motivation than those who reported around 3-6 hours studying. The results for continuing with the major did not yield an interpretable pattern.

Amotivation significantly influenced GPA (F (1, 475) = 19.03, $p < .001$, partial $\eta^2 = .04$), Motivated (F (1, 475) = 16.15, $p < .001$, partial $\eta^2 = .03$), Expected Grade (F (1, 475) = 33.63, $p < .001$, partial $\eta^2 = .07$), and Final Grade (F (1, 475) = 18.17, $p < .001$, partial $\eta^2 = .04$). Visual inspection of means revealed negative linear effects for GPA, Motivated, and Expected Grade, and a curvilinear effect for Final Grade. Those students who received Ds reported higher levels of amotivation than students who received higher or lower grades.

Physics. Only the amotivation subscale yielded a significant model (Pillai's Trace = .20, F (9, 113) = 3.24, $p < .01$, partial $\eta^2 = .21$). Five dependent variables yielded significant models: Hours Studying (F (7, 129) = 2.25, $p < .05$, partial $\eta^2 = .12$), Difficulty (F (7, 129) = 3.36, $p < .01$, partial $\eta^2 = .16$), Motivated (F (7, 129) = 3.71, $p < .01$, partial $\eta^2 = .18$), Expected Grade (F (7, 129) = 4.94, $p < .001$, partial $\eta^2 = .22$), and Final Grade (F (7, 129) = 3.50, $p < .01$, partial $\eta^2 = .17$).

Amotivation significantly influenced Difficulty (F (1, 129) = 12.29, $p < .01$, partial $\eta^2 = .07$), Motivated (F (1, 129) = 9.26, $p < .01$, partial $\eta^2 = .05$), and Expected Grade (F (1, 129) = 6.82, $p < .05$, partial $\eta^2 = .02$). Visual inspection of means revealed a negative linear effect for expected grade and curvilinear effects for Difficulty (amotivation peaking at the extremes) and Motivated (amotivation peaking in the center).

Nutrition. Two subscales yielded significant models: IM-To Know (Pillai's Trace = .47, F (9, 26) = 3.24, $p < .05$, partial $\eta^2 = .47$) and amotivation (Pillai's Trace = .44, F (9, 26) = 3.24, $p < .05$, partial $\eta^2 = .44$). Two dependent variables yielded significant models: Hours Studying

(F (7, 41) = 3.85, $p < .01$, partial $\eta^2 = .44$) and Final Grade (F (7, 41) = 2.68, $p < .05$, partial $\eta^2 = .36$).

IM-To Know significantly influenced Final Grade (F (1, 41) = 4.57, $p < .05$, partial $\eta^2 = .12$). Visual inspection of means revealed a curvilinear effect such that students with low levels on this subscale received Cs whereas students with high levels were more likely to receive As and Fs. Amotivation did not predict either of the variables in the significant models.

Table 4. Influence of AMS subscales on dependent variables by course discipline.

	Dependent Variable								
Course discipline	Continue	GPA	Attendance	Preparation	Hours studying	Perceived difficulty	Motivated	Expected grade	Actual grade
HAP									
EM-Identified	Positive linear	Positive linear	—	—	—	—	—	Positive linear	Positive linear
EM-External	Uninter pretable	Positive linear	Positive linear	—	Bell-shaped curvilinear	—	Positive linear	Positive linear	Positive linear
Amotivation	—	Negative linear	—	—	—	—	Negative linear	Negative linear	Bell-shaped curvilinear
Physics									
Amotivation	—	—	—	—	—	U-shaped curvilinear	Bell-shaped curvilinear	Negative linear	—
Nutrition									
IM-To Know	—	—	—	—	—	—	—	—	U-shaped curvilinear

IV. Discussion and Conclusions.

This study is an extension of our previous work on motivation in allied health students (Maurer et al., 2012). It explored students' academic motivations to better understand how motivation may contribute to students' success in HAP, physics, and nutrition, and whether there are differences in motivation among students in these courses. Since no previous studies used the AMS across multiple course disciplines to study student motivation, this study brings a unique perspective to research in motivation.

Results obtained offered support for all three hypotheses. Our first hypothesis stated that the AMS scale could be applied to specific courses, not just higher education globally as exemplified by reliabilities comparable with those previously reported. Our data revealed that the reliabilities for all of the seven subscales of the AMS were similar to previously reported reliabilities and consistent across all three course disciplines. This suggests that the AMS can be adapted to specific courses in HAP, physics, and nutrition, with reliable results and can be used as an instrument to study motivation in these courses.

Our second hypothesis stated that the AMS subscales would be significantly different between students enrolled in the three course disciplines (HAP, physics, and nutrition). Specifically, students in nutrition courses will report higher levels of intrinsic motivations and lower levels of extrinsic motivations than students taking HAP and physics courses. Although both intrinsic and extrinsic scores were higher than amotivation scores across all three course disciplines, the data showed significant differences between intrinsic motivation and extrinsic motivation subscales. It seems that students in nutrition courses are mostly driven by IM-To

Know, HAP students are mostly driven by EM –Identified, and students in physics courses are driven by EM-External. Our results support previous research and indicate that students taking nutrition courses have predominantly intrinsic motivation. Since the nutrition class is an elective for many majors and focuses on current nutrition trends and their impact on health, it is possible that students self-select by degree of interest and can see a more direct connection between their learning and their own personal health status. In comparison to the other two course disciplines, nutrition is also considered an easier class and students perform better academically. HAP on the other hand is a required class for all allied health majors, so even though students value this class (Sturges, Maurer, and Dobson, 2012), they consider it difficult (Sturges and Maurer, 2013) and their motivation for success is reflected in high EM-Identified. This supports our previous research in HAP classes where extrinsic motivation was highest on the AMS (Maurer et al., 2012). Physics is a required class for multiple majors, including non-physics majors or even non-science majors, as students take this class to satisfy major requirements. Since physics serves as a prerequisite for future major courses, students might see less intrinsic value in the course while they are completing the course, and as such they might be more motivated to receive a passing grade than to really learn or understand the material. This could influence their primarily EM-External orientation, where students are motivated by an extrinsic reward (progressing to major) or avoiding punishment (not progressing to major).

Overall, students in all courses scored high on EM, which supports previous research findings indicating a more consumerist approach to education. It also supports our previous findings (Maurer et al., 2012) which indicate that instructors can influence students' motivation on the extrinsic motivation subscales through an attendance policy, in-class assignments and other activities, but have little control over students' intrinsic motivation.

Our third hypothesis stated that student motivation would influence study habits and efforts (class attendance, completion of assignments, and hours spent studying) and final grade. Specifically, higher levels of intrinsic and extrinsic motivations will be associated with higher levels of study habits, efforts, and final grades. Conversely, higher levels of amotivation will be associated with lower levels of study habits, efforts, and final grades. Numerous significant results emerged from this analysis. For HAP, student motivation did indeed influence final grade and multiple student study habits and efforts. The results suggest a strong influence of EM for this population. It could be that due to the position of the HAP class in the allied health curriculum, students value the class, even if they don't like it, which is seen in the positive linear effect of their GPA and expected/final grade. On the other hand, they are also driven by an extrinsic reward (progressing to major) or avoiding punishment (not progressing to major), when it comes to their attendance and expected/final grade.

However, five of the significant results yielded curvilinear effects, contrary to the general predictions of SDT. In fact, two of the three significant results for physics, and the only significant result for nutrition, were curvilinear. Thus, although our results offer significant support for our third hypothesis, and the significant linear effects we observed are consistent with SDT, the curvilinear effects suggest that in shifting the focus from global academic motivation to academic motivation for a specific course, some of the assumptions of SDT may not hold. There may even be course differences in the predictive efficacy of the theoretical model. Future replication and extension of this research may be required to determine if SDT may need to be revised in order to be used at the specific course level. Ideally, matched upper-level courses in several disciplines with similar class sizes could be used.

V. Limitations.

The findings of this study should be interpreted taking into account several project limitations. First, although the study had a large sample size and targeted three different course disciplines, there was an uneven sample distribution across classes. The sample was heavily represented by HAP students due to the larger class sizes and greater number of sections taught. This inequity across courses disciplines reduced statistical power for the physics and nutrition analyses and may partially explain why fewer significant effects were observed for those courses compared to HAP. Future studies should target larger samples of students taking physics and nutrition courses to address this possibility. It is also possible that there is a shift in motivation as students progress in their selected major and future research should explore this possibility by assessing student motivation longitudinally and across different majors which could shed more light on why students in nutrition courses are primarily driven by intrinsic motivation. Second, the sample of students all came from the same university and as such, it is unknown if we can extrapolate these results to other populations of students at different universities. Finally, the five curvilinear effects that were observed are curious and not fully interpretable from a quantitative perspective. A qualitative approach to this type of study to examine additional factors that contribute to these effects may be required.

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The impact of an interdisciplinary learning community course on pseudoscientific reasoning in first-year science students

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Abstract: This case study examined the development and evaluation of an interdisciplinary first-year learning community designed to stimulate scientific reasoning and critical thinking. Designed to serve the needs of scholarship students majoring in mathematics and natural sciences, the six-credit learning community course was writing-intensive and emphasized general scientific reasoning and critical thinking skills. Success of the course was measured using a pre-test/post-test design that assessed students' paranormal beliefs. Outcomes of the study indicated students' paranormal beliefs were significantly lower at the end of the semester than at the beginning, which was used as a surrogate measure of scientific reasoning that was directly relevant to course content. Supplementary analyses demonstrated that their (a) paranormal beliefs were significantly lower than other students and (b) students self-identified the importance of the scientific reasoning skills learned in the course without being prompted on their teacher-course evaluations. The results of this study can inform the design of interdisciplinary, scientific reasoning courses.

Keywords: Pseudoscientific thinking, critical thinking, learning community, scientific reasoning, first-year students

I. Introduction & Background.

Many college professors attempt to promote scientific reasoning and critical thinking within their courses. According to Shermer (2002, p. 18) scientific reasoning is:

> A set of methods designed to describe and interpret observed or inferred phenomena, past or present, and aimed at building a testable body of knowledge open to rejection or confirmation.

Further, Halpern (1997, p.4; see also Halpern, 1998), defines critical thinking as:

> thinking that is purposeful, reasoned, and goal directed – the kind of thinking involved in solving problems, formulating inferences, calculating likelihoods, and making decisions when the thinker is using skills that are thoughtful and effective for the particular context and type of thinking task.

Clearly, scientific reasoning and critical thinking skills are an essential foundation of skepticism and evidence-based reasoning that are the foundation for science. Thus, a goal of most first-semester introductory science classes is to acculturate students in reasoning based on evidenced obtained through the scientific method (Druger, 2002). While this has always been a component of science education, more emphasis is being placed on understanding the nature of science and scientific reasoning of late (National Research Council, 1998). Even though many of these early scientific-reasoning skills may be generalized beyond a specific scientific discipline,

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one cannot separate scientific content from scientific reasoning and critical thinking (see for example, Nelson, 1999) although critical thinking can be developed supplementally in such a way that it strongly supports deeper learning of scientific content (Adey & Shayer, 1993). Other studies have examined the impact of learning communities on reasoning and critical thinking (e.g., Browne & Minnick, 2005) in general, focusing on learning communities that pair an introductory science course with a course from another discipline. The present study focuses on whether a specially designed learning community for science majors can influence students' pseudoscientific thinking and thus improve their skeptical, scientific, and critical reasoning.

The Science Scholars Learning Community (LC) was a two-course, team-taught program designed for a specific group of scholarship recipients at St. John Fisher College. The LC program at Fisher was structurally similar to those at other school institutions; first-year students were housed in the residence halls near their LC peers so that the students developed a close-knit cohort that offered academic and social support during the adjustment to college. According to Inkleas, Soldner, Longerbeam, and Leonard (2008, p. 502), this LC fell into the category of "small, limited resourced, primarily residential life emphasis" programs.

The students in the Science Scholars Learning Community came to the college with a sound basic high school understanding of science and were specifically selected for the scholarship program based on excellent high school performance in science and mathematics. The course cluster was designed around comparing pseudoscientific thinking and scientific reasoning and emphasized methods of improving scientific reasoning and critical thinking by learning, discussing, and using scientific methods. Thus, our primary research questions for this study were

1. In what ways can this LC impact students' pseudoscientific thinking?
2. How does the pseudoscientific thinking of the students in the learning community compare with the general student population?

A secondary research questions, assuming a positive answer to the first questions was:

3. Do improvements in pseudoscientific thinking translate into improvements in critical thinking and scientific reasoning?

A. Brief Background about Learning Communities.

The Learning Communities National Resource Center (n.d.) offers several models of learning communities, but in general, learning communities are a collection of courses in which a cohort of students participates. These courses can be either loosely connected or tightly linked with integrated content (Smith, MacGregor, Matthews, & Gabelnick, 2004). In some cases, the same group of students is enrolled in several courses, such as calculus and introductory physics, and a seminar, which helps students make connections between the linked courses. A coordinated studies model, on the other hand, places the cohort in a team-taught block that covers the material of several traditional courses with integration among all topics.

These learning communities, which are planned collaboratively among the faculty members involved combine content knowledge with skills practice (Smith et al., 2004). According to Smith and colleagues, learning communities are one of the solutions to recent calls for educational reform, because students are actively engaged and reflective. The reflection in action (e.g., Schön, 1987) helps students to build metacognitive structures necessary for the critical and creative thinking required about academic content. Because of this, learning communities have been used to improve retention, attendance, and social behaviors for first-year

students (Inkelas, Daver, Vogt, & Leonard, 2007). In fact, they have also been used specifically in science and engineering programs to help students make the transition to college (Smith, et al., 2004) and improve general critical thinking skills (Quitadamo, Brahler, & Crouch, 2009).

A similar example of a science-based LC involving the coordinated studies model is provided by Morgan, Carter, Lemons, Grumbling, and Saboski (1995). In Fisher's cohort-based cluster learning community model, courses in the LC are linked by a common theme, and the students are housed together to provide a community of support outside of the classroom. Such living-learning communities tend to promote peer-support networks and enhance campus involvement (Dabney, Green, & Topalli, 2006) At Fisher, each LC fits into one of two formats: (a) a standard first-year composition course paired with one content-area, general education course or (b) a cluster of two content courses taught in a writing-intensive format. The Science Scholars LC is an example of the second model. In either model, all courses in a cluster revolve around a common theme, such as the Vietnam War, the nature of self, the economics of sports, or, as in this case, the nature of scientific thinking. LCs have been a part of the Fisher first-year experience for over a decade. Similar to the findings at other schools, the LCs have resulted in higher first-year retention rates (e.g., Dabney et al., 2006; Dodge & Kendall, 2004), cross-disciplinary communication and collaboration among the faculty, and tighter-knit student cohorts.

One example of a science-based LC involving the coordinated studies model is provided by Morgan and colleagues (1995). The course of study involves a year-long experience combining introductory courses in biology with a literature course and an environmental science course in addition to a one-credit seminar. Their findings showed that students in the LC improved significantly on intellectual development, suggesting that the LC had improved their reasoning and critical thinking skills (see also work by Browne & Minnick, 2005) and students' ability to apply these to decision-making and value judgments.

B. Critical Thinking, Scientific Reasoning, and Pseudoscientific Beliefs.

Halpern's (1997) definition of critical thinking, cited above, is a broad attempt to capture the multitude of thinking skills that might be involved in "critical thinking" by generalizing the concept as dealing with "thinking that is purposeful, reasoned, and goal directed." It seems, though, this view of critical thinking as a generic skill that can be acquired independent of specific content may be flawed. Recent studies have found that many academics describe critical thinking differently (Moore, 2013) using such a variety of descriptors that one is tempted to believe that there is no single elephant being described by all of the blind academics. However, deeper analysis of the concept (Davies, 2013) yields a commonality to all of these definitions that is instantiated differently in different disciplines. Thus, there is a common core of learning to think in a way that prioritizes logic and evidence over instinct, and this core can be approached and learned in a way that allows it to easily transfer across disciplines. At the same time, each discipline has its own criteria for what constitute logic and evidence. In the sciences, critical thinking is instantiated by the term "scientific reasoning" which combines aspects of analysis with specific skills related to experimental design (National Research Council's Committee on Undergraduate Science Education, 1999).

Generically then, critical thinking includes the judgment and a skeptical stance toward evidence that is presented. This allows one to then test to what degree a given assertion is supported by the evidence and reasoning presented, and suggests a tradeoff between learning to

think critically and accepting paranormal beliefs. This tradeoff is partially supported by the literature. For example, past research has examined the relationship between critical thinking and paranormal beliefs, showing in general (cf., Roe, 1999) that critical thinking is negatively related to paranormal beliefs (Aarnio & Lindeman, 2005; Cheung, Rudowicz, Kwan, & Yue, 2002; Messer & Griggs, 1989) or reported past paranormal experiences (Royalty, 1995). Further, past research has demonstrated a negative correlation between paranormal beliefs and reasoning ability (Hergovich & Arendasy, 2005) and that paranormal beliefs are unrelated to age (Aarnio & Lindeman, 2005). Other studies, however, have found that higher levels of education do not necessarily translate into lower paranormal beliefs (Farha & Steward, 2006). This same study also examined paranormal beliefs across the disciplines, finding that students in the sciences fell somewhere in the middle in terms of paranormal beliefs (social sciences had the highest percentage of believers) and that were virtually no differences attributed to gender. Thus it seems that even further training within a scientific discipline, which one expects to focus on scientific reasoning, is not sufficient to eliminate a student's beliefs in paranormal (or more broadly, pseudoscientific) phenomena, suggesting that individuals possess the capacity to engage in different modes of thinking selectively even though the selection may not be made a conscious level. This also suggests that without explicitly applying the generic skill of critical thinking to the specific contents of pseudoscience and the paranormal, students may develop strong scientific reasoning and critical thinking skills while still holding uncritical beliefs in phenomena such as spontaneous human combustion and fortune telling.

C. College and Student Profiles.

St. John Fisher is a private liberal arts college in the Catholic tradition located between the city of Rochester, New York, and the eastern suburbs. Admission is competitive, and the majority of students are drawn from a 100-mile radius of the campus, resulting in a student population mostly from upstate New York. Many students come from the outlying rural school districts, and many are drawn to Fisher because of the Catholic heritage of the school. Most of our Science Scholar Learning Community students fall close to national and state averages in academic achievement in high school (e.g., mean national high school GPA of 88% versus 94% for the science scholars). At the time of this study, students in the top two tiers of scholarships with an interest in biology, chemistry, computer science, mathematics or physics are also offered the opportunity to apply to the Science Scholars Program. Most students have completed several Advanced Placement courses in mathematics and science or have participated and received credit for other college-credit courses before high school graduation. Almost all of the Science Scholars have completed four years of mathematics and science in high school and are academically motivated students with a strong interest in the sciences. Biology and chemistry are the most common major choices followed by mathematics. The remaining minority of students are equally split between computer science and physics.

D. Course Background and Design.

The Science Scholars Learning Community was a writing-intensive, two course (6-semester hour) experience. The explicit connection between writing and science helps improve students' scientific writing (Kokkala & Gessell, 2002) and provides them with valuable practice applying the tools of the course independently. Rather than give two separate grades for the two courses in

which the students were officially registered, students received the same grade for both courses, and both instructors participated in reading all major papers. In addition, a substantial component of the course grade was based on in-class and small writing assignments, as well as a group research project that culminated in a large team-run debate.

Unlike many of the LCs at Fisher, the Science Scholar Learning Community was not composed of existing first-year courses like introductory psychology or chemistry 101. Thus, there were no departmental expectations to provide the foundation for future courses in a discipline. Instead, two new courses were created to allow the Science Scholar Learning Community to explore the nature of science independent of a particular discipline. One course was listed in the interdisciplinary studies program while the other was listed under the mathematics, science, and technology integration program. While neither course counted for credit in any major, both courses provided students with credit towards meeting the college core requirements. Together, these courses explored the nature of science by comparing scientific fields and scientific thinking with pseudoscience and science fiction topics. One of the faculty members in this LC normally taught in the Department of Psychology, and the other in the Mathematical and Computing Sciences department. Thus, by design, students were exposed to different perspectives on scientific and critical thinking. The faculty members met regularly to discuss the course and the students and to ensure that each class period connected to the previous and subsequent periods and maintained the structure of the LC.

This also meant that each of the freshman-level writings completed during the semester was directly tied to all LC content rather than being unrelated at times. For example, when students were introduced to the idea of critically analyzing evidence, we also discussed how to summarize sources and properly cite them, with the student practice being tied to their particular paper. During the semester, both instructors worked on the writing topics with the students, as appropriate to the flow of the LC and student needs. Both instructors used writing assignments to help students practice the skills and thinking that were the goals of the LC.

The course had two primary texts. The first provided an outline of skepticism, scientific reasoning, and critical thinking, in contexts ranging from alien abduction scenarios and witch hunts to psychic powers and holocaust deniers. Shermer's (2002) *Why People Believe Weird Things* provided an outline of skepticism, scientific reasoning, and critical thinking in a wide range of contexts. The second text, *Taking Sides: Clashing Views on Controversial Topics in Science and Technology* (Easton, 2002, 2004), was a collection of pro and con essays on a variety of science and technology issues. These two books were supplemented with newspaper articles, magazine articles, Internet sources, videos, and other media as appropriate. Throughout the experience, students were expected to locate and evaluate additional resources, using the information literacy skills emphasized in the LC program at Fisher. In addition, we used two separate writing references (Aaron, 2003; Lester & Lester, 2003).

E. Course Structure and Implementation.

The students in the Science Scholar Learning Community met for approximately three hours on Tuesday and three hours on Thursday afternoons. Each class consisted of a variety of pedagogical modalities, including short lectures, class discussions, student presentations and debates, in-class assignments, and/or watching films or film clips that supported course content. During the term, students explored and wrote four papers, each dealing with different scientific topics. We began the course each semester by using a demonstration of psychic powers and tied

this demonstration to a unit of introductory scientific reasoning. The other instructor served as a confidant in these tricks, encouraging the students to take on evidence presented and think critically about it, and having them list various things they could change about the demonstration. The goal was for the students to think critically while the "psychic" tried to adapt as needed to overcome their suggestions and tests. In each year of the LC, the students eventually found a controlled change in the demonstration which negated the abilities for the instructors to successfully complete the trick.

All of this served to accomplish one main learning goal: it established the course content as learning how to think about the world critically. Students often reported that this one activity, on the first day of the semester, made a considerable difference for them in the ability to begin to think critically about information. Throughout the course, the instructors provided experiences to support the development of critical thinking in a structure similar to that in cognitive acceleration (Adey & Shayer, 1993) through stages of concrete preparation, cognitive conflict, metacognition and bridging. Concrete preparation was provided by connections to real situations and experiences, such as the introductory psychic demonstration. Cognitive conflict was generated through readings, discussions and various media presentations exposing students to multiple components and perspectives on the issues. The writing component of the LC provided opportunities for metacognition to be manifested, and parallels among the various situations and the common ways in which thinking goes wrong served as a bridge throughout the course.

The course structure used active learning principles to help to improve learning (Yoder & Hochevar, 2005). For example, students were frequently engaged in small group discussions and short presentations to the class during class time. Almost every class period involved some form of informal or formal writing, usually a short paragraph or so related to the current discussion, either to prime the students before the discussion or to summarize their ideas after. Some of these focused specifically on improving their writing skills, such as revising a particular paragraph or sentence of their work, or re-writing a paragraph using a different voice.

II. Method.

Clearly, the class was designed to stimulate critical thinking and scientific reasoning. During two of the four years that we co-taught the course, we assessed whether students' level of reasoning improved. To do so, we conducted a pre-test/post-test nonexperimental design using the Paranormal Beliefs Scale (Tobacyk & Milford, 1983) to assess their level of reasoning about paranormal phenomena. We also compared students' scores on the Paranormal Beliefs Scale to a) a control group of means from students in the original Tobacyk and Milford (1983) study, and b) a control group of students at the college. Finally, we conducted a qualitative analysis to examine students' unprompted reports of learning about critical thinking and scientific reasoning through the comments on our teacher-course evaluations.

A. Design and Participants.

Our design met the criteria of a quasi-experiment (see Cook & Campbell, 1979). The key participant group included the students from two cohorts of the LC. To learn about content-specific paranormal and pseudoscientific critical thinking, we collected information from the first-year Science Scholars students in the class during two different years. In the first year of the study (2003, the second year we taught the class), we collected data from 22 of 23 enrolled

students in the class (n = 14 women, n = 9 men), for a 96% response rate. In the second year (2004, the third year we taught the class), we collected data from all 21 enrolled students (n = 14 women, n = 7 men), for a 100% response rate.

The main phase of the study utilized a pre-test/post-test design. Specifically, responses to the Paranormal Beliefs Scale (PBS, Tobacyk & Milford, 1983) at the beginning of the semester were compared to responses to the PBS at the end of the semester. Data from the key participants were also compared to several other data sets: (a) normative data from Tobacyk and Milford and (b) posttest data from faculty and other students from a second phase of the study (spring 2007).

B. Measures.

The key surrogate measure of reasoning for the study was the 25-item Paranormal Beliefs Scale created by Tobacyk and Milford (1983). We used this scale because our curriculum directly compared pseudoscientific claims (e.g., psychic powers and alchemy) to what is known in their respective scientific fields (e.g., psychology and chemistry). The Paranormal Beliefs Scale provides one complete measure of paranormal beliefs that is based on an average of the items. It also includes seven subscales, including traditional religious beliefs (e.g., *The soul continues to exist though the body may die)*, psi (e.g., *Mind reading is not possible)*, witchcraft (e.g., *Black magic really exists)*, superstition (e.g., *Black cats can bring bad luck)*, spiritualism (e.g., *Reincarnation does occur)*, extraordinary life forms (e.g., *The Loch Ness monster of Scotland exists)*, and precognition (e.g., *Astrology is a way to predict the future)*. Most measures had sufficient inter-item reliability; those that did not may be due to the small sample sizes used to calculate the α coefficients (see Table 1).

Table 1. Cronbach's α coefficients for paranormal beliefs scale and each subscale as a function of sample and pre-test/post-test administration.

	Sample: Science Scholar Students		2006/07
	Pre-test α (n = 43)	Post-test α (n = 43)	Students (n = 228)
Entire Paranormal Beliefs Scale (25 items)	.85	.89	.92
Traditional Religious Beliefs scale	.90	.88	.85
Psi subscale (4 items)	.81	.70	.84
Witchcraft subscale (4 items)	.69	.80	.84
Superstition subscale (3 items)	.85	.88	.81
Spiritualism subscale (4 items)	.78	.80	.80
Extraordinary Life Forms subscale (3 items)	.88	.95	.90
Precognition subscale (3 items)	.71	.54	.75

In all of the groups, we had acceptably low measures of skewness and kurtosis (all < 1, well under the generally accepted minimum of 2), and the variances in different groups all had acceptably low F_{max} test results (all < 2, well under the generally accepted cutoff of 3). Further, though the students in this design are not fully independent because they were in the same class, it is common for researchers to assume independence in evaluations of classroom behavior because the students are working independently. Thus, the study appropriately met the requirements of normality, heterogeneity of variance, and independence necessary to conduct *t*-tests and ANOVAs.

C. Procedure.

The Paranormal Beliefs Scale was administered at the beginning of the first class meeting, using a paper-and-pencil questionnaire. The same measure was also administered on the last day of the semester (14 weeks later). To guarantee anonymity, students selected a pseudonym that they used on both the pretest and posttest so that their responses could be matched.

For comparison purposes, we also collected information from other SJFC students. Unlike the previous study, these data were collected using an online survey. All undergraduate students (n = 2,703) were sent a link to the online survey and brief explanation of the study via e-mail the week following finals but prior to commencement. They were given 10 days to complete the online survey. A total of 326 participants responded by at least starting the survey.

Participants in these comparison samples first saw a page with consent information, and were required to consent prior to participating. Four did not consent, and their data were removed. Respondents were asked to indicate their status (i.e., undergraduate or graduate students). Those who declined to indicate status (n = 19) or indicated they were graduate students (n = 25) were immediately routed to the debriefing by the system. To exclude students who were in the classroom sample, respondents were also asked (a) whether they were Science Scholars and (b) what year they began at St. John Fisher College. This resulted in the elimination of 12 more responses. Finally, 38 participants did not fully complete the Paranormal Beliefs Scale, for a total usable sample size of 228 participants.

All phases of this study were reviewed and approved by the St. John Fisher College Institutional Review Board. Each participant in our classes consented to allowing us to use his or her data in the study (those in the online survey who did not were immediately routed to the debriefing). All data were collected anonymously, and participants were debriefed either face-to-face or with a written online paragraph, depending on the type of administration.

D. Analysis Plan.

The main analyses for the students in our classes utilized paired-samples t-tests to compare their pretest scores to those from their posttest. We also conducted one-sample t-tests comparing the scores from the students in our classes to the averages provided by Tobacyk and Milford (1983). Finally, we compared posttest scores of the students in our classes to other students' scores using a one-way ANOVA. All analyses were conducted using the entire scale average as well as with all seven subscales.

III. Results.

A. Analyses of Research Questions.

The first research question asked whether students in our class had lower paranormal beliefs at the end when compared to their scores at the beginning. We tested this question using paired-samples t-tests for the entire Paranormal Beliefs Scale and all of the subscales. All but one post-test mean was statistically lower than the pre-test mean, and of those that were significant, all were in the medium to large range (Table 2). The only subscale that did not decrease significantly was the belief in extraordinary life forms. Thus, students had lower paranormal beliefs at the end of the course than they did at the beginning.

Table 2. Means and standard deviations for paranormal beliefs scale and each subscale from students in our class as a function of pretest-posttest administration (n = 43).

	Pretest *M*	Posttest *M*	t-test	*p*	Cohen's d
Entire Paranormal Beliefs Scale (25 items)	2.71 (.45)	2.34 (.54)	7.10	<.001	.74
Traditional Religious Beliefs scale	3.92 (.88)	3.73 (1.04)	3.73	<.001	.20
Psi subscale (4 items)	2.48 (.73)	1.94 (.67)	5.14	.001	.77
Witchcraft subscale (4 items)	2.41 (.74)	1.91 (.75)	5.56	<.001	.67
Superstition subscale (3 items)	2.00 (.97)	1.75 (.91)	3.04	.004	.27
Spiritualism subscale (4 items)	2.80 (.73)	2.35 (.79)	6.22	<.001	.59
Extraordinary Life Forms subscale (3 items)	1.88 (.88)	1.85 (.97)	.44	.66	.03
Precognition subscale (3 items)	3.22 (.77)	2.68 (.80)	4.69	<.001	.69

Our second research question examined whether students in our class had lower paranormal beliefs at the end of the semester than the students in the original Tobacyk and Milford (1983) study. We tested this question using independent-sample *t*-tests comparing the pre-test and post-test means and standard deviations to the means and standard deviations from Tobacyk and Milford. As Table 3 shows, all of the post-test means were significantly lower than the means from Tobacyk and Milford. Interestingly, many of the pre-test means were also significantly lower. Furthermore, as can be seen in the table, the nonsignificant finding from Research Question 1, which compared pre-test to post-test scores on the extraordinary life forms subscale, may be due to the fact that the Science Scholar students were significantly lower in pre-test means than Tobacyk and Milford's. Further, other research has reported anomalies in this subscale (Aarino & Lindeman, 2005).

Another aspect of the second research question examined whether students in our LC had lower paranormal beliefs at the end of their semester than the typical student at St. John Fisher College. We tested this by comparing post-test scores using independent samples *t*-tests. As depicted in Table 4, the results of these analyses demonstrated that the students in our learning community scored significantly lower on the entire Paranormal Beliefs scale than the typical St. John Fisher College student. Additionally, the students in our learning community scored lower on each of the paranormal beliefs subscales than the typical St. John Fisher College student, although only four of seven of these comparisons were statistically significant.

B. Supplementary Qualitative Analysis on Teacher-Course Evaluation Comments.

To answer the third research question, a supplementary qualitative analysis using the teacher-course evaluations across the two years of the study was conducted. The teacher-course evaluations ask for quantitative assessment and optional written feedback about areas such as course goals and objectives, aspects of the course students found beneficial, overall impressions,

and additional comments. Without being asked or prompted, 14 students wrote that the course improved critical thinking, eleven used the term *skeptic* or *skepticism*, eleven discussed how course content improved their thinking and questioning, eight discussed how it improved their ability to evaluate and/or analyze, and one specifically discussed how it improved scientific reasoning. For example, one student wrote that the course "emphasized the critical thinking portion." Another wrote that the content "expanded our learning and made us skeptical." Another comment stated that "many discussions helped me to think scientifically and made me much more articulate." Finally, one student summed up the course experience by saying, "I learned to think more critically." The unsolicited comments provide further evidence of meeting the goal of improving scientific reasoning and evidence-based critical thinking.

Table 3. Means and standard deviations for paranormal beliefs scale and each subscale from students in our class (n = 43) compared to means from Tobacyk and Milford (1983) as a function of pretest-posttest administration.

	Tobacyk & Milford	Pre-test		Post-test	
	M (SD)	*M (SD)*	Cohen's d	*M (SD)*	Cohen's d
Entire Paranormal Beliefs Scale (25 items)	3.07 (.48)	2.71* (.45)	.55	2.34* (.54)	1.47
Traditional Religious Beliefs scale	4.24 (.90)	3.92* (.88)	.36	3.73* (1.04)	.52
Psi subscale (4 items)	3.19 (.84)	2.48* (.73)	.90	1.94* (.67)	1.65
Witchcraft subscale (4 items)	2.77 (.85)	2.41* (.74)	.45	1.91* (.75)	1.07
Superstition subscale (3 items)	2.08 (.82)	2.00 (.97)	.09	1.75* (.91)	.38
Spiritualism subscale (4 items)	2.64 (.79)	2.80 (.73)	.21	2.35* (.79)	.37
Extraordinary Life Forms subscale (3 items)	2.82 (.83)	1.88* (.88)	1.10	1.85* (.97)	1.07
Precognition subscale (3 items)	3.52 (.84)	3.22* (.77)	.37	2.68* (.80)	1.02

* Means differ from Tobacyk & Milford (1983) at $p < .05$.

These self-reported changes were also seen in the ways the students presented and used evidence in their writing and in classroom activities, such as the team debate. For example, during we often witnessed the students challenging each other's evidence and claims during the debate. One side would make an assertion, and students on the other side would immediately begin digging on the Internet to locate the information and explore other evidence related to it. This led to much deeper debates and discussions than one might expect if students came prepared only to work with previously prepared notes, as it allowed for spontaneous exchanges and an analysis of new information as it was presented. It should be noted that students were directed that they be "engaged" in the debate even when they were not speaking, but that the instructors did not specifically require students to conduct on-the-spot searches to challenge the opposing side; the students carried out these activities on their own, powerfully demonstrating

some of the ways that they had internalized the concept of critical thinking. Such displays occurred in all four years of the LC.

Table 4. Means and standard deviations for post-test paranormal beliefs scale and each subscale from students in our class (n = 43) compared to means from the faculty (n = 86) and other students (n = 228).

	Post-test *M (SD)*	Other SJFC Students *M (SD)*	Cohen's d
Entire Paranormal Beliefs Scale (25 items)	2.34 (.54)	2.74* (.62)	.69
Traditional Religious Beliefs scale	3.73 (1.04)	3.84 (.91)	.11
Psi subscale (4 items)	1.94 (.67)	2.62* (.88)	.87
Witchcraft subscale (4 items)	1.91 (.75)	2.38* (.87)	.58
Superstition subscale (3 items)	1.75 (.91)	1.94 (.83)	.22
Spiritualism subscale (4 items)	2.35 (.79)	2.77* (.88)	.50
Extraordinary Life Forms subscale (3 items)	1.85 (.97)	2.05 (.95)	.20
Precognition subscale (3 items)	2.68 (.80)	3.32* (.92)	.74

* Means differ from the posttest mean at $p < .05$.

IV. Discussion and Implications for Practice.

Our evaluation demonstrated that, at least as measured using the Paranormal Beliefs Scale, an interdisciplinary LC that emphasizes the scientific method through the use of writing and other active-learning techniques can decrease students' pseudoscientific thinking. Specifically, at the end of the semester students in the LC scored lower on the Paranormal Beliefs Scale than (a) they did in the beginning of the semester, (b) than other students at the college, and (c) than mean scores (used as norms) provided in the original research by Tobacyk and Milford (1983). This decrease was not the primary goal for the LC; indeed, it was largely a product of students' applying the main topics and tools of the course to the content (pseudoscience) we chose as a vehicle for exploring critical thinking. Pseudoscience was selected as the content primarily for two reasons. First, we expected it to be engaging, allowing students to consider a variety of situations and ideas in different contexts that can be entertaining. Second, the LC was designed for students from biology, chemistry, computer science, mathematics, and physics. Pseudoscience allowed the students to bring many of these disciplines into the discussion, providing an interdisciplinary approach that we value.

Our LC examined scientific reasoning and critical thinking through the use of formal writing, informal writing, debates, group projects, in-class group exercises, and problems that compared pseudoscientific concepts to scientific counterparts. Through this comparison, students were compelled to analyze and evaluate claims using a generalized scientific method.

Specifically, our course was structured around Shermer's (2002) classification of where thinking goes wrong, including problems in scientific thinking, problems in pseudoscientific thinking, logical problems in thinking, and psychological problems in thinking. Thus, the LC seems to have served the first-year Science Scholar students well in meeting their needs to understand scientific thinking and improve their writing without being indoctrinated into a specific discipline. Further, the class allowed students to extend critical thinking and scientific reasoning concepts beyond what they typically experience in the classroom and/or a laboratory course.

The students in the LC were drawn from several different majors in the sciences and mathematics. Thus, while the ideas of scientific thinking were also being taught in other courses, the only common experience to all students was this LC. Even when critical thinking processes are made explicit, they tend to be discipline-focused so that biology courses develop thinking like a biologist while physics courses teach how to think like a physicist. Discipline-focused reasoning can limit both the tools one uses in reasoning as well as the domain to which the reasoning is applied. The LC described here, as well as the scale used, lies far from any of these particular science disciplines. Thus, one can reasonably conclude that the writing intensive, interdisciplinary experience of the LC was one of the tools that furthered their ability to analyze such claims and consider evidence.

Other colleges and universities could easily modify this LC and apply it to creating an LC that serves their students because the techniques and evaluation described here are quite portable. The active learning techniques can be modified and used by instructors at most institutions regardless of academic emphasis or size. The writing projects and classroom debates could easily be incorporated into other courses, and the *Taking Sides* text is available in many areas (such as climate change) that would provide a starting point for such activities. Finally, by applying critical thinking skills and scientific reasoning to pseudoscientific topics, students were highly engaged, a necessary first step to learning.

V. Limitations and Future Research.

As with any classroom-based research, this study has limitations. For example, our students were a select group of high performers, making it quite easy for us, as novice writing instructors, to work with them on improving their writing. Second, we only evaluated two of the four years when we taught the course. However, we modified and improved it considerably after the first year so the evaluation would be of a considerably different course. Further, we kept the course structure mostly constant among the final three of our four years, so an evaluation during the fourth year would likely yield similar results to that of years two and three. Finally, we used the Paranormal Beliefs Scale (Tobacyk & Milford, 1983) as a surrogate measure of scientific reasoning. Given the focus of our course on contrasting pseudoscientific thinking with scientific reasoning, this measure is likely reasonable at tapping some of the thinking around pseudoscience.

The Paranormal Beliefs Scale by itself may be only a surrogate measure of scientific reasoning and critical thinking, but the results from this study are supported by other, anecdotal data from the course. One such experience relates to the way a group of the students managed to turn our initial psychic demonstration against us. During a later class activity exploring the statistics of ESP-type card guessing, several students in the class achieved a perfect 10/10 ratio guessing the cards with four different card viewers. Random guessing would only explain this event as a once-in-the-history of the universe likelihood. After a discussion of this, the students

admitted to having created a method of "tells" so that a confederate would easily know what kind of card was being viewed simply from the way the viewer held the card. Such actions clearly demonstrate students moving toward deeper critical thinking in the sense of Bloom's taxonomy (Anderson & Krathwohl, 2001), moving well beyond the lower levels of reasoning and far into the application and creation levels of reasoning.

With respect to future research, critical thinking can be evaluated either by using the literature to identify or develop a content-specific critical thinking scale (Renaud & Murray, 2008) or instead by using a general critical thinking scale (e.g., Cheung, Rudowicz, Kwan, & Yue, 2002). Specific critical thinking scales, such as those to better understand scientific reasoning about biology (McMurray, Beisenherz, & Thompson, 1991), critical thinking about diversity (Pascarella, Palmer, Moye, & Pierson, 2001), or for evaluating paranormal beliefs (Tobacyk & Milford, 1983) can measure content-specific critical thinking. On the other hand, any instructor who modifies our course content could also consider general methods of evaluating critical thinking, including the widely used Watson-Glaser Critical Thinking Appraisal short form (Watson & Glaser, 2008), which has at least some use in assessing general critical thinking (e.g., Loo & Thorpe, 1999).

Another future question that remains is whether a course such as this would work beyond our self-selected scholarship students or with non-science students. As reported, we had a set of scholarship students who were, on average, highly motivated, more prepared for college than the typical Fisher student, and focused on learning science in their first year. Programs like this tend to have a critical thinking emphasis (Inkleas & Weisman, 2003). Regardless of our sample, the active methods used in the course should help to motivate many students (Yoder & Hochevar, 2005). Further, our interdisciplinary focus improved general critical thinking and scientific reasoning within and beyond the classroom and could apply to students who are not science majors. Thus, it is likely that this will work beyond the sample, and future courses should test and evaluate its reliability as an instructional approach. Learning communities are used, in part, to improve retention rates and student satisfaction. While these are admirable goals, LCs can also be used to improve general scientific reasoning and critical thinking (Browne & Minnick, 2005) and also, as this research demonstrates, can improve science-specific reasoning.

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Water as life, death, and power: Building an integrated interdisciplinary course combining perspectives from anthropology, biology, and chemistry

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Abstract: In response to a request from a campus student organization, faculty from three fields came together to develop and teach an integrated interdisciplinary course on water issues and social activism. This course, "Water as Life, Death, and Power", brought together topics from the fields of anthropology, biology and chemistry to explore water rights, access to clean water, and water treatment methods. Students enrolled in the course developed interdisciplinary projects related to a variety of local and global water issues to present real-world solutions at a university-wide student research showcase. This article describes the process by which the faculty learning community designed the course as a truly integrated whole, and reflects on the challenges and rewards of teaching a course in this way.

Keywords: course design, instructional learning community, water issues, student activism.

We are not students of some subject matter, but students of problems. And problems may cut right across the borders of any subject matter or discipline. – Karl Popper (1963, p. 88)

I. Interdisciplinary Teaching is Central.

Most college courses deliver course content through a single disciplinary lens. Students taking courses such as chemistry, biology, or anthropology are introduced to each discipline's perspectives: how do chemists, biologists, or anthropologist think about the world, and solve problems? In contrast, interdisciplinary learning encourages students to analyze complex problems from several perspectives, to place problems and solutions within a larger world context, to empathize with multiple stakeholders, and tolerate ambiguity and complexity (DeZure, 2010). Interdisciplinary thinking requires the integration of ideas from several fields or perspectives, including across scientific disciplines (Spelt, Biemans, Tobi, Luning & Mulder, 2009). Most real-world problems are fuzzy, with ill-defined boundaries, and the more students integrate several disciplines, the more successful they will be at finding solutions (Begg & Vaughan, 2011). This approach is considered essential to solving complex, large-scale problems such as global access to clean water, medicines, or food security, or other multifaceted societal issues (Barisonzi & Thorn, 2003; Eisen, Hall, Lee, & Zupko, 2009).

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A. The Call From UAEM Students at CMU.

Universities Allied for Essential Medicines (UAEM) is a coalition of undergraduate, graduate and professional-studies students at academic institutions worldwide dedicated to providing global access to affordable medicines. Central Michigan University (CMU) is a regional state university serving the surrounding rural areas in the central and northern counties of Michigan. CMU students formed a UAEM chapter in 2008. These students major in diverse fields such as health administration, public health, biomedical sciences, biochemistry, neuroscience, and psychology, but are linked by a common set of aims: 1) to encourage universities to insist on generic versions of drugs when patenting and licensing discoveries to pharmaceutical companies; 2) to encourage faculty research on neglected diseases; and 3) to educate and empower students on issues of global health inequities.

In April 2011, the CMU UAEM students organized a conference on global and local health disparities. Conference time included scheduled brainstorming sessions about how to further chapter goals. One of the ideas to emerge was to promote the development of interdisciplinary courses in global health. To educate their peers in global health inequities, the students argued, they first needed undergraduate courses that combined interdisciplinary teaching with solving real world problems, combining theory with activism. Three CMU UAEM faculty advisors took up the challenge to develop such a course: Stephen Juris (Biology); Anja Mueller (Chemistry); and Cathy Willermet (Anthropology). We designed this course to integrate all three disciplines around a complex problem, and encourage both interdisciplinary thinking and activism in our students.

B. Course Development.

We applied for and received modest funding from CMU's Faculty Center for Innovative Teaching (FaCIT) to develop the interdisciplinary course "Water as Life, Death, and Power," focusing on water issues, with the goal of inspiring activism, as part of FaCIT's Faculty Learning Community program initiative. We wanted to intentionally integrate content and theoretical approaches from biology, chemistry, and anthropology to tackle issues of water use, water rights, and health into one course.

We proposed the following outcomes to FaCIT: (1) develop a Master Course Syllabus for an interdisciplinary undergraduate water class; (2) increase our experience with best practices in how to teach interdisciplinary courses; (3) develop interdisciplinary student group projects; and (4) plan an assessment strategy to measure change in interdisciplinary thinking and activism levels. FaCIT assigned one of the authors (Eron Drake) to our project as an instructional designer. We also partnered with several UAEM students (Samik Upadhaya and Pratik Chhetri) to help design and teach the course. Finally, we partnered with CMU Faculty Librarian, Shu Guo, to provide research support to students for the course. Thus, we created a unique instructional learning community consisting of faculty, staff, and students charged with developing, implementing, and assessing the interdisciplinary course on water. This faculty learning community (FLC) and student learning community (SLC) combined to help us develop and teach the course. Early preparation efforts included a review of collaborative learning best practices, review of interdisciplinary literature, and strategies to assess interdisciplinary learning.

We decided to split the course into two equal parts. The three-credit course was designed for four contact hours per week. Half of the course would consist of a lecture component, where

the faculty provided content focusing on the disciplinary issues relating to water. The other half would be a seminar component, where the UAEM students provided content focusing on activism and collaborative learning. In an appendix, we include the weekly outline to provide a daily list of course activities.

II. Teaching Methods.

A. Lecture component.

A difficulty in an interdisciplinary course is figuring out how three faculty from three disciplines will actually integrate their teaching. A common practice in team-taught courses is for each faculty to separately prepare lectures to be taught consecutively. This is a multidisciplinary approach, where disciplines are juxtaposed, but remain distinct. For a course to be interdisciplinary, the disciplines have to be integrated or blended (Klein, 2010). It is difficult to achieve an interdisciplinary synthesis for both the faculty and the students without a continuous modeling of the integration of fields. Indeed, language and socialization within disciplines can subtly shape teaching and learning (Woods, 2007). Therefore, we decided that all faculty would be present at all classes, and ideally teach in all class periods. This teaching model is more difficult and time consuming, but ultimately more effective in achieving interdisciplinary understanding (Krometis, Clark, Gonzalez, & Leslie, 2011).

We identified two major objectives of the course: 1) developing interdisciplinary thinking rather than focusing specifically on content; and 2) encouraging students to engage in actively solving current, real-world problems in an interdisciplinary way. Since the faculty had expertise in different aspects connected to water, we initially developed a course outline focusing on water issues. Each FLC faculty member contributed important water-related content within his or her specific disciplines. For example, over the course of the semester we wanted to discuss topics such as stratification and power relationships that develop due to differential access to water (anthropology), pathogen emergence and passage through water (biology), the chemical properties of water (chemistry), and different water treatment methods (all three fields). To tie the topics together, we focused on cholera, a water-borne pathogen with widespread effects on human populations.

The course outline reflected both the global focus of each week as well as contained details of important concepts that needed to be addressed in instructing this material. Concepts within the outline were ordered to reflect a logical flow: first, a historical perspective; second, an ecological connection of humans and pathogens; third, a discussion of the diseases associated with pathogens; finally, exploration of water sanitation methods and technologies. While all faculty developed their own material, we shared one integrated slide file per day, so we could step in and out of the lecture as appropriate. This ostensibly would ensure an interdisciplinary teaching experience and allow for open dialogue among the participants and faculty in the class. Furthermore, since the students also had a diverse set of backgrounds (anthropology, biology, chemistry) and were entering the course early in their academic career, development of the slides needed to account for the fact that some of the students in the classroom may not have ever been exposed to one or more of the disciplines or may have been exposed several years prior at a rudimentary level.

Another key element to making the interdisciplinary connections was the interactive lecture model we employed. While we utilized standard presentation software, we also integrated

questions, discussions, free writes, videos, and case studies into the class period. Connections could be more easily made, then, between content and disciplines. For example, during a discussion about how humans and pathogens interact (content), we discussed food production activities that impact water and human settlement patterns, and how that can increase certain chemicals and pathogens that humans encounter as a result. All three faculty were to talk, with active student participation, towards the goal of an interactive extended discussion.

As the outline was developed and refined, it became evident quickly that the amount of content reflected in each discipline could easily fill up a course in each one of the disciplines being covered, and that the focus should be more on connection of the material among the disciplines and less on content delivery alone. It also became apparent that the three faculty members would need to be involved in explicitly highlighting these connections throughout the course. In order to prevent saturating the course with content during each lecture period, we defined a succinct "point of the day" for each lecture period to ensure that the main point was not lost in the details of the content within the three disciplines.

"Point of the Day." Development of the "point of the day" proved to be not only useful for delivery of the course material in a focused manner, but also aided development of the course. The "point of the day" came from the notion of essential questions, and enduring understandings, utilizing "backward design" instructional design considerations (Wiggins & McTighe, 1998). These were written in a question format. Since each faculty member brought a different expertise, and since the content needed to be connected in order to deliver a truly interdisciplinary course, the "point of the day" aided in determining which content was the true focus of the course for that day. It also aided in identifying discussion items and group work that could be presented to students in the course at the appropriate time. Finally, the "point of the day" aided in our development of slides – each faculty member had to connect the slide content to the overall point of the day. The first slide of each class was the "point of the day," so students knew the point as well; examples include: "What are the properties of water that make it essential for life?" "How do humans and pathogens interact?" and "How can we make water cleaner?" We used the first "point of the day" to engage students in a meta-cognitive discussion of the course itself: "How are we teaching this course, and why are we teaching it this way?"

B. Active and Collaborative Learning Component.

Seminar. One key component of the course focused on the empowerment of students to become actively involved in projects centered on water issues. This component focused on students working together to research issues and develop grass-root campaigns with the goal of improving a water-issue outcome. The seminar devoted time to ideas and concepts centered on education and advocacy of global issues, and interdisciplinary group work. Guest speakers included representatives from non-profit organizations such as Take Back the Tap and the Thirst Project; librarian Shu Guo (interdisciplinary research strategies) as well as CMU professors from the disciplines of anthropology (water issues in Peru); biology (fecal bacteria in the Great Lakes); geochemistry (water collection tanks in Belize); humanitarian logistics (water treatment and education); and sociology (unequal access to water among U.S. stakeholders). UAEM graduate students and advanced undergraduate students were involved in the development of the seminar component outline. They worked closely with the faculty members to integrate the seminar and lecture material. This ensured that the two components were not separate entities but rather

integrated the overall goals of the course. While students ran the seminar, the faculty were present as well.

Collaborative student projects. Collaborative learning refers to learning activities expressly designed for and carried out through pairs or small interactive groups (Barkley, Cross, & Major, 2005). Based on a review of over 90 years of research, strategies that involve the instructional use of small groups improve learning outcomes relative to individual work across the board (Johnson, Johnson, & Smith, 1998). In particular, these small group instructional strategies lead to higher student achievement, higher-level reasoning skills, more frequent generation of ideas and solutions, and provide for greater transfer and retention of learning concepts. As the goals of this course were to increase interdisciplinary learning and increase activism, we felt strongly that working in groups was essential to model collaborative efforts to solve big problems. For the purposes of this project, we relied on techniques developed by Barkley, Cross, and Major (2005), who developed their techniques from the literature on both cooperative and collaborative learning.

We organized the course around a semester-long interdisciplinary project. We allowed for some choice but mostly formed groups with as many different disciplines as possible. All groups first had to decide on a group contract to set up group rules and solve inter-personal problems. Groups had to identify a project related to water, and collectively work towards a solution. The project was parsed into several pieces: a group contract, problem statement, solution concept map, elevator pitch, and abstract. The teaching team guided projects, and provided periodic in-class feedback meetings in response to progress reports. The final project was presented at a campus-wide poster presentation. This event, the Student Research and Creative Endeavors Exhibition (SRCEE), showcases student research to the entire campus community, and their abstracts are printed in a formal program. The exhibition provided a platform to not only allow for a measureable outcome of the course, but also served for students to be able to promote their advocacy issues among the CMU community.

III. Teaching the course.

The course was offered in the Spring 2013 semester, with no required prerequisites. Twenty-nine students registered and completed the course. Of these 29 students, 12 were male and 17 were female. Students registered for the course under one of three course designators: 15 students registered under the anthropology designator, 13 students registered under the biology designator, and one registered under the chemistry designator. Students represented a broad range of majors: Anthropology, Biology, Biomedical Sciences, Broadcasting, Chemistry, Geography/Environmental Policy, Geology, History, Journalism, Music, Political Science, and Psychology.

A. First days.

In the beginning, many of us were anxious about the process of teaching in multiple disciplines simultaneously: how were we going to mix and re-mix disciplines in a single class period? Our strategy: during lecture periods, we all stood in front of the room at all times. By sharing the stage, so to speak, none of us were in charge. In that way, we were each out of our comfort zones. We checked and rechecked with each other about who was taking over when. We were

concerned that stepping in with a question or comment would be awkward or uncomfortable. This turned out to be an unnecessary worry. Our planning time as a learning community had fostered the essential trust needed for the smooth classroom experience.

Early on it became clear that it would be difficult to develop the course without a structure that helped keep us all on track, so each of us were responsible for specific tasks. The "point of the day" organization focused the lectures and smoothed the process of preparing truly interdisciplinary lectures. We needed weekly collaborative meetings to organize the lectures and seminars. One of us kept weekly meeting minutes, recording our decisions as well as our upcoming deadlines. Another of us amended the upcoming course calendar as it changed in response to student needs and guest lecture schedule changes. A third made sure the final draft of the slides were available on Blackboard as well as in the classroom on the right day. The seminar instructors (Upadhaya and Chhetri) made sure that we didn't forget upcoming student deadlines, suggested content and advocacy material, and graded student work in a timely manner. We all were concerned about how much time this planning and teaching this course would take. Two of the faculty were teaching this course in addition to their regular teaching loads. Our service and research obligations were not reduced to accommodate this course.

As the course was unusual in format – lectures and discussions, some short reading assignments, and group research – some of the students early on made little effort at preparing for class. For example, written reflection prompts were assigned to course readings; students did not write very substantive answers to the first reading reflection. The initial concept maps groups prepared for their project showed little serious effort at project planning, perhaps because they were unfamiliar with the concept map format. Early on, a couple of groups had some interpersonal challenges, or difficulty in identifying an appropriate project.

B. Mid-semester.

While all of our teaching styles were different, we had relaxed into a routine whereby we could switch disciplines smoothly. A certain rhythm, humor, and sense of serendipity prevailed. One reflective example of smoothness achieved in the course was seen as we were discussing epidemics of disease. As all three faculty were engaged in lecture, we were able to discuss the biology of transmission and cause of different diseases, while seamlessly integrating anthropological and chemical connections to these same disease epidemics. Links between guest speakers and course content were complementary in unexpected ways. For example, guests from Take Back the Tap introduced problems with the Nestle Corporation's water bottling activities in Michigan, which we were able to reference for the final exam case study; one guest speaker from a science field unexpectedly referenced material from earlier speakers regarding business' six sigma methodology and Paul Farmer's activism, highlighting the interdisciplinary nature of water issues.

We were doing some of the planning and scheduling for student group work deadlines as we went. This time investment, we hope, will be less burdensome the second time around. The weekly meetings were essential to keep us on track, to discuss student projects, group progress and concerns.

Another concern that surfaced mid-semester was the uncertainty about what the students were actually learning. We were all still very interested in trying to get students to think and comprehend in an interdisciplinary approach. No one expressed concern that "his" or "her" discipline was being short-changed or neglected. However, because we focused the students on

applying the material in lecture, where possible, to their group project, no midterm examinations or content quizzes were administered. We planned the final examination assessment, concerning lecture and seminar content, as a group competition. The concern was that, in focusing on the interdisciplinary aspects of water rights and treatment issues, not enough deep learning in any of the fields would be retained. Or, alternatively, we were presenting disciplinary material in too complicated a way that privileged some students over others. We were hoping that our methods were, in fact, effective. At this stage, we were keeping our fingers crossed.

The students' written responses showed improvement in terms of both length and content as the semester progressed. For instance, when assigned a reading towards the end of the semester regarding the outbreak of cholera in Haiti and the failure of the United Nations to take adequate responsibility for the outbreak, the responses from students showed genuine frustration and outrage. More importantly, students were able to provide critical analyses on both sides of the topic and suggest possible solutions to the crisis – an aspect generally lacking in previous written assignments. The written responses as well as in-class discussions indicated that the students were increasingly realizing the complexity of global issues and showed a healthy skepticism regarding the information being presented to them. As a result, some students refrained from drawing quick conclusions regarding the issues being discussed. An open ended prompt asked students to think about additional information they would like to have regarding the reading topic. In response, some students displayed enhanced critical thinking skills by demanding specific information and questions for the article' s author. The students seemed to get the general idea we are trying to convey – the issues related to water are complex, requiring several disciplines to measure, analyze, evaluate, and solve them.

We instituted progress reports and face-to-face feedback sessions to help keep students focused on their group projects. Eron Drake presented specific advice about how to present research in poster form, and how to develop a three-minute presentation about it, to help train for their SRCEE presentation. The campus newspaper ran a story on our course in mid-semester, focusing on its unusual format and interdisciplinary projects (Harrison, 2013). This positive press was very gratifying, and the course increasingly received attention from faculty and departments all over campus, and during SRCEE.

C. End of semester.

The students worked hard on their group projects (for the most part), but we needed to insist on regular updates and provide feedback to keep them on track. As a late decision, we used some of the seminar meeting times for this, which allowed us to ensure that students were meeting goals that they needed to meet. At the end of the semester, the students' progress in their group project was clearly evident. Their SRCEE presentations showed their passion for their projects, and even the groups that started slowly ended up with results they were proud of. Student groups proposed the following:

- Development of a time-release version of an existing anti-worming drug for schistosomiasis in Uganda, along with educational call-and-response children's song on how to avoid getting sick;
- A plastic water bottle deposit campaign to promote recycling and tap water usage;
- Installation of composting toilets at CMU to reduce water consumption;
- Community education on hydrologic fracturing to understand water contamination;

- Modification of city green-lawn ordinances to reduce local water contamination through chemical runoff;
- Analysis of strategies to connect Iowa farmers to government programs to promote bioswale buffer zones along the Mississippi River, to reduce downriver dead zones;
- Proposal to Mayoral Office in Copacabana, Bolivia to design totora reed beds that clean wastewater before it enters Lake Titicaca;
- Water disinfection techniques using solar UV radiation (SODIS) in plastic bottles in Uganda.

Some of the groups indicated that they would continue their activism beyond the end of the class. In fact, one group presented their project at a university-wide roundtable meeting on multidisciplinary education and research in global health in May 2013. Here we could see the growth of the students and what they could do when working together. Faculty member Steve Juris notes that

> I have to say that was one of my proudest moments as an instructor – it's easy to see success on exams and that students can learn and understand the material, but to see it applied in such a way and to see the students truly committed to their work is something instructors rarely get to see – I feel blessed that I was able to witness that growth firsthand.

The final exam was a mixed success. The final exam was a combination of an objective portion and a jigsaw-style hypothetical case study portion. For the case study, students were given one of eight stakeholder roles with associated facts known to that stakeholder. The students had to learn their stakeholder information, and then negotiate with other stakeholders for mutually satisfying short-term and long-term solutions for a fictional water crisis. The solutions had to be voted on by the group, and the reason for each vote had to be explained. It was evident in the process that for each proposed solution, all stakeholders were respected and taken into account, further demonstrating that the students understood that these issues are complicated and diverse, requiring a lot of disciplines to solve. All groups proposed short- and long-term solutions that all stakeholders could support (with one abstention for one group). Also, all long-term solutions weighed ecological, economic, and societal factors. This felt like a victory. Results from multiple-choice portion of the exam indicated that we may have been less effective in presenting the content itself. Students had not internalized that their learning of the content material would also be assessed in an objective way, and in-class comments prior to and after the exam indicated that they had not adequately reviewed the slide content. In subsequent offerings, we will need to be clearer in explaining that content is also important for their success in the class. A few additional assignments explicitly applying lecture content would bring that point home.

IV. Reflections on the process.

A. Faculty.

Overall, the course was a success in meeting the goals of increasing student awareness of interdisciplinary approaches through group work. We all did our very best to try and distill from our fields the relevant information without bogging down in details. However, we each were aware that we were only skimming the surface (to use a water metaphor), and each of us could teach a separate course with more depth. That tension existed internally within us individually,

but not externally to the group; there was no intragroup conflict about adding/removing content. Rather, we showed respect for each other's disciplines and unique knowledge both at meetings and in the classroom (although some playful teasing prevailed). Without this team rapport, things would have gone much less smoothly.

The FLC was crucial for course development. This team rapport was not accidental; we developed it through the FLC/SLC course development process. Through the development process, we were able to tackle the problem of interdisciplinary assessment. Only then did we work out the content of the class itself. Using the "point of the day," the lectures became focused; it was much easier to prepare truly interdisciplinary lectures where all disciplines were connected by a single point.

B. UAEM students/seminar instructors.

The UAEM student participants were pleased to see this course come to fruition. If not unique, the course was certainly unusual in being an inter-college interdisciplinary course. They were very optimistic that this course would set a precedent for other similar courses to be developed at CMU. Seminar instructor Samik Upadhaya remarked, "Perhaps for the first time, we, as students, were able to provide input to a course from the very early stages of planning." They noted that most of the enrolled students seemed to value the importance of this course and the wealth of knowledge they gained at water issues from three separate disciplines. Third, they felt that the incorporation of an activism component in the course helped to develop leadership skills and group work ethics among the participant students. Students had complete ownership of the projects, which seemed to instill a sense of responsibility and togetherness in the groups. Through peer instructor mentoring, some of the groups really made significant leaps in their projects, which was really encouraging for the UAEM seminar instructors to observe. Teaching a course where multiple disciplines were integrated together to present a 'bigger' picture of water issues gave a unique learning opportunity to the UAEM students.

C. Enrolled students.

Students were asked to complete anonymous feedback forms with Likert-scale and open-ended feedback options. Responses indicated that the felt that the course was successful, although many students wished for greater organization or a different balance between disciplines. Anonymous student comments included:

> *I think it's important for different fields to come together and develop a solution to the increasingly urgent water crisis.*
>
> *I am much more curious about water issues! I want to know more. I don't like what I know and I want to help!*
>
> *I didn't realize how serious the water issue is in the US and globally. Hopefully more people take action to help slow down water depletion.*
>
> *I appreciate this class taking the time and effort to tackle water issues from a dynamic perspective. Thank you.*

> *It is troubling that the cost of even dirty water is so high in some areas, and until everyone has access to clean, affordable water global equality will not be possible.*
>
> *This course should be included as a capstone to the environmental policy major!*

Students also commented on the engaging structure of the course. One student suggested a jigsaw-style approach to subject matter:

> *Maybe if we split up and were taught each subject thoroughly and then combined in groups based on BIO, CHM, and ANTHRO…*

D. FaCIT.

FaCIT's goal for the FLC program was to encourage formation of cross-disciplinary groups who would engage in an active, collaborative, yearlong program focused on enhancing teaching and learning. From that perspective, this FLC had very ambitious goals and, yet, was able to make great strides and significant accomplishments because of their leadership at CMU, and their commitment to each other, the UAEM students, and the goals of the FLC. By the end of the Spring 2012 semester, the FLC had developed a new master course syllabus, which was cross-listed by three departments and integrated a seminar that would be team-taught with UAEM graduate students. In addition, they presented the development of this course at two conferences and proceeded to begin work on an undergraduate multidisciplinary certificate program in social justice in global health. Finally, because of FaCIT's involvement in this FLC initiative, Eron Drake has been able to recommend the course framework, team-based learning activities, and major course projects to other faculty interested in interdisciplinary work and enhanced student understandings.

V. Institutionalizing the Course (the Master Course Syllabus).

At CMU, all courses must maintain a Master Course Syllabus (MCS), which is written by faculty and must be approved through the curricular process at the department, college, and university levels. The MCS contains a description of the course, required prerequisites, goals and objectives, a bibliography, and a suggested outline, course materials, and evaluation methods. Faculty have discretion to change instructional and evaluative methodologies but may not substantially alter the scope of material covered, or the goals and objectives. Master course syllabi are used to evaluate whether a particular course will be included in the University Program, which is part of a student's general undergraduate education requirements. Therefore, for this new course to be institutionalized, we had to develop an MCS and apply for its inclusion for general education credit.

This process was not as easy as it may appear. A major obstacle to this method of collaborative teaching is the disciplinary, silo-based structure of the university itself. While interdisciplinary education is often touted as a best practice in education (e.g., Chettiparamb, 2007; Huber & Hutchings, 2005), the institutional organization of universities often raises barriers to interdisciplinary teaching. A university is usually organized by grouping disciplines into colleges. A complex curricular process exists that affects course and program development at the department, college, and university-wide level. Some departments may have difficulty

accepting courses containing content from other fields under their designator, and this can have a dampening effect on interdisciplinary course development.

We conceived of this course as interdisciplinary from the ground up. Three disciplinary fields were involved (Anthropology, Biology, and Chemistry), which were housed in three different departments in two colleges. CMU does not have an "interdisciplinary education" course designator. At CMU, the general education requirements are called the "University Program." Until recently, the University Program requirements for undergraduates included an integrative and multidisciplinary studies section; all students were required to take one course in this area. However, despite persistent calls for increasing interdisciplinary education in higher education as an effective practice (e.g., Huber, 2002; Klein, 1990; Scott, 2002, Sá, 2008), in 2011 CMU removed this requirement completely from the University Program, effective 2014. Any new course that is designed as interdisciplinary must fit another category, such as Global Studies or Descriptive Sciences. This meant that, despite the fact that there was only one course taught by three instructors, the three departments would need to offer separate courses that would be cross-listed across disciplines. A student would need to choose to register for the course under the anthropology (ANT 250) biology (BIO 250), or chemistry (CHM 250) course designator. However, for cross-listing to be allowed, the departments and colleges would have to approve the identical syllabus with three course designators.

The FLC team carefully wrote the MCS to incorporate course goals and essential content from anthropology, biology, and chemistry perspectives in as equal proportions as possible. We asked each department to consider the course at the 200-level, and apply it as student credit for the major. We chose this level (instead of a 100-level survey course) because, although students may not have coursework experience with each of the three fields yet, the level of critical thinking we were envisioning was more sophisticated than that usually expected in a 100-level survey course. All three departments ultimately approved the same syllabus (although each had revisions that had to be then incorporated by the other departments), but only one department allowed it to count for credit toward the disciplinary major. The two colleges then took up the courses with the shepherding assistance of the two colleges' Assistant Deans in charge of curriculum. The course was approved in Spring 2013; however, since the curricular process was still ongoing at the beginning of the semester, we offered this course as a cross-listed special topics course in each of the three departments.

Another institutional barrier to interdisciplinary courses involves faculty compensation. Interdisciplinary courses take more time to prepare and teach; yet that is not reflected in teaching load or compensation. Under a collaborative teaching model, three faculty are doing the work for three credit hours, instead of just one, making it more expensive in a budget. Cost sharing can be even more problematic when it spans academic departments or colleges; each department and college has its own set of goals and pressures, which must be taken into consideration. For this course, the funding solution was to split the course cost equally amongst the departments, and count only one credit hour of work for each faculty member instead of the three actually performed. Two of us taught this course over our regular teaching load of three courses per semester. Teaching this course regularly outside of load will be difficult to sustain, as it increases faculty teaching load without a commensurate increase in compensation or reduction in other teaching, research, or service duties. We decided to teach collaboratively despite the structural funding challenges because we felt strongly that a diverse expertise was beneficial to our students as well as to ourselves. , We will continue to work with administration to find a sustainable solution that is fiscally sounds and equitable across both colleges and all three

departments. Successful course outcomes for faculty and students can help encourage administrators to address these challenges.

VI. Future Steps.

We plan to teach Water as Life, Death, and Power every fourth semester. Since the course has been taught once, we have completed the essential work to prepare content and structure. We know and trust each other's teaching styles, and have a familiarity with how to work together effectively both in and out of the classroom. We have worked out details about student deadlines, grade weighting, and writing assignments, and we fully expect a smoother ride next time. We will continue to explore active and collaborative activities that engage all students.

In retrospect, our approach to the course on water and activism dovetails with that of Rittel and Webber's (1974) notion of "wicked" problems: a class of problems arising from extreme degrees of uncertainty, risk, and social complexity. A wicked problem is one in which both the problem and solutions are not known. Examples of wicked problems include obesity, aging, global poverty, global diseases, cancer, campus violence, natural disasters, racial genocide, etc.

> Water resources policy problems are wicked then because they challenge us to confront water policy problems on four fronts simultaneously: (1) we must transcend our disciplinary camps and face the uncertainties that ride with combining our sciences; (2) we must integrate two types of knowledge (i.e., our scientifically processed traditions of knowledge must be adapted to site-specific circumstance with the assistance of people who know important, but different things than scientists know); (3) water resource issues simultaneously affect conflicting stakeholders and biotic complexity across multiple levels; and (4) individual rationality of particular actors must be constrained by local organizations in ways that empower people to provide themselves and wider society with sustainable common property regimes that can manage the interdependence of people, water, and biota in resource acquisition, allocation, and maintenance. All of this requires effective local organizations that can provide the social and organizational capacity for work that cannot be accomplished by individual citizens as resource appropriators or environmentalists, by central bureaucratic managers, or by scientists. (Freeman, 2000, p. 487)

For our students (and future policymakers) to be empowered to effect change, they must learn to collaborate across disciplines, since, as Freeman (2000) suggests, "our educated capacity in one discipline (or more realistically in one sub-discipline) tends to be associated with trained incapacity in other fields of relevant knowledge" (p. 484). Interdisciplinary courses focused on "wicked" problems are one way to help students, and all of us, succeed.

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Appendix. Weekly Outline of Activities, Water Course.

Point of the Day	Lecture	Seminar
Week 1		
Intro to course	- Syllabus review - IRB consent forms - Pre-test administration - Show water video	- Video showcasing student leadership, student power, and development of grassroots movements
How are we teaching this course, and why are we teaching it this way?	- Definitions of disciplines (what are ANT, BIO, CHM perspectives?) - What is interdisciplinary thinking?	- Guest speaker on how to work effectively in groups - Form groups
Week 2		
Where is water, and how accessible is it?	- Water cycle - Water reservoirs - Brainstorming: what are important things to talk about in context of water? How do humans use water?	- Discussion of group project - Discuss seminar readings and reflection sheet - Introduction to NGOs - Guest speaker on Six Sigma
What do we use water for, and what factors affect its use and availability?	- What factors affect water use? - Biotic/abiotic factors affecting water	- Guest speaker from the Thirst Project
Week 3		
What are the properties of water that make it essential for life?	- Properties of water - Challenges bacterial pathogens face in water - Water chemistry	- EWB's Failure Report video - TED talk, David Damberger - Guest speaker on cultural complexities in providing assistance - Group Contract due
How do humans impact water quality and availability?	- Human impact on water availability and quality	- Group discussion on working to help in a culturally sensitive way - Reading reflection #1 due
Week 4		
	- Group work - Concept map due - Librarian Shu Guo presents on interdisciplinary research strategies	- Group work - Open library research time: five citations due by end of seminar period

Point of the Day	Lecture	Seminar
Week 5		
How do humans and pathogens interact?	- Human ecology/Human impact on ecology - Epidemiological transitions - Human behavior and habitat selection - Co-evolution of pathogens with human societies	- Group work on project statement, elevator pitch - Revised group contract due
Week 6		
How do bacteria make people sick?	- Human-bacteria interface - Mechanisms of bacterial infection - Pathogenesis of bacteria in humans - Prevalence/examples of bacteria in water	- Elevator pitch presentation by group
How can pathogens affect human populations?	- History of cholera - Past epidemics - Emergence of pandemic serotypes (El Tor and Classical) - Cholera ecology and connection to human ecology	- Understanding region-specific problems - Group discussion on how to evaluate the intensity and sensitivity of an issue (local vs. global) - Guest speaker on developing sustainable logistical pathways
Week 7		
How do diseases spread?	- Epidemiology and spread of diseases - Spread of disease in population (kinetics of biology) - Kinetics of transport in the body (bacteria and drug) - Factors affecting bacterial infection - Cholera epidemiology	- Multidisciplinary approaches to addressing water borne diseases (biomedical research, socio-cultural interventions, etc.) - Reading reflection #2 due
What are epidemics, and what causes them?	- Epidemic vs. pandemic - Cultural/historical factors impacting development/spread of epidemics - Bacterial evolution - Connection between mode of transmission and human behavior	- Guest speaker on beach pathogen research - SRCEE abstract due

Point of the Day	Lecture	Seminar
Week 8		
How do pathogens live in water, and how can we fight them?	- Bacteria-water interface - Cholera-human interface - Factors affecting bacterial survival in water - Bacterial/aquatic life interface, connection and impact on human health	- Teaching team meets with groups - SRCEE abstract revision
Week 9		
Everything you ever wanted to know about cholera and your intestines	- Human activities that impact contraction/spread of cholera - Biochemistry of cholera - Cholera lifecycle, toxin action - Cholera virulence factors - Human gut biology	- NGO Case Study: Partners in Health and Cholera outbreak in Haiti
How is cholera treated?	- Comparison of cholera outbreaks in U.S., India, Haiti - Treatment and prevention - Indigenous approaches to disease prevention and treatment	- Guest speaker on building water storage/filtration systems in Belize - Group progress reports due
Week 10		
How can we make water cleaner?	- Municipal water treatment in global context - Cultural factors affecting development of water treatment - Overview of filtration, sedimentation, biological purification, and toxins	Guest speaker from Take Back The Tap on bottled water
What basic physical methods treat water?	- Physical water treatment methods	- Teaching team meets with groups - Group work
Week 11		
How can we assess our success in different contexts?	- Physical water treatment methods - Impact of methods on local/regional populations - Locally sustainable methods	- Guest speaker on poster preparation skills
How can bacteria treat water?	- Biological water treatment methods	- Group discussion on UN responsibility towards Haiti due to cholera outbreak - Reading Reflection #3 due - Group progress reports due

Point of the Day	Lecture	Seminar
Week 12		
How can we assess our success in different contexts?	- Biological water treatment methods - Impact of methods on local/regional populations - Locally sustainable methods - Field trip to water treatment plant	- Teaching team meets with groups - Group work
Week 13		
What are the power inequalities that can affect access to clean water?	- Structural inequalities to clean water access - United Nations statement on human rights to clean water - Inequalities in water supplies and contaminants	- Teaching team meets with groups - Group work day - Reading Reflection #4 due
Week 14		
	- SRCEE – self-and peer evaluation	
What are some examples of legal consequences—successes and failures?	- Potential legal consequences to unequal access to clean water - Examples of contaminants in water systems	- Reading Reflection #5 due
What factors should be considered in developing new water treatment solutions?	- New water treatment solutions - Cultural factors affecting adoption of new technologies - Simple filtration and sterilization methods	
Week 15		
	Final exam	Open discussions on what we have learned, what we can do
Week 16		
	Wrap-up - IRB consent forms - Post-test administration	

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JOSOTL
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Style Sheet for the *Journal of the Scholarship of Teaching and Learning*

John Dewey[1] **and Marie Curie**[2]

Abstract: This paper provides the style sheet for the Journal of the Scholarship of Teaching and Learning. Manuscripts submitted for publication should adhere to these guidelines.

Keywords: radiation, metacognition, identity theory, constructivism, educational philosophy.

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The final manuscript should be prepared in 12-point, Times New Roman, and single-spaced. Submissions should be double-spaced. All margins should be 1 inch. The text should be fully left- and right-justified. The title (in 16 point bold) and author's name (in 12 pt. bold) should be at the top of the first page. The author's name should be followed by a footnote reference that provides the author's institutional affiliation and address. The abstract should be indented 0.5" left and right from the margins, and should be in italics.

Except the first paragraph in a section subsequent paragraphs should have a 0.5" first line indent. Use only one space after the period of a sentence (word processors automatically adjust for the additional character spacing between sentences). The keywords should be formatted identically to the abstract with one line space between the abstract and the keywords. Authors should use keywords that are helpful in the description of their articles. Common words found in the journal name or their title article are not helpful.

Pages should be unnumbered since they will be entered by the Journal editorial staff. We will also insert a header on the first page of the article, as above.

References should be incorporated in the text as authors name and date of publication (Coffin, 1993), with a reference section at the end of the manuscript (see below for the desired format for the references). Titles of articles should be included in the references in sentence case. Unless instructed otherwise in this Style Sheet, please use APA style formatting. Footnotes should incorporate material that is relevant, but not in the main text.

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Major section headings should be flush-left, bold-faced, and Roman numeral numbered. Major section headings should have one-line space before and after. The first paragraph(s) of the article do not require a major heading.

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Sub-section headings should also be flush-left, in italics, and alphabetically numbered. Sub-section headings should have a one-line space before and after. Sub-sub-sections should appear at the beginning of a paragraph (i.e., with an 0.5" indent, followed immediately by the text of the sub-sub-section), with the heading also in italics.

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Tables and figures should be inserted in the text where the author believes they best fit. They may be moved around a little to better correspond to the space requirements of the Journal. If necessary, tables and figures may occupy an entire page to ensure readability and may be in either portrait or landscape orientation. Insofar as possible, tables should fit onto a single page. All tables and figures should be germane to the paper. Tables should be labeled as follows with the title at the beginning (in bold), with data entries single-spaced, and numbered. Column labels should be half-line spacing above data.

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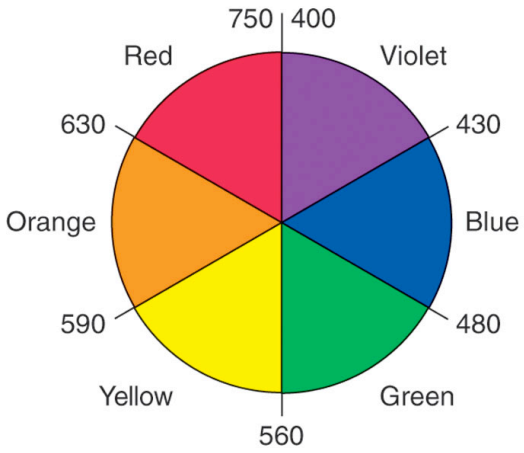

Figure 1. Color wheel with wavelengths indicated in millimicrons. Opposite colors are complementary.

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Appendix

Please insert any appendices after the acknowledgments. They should be labeled as follows:

Appendix 1. The Title of the Appendix.

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