Using Competing Narratives to Increase Critical Thinking Abilities

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Abstract

The purpose of our study was to explore the impact of a nontraditional approach, competing narratives, in a large-enrollment higher education course. Post-secondary students enrolled in a Natural Resource Conservation 101 course participated in a project to evaluate the efficacy of a competing narratives analysis on the development of critical thinking skills. Students' critical thinking skills were evaluated before and after the competing narrative coursework using a standardized critical thinking assessment test scored by faculty graders. The pedagogical approach consisted of a series of writing assignments to critically assess readings from two popular, opinionated texts with contradictory messages on the topic of anthropogenic climate change. A third authoritative, neutral-toned text on climate change was provided as a reference. Students were asked to confirm data interpretation, identify logical fallacies and biases and generally compare and contrast the competing narratives. Using paired t-tests for comparison of pre-/post-course scores, critical thinking skills improved for five of the 15 specific skill areas assessed by the test. Students' post-course scores were also higher than national norms for seven of the 15 skill areas. Specific critical thinking skill areas for which students' scores improved to higher than national norms aligned with competing narratives assignment learning objectives.

Introduction

To accommodate the evolving needs of 21st century students, pedagogical approaches such as making content relevant to students, developing thinking skills, addressing misunderstandings directly and fostering creativity are becoming more prevalent (Saavedra and Opfer, 2012). Today's students have a unique set of skills that can be organized into six primary categories: life, workforce, applied, personal, interpersonal and noncognitive (McComas, 2014).

We analyzed the effect of a "competing narratives" pedagogical approach on the development of students' skills identified in McComas's (2014) applied and personal skills categories. The applied skills category addresses accessing and analyzing information, effective communication, and determining alternative solutions to problems. The personal skills category addresses curiosity, imagination, critical thinking and problem solving (McComas, 2014). The pedagogical approach for this study used teaching strategies suggested by Saavedra and Opfer (2012) to encourage students to analyze and evaluate the claims of two book narratives with opposing viewpoints (competing narratives) on global climate change.

The competing narratives approach is grounded in constructivism. This educational philosophy suggests learning should occur in authentic environments and, thus, knowledge construction is enhanced when the experience is authentic (Doolittle and Camp, 1999; Splan et al., 2011). One role of higher education is to build on students' previous knowledge and authentic experiences while encouraging them to use higher-order thinking skills, such as those expressed in Bloom's (1956) taxonomy. Specifically, the development of students' critical thinking abilities is often targeted through pedagogical approaches that urge students to analyze, synthesize, and evaluate (Bloom, 1956; Duron et al., 2006).

Traditional pedagogical approaches cannot achieve the constructivist values desired in higher education when dealing with many students at once (Bostock, 1998). Therefore, the purpose of our study was to explore the impact of a nontraditional approach, competing narratives, in a large-enrollment higher education course. The pedagogical approach used in this study remained consistent with the constructivist approach by encouraging students to incorporate their personal experiences in the analysis, synthesis, and evaluation of two distinctly different global climate change viewpoints expressed in

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two separate book narratives. Two research questions guided this study:

1. How are students' critical thinking abilities affected by a competing narratives pedagogical approach?
2. After completion of the entry-level, semester-long course, how do students' critical thinking abilities compare to national norms?

Methods

Montana State University's (MSU) introductory Natural Resource Conservation course (NRSM 101) is an entry-level, three-credit course. Course objectives include introducing global and local soil, water, rangeland, and wildlife conservation issues and improving students' abilities to think critically about natural resource management. In addition to a standard text to address contextually based concepts (Chiras and Reganold, 2009), two short, competing narratives with provocative and opposing views on global climate change (Berger, 2013; Goreham, 2013) were assigned so students could evaluate the strengths of presented arguments. A third climate change text, more authoritative and neutral in political tone (Eggleton, 2013), was used to help students reconcile disagreement between the competing narratives.

Early in the semester, students were introduced to common fallacies of critical thinking as well as examples of fast and slow thinking. Fast thinking is characterized by jumping to conclusions based on personal biases and emotional inclinations, whereas slow thinking is represented by logical and reasoned thought (Kahneman, 2011). Critical thinking skills were initially targeted and developed through a writing assignment based on the main text, Chiras and Reganold (2010). Then, in weeks 13 and 15 of the 16-week semester, students submitted written assignments that compared and contrasted arguments from the competing narratives, using the neutral climate change text as a mediator. In total, three writing assignments were used to encourage students to examine the scientific merit of various arguments presented in the competing narratives.

The MSU Institutional Review Board approved the study protocol and all participants provided written informed consent prior to participation in the study. The target population was all undergraduate students enrolled in NRSM 101 during the fall 2014 semester (N=209). Similar to numerous other studies that explored the development of students' critical thinking abilities (Bers et al., 1996; Friedel et al., 2008; Iwaoka et al., 2010; Perry et al., 2015), we used a matched-pairs pretest–posttest design. Pretests and posttests were administered separately during weeks 1 and 15 of the 16-week semester.

Based on the pedagogical approach and learning outcomes of NRSM 101, we determined the Critical Thinking Assessment Test (CAT) was the most appropriate instrument to evaluate students' critical thinking abilities. The CAT is a tool supported by the National Science Foundation and created to assess and improve critical thinking abilities (Center for Assessment and Improvement of Learning [CAIL], 2010). Among other uses, it is designed to evaluate the effects of a specific course through a pretest–posttest design (CAIL, 2012). As displayed in Figure 1, it includes 15 short-answer questions based on real-world situations developed to accurately assess important components of critical thinking, such as effective communication, the ability to evaluate and interpret information, problem solving and creative thinking (CAIL, 2010).

Figure 1. Skill areas assessed by the Critical Thinking Assessment Test (CAIL, 2012)

Specific Skill Areas Assessed by the Critical Thinking Assessment Test	
1. Summarize the pattern of results in a graph without making inappropriate inferences	9. Determine whether an invited inference in an advertisement is supported by specific information
2. Evaluate how strongly correlational-type data supports a hypothesis	10. Provide relevant alternative interpretations for a specific set of results
3. Provide alternative explanations for a pattern of results	11. Separate relevant from irrelevant information when solving a real-world problem
4. Identify additional information needed to evaluate a hypothesis	12. Use basic mathematical skills to help solve a real-world problem
5. Evaluate whether spurious information strongly supports a hypothesis	13. Identify suitable solutions for a real-world problem using relevant information
6. Provide alternative explanations for spurious associations	14. Identify and explain the best solution for a real-world problem using relevant information
7. Identify additional information needed to evaluate a hypothesis	15. Explain how changes in a problem situation might affect the solution
8. Use/apply relevant information to evaluate a problem	

Under direct supervision of a CAIL-trained individual, 10 faculty members representing multiple academic disciplines scored the CAT assessments. Detailed scoring rubrics provided by CAIL were used to enhance consistency and reliability in evaluations. The CAT was administered to the entire population (N=209). However, because of limited resources (primarily faculty scorers' time), 40 matched pairs were randomly selected for scoring. After culling matched pairs for completeness, 37 (n=37) were deemed useable. This quantity of assessments met CAIL's recommendation of obtaining a minimum of 10 matched pairs to evaluate changes in critical thinking abilities through a pretest–posttest design.

Satisfying common belief that reliability coefficients of 0.80 or higher are "sufficiently reliable" (Gall et al., 1996, p. 200), CAIL (2010) reported inter-rater reliability examinations on the CAT at the level of 0.82 and a test-retest reliability coefficient of greater than 0.80 (CAIL, 2012). To further ensure inter-rater reliability, two faculty scorers evaluated each question; if the initial two scorers disagreed, a third scorer evaluated the question. A numerical average of the three scores was recorded. At an alpha level of 0.70, internal consistency was deemed reasonably good by CAIL (2010). The lower internal consistency was due in part to the numerous components of critical thinking evaluated by the instrument (CAIL, 2010).

Per typical educational research, statistical significance was set a priori at $p < 0.05$ (Gall et al., 1996). The t distribution was used to determine the level of sta-

tistical significance of an observed difference between sample means among small samples sizes (Gall et al., 1996). To address research question one, paired-samples *t* tests were used to determine if the pedagogical approach of NRSM 101 made a statistically significant difference in students' critical thinking abilities. To address the second research question, a one-sample *t* test used CAT national norm data collected from freshmen- and sophomore-level higher education students across the nation was conducted. Students' posttest scores were selected for this comparison to take into account any effects of enrollment in NRSM 101. Effect sizes quantifying group differences were interpreted using Cohen's (1992) criteria, wherein 0.02 is considered small, 0.15 is medium and 0.35 is large.

Results and Discussion

Our sample was primarily composed of females (62.2%) less than or equal to 20 years of age (67.6%). Nearly the entire sample (91.9%) self-identified as white. The demographic representation was as expected for this course. Historically, NRSM 101 has been comprised of approximately 75.0% freshmen or sophomores between the ages of 17 and 20 years of age. Multiple paired-samples t tests were conducted to compare pre-course and post-course critical thinking abilities according to the 15 specific skill areas assessed by the CAT (Table 1). Students' posttest scores were statistically ($p < 0.05$) higher than their pretest scores on five of the 15 specific skill areas and on their overall CAT total score.

Representative of the strongest increase between pretest and posttest performance ($p < 0.01$; d=0.78), students' abilities to evaluate the strength of correlational-type data aligned with the desired outcomes of the competing narratives pedagogical approach. As a component of one of the three primary writing assignments, students were asked to examine evidence provided by the authors of the competing narratives and evaluate the validity of claims. This prompt pushed students to evaluate competing claims that were often represented through correlational type data and displayed in charts or graphs. The same targeted approach serves as a possible explanation to the second strongest increase between pretest and posttest performance ($p < 0.05$; d=0.61), summarizing a pattern of results in a graph.

Students also saw substantial, significant increases in their abilities to use and apply relevant information ($p < 0.01$; d=0.51) and to identify and explain the best solutions for real-world problems ($p < 0.05$; d=0.59). Beyond the initial assignment that prompted students to examine evidence and validity, students were repeatedly asked to apply relevant theories and information to the real-world issues presented in the competing narratives. According to Saavedra and Opfer's (2012) 21st century teaching recommendations, this deliberate approach of continually incorporating real-world, relevant applications could help explain the increase in both aforementioned critical thinking skill areas.

Research question one asked how students' critical thinking abilities were affected by the use of a competing narratives pedagogical approach. Reflective of McComas's (2014) 21st century skills and Saavedra and Opfer's (2012) teaching strategies, our primary conclusion is that enrollment in an entry-level, semester-long course that uses a competing book analysis approach to encourage students to analyze and evaluate claims can positively influence students' overall critical thinking abilities. Abiding by the tenant of constructivism, wherein learning should occur in authentic environments and be enhanced by personal experience (Doolittle and Camp, 1999; Splan et al., 2011), the competing narratives approach impelled students to construct new knowledge from inspecting their own previous experiences and opinions of global climate change and strive for the higher levels of Bloom's (1956) taxonomy.

Results from the second research question served more as a benchmark for the critical thinking abilities of a targeted group of students within the College of Agriculture. Research question two sought to compare students' posttest scores with CAT national norm data through t tests (Table 2). Students' posttest scores were higher than national norm data on seven of the 15 skill areas assessed by the CAT, as well as on their overall CAT score. Students displayed the greatest separation above national norms in their abilities to evaluate the strength of correlational-type data ($p < 0.001$;

Table 1. Results of NRSM 101 Students' Paired Samples t Tests (n = 37)

Skill area assessed	Pretest mean	Posttest mean	p^z	Effect size^y
Evaluate strength of correlational-type data	0.81	1.78	**	+ 0.78
Identify additional information needed to evaluate a hypothesis	1.32	0.62	**	- 0.68
Summarize pattern of results in a graph	0.57	0.84	*	+ 0.61
Identify and explain the best solution for a real-world problem	1.49	2.59	*	+ 0.59
Use/apply relevant information	1.03	1.38	**	+ 0.51
Identify suitable solutions for a real-world problem	0.65	1.03	*	+ 0.40
CAT total score	15.25	18.05	**	+ 0.52

^{z}Probability of difference. ^{y}Mean difference divided by pooled group SD (0.02 = small, 0.03–0.15 = moderate, > 0.35 = large).

* p < 0.05. ** p < 0.01.

Table 2. Results of NRSM 101 Students' Posttests Compared to National Norm Data (n = 37)

Skill area assessed	Posttest mean	National mean	p^z	Effect size^y
Evaluate strength of correlational-type data	1.78	0.69	***	+ 0.98
Provide alternative explanations for spurious associations	1.73	1.04	***	+ 0.87
Use/apply relevant information	1.38	0.88	***	+ 0.72
Identify additional information needed to evaluate a hypothesis	0.24	0.57	**	- 0.63
Summarize pattern of results in a graph	0.84	0.58	**	+ 0.59
Evaluate spurious information	0.78	0.52	**	+ 0.57
Explain how changes in a problem might affect the solution	1.00	0.52	***	+ 0.53
Identify and explain the best solution for a real-world problem	2.59	1.65	**	+ 0.50
CAT total score	18.05	13.66	***	+ 0.79

^{z}Probability of difference. ^{y}Mean difference divided by pooled group SD (0.02 = small, 0.03–0.15 = moderate, > 0.35 = large).

* $p < 0.05$. ** $p < 0.01$, *** $p < 0.001$.

d=0.98), provide alternative explanations for spurious associations ($p < 0.001$; *d*=0.87), and use and apply relevant information ($p < 0.001$; *d*=0.72). The only skill area where students scored lower than national norm data was in their ability to identify additional information needed to evaluate a hypothesis ($p < 0.01$; *d*=0.63).

Due to demographic and academic program differences, care must be taken when comparing students' scores to CAT national norm data. Even though these students' posttest scores were higher than national norm data on seven of the 15 CAT skill areas, their pretest scores were already higher than national norm data on two of the 15 skill areas. Posttest scores were used as the primary comparison unit to incorporate potential effects of the competing narratives approach. The seven CAT skill areas where students excelled beyond national norms were reflective of their abilities to evaluate and interpret information and solve problems. However, similar to Perry et al.'s (2014) observations of a comparable population, students in this study did not outperform national norms in the skill areas founded in creative thinking and effective communication. *"Creativity is not a fixed characteristic…rather, it is incremental, such that students can learn to be more creative"* (Saavedra and Opfer, 2012, p. 12). Thus, educators must not forget the importance of integrating opportunities for their students to engage in creative thinking.

Summary and Implications

Implications for curriculum development and teaching stem from the conclusion that the competing book analysis approach had a positive influence on students' overall critical thinking abilities. Therefore, instructors who are seeking alternative approaches to increasing students' critical thinking abilities should consider the competing narratives approach. As Saavedra and Opfer (2012) established, learning 21st century skills, such as critical thinking, requires relevant content, teaching through the disciplines, and addressing misunderstanding directly. *"When personal context and meaning are established and critical thinking occurs, instructors can increase competency"* (Riehle, 2012, p. 234). The pedagogical approach used in our study intentionally incorporated a relevant topic of interest that crossed multiple disciplines and allowed numerous opportunities to discuss information fallacies. We recommend that educators who wish to replicate this approach follow a similar method, without negating the importance of student involvement and writing. For knowledge to be constructed rather than transmitted, students need to engage with the teaching process and content (Hussain, 2012; Narayan et al., 2013).

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