Modeling Teaching Techniques: Preservice Nonformal Educators' Adoption of Techniques that will Influence Employability of their Future Audiences

Carla B. Jagger[1]
Riverdale High School
Mt. Blanchard, OH

Susie Whittington[2]
The Ohio State University
Columbus, OH

Abstract

The purpose of the study was to describe teaching techniques that can be used by university educators to impact employability skills of preservice nonformal educators' future audience members. Specifically, the study was designed to describe preservice nonformal educators' use of teaching techniques in their university microteaching laboratory, given the instructor-modeled teaching techniques used during class sessions. In addition, the researchers sought to describe preservice nonformal educators' critical cognitive processing given the teaching techniques observed and used by preservice nonformal educators. A census of fourteen students, who were pre-enrolled in the course, became the convenient population for the study. Three instruments were used to describe student use of teaching techniques, and student cognitive processing. Students were split into one of two groups prior to the first class session; one group received lower cognitive bonus questions, while the other group received higher cognitive bonus questions on all closing reflections during class sessions. Results were that five students used three of the instructor-modeled teaching techniques, timed-pair share, jot-thoughts and window-paning (Kagan, 1994), for a total of 12 frequencies of use, during the students' microteaching laboratories. In addition, no students scored higher than the lowest level of critical thinking during their critical cognitive processing on the reflections at the close of each class session.

Introduction

In March 2010, the unemployment rate was at 9.7%, as reported by the U.S. Bureau of Labor Statistics. Those without a job for 27 weeks or more increased to 6.5 million during that month. Teenagers were reported as the most unemployed working group at 26.1% (U.S. Bureau of Labor Statistics, 2010). During these uncertain economic conditions, educators must equip students with the skills they need for entering a changing and uncertain workforce. Some suggest that many of the skills that will be required for entering a changing workforce are those that are taught through the use of cooperative learning techniques for teaching.

Cooperative learning techniques offer students opportunities to work in small groups, a skill that most employers expect from new employees (Ravenscroft, 1997). Ravenscroft (1997) indicted that due to the nature of cooperative learning activities, students are teaching and coaching each other, which improves their learning while simultaneously improving their social interaction skills. Through the coaching and teaching of their peers, students are able to *"articulate their cognition and are able to observe and adopt the learning and study strategies of other students"* (p. 187).

According to Johnson and Johnson (1999), structuring learning situations cooperatively promotes students to work together to achieve group success. Consequently, when students work together towards a common goal, it typically results in higher achievement and greater productivity than if students work alone (Johnson and Johnson, 1999). Additionally, Johnson et

[1] Agricultural Science Educator; Email: Jagger.16@gmail.com
[2] Professor, 208 Agricultural Administration Building, 2120 Fyffe Road; Email: whittington.1@osu.edu

al., (2007) wrote that cooperative learning results in a greater transfer of the content learned from one situation to another, higher-level reasoning, and meta-cognition.

Theoretical Framework

Three theories were used to build the theoretical framework; Piaget's Theory of Cognitive Development lays the foundation. Woolfolk (2007) explains Piaget's theory as a model for describing how humans think about a problem and their surroundings. Piaget's theory consists of four stages including sensorimotor, preoperational, concrete operational, and formal operational (Woolfolk, 2007). Accordingly, students in this study should be operating at the formal operational stage of cognitive development, and are therefore cognitively able to interpret the value of given teaching techniques to social development.

The second theory was Bloom's Taxonomy; Bloom et al. (1956) established a hierarchy of cognition comprising six levels. Theoretically, as one cognitively works through the hierarchy, each level demands the use of the lower cognitive levels. The six levels include: knowledge, comprehension, application, analysis, synthesis and evaluation. For this study, teaching techniques will be used that, theoretically, cause students to operate at the highest levels of Bloom's hierarchy. The original Bloom's hierarchy was chosen by the researchers so that comparisons could be made to previous student data collected using that taxonomy.

The third theory was the social interdependence theory, supporting that the achievement of each individual's goal in a group is effected by the other member's actions (Johnson and Johnson, 2007). There are two kinds of social interdependence; the first is positive, which encourages cooperation and the second is negative, which encourages competition (Johnson and Johnson). Positive interdependence is when members of a group perceive they can only reach their individual goals when the other group members reach their goals. Negative interdependence exists when members of a group perceive they will only reach their individual goal when the other members fail to reach their goals (Johnson and Johnson). For the purposes of this study, the teaching techniques used will influence interdependence and cognitive processing.

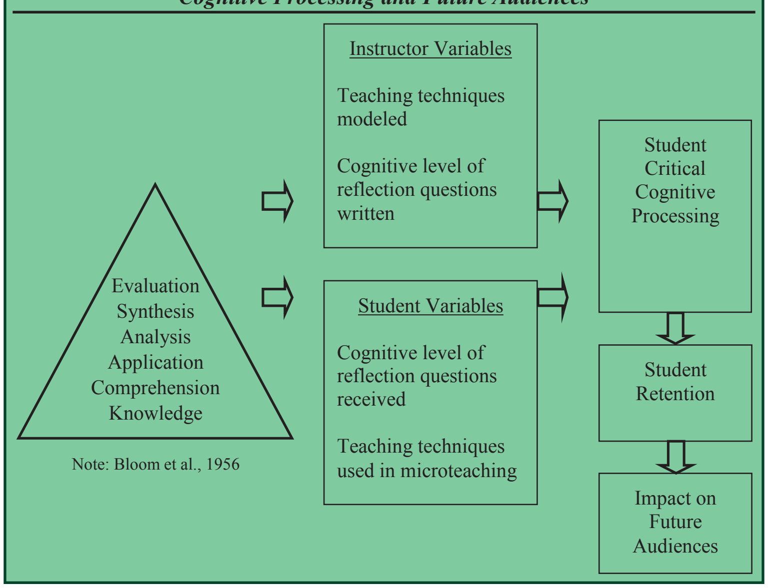
Conceptual Framework

Two variables related to the instructor and two variables related to the students were examined in this study to describe teaching techniques used by the instructor and cognitive processing of the students across a 10-week university course (see Figure 1). The two variables, related to the instructor, were cooperative learning techniques modeled (Interdependence Theory) during class sessions and the cognitive level of reflection questions written (Bloom's Hierarchy). Student variables included the cognitive level of reflection questions they received (Piaget's Theory and Bloom's Hierarchy) and the cooperative learning techniques (Interdependence Theory) they used in their microteaching lessons. These variables were used to describe the student's critical cognitive processing during a 10-week university course.

Purpose and Objectives

The purpose of the study was to describe teaching techniques that can be used by university educators to impact employability skills of preservice nonformal educators' future audience members. Specifically, the study was designed to describe preservice nonformal educators' use of teaching techniques in the microteaching laboratory during a university Methods of Teaching in Non-formal Environments course, given the instructor-modeled teaching techniques used during class sessions. In addition, the researchers sought to describe preservice nonformal educators' critical cognitive processing when answering higher cognitive level questions, given the teaching techniques observed by the study participants and then used during their microteaching laboratory sessions. It was expected that preservice nonformal educators would implement new teaching techniques into their microteaching laboratory sessions once they saw them modeled in class. In addition, the researchers expected the teaching techniques modeled by the instructor and then adopted by the preservice nonformal educators, to influence the level of critical cognitive processing

Figure 1. Conceptual Framework of Factors Influencing Student Critical Cognitive Processing and Future Audiences



evidenced in the responses to closing reflections during class sessions.

The following research objectives guided this descriptive study:

1. To describe observed student use of instructor-modeled teaching techniques during microteaching laboratories.
2. To describe student critical cognitive processing when responding to higher cognitive level reflection questions.

Review of Related Literature

Cooperative Learning

Cooperative learning is the incorporation of students working in groups to accomplish the same goal (Gillies, 2007). However, not all group work is effective cooperative learning. Instead, by using various techniques, the instructor should guide cooperative learning; if done properly, cooperative learning can contribute to student achievement (Gillies, 2007). Also, to ensure effective cooperative learning is taking place, individual performance, not just group performance, should be checked frequently to insure that all students are contributing to the group (Johnson and Johnson, 1999).

Responsibilities of cooperative-based group members include: ensuring positive academic progress is taking place; holding each other accountable for the learning; and providing each member with support and assistance to accomplish the goals (Johnson and Johnson, 2007). The three responsibilities listed here, along with social skills and group processing, are identified by Johnson and Johnson (1999) as the five essential elements of cooperative learning.

Gillies and Boyle (2010) examined perceptions of 10 middle school teachers when implementing cooperative learning in their classrooms. Gillies and Boyle interviewed the participating teachers, after each had embedded cooperative learning techniques into two units of instruction, both lasting 4-6 weeks. During the interviews, the teachers reported they had a positive experience incorporating cooperative learning. Comments mentioned were that students not only learned to interact with one another, but were also willing to take risks with their own learning (Gillies and Boyle). Teachers saw additional benefits of cooperative learning, including better management and structure of their lessons. Some issues reported in the implementation of cooperative learning were: student socializing, time management and the organization required on the teacher's part. Most of the teachers suggested cooperative learning be used more widely, while a few indicated it was a *"challenge and required commitment on the part of the teacher if it (cooperative learning) was to be implemented effectively"* (Gillies and Boyle, p. 938).

Critical Thinking

Critical thinking is defined by Wiederhold and Kagan (1992) as *"a set of abilities and behaviors that allow students to look beyond the information presented, make connections, develop cognitive organizers, and create personal meaning"* (p. 201). When involved in critical thinking, one engages in metacognition, which is the ability to self-think through a process and create a strategy to obtain the information needed to complete the problem-solving situation (Wiederhold et al., 2007). Woolfolk stated, *"this knowledge is higher order cognition used to monitor and regulate cognitive processes such as reasoning, comprehension, problem-solving, learning and so on"* (p. 267).

Higher Cognitive Questioning

Higher cognitive questions are characterized by two factors; the first is that students are required to state predictions, solutions, explanations, evidence, interpretations, or opinions; and the second is that the answer should not be readily available to them from the curriculum taught (Gall et al., 1978). Newmann (1987) defined higher order thinking as a result of higher cognitive questioning or teaching, as the opportunity one is given to interpret, analyze, or manipulate information, because the solution cannot be found through the routine application of previously learned content. Newman stated that, lower order thinking involves repetitive behaviors, such as memorizing and inserting a solution. Therefore, questioning students at higher cognitive levels stimulates cognitive skills and moves them beyond memorizing content (Gall et al., 1978).

Methods

Population and Sample

Students enrolled in a Methods of Teaching in Non-formal Environments course were the convenient population for the study. All students (N=14) agreed to allow samples of their work to be reviewed for the purpose of the research (approved by the Behavioral and Social Sciences Institutional Review Board #2009B0405). Students enrolled in the course were preservice nonformal education students, so they were preparing to be extension educators and community and industry leaders. The majority of the students (n=8) were Agricultural and Extension Education majors in the Extension option. Five students were working toward an agricultural education minor. One study abroad student from England requested to audit the course. All students, except the study abroad student, were required to take the course to fulfill either their major or minor curriculum requirements for graduation. As such, this population of students is well-positioned to learn cooperative learning techniques, so they can use the skills developed by the techniques to influence their audiences throughout their careers.

Instrumentation

Closing Reflections

The researchers used three instruments to collect data for this study. The first was, closing reflections that the students received at the end of each class session. The class was split evenly into two groups. The first group (n=7) received a lower cognitive bonus question (knowledge or comprehension level question) on each closing reflection, while the second group (n=7) received a higher cognitive bonus question (analysis, synthesis or evaluation level question). Only the higher cognitive questions were evaluated using a critical thinking rubric; the lower cognitive questions were evaluated as right or wrong. Each bonus question on the closing reflection was created using the Florida Taxonomy of Cognitive Behavior (Webb, 1968). Inter-rater reliability was established by the researcher writing the question and another researcher independently, each class day, obtaining agreement on the cognitive level of questions that were being asked. The researchers established 100% agreement across the ten-week university course. A panel of experts in the field of teacher preparation and agricultural education reviewed the reflection questions to determine content validity of the questions used in the research. The panel determined the questions to be appropriate for assessing the cognitive level purported to be measured.

Critical Thinking Rubric

The second instrument was the critical thinking rubric for which the researchers used the Florida Rubric for Assessing Critical Thinking Skills (FRACTS) (Friedel et al., 2008) to evaluate student responses on all higher cognitive bonus questions. An expert panel of researchers in critical thinking developed FRACTS; this panel of experts set out to determine the essential elements of each critical thinking skill: analysis, evaluation and inference (Friedel et al.). The focus of the instrument was examining the process of critical thinking, instead of the product; it can be used in both audible and written responses. For the purpose of this study, written responses were examined.

Within the three constructs defined by FRACTS, analysis, evaluation and inference, there are six descriptors, creating a total of 18 descriptors. When evaluating a response, each descriptor received a score of one, two, or three; A score of one indicated that the individual showed no evidence of demonstrating or using the specific critical thinking skill. The score of two indicated that the individual provided hints of using the specific critical thinking skill.

Finally, the score of three indicated that the individual clearly demonstrated the specific critical thinking skill. The total range of scores for FRACTS is 18 to 54; within the three constructs, the range of scores is 6 to 18. The recommended interpretation of both the construct and total scores received on FRACTS, can be found in Table 1 and Table 2 respectively.

Table 1. Interpretation on each Construct Score Received on the Florida Rubric for Assessing Critical Thinking Skills (FRACTS)

Construct Score	Interpretation
6 to 9	Low level of critical thinking
10 to 14	Common level of critical thinking
15 to 18	High level of critical thinking

Note: Friedel, personal communication, April 13, 2010.

Table 2. Interpretation of Total Score Received on the Florida Rubric for Assessing Critical Thinking Skills (FRACTS)

Construct Score	Interpretation
18 to 28	Low level of critical thinking
29 to 43	Common level of critical thinking
44 to 54	High level of critical thinking

Note: Friedel, personal communication, April 13, 2010.

Validity for FRACTS was established by an expert panel of researchers in critical thinking (Friedel, personal communication, April 13, 2010). For this study, reliability for the critical thinking rubric instrument was established using test-retest procedures (Ary et al., 2002). The researchers re-analyzed randomly selected closing reflections using the critical thinking rubric. *A priori*, a 95% confidence band was established as acceptable for each closing reflection. Upon one test-retest measure, the researchers had achieved the acceptable rate (95%) for both inter-rater and intra-rater reliability.

Microteaching Lab Videos

The third instrument used was the microteaching lab videos of each student. Students were required, as part of the course, to participate in microteaching labs, in which they developed daily plans and taught the content to their classmates. The researchers retained a copy of these videos, with permission from the students, in order for the researchers to analyze the microteaching laboratory lesson. Each student's lesson was analyzed, with a frequency count, for the use of the teaching techniques that had been demonstrated by the instructor during class sessions.

Reliability for the microteaching lab videos was established using test-retest procedures (Ary et al., 2002). The researchers reanalyzed randomly selected microteaching videos. Intra-rater reliability for the microteaching lab videos was established for the researcher by analyzing a randomly selected microteaching lab video. Five weeks later, the same researcher reanalyzed the same microteaching lab video. *A priori* a 95% confidence band was established as acceptable. Upon one test-retest measure, the researcher had achieved the acceptable rate (95%).

Data Collection and Analysis

Closing Reflection

At the end of each class session, the graduate student researcher always handed-out the closing reflection, to ensure that each student received the correct cognitive level of question (according to the group to which he/she had been randomly pre-assigned). To help combat any researcher bias, an undergraduate student employee in the department graded all of the reflections (students were assigned numbers so anonymity was maintained). After the reflections were graded, a copy was filed in the research records; the original was returned to the student.

FRACTS

Both the graduate student researcher and the undergraduate student employee evaluated the closing reflection using FRACTS. Each rater received training from another researcher with extensive experience in the use of FRACTS. Training involved an explanation of the instrument followed by practice evaluating several closing reflection responses. The trainer was present during the first practice rating to answer questions for the raters. After the training, inter-rater reliability (a measure of rater consistency) was assessed by using fourteen closing reflection questions. The researcher calculated the percent agreement between the coders, which reflected an inter-rater reliability of 93.

Microteaching Lab Videos

Three strategically selected lecture sessions for the Methods course were taught using purposefully selected cooperative learning techniques. All of the students received the same instruction. The graduate student researcher gave these lectures so the students could easily distinguish between the lecture sessions in which the cooperative learning class sessions were taught and the other class sessions. Three to five of the following teaching techniques were used during each strategically selected class session: jot thoughts, paraphrase passport, timed pair-share, inside-outside circle, Q-approach, send a star and window-paning as described by the Kagan (1994) curriculum of cooperative learning techniques.

Student use of the instructor-modeled teaching techniques, during their microteaching laboratories, was collected as a frequency count. The researcher watched each student's microteaching lab video and recorded the frequency of use of cooperative learning teaching techniques.

Following the data collection period, all student responses and observations were entered into the Statistical Package for the Social Sciences 17.0 (SPSS 17.0). Appropriate measures of central tendency, variability, frequency counts and percentages were generated for each characteristic of interest in the study. The SPSS 17.0 was used to run all analysis of the data for the study. The unit of analysis for this study was post-secondary students (N=14). The SPSS program was designed especially for analyzing data collected in studies related to social and behavioral research.

Table 5. Instructor-modeled Techniques Used by Students during Microteaching Laboratories

Technique used	Frequency
Timed-Pair Share	9
Jot-Thoughts	2
Window-Paning	1

Results

Student Use of Instructor-Modeled Teaching Techniques during Microteaching Laboratories

Findings were, that out of the 27 microteaching lessons recorded, 12 frequencies of use of the instructor-modeled teaching techniques were recorded for five of the fourteen students. Out of the seven cooperative learning techniques modeled by the instructor, three were used by the students during their microteaching laboratories: timed-pair share, jot-thoughts and window-paning. In Table 5, the frequency of techniques used during microteaching by the five students is recorded.

Critical Cognitive Processing When Responding to Higher Cognitive Level Reflection Questions

Student responses in the higher cognitive questions group were analyzed using FRACTS. Data were reported missing when students chose to not answer the question, or were absent for the day. A total of ten closing reflections were reported as missing data, leaving 89.8% of the closing reflections to be analyzed. On average, student responses to the higher cognitive questions scored 18.9 on the critical thinking rubric (range = 18 to 28).

Conclusions/Recommendations/ Implications

Use of Instructor-Modeled Teaching Techniques

Students did not tend to use the instructor-modeled teaching techniques during microteaching lessons after seeing them modeled by the instructor during class sessions. The teaching techniques used during microteaching laboratories were timed-pair share, jot-thoughts and window-paning. A description of each cooperative learning teaching technique follows:

Jot thoughts: Consists of splitting the class into groups of any size. Once the groups are formed, the instructor provides each group with slips of paper for them to jot their ideas. Once the groups are given a task/ question they put only one idea on each slip of paper, but they should also try to fill the surface of their desk with as many ideas as possible. No slip of paper should overlap another (Kagan, 1994).

Timed-pair share: Allows students a specified amount of time to share their thoughts about a given topic. Once the time has expired, they spend the same amount of time listening to their partner's idea, giving both students an equal amount of time to share and voice their opinions (Kagan, 1994).

Window-paning: Allows students to conceptualize an idea visually. Instructors discuss and breakdown a situation, process and story line into smaller bits of information. The students have in front of them a sheet of paper divided into the number of sections needed for the content being delivered. As the instructor presents the information, the students draw a picture that will help them remember that part of the process. Once the content has been delivered, students break into groups and verbally explain the content material they drew in their windowpanes (Kagan, 1994).

Professors teaching methods classes to preservice nonformal educators need to be purposeful about sharing the names of the teaching techniques being used during class sessions, as well as the reasons for the selection of the techniques; for example, sharing with the preservie educators the employability skills that the technique develops could influence the adoption of the use of the technique. Professors must then indicate that they are expecting the preservice educators to use the technique(s) in microteaching laboratories. This level of purposeful approach will impact the adoption of future use of these techniques for teaching employability skills to various audiences. Also, if a portion of the microteaching scoring rubric is designed to reflect a grade for the use of the instructor-modeled teaching techniques, adoption rate will increase among the preservice nonformal educators.

Student Critical Cognitive Processing

Students in the higher cognitive group answered reflection questions at the lowest level of critical thinking. Therefore, educators should teach to and assess students at the level of cognition that is stated in the daily lesson objectives. Crowe et al., (2008) stated that if educators are teaching at higher cognitive levels, but testing only at the knowledge level, students assume that they really do not need to put forth as much effort at the higher levels. In addition, if educators teach at the knowledge level, but test at higher levels, students often perform poorly because they have not had the opportunity to cultivate higher level thinking skills. Whittington and Newcomb (1993) recommended that students be tested at higher cognitive levels only after the students have received instruction that was delivered (modeled) at the higher cognitive levels.

When preparing future nonformal educators to use techniques that influence employability skills, Gillies and Boyle (2010), stated they should be "trained in the skills needed to implement cooperative learning in their classrooms" (p. 938), including using structured cooperative activities, creating challenging tasks and being able to teach students the social skills needed to effectively work in groups. Ravenscroft (1997) indicated that research conducted on cooperative learning shows positive achievement in students. Not only will students put forth more effort to achieve a goal when participating in structured cooperative activities, they will also develop positive and supportive relationships (Johnson and Johnson, 1999). When engaging in cooperative learning activities, students are able to observe outstanding group member behaviors and emulate them to become better students themselves (Johnson et al., 2007). Adoption of these teaching techniques will influence the level of employability skills role-modeled to future learners.

Discussion and Further Research

The purpose of the study was to describe teaching techniques that can be used by university educators to impact employability skills of preservice nonformal educators' future audience members. To accomplish the purpose of the study, researchers chose an agricultural education methods class, since the enrollment for the course was preservice nonformal educators. The researchers expected that students would implement new teaching techniques into their microteaching laboratory sessions simply because they saw them modeled in class and, therefore, would want to add them to their teaching repertoire. The expectation was not met.

In addition, since the researchers strategically selected very specific teaching techniques that had a brain-based reputation, the researchers expected the teaching techniques modeled by the instructor to influence the students' level of critical cognitive processing. In addition, the researchers thought that student adoption and use of the techniques would further influence student critical cognitive processing. The techniques were not influential to student critical cognitive processing and, without adoption and use of the techniques, no opportunity existed for further influence on critical cognitive processing.

More research needs to be conducted, with a larger population, to further examine the relationship of instructor-modeled teaching techniques to preservice nonformal educators' use of techniques that influence employability of their future audience members. Preservice nonformal educators in this study were not required to or asked to use the instructor-modeled teaching techniques because the researchers wanted to see if and how often the preservice educators used the techniques in their own teaching after simply observing the techniques used in lecture. In a future study, researchers will design the study such that students are required to use the instructor-modeled techniques in their microteaching. The study will also be conducted across a longer period of time such that the potential for influence is greater.

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Response-Shift Bias in Critical Thinking[1]

Brandi K. Phillips[2] and Brian E. Myers[3]
University of Florida
Gainesville, FL

Abstract

Students' responses to the EMI Critical Thinking Test were examined for response-shift bias, a phenomenon found in previous studies using tests of other constructs in which participants provided inconsistent responses in pre-tests compared to then-tests. Pre-test scores of a sample of 75 students enrolled in animal science courses at the University of Florida were compared to the students' then-test scores, which were obtained upon completion of the course and consisted of self-reports of students' prior critical thinking skills. Comparison of the pre-test scores and then-test scores in this study did not provide evidence of a response-shift bias. The influence of demographic variables including gender and ethnicity was also examined and results indicated that the appearance of response-shift bias was not impacted by either variable. The results of this study were not consistent with limited previous research and future studies should further investigate the phenomenon of response-shift bias with respect to the EMI Critical Thinking Test as well as other self-report tests.

Introduction

Frequently in educational research, it is necessary to evaluate perceptions, knowledge, attitudes and behaviors of participants as they relate to a treatment. Self-reports of these constructs are often provided using a pre-test-post-test research design. Comparisons can then be made between the respondents' perceptions at the start of treatment and upon completion, allowing researchers to determine the effect of the treatment on the participants.

In some instances, however, obtaining a pre-test from participants may not be practical or feasible. Additionally, concerns have been expressed regarding the ability of participants to accurately self-report prior to a treatment due to their lack of knowledge surrounding the subject of interest (Rockwell and Kohn, 1989). The testing effect may also pose a threat in pre-test-post-test designs, as research has shown that a pre-test can improve learning which is reflected in the post-test (McDaniel et al., 2007). Ary et al. (2010) have described pre-test sensitization as a threat to validity for attitude and personality inventories, resulting in students carefully considering their responses and changing their answers based on self-reflection and not necessarily on the effect of the treatment. Such instances may call for a post-then design, in which participants provide their self-report of pre-treatment knowledge or perceptions (then) at the same time as their post-treatment knowledge or perceptions (post).

Response-shift bias has been identified as a potential threat to the validity of pre-test-post-test research designs. Howard and Dailey (1979, p. 145) defined response-shift as "the difference between pre and then self-report ratings." Several studies have noted a response-shift in participants' responses (Howard and Dailey, 1979; Rohs, 1999). As a result, researchers have recommended that post-then data be collected in addition to pre-test data for all studies using self-rating measurement methods (Howard and Dailey, 1979; Rohs, 1999) before and after treatments.

One such study, conducted by Howard and Dailey (1979), tested for response-shift bias using a seven-item questionnaire to evaluate interviewer skills before and after a five day workshop. Twenty-one individuals participated in the study and completed a pre-test as well as a post-then-test. In addition, the researchers taped first and last practice interviews of each of the participants and trained judges rated the behavior of each on a 9-point scale. A response shift was discovered in the participants' self-reports on four of the seven items. Further, it was noted that the then-test reports were more closely aligned with the ratings assigned by judges as opposed to the pre-test reports. While a cause for the response shift was not investigated in this study, the shift was observed. The then-test scores were found

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[2]Graduate Assistant and Master's Student, Agricultural Education and Communication; Email: brandikphillips@ufl.edu
[3]Associate Professor and Associate Chair, Agricultural Education and Communication; Email: bmyers@ufl.edu

to be more accurate representations of interviewer skills than pre-test scores (Howard and Dailey, 1979).

This phenomenon was investigated later by Rohs (1999). Students in an undergraduate agricultural leadership course participated in a similar study using the Youth Leadership Life Skills Development Scale in pre-post and post-then comparison (Rohs, 1999). A group of 30 students participated in a pre-post-test and 28 completed a post-then-test. The data appeared to indicate a response shift, as post-then students reported greater changes compared to the pre-post participants (Rohs, 1999).

In some cases, however, response-shift bias may not pose a threat. Sprangers and Hoogstraten (1988) tested the effects of a bogus-pipeline induction on response-shift bias in testing first aid knowledge of psychology students before and after a first aid film. Results from this research showed no response-shift in the bogus-pipeline experiment, fitting with the researchers' hypothesis. An unexpected finding was that response-shift had also not occurred in the non-bogus-pipeline component (Sprangers and Hoogstraten, 1988). This indicates that there may be certain circumstances under which response-shift bias is not a threat to validity for pre-test-post-test designs.

Although several studies have been conducted to test for response-shift bias (Howard and Dailey, 1979; Sprangers and Hoogstraten, 1988; Rohs, 1999), this phenomenon may not occur under all pre-test-post-test circumstances (Sprangers and Hoogstraten, 1988). Previous studies have looked at student groups as a whole, without providing any data on possible relationships between response-shift and student characteristics. This information may provide valuable insight into response-shift bias. This study investigated response-shift bias using the Engagement, Cognitive Maturity and Innovativeness (EMI) critical thinking test, considering demographic variables which included gender and ethnicity.

A pre-test-post-test analysis of EMI critical thinking test scores of students at the University of Florida was used to determine whether participation in animal science courses and activities impacted critical thinking (Miller et al., 2011). Results of this analysis demonstrated that as a result of participation in animal science courses and activities, students demonstrated improvement on the Innovation and Engagement scales. Then-test data were also collected from these students, but had not been analyzed in the study conducted by Miller et al. (2011). By analyzing the then-test data of these students, this study attempted to validate the results of the former study.

Methods

The purpose of this study was to determine if a response shift existed between then-test responses and pre-test responses of participants providing a self-evaluation using the EMI critical thinking test. Given this information, researchers may be more able to appropriately determine the accuracy of self-reports evaluated in both pre-then-post as well as post-then-pre designs.

The following objectives were used to guide this study:

1. Evaluate the difference between pre-test scores and then-test scores of the EMI instrument for students enrolled in classes at the University of Florida.
2. Evaluate the difference between pre-test scores and then-test scores of the EMI instrument based on demographics.

The population for this study consisted of students enrolled in the Introduction to Animal Sciences course (n = 66), as well as those enrolled in the Meat Selection and Grading (n = 3) and Live Animal Evaluation (n = 6) courses, at the University of Florida during the 2009-2010 academic school year. Each of the courses provided students with both lecture and laboratory instruction.

Participating students were asked to evaluate their critical thinking skills before and after one semester of participation in the courses. Ricketts and Rudd (2005) developed the EMI test to measure critical thinking disposition in a 26 item response test, consisting of 11 questions measuring engagement (defined as "students' predisposition… to use reasoning" p. 33), eight questions measuring cognitive maturity ("awareness… of their own and others' biases and predispositions" p.33) and seven questions measuring innovativeness (students' predisposition to seek truth). Cronbach's alpha scores of .79, .75 and .89 were given for Innovativeness, Cognitive Maturity and Engagement, respectively (Ricketts and Rudd, 2005). Students were administered the test at the beginning of the programs (pre-test); upon completion of the program, students were asked to fill out the instrument again, including their responses after the course or team activities (post-test). Following the post-test, the participating students were asked to evaluate their responses previous to enrollment or participation (then-test).

Data were then analyzed using SPSS® for Windows™ software. A paired t-test was used to compare pre-treatment responses given prior to participation (pre-test) with pre-treatment responses given after participation (then-test) for totaled values for the following constructs: engagement, cognitive maturity and innovativeness. The total values for the combined constructs were also compared using a paired t-test analysis. *A priori*, a significance level of $p < .05$ was set. Responses of each construct and the totals were also compared based on gender and ethnicity to determine what trends, if any, may have existed based on demographic information provided by the participants.

Results and Discussion

Objective One - Evaluate the Difference between Pre-Test Scores and Then-Test Scores of the EMI Instrument for Students Enrolled in Classes at the University of Florida.

The average score of participants' responses to the engagement portion of the EMI critical thinking test was M = 43.83 at pre-test and M = 43.85 at then-test. A p value of 0.96 indicated no significant difference between pre and then responses for this construct. Participants' measures of cognitive maturity were reported as M = 30.73 at pre-test and M = 31.03 at then-test. No significant difference between pre and then responses existed (p value = 0.44). Average values of M = 27.75 at pre-test and M = 28.01 at then-test were reported for innovativeness. A p value of 0.47 indicated no significant difference in response scores.

Table 1. Mean Pre and Then Scores of Critical Thinking Constructs

Item	Mean - Pre	Mean - Then	T	p
Engagement	43.83	43.85	-0.06	0.96
Cognitive Maturity	30.73	31.03	-0.77	0.44
Innovativeness	27.75	28.01	-0.72	0.47
Total	102.31	102.89	-0.61	0.54

Objective 2 - Evaluate the Difference between Pre-Test Scores and Then- Test Scores of the EMI Instrument Based on Demographics.

Male respondents' (n = 19) average score for the total EMI critical thinking test was M = 104.26 at pre-test and M = 102.53 at then-test. No significant difference between the pre and then-tests was determined based on a p value of 0.31. The average score of female respondents (n = 56) for the total EMI critical thinking test was M = 101.64 at pre-test and M = 103.02. A p value of 0.24 indicated no significant difference between pre and then-test scores.

The majority of participants were White (n = 64), with total average scores of M = 101.75 at pre-test and M = 102.33 at then-test. A p value was calculated at 0.57, so no significant difference existed between the pre and then-tests. The Non-White participants (n = 11) had similar results. Average scores were 105.55 at pre-test and 106.18 at then-test. The p value of 0.83 indicated that no significant change occurred in this group of participants either.

No significant differences were found between the pre-test scores and the then-test scores reported by participating students with respect to any of the constructs measured by the EMI test. Total scores likewise yielded no significant difference between pre and then scores. Average scores for the EMI critical thinking test in total at the time of pre-test was M = 102.31 and M = 102.89 at the time of then-test.

Table 2. Mean Pre and Then Scores of Critical Thinking Constructs of Male Participants

Males	n	Mean - Pre	Mean - Then	t	p
Engagement	19	31.26	30.84	0.64	0.53
Cognitive Maturity	19	44.89	43.63	1.41	0.18
Innovativeness	19	28.11	28.05	0.08	0.94
Total	19	104.26	102.53	1.06	0.31

Table 3. Mean Pre and Then Scores of Critical Thinking Constructs of Female Participants

Females	n	Mean - Pre	Mean - Then	t	p
Engagement	56	30.55	31.09	-1.177	0.244
Cognitive Maturity	56	43.46	43.93	-0.821	0.415
Innovativeness	56	27.63	28.00	-0.846	0.401
Total	56	101.64	103.02	-1.194	0.238

Table 4. Mean Pre and Then Scores of Critical Thinking Constructs of White Participants

White	n	Mean - Pre	Mean - Then	t	p
Engagement	64	30.52	30.81	-0.715	0.477
Cognitive Maturity	64	43.63	43.69	-0.120	0.905
Innovativeness	64	27.61	27.83	-0.557	0.579
Total	64	101.75	102.33	-0.556	0.573

Table 5. Comparison of Mean Pre and Then Scores of Critical Thinking Constructs Non-White Participants

Non-White	n	Mean - Pre	Mean - Then	t	p
Engagement	11	32.00	32.27	-0.280	0.785
Cognitive Maturity	11	45.00	44.82	0.132	0.898
Innovativeness	11	28.55	29.09	-0.493	0.633
Total	11	105.55	106.18	-0.217	0.832

This study showed no evidence of response-shift bias. Within this sample, pre-test and then-test scores of participants demonstrated no significant difference in self-reports on the EMI critical thinking test administered ($p > .05$). No significant difference was reported in the individual components of the EMI critical thinking test, including engagement, cognitive maturity and innovativeness ($p > .05$). Additionally, analysis revealed no significant difference between pre and then reported scores of males compared to females ($p > .05$). Scores between pre and then reports of White students and Non-White students also showed no significant difference ($p > .05$). Demographic variables investigated in this study appeared to have no effect on the likelihood of response-shift bias for the participants.

The findings of this study contradict those of Rohs (1999) and Howard and Dailey (1979). As the study conducted by Sprangers and Hoogstraten (1988) indicated, response-shift bias may not threaten the validity of all tests. This may include the EMI Critical Thinking Test or possibly measures of the critical thinking construct. A deeper understanding of response-shift bias is needed, as well as how to address response-shift bias if it is found to be present. Relatively few studies have investigated this phenomenon; therefore, research is needed to test whether response-shift bias exists as a threat to validity in pre-test-post-test designs using the EMI instrument, as well as other self-report measures. Tests used to measure perceptions of individuals with regard to animal welfare issues, use of genetically modified agricultural products and other issues faced by the agriculture industry could benefit from further investigation of response-shift bias.

Studies should continue to collect pre-test-post-test data in conjunction with post-test-then-test designs to verify results. Future research may also include demographic variables to determine whether factors such as gender and ethnicity affect response-shift bias when such a phenomenon is discovered. The impact of participant variables such as age and experience should also be considered in future research.

Summary

The purpose of this research was to determine if response shift occurred between participants' responses to the EMI critical thinking test before a treatment and a then-test following treatment. A total of seventy five students participated in the study. Participating students completed the EMI critical thinking pre-test at the beginning of the courses, as well as a then-test upon completion of the courses. The participants of this study were selected purposively and consisted of students enrolled in animal science courses at the University of Florida. Results therefore cannot be generalized outside of this population.

No significant differences were found between pre-test and then-test scores of participants selected for this study. Gender and ethnicity of the participants did not result in significant differences between pre-test and then-test scores. Response-shift bias was not a threat to the validity of the EMI Critical Thinking Test within the population selected for this study.

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