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An Evaluation of Teaching Methods Based on Cognitive Achievement

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Abstract

The purpose of this study was to determine if there were significant differences in cognitive achievement between different instructional techniques used with students enrolled in high school agricultural science classes. Lesson content covered the production, uses, and performance of biodiesel fuels in compression engines. Treatments were different instructional techniques including lecture, demonstration, and a combination of lecture and demonstration. Cognitive achievement was measured on low level cognition and high level cognition. In addition, this study sought to find any correlation between student perceptions of lecture versus demonstration and tinkering self-efficacy on student achievement. An experimental pretest-posttest design was used to conduct the study. A sample population included 27 classes (N = 333). Nine classes were used per treatment. The subjects were taught using one of the three treatments based on random selection. Each subject received a pretest prior to the lesson and then a posttest following the treatment. Student perceptions of tinkering self-efficacy and perceptions of demonstration and lecture were collected for every subject. Data collected for this study revealed no significant difference across instructional techniques on knowledge acquisition. However, when comparing treatments and cognitive achievement, there was a significant difference between the combination technique and the lecture technique on high cognitive achievement. There was not a significant difference on students' cognitive achievement on low level cognition. There was not a significant correlation between student perceptions (preference) of instructional technique and knowledge acquisition. Nor was there a significant correlation between student perceptions of tinkering self-efficacy and knowledge acquisition. There was a significant correlation between tinkering self-efficacy and student preference of instructional technique.

***Keywords*:** Teaching, Methods, Alternative Energy, Secondary, Students

Introduction

For years, educational theorists and philosophers have been trying to identify exactly what learning is and how it occurs. Learning is a process that can change behavior or knowledge towards situations through experience (Woolfolk, 2010). However, there are many factors that influence situations or experiences. These factors not only affect how much is learned but also the premise under which learning is occurring. Because numerous theorists conceptualize that experiences lead to knowledge acquisition, the question remains regarding selecting the best method to aid in knowledge acquisition in the classroom.

"Learning occurs as a result of experiences had by the learner" (Roberts & Harlin, 2007 p. 47). Experiential learning is simply learning by doing (Dewey, 1938). When an individual experiences a reality, that reality becomes knowledge, thus knowledge acquisition or learning occurs. A similar philosophy, or theory, is that of psychologist Lev Vygotsky (1978), who believed that learning is a tool in development; and through action, learning will occur.

There are many different learning styles which instruction may be directed; therefore, knowledge about learning styles can benefit planners and individual educational experiences (Curry, 1983). The different types of learning styles include auditory, visual, and kinesthetic or tactile (Cano & Hughes, 2000; McGregor, Fraze, Baker, Burley, and Byrd, 2004). A conclusion from the previously cited sources may indicate that every student learns differently. This conclusion is supported with research completed by Cano, Garton, and Raven (1992) who found that "students differ in learning styles, personality styles, and in their preferred method of teaching (pg. 51)." Because of this, not all students learn the same and it becomes important to adapt lessons that meet the needs of different learning styles (McGregor et al., 2004).

According to Honigsfeld and Dunn (2009), students learn most effectively when they are fully engaged. Furthermore, "teaching occurs when performance is achieved with assistance" (Tharp & Gallimore, 1991, p. 11). Researchers (Elmoselhi et al. 2010, Honigsfeld and Dunn, 2009; Tharp and Gallimore, 1991) purport that teachers should strive to fully engage students in a directive learning environment. Because of instructors' key role in student engagement, instructors should be selecting teaching methods based on learning styles (McGregor et al., 2004). If students cannot focus because of a lack of understanding, student engagement is lost (Honigsfeld & Dunn, 2009). Therefore, selecting a learning style to which the instruction is directed is necessary for student engagement.

For years, the main method of delivering content was traditional lecture-type instruction (Broadwell, 1980; O'Malley & McCraw, 1999). However, lecture does not satisfy the call for experiential learning because it lacks the hands-on experience component necessary for the development of hands-on skills (Dewey, 1916; Roberts & Ball, 2009). A common method of delivery in agricultural education, to provide experience, is through hands-on demonstrations. Using hands-on demonstrations, a student is able to be actively involved in the lesson. Kolb's experiential learning process (1984) purports that learning occurs due to the creation of knowledge. Other theorists agree and tout similarities to Kolb's vision of how learning occurs through experience (Roberts, 2006). The similarities include an initial or engaging experience, exploration or reflection towards previous experience(s), generalizations made about what is/has occurred, experimentation and evaluation of the process/experience. Most agree that learning is or can be cyclic when referring to this type of learning process.

There have been multiple studies which compare different teaching methods and their impact on effectuating knowledge (Dyer & Osborne, 1996; Kolb; 1984; Korwin & Jones, 1990; O'Malley

& McCraw, 1999; Ott, Mann, & Moores, 1990; Sallee, 2012). A recent study by Sallee (2012) concluded that there was a positive correlation between student test scores and high perceptions in tinkering self-efficacy. Tinkering self-efficacy is a personal perception that by using experiential and kinesthetic procedures, learning occurs more effectively. Another finding indicated a positive correlation between perceptions of tinkering self-efficacy and teaching method used (Sallee, 2012). The conclusion was that presentation method had a significant impact on student learning based on the students' perceived ability towards tactile based learning. Moreover, students taught using the problem-solving approach (experiential learning) exhibited higher mean scores on achievement tests than those taught using the subject matter approach (Dyer & Osborne, 1996).

Studies show correlations and comparisons of different methods of teaching, but there appears to be a need for further research. Results from a study performed by Newsome, Wardlow, and Johnson (2005) suggest that the results comparing teaching methods vary from school to school. Thus, further investigation into the phenomenon of how students learn based in differentiated methodologies should be explored.

Purpose and Objectives of Study

The type of teaching methodologies that has the greatest impact on cognitive achievement is a concern of education professionals. Furthermore, there is a lack of evidence within the literature that demonstrates strong comparisons of different teaching methods; lecture, demonstration, and a combination of lecture and demonstration. Therefore, this study is guided by a need for comparing teaching methods and their effect on cognitive achievement.

The purpose of this study was to determine if there was a significant difference ($p \leq .05$) in instructional teaching methods including lecture, demonstration, and a combination of lecture and demonstration. The study also investigated differences in cognitive gains (high or low) between the different methods of instruction. This study also sought to determine the influence of student perceptions of instructional methods on knowledge acquisition as well as the influence of tinkering self-efficacy on knowledge acquisition.

The following research questions guided this study:

1) What impact do instructional techniques have on students' level of knowledge acquisition?
2) What impact do instructional techniques have on students' cognitive level of knowledge acquisition?
3) What is the relationship between student perceptions of instructional technique and knowledge acquisition?
4) What is the relationship between tinkering self-efficacy and preferred instructional technique?
5) What is the relationship between tinkering self-efficacy and knowledge acquisition?

Methodology

This study incorporated an experimental pretest-posttest design (#2) (Campbell, & Stanley, 1996). Based on related research in this field and the literature, an alpha level was set *a priori* at .05. Although the researchers recognize that eliminating completely the possibility of a type I or type II error is not possible with this alpha level, the alpha level helped prevent a type I or type II error.

Population and Sampling

The target population for this study was all high school agriculture science classes in Northwest Arkansas. The accessible population was all students enrolled in those high school agriculture science classes in the spring semester of 2011. Since not all students could be accessed due to limitations of the researchers, a sample was drawn. The sample included 27 intact classes from various schools throughout Northwest Arkansas. There were five schools contacted which agreed to participate in the study. A total of 27 classes were sampled; there were nine classes per treatment (N = 333). The schools were selected randomly upon agreement from the teacher to participate in the study. The researchers obtained permission from the students to allow data to be collected.

The study was comprised of students enrolled in agricultural science courses in Northwest Arkansas in the spring of 2011. Of the original 364 subjects, 31 were removed from the study due to an absence. Therefore, a usable sample size of N = 333 was obtained for the study. The majority (66.67%) of the participants were male and the remaining (33.33%) were female. Participant ages ranged from 14 to 19. Of the participants, there were 130 ninth graders (39.04%), 90 tenth graders (27.03%), 70 eleventh graders (21.02%), and 43 twelfth graders (12.91%).

The participants also reported grades made in general education classes along with grades in agriculture classes. Subjects reported grades for general education classes and agriculture classes with a range from A-F on a normal 4.0 scale (See Table 1).

Table 1. Participants Grades in General Education Classes and Agricultural Classes (N = 333)

Grades		*f*	%
A			
	General	69	20.72
	Agriculture	172	51.65
B			
	General	155	46.55
	Agriculture	121	36.34
C			
	General	93	27.93
	Agriculture	35	10.51
D			
	General	15	4.50
	Agriculture	4	1.20
F			
	General	1	0.30
	Agriculture	1	0.30
Total			
	General	333	100.00
	Agriculture	333	100.00

Additionally, the participants reported whether or not they live on a farm (See Table 2). A majority of subjects (n = 213, 63.96%) did not live on a farm and 120 subjects (36.04%) reported living on a farm.

Table 2. Participants Living on a Farm (*N* = 333)

Residence	*f*	%
Farm	120	36.04
No Farm	213	63.96
Total	333	100.00

The final demographic information reported was the use of biodiesel. Because only 120 subjects reported living on a farm, only 120 subjects reported use, or not, of biodiesel (Table 3). This was done to satisfy the question asked; "If you answered 'yes' to living on a farm, do you use biodiesel?" However, the researchers recognize multiple applications of biodiesel beyond agriculture/farm use (Sallee, 2010). A large majority, 89.17%, of subjects living on farms reported no use of biodiesel (*n* = 107). There were 13 subjects (10.83%) who reported yes to the use of biodiesel.

Table 3. Participants Who Use Biodiesel (*N* = 120)

Biodiesel Use	*f*	%
Use	13	10.83
No Use	107	89.17
Total	120	100.00

Procedures

Lesson Content

A 50 minute class period was utilized to commence this research study. Forty minutes were allowed for the content portion of the instruction and ten minutes were allotted for the posttest. The content of the lesson was basic bio-diesel production and performance. This content included an explanation of bio-diesel, how it is made, uses, and required quality standards. Finally, the students were informed of the environmental effects of biodiesel (emissions), and how it performs in engines (horsepower, torque, and fuel consumption).

Variables

The major variable of the study was knowledge acquisition as influenced by the treatment. The three levels of the variable of study were teaching with lecture only, teaching with demonstration only, and teaching with a combination of lecture and demonstration. Classes lasted 50 minutes. The length of time in which instruction occurred was 40 minutes for all classes. There was a pretest given on the previous day of the treatment which lasted 10 minutes. The following day, the treatment was administered for exactly 40 minutes. Each class received one of the three treatments. Following the treatment, a posttest was administered. The students received the same allotted time of no more than 10 minutes to complete the posttest. The objectives covered in all treatments were identical in content and only varied in method of delivery. Data was collected from 27 classes, nine classes per variable.

The first variable was a lesson via lecture only. The lecture lesson was simply a dissemination of facts where no PowerPoint or discussion was used. The second variable tested was demonstration only. Subjects were gathered around the device and allowed to see what was being taught, as it was being demonstrated. Led by the researchers, they collected data and were allowed to adjust the demonstration device so they could understand how the system worked and how to operate it. The third variable was a combination of lecture and demonstration. The instruction began in the class with a brief lecture which included a

PowerPoint slideshow, and then the subjects gathered around the demonstration device as instruction continued. Again, data regarding the system was collected so subjects could visually see and understand similarities or contrasts between the fuels. Material was presented to the subjects as the device was being used in both demonstration and the combination treatments.

Instrument

The instrument used was a modification of a previous instrument used for a similar study. The original instrument developed by Sallee (2012) consisted of 20 knowledge-based questions, eight 1-5 Likert-type questions on biodiesel perception, and eight 1-5 Likert-type questions on tinkering self-efficacy, and seven demographic questions.

The newly developed instrument sought to ask knowledge-based questions that targeted levels of cognitive thinking. The instrument consisted of 16 multiple choice questions: eight questions which targeted low level cognition and eight questions which targeted high level cognition. The perception questions were written to obtain perspectives of instructional technique preference. Ten questions are utilized and were Likert-type questions on perceptions of teaching method preference. Five of the questions were in regard to perceptions of demonstration and five were about lecture. Further, ten Likert-type questions were used to determine tinkering self-efficacy of participants. Finally, the seven demographic questions were age, gender, classroom performance (agriculture and non-agriculture), and residence (location and farming background). Permission was received from Sallee to use a modified version of the instrument.

The pretest contained the knowledge questions, tinkering self-efficacy questions, and the demographics sections. The posttest consisted of the same 16 questions rearranged in a different order, and it contained the methodology perception questions. The instrument was developed from the related literature to meet face validity. It was also thoroughly reviewed by a panel of experts to meet content validity. The panel offered suggested changes and professional insight to question construction.

Field and Pilot Testing

Prior to pilot testing, the researchers conducted a field study. An agricultural mechanics class at the University of Arkansas was selected to field test the lessons. The pretest was administered, content was presented, and a posttest was administered following the lesson to test for any errors in the lesson content. Only two lessons were field tested: the lecture lesson and the demonstration lesson. The class of 26 students was split into two groups. The first received the lecture and the second received the demonstration.

A pilot test was conducted using three different intact classrooms in Siloam Springs, a high school in Northwest Arkansas. There were 60 subjects in total. The treatments were presented as specified by the procedure. After receiving permission, the subjects were given a pretest on the first day. The second day, students received the lesson/instruction and a posttest immediately followed.

Instrument Reliability

The two components of instrument reliability are stability and internally consistency. The field test and pilot test both served as means for testing stability and internal consistency. The Cronbach’s Alpha statistic was measured to test the consistency of subjects’ answers for similar questions. The pretest resulted in a Cronbach’s Alpha value of .49. The posttest returned a value of .74.

Results and Data Analysis

Data were collected on every treatment and each treatment used the same instrument. After implementation of the instrument, data was coded and entered into Microsoft Excel, 2010 spreadsheet for statistical analysis. Data were collected in the spring semester of 2011. Individual participants were not identified; only numerical representations were used where each participant was randomly assigned a unique number and all other identifying information was eliminated. Once the information was collected and organized, subjects' data that did not contain both parts of the instrument (pretest and/or posttest) or missed part of the treatment were discarded and removed from the data set.

Data were organized by the researchers and tested using SAS 9.2 for Windows statistical package. The researchers used descriptive statistics to analyze the demographic characteristics of the data. Inferential statistics were used to analyze the data collected from the instrument. The researchers used a multiple analysis of variance (MANOVA) for research questions one and analysis of variance (ANOVA) with Tukey test was used for question two (Spatz, 2008). A Pearson-Product Moment correlation coefficient was implemented for questions three, four, and five.

Research Question 1 - What impact do instructional techniques have on students' level of knowledge acquisition?

Table 4 shows the results of instructional techniques on knowledge acquisition (low and high cognitive processing) for the entire group $N = 27$. The F value = 2.68 ($p = .1$) resulted in no significant difference between low cognitive scores and treatments of instructional technique. However, there was significance ($F(1, 26) = 8.96$, $p < 0.01$) among high cognitive knowledge acquisition within treatments.

Table 4. Comparisons of Knowledge Acquisition Based on Cognition (*N = 27)*

	df	SS	MS	*F*	*p*	d	Power
Group							
Low Cognition	1	1.13	1.13	2.68	.11	.10	.35
High Cognition	1	3.84	3.84	8.96	<.01*	.26	.82

* Significant at the 0.05 level.

Research Question 2 - What impact do instructional techniques have on students' cognitive level of knowledge acquisition?

Table 5 displays the mean scores for groups' pretest and posttest scores for all 27 groups. All groups (N=27) received a treatment; nine received lecture, nine received demonstration, and nine received a combination of lecture and demonstration. Results indicated no significant difference of instructional techniques across low cognitive gains ($F(2) = 1.69$, $p = .21$). Lecture returned a mean score of 1.56 (*SD* 0.83); demonstration ($M = 2.03$, *SD* 0.63); combination ($M = 2.06$, *SD* 0.45). However, analysis did return a significant difference between instructional techniques across high cognitive processing ($F(2, 24) = 4.36$, $p =.02$).

Table 5. Group Mean Cognitive Scores (*N = 27)*

	Low Cognitive		High Cognitive	
	*M**	*SD*	*M**	*SD*
Lecture	1.56_A	0.83	2.00_A	0.65
Demonstration	2.03_A	0.63	2.38_{AB}	0.78
Combination	2.06_A	0.45	2.92_B	0.55

* Values with the same letter subscript are not significantly different (Tukey).

Research Question 3 – What is the relationship between student perceptions of instructional technique and knowledge acquisition?

Table 6 illustrates the correlations between perceptions of demonstration and lecture on high and low cognitive achievement. Perceptions of only lecture and only demonstration were taken to understand student interest in a lecture type lesson verses a demonstration type lesson, respectively. Results indicate no significant difference among perceptions of lecture on low cognitive processing (r = -.09); nor high level processing (r = -.25). Demonstration perceptions returned no significance between low (r = -.19) or high (r = -.25). There was also no significance found (r =.27, r = -.05) between group scores among perceptions of lecture and demonstration.

Table 6. Correlations (r) between Instructional Technique Perceptions and Knowledge (N = 27)

	Demo P	Lecture P	Low Cog.	High Cog.	Group
Demo P	-	.38	-.19	-.25	-.05
Lecture P		-	-.09	.25	.27
Low Cog.			-	.40*	.31
High Cog.				-	.51*
Group					-

* Correlation is significant at the 0.05 level.

Research Question 4 - What is the relationship between tinkering self-efficacy and preferred instructional technique?

The results indicated the correlation had no statistical significance (r =.37) between student perceptions of tinkering self-efficacy and preference of a demonstration lesson (See Table 7). However, there was a statistical significance at the 0.05 level across tinkering self-efficacy and lecture (r =.51). Students, who perceived themselves high tinkerers did not prefer a lecture lesson format.

Table 7. Correlations (r) between Perceptions (N = 27)

	Demo P	Lecture P	Tinkering
Demo P	-	.38	.37
Lecture P		-	.51*
Tinkering			-

* Correlation is significant at the 0.05 level.

Research Question 5 - What is the relationship between tinkering self-efficacy and knowledge acquisition?

Table 8 illustrates the correlations. The results of the data indicated no significant difference in one's tinkering self-efficacy towards achievement in cognitive levels. The correlation between tinkering and low cognitive processing was r = -.11; high resulted in r = -.02.

Table 8. Correlations (*r*) between Tinkering Perceptions and Test Scores (*N* = 27)

	Low Cognition	High Cognition	Group	Tinkering
Low Cognition	-	.40*	.31	-.11
High Cognition		-	.51*	-.02
Group			-	-.07
Tinkering				-

* Correlation is significant at the 0.05 level.

Discussion

Research Question 1 was developed to examine the impact that instructional treatments have on students' level of knowledge acquisition. The results indicated that there was a significant difference across treatments on high cognitive processing, but not on low cognitive processing. Research Question 2 was developed to examine the impact that instructional treatments have on a students' cognitive level of knowledge acquisition.

The research established that there could be a beneficial use of different methods of instruction; active and passive (Bonwell, 1991; Dewey, 1916; von Glaserfeld, 1989; Vygotsky, 1978). Bonwell (1991) established that lecture is a form of passive learning because the senses are not engaged beyond just listening. According to Bligh (2000) lecture is considered the best means of instruction because teachers can convey a lot of information in a short amount of time. However, this study does not agree with the previous research: no statistical significance was found when using the lecture technique on low or high cognitive processing. Further, research was found which also disagrees with the results of this study by Hosseini, Dastani, Akbari, Baradaran, Hosseini, and Moonaghi (2009).

The other form of learning, active (pertaining to this research) is demonstration (Bonwell, 1991). The literature suggests that demonstration is appropriate because it engages student senses and gets the students physically involved in learning (Bonwell, 1991; Dewey, 1916; Korwin & Jones, 1990; O'Malley & McCraw, 1999). Additionally, a study by Korwin and Jones (1990) found statistically significant gains of knowledge when using a hands-on (active) approach to learning. This study found that students taught using the demonstration method did not significantly differ from those taught with traditional lecture-type instruction. Therefore, the results of this study differs from previous research which found statistical significances when using the demonstration (active) technique.

Elmoselhi et al. (2010) established, through research, that getting students more involved in what they learn provides students the ability to accomplish more complex, related tasks. Honigsfeld and Dunn (2009) also stated the best strategy for engaging students is through hands-on instructional methods allowing students to learn on their feet. This study does not agree with the previous research.

Additionally, Elmoselhi et al. (2010) stated that providing students with active instructional techniques allows better understanding of basic concepts. Basic knowledge is similar to recall knowledge which is low level cognitive processing (Bloom, Englelhart, Furst, Hill, & Kratwohl, 1956). This research sought to find differences in levels of cognitive development; and the statement by Elmoselhi disagrees with the findings of this study. No significance difference was found across all treatments on low cognitive knowledge acquisition.

The demonstration instructional technique closely aligns with the philosophies of John Dewey (1916) whose focus was in experiential learning: learning by doing. Piaget's theory (1970) is very similar to Dewey's experiential learning theory. Piaget believed that learning occurs as a result of interactions with the environment surrounding the learner. The philosophies of Dewey and Piaget do not agree with the finding of this study on low cognitive achievement. However, on high cognitive achievement, lecture returned the lowest results and was significantly different from the combination technique; but not significantly different from the demonstration method. The combination method includes both lecture and demonstration techniques.

Previous research (Elmosilhi, et al., 2010; Honigsfeld & Dunn, 2009; Korwin & Jones, 1990) pointed to greater gains in knowledge through demonstration. Reciprocal research (Bligh, 2000; Broadwell, 1980; Yadav et al., 2010) showed that lecture was the more appropriate method for effectuating knowledge. This study disagrees with all indicated studies. Knowledge was not affected differently on low cognitive processing. Knowledge was also not effected on high cognitive processing between lecture and demonstration.

This study sought to test a third treatment of combining lecture with demonstration. The justification was based on inconclusive research comparing the two and a lack of research testing the combination of the two. It is noteworthy to state that all instructional techniques returned positive results signifying that all techniques were effective. Results from this study indicated that the combination method was not significantly different from lecture or demonstration on low level cognitive processing. However, on high level cognitive processing the combination method was significantly better than the lecture method. Additionally, the combination method was not significantly different from demonstration.

Research Question 3 was developed from the literature which discussed the importance of instructional methods on students' academic achievement (Roberts, 2006; Tharp & Gallimore, 1991; Woolfolk, 2010). Teaching methods (instructional techniques) were labeled as important to student achievement because of different factors including learning styles, educational theories, and cultural backgrounds (Hosseini et al., 2009). It was stated that different methods targeted different learning styles and, therefore were essential to effective instruction (Hosseini, et al., 2009). Further, Roberts (2006) stated the importance of recognizing previous research indicating student preference to teaching method and the influence it has on learning. However, the data in this study found no significant differences in perceptions of instructional technique and knowledge acquisition.

The United States Department of Education (2012) reported that teachers are important to student success because they can create the conditions to foster excellence in the classroom. Although this study found different results related to instructional technique, it does not disagree with this statement. The statement claims that teachers are responsible for student success by creating a school condition to generate that success. However, this may not pertain to instructional technique because the use of 'school condition' may be interpreted to mean something else. However, for this study specifically, 'school condition' did not mean instructional technique. The purpose of teaching is to instill a desire to learn in students (Rogers & Freiberg, 1994). According to this study, that is not accomplished through instructional technique.

The philosophies of Vygotsky (1978) and Dewey (1916) state that teachers' critical role in education is effectuating student learning by directing the experiences of the learner(s). This also does not align with the findings in this study. Dewey's and Vygotsky's theories are not limited to instruction technique, but this portion of the study disagrees with their ideals on directing instruction towards a hands-on approach.

Research Question 4 was developed to identify the relationship between tinkering self-efficacy and preferred instructional technique. This questions was based on the findings of Sallee (2012) included a positive correlation between tinkering self-efficacy and preferred method of instruction. Data resulted in a positive correlation between tinkering self-efficacy and preferred method of instruction. Specifically, students who perceive themselves high in tinkering self-efficacy had a significant tendency to prefer the demonstration method of instruction over lecture.

Based on Dewey's philosophy of experiential learning (1916), it would stand to reason that students who prefer the demonstration method would also perceive themselves as tinkerers. These particular students enjoy partaking in the experience of learning and therefore follow the theme of the experiential learning philosophy because they perceive highly the ability to learn with action. (Dewey, 1916; Roberts & Harlin, 2007). The demonstration method is considered active and the lecture is considered passive (Bonwell, 1991; von Glaserfeld, 1989). Therefore, the students that like to tinker are active and would prefer the demonstration technique. The findings of this study agreed with the philosophy.

Research Question 5 was developed to identify relationship between tinkering self-efficacy and knowledge acquisition. Tinkering self-efficacy was defined as one's perceived comfort in their own ability to complete a task (Baker & Krause, 2007; Bandura, 1977). The provided definition only implies one's perception, not their actual, proven ability. Rowe (1978) states that tinkering is a very beneficial tool that can be used in education. However, this study resulted differently. There was no significance found between tinkering self-efficacy and knowledge acquisition.

Sallee (2012) found a correlation between those which perceive themselves high in tinkering self-efficacy and cognitive achievement. However, this study did not coincide with the findings of Sallee. Koch, (2012) in a similar study also found no significant correlation between tinkering self-efficacy and instructional method used on knowledge acquisition, which aligns with the findings in this study.

Implications and Recommendations

Agriculture education instructors have a unique challenge to instruct students because the material is not the same as traditional core courses. Therefore, traditional instructional techniques may not be the most appropriate in agricultural education settings. While components of lecture and demonstration were effective in helping students learn, the combination method was overall the best method used. The point of education is to provide students the ability to think at higher levels and to think holistically about subjects so that they may apply greater knowledge to real world problems. The instructional technique of combining lecture and demonstration is the most effective method of teaching agriculture students in Northwest Arkansas to achieve high levels of cognitive processing.

Students did not seem to learn better on low level cognitive processing across the three treatments (lecture, demonstration, and lecture/demonstration). Therefore, when instructing students with material that targets low level cognition, it should not matter which method is used. It may be suggested that lecture would be an effective method due to the fact that not as much time and preparation goes into preparing a lecture as it would a demonstration for similar results.

The effects of student perceptions of instructional techniques on knowledge acquisition were not significant. The implication of these results is that it does not matter which method the students prefer because they will either learn (or not) the material the same. It is recommended to further research this area since there is conflicting results in the literature. Also, a study which further isolates this variable may find more accurate results.

Tinkering self-efficacy was another component of this study that is worthy of discussion. The results of this study indicated that students who perceive themselves as tinkerers also prefer the demonstration method of instruction and do not prefer the lecture method of instruction. However, it is not complementary with the fact that this study found no significant difference between knowledge acquisition and preferred method of instruction. Tinkerers prefer demonstration, but those who prefer demonstration did not score higher when they receive a demonstration. The study also found no significance between tinkering self-efficacy and knowledge acquisition. The correlations complement each other by being consistent. Tinkerers do not perform better across instructional techniques than do non-tinkerers. Again, further research is recommended to further examine and understand the relationship between perceptions of instructional technique and knowledge and the relationship between preference of instructional technique and knowledge acquisition.

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