Journal of Agricultural Education
Volume 54, Number 2, pp. 130 –142
DOI: 10.5032/jae.2013.02130

Student Perceptions of Instructional Methods Towards Alternative Energy Education

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The effectiveness of different methods of instruction has been discussed since the early years of formal education systems. Lecture has been deemed the most common method of presenting information to students (Kindsvatter, Wilen, & Ishler, 1992; Waldron & Moore, 1991) and the demonstration method has been symbolized as the most effective tool developed for teaching (Seevers, Graham, Gamon, & Conklin, 1997). Engaging students is paramount to allowing instructors to expand student knowledge levels. The purpose of this study was to determine if the Arkansas Secondary Biodiesel Education Program (ASBEP) over alternative fuels had an effect towards student interest. A significant difference was found between student interest in method of presentation, $t(7) = 8.29$, $p < .05$. Furthermore, a strong positive correlation ($r = .73$) was found between posttest scores and student tinkering self-efficacy. Tinkering self-efficacy was also found to be positively and significantly correlated with method of instruction. Through understanding perceptions held by student being taught through different methods, instructors can capitalize and further knowledge acquisition by students.

Keywords: Student Perceptions, Alternative Energy, Agricultural Education, Tinkering Self-efficacy, Instructional Method

Secondary students enrolled in today's agricultural science classrooms are inundated with information. Furthermore, differentiated methods of learning with available technology can be utilized in today's classroom. Teachers in today's classroom setting must engage students actively through the instruction process in order to impact student learning. The problem solving method of instruction is a time-honored technique to present information to students in the agricultural science classroom (Boone, H.N. & Newcomb, L.H. 1990; Flowers, J. & Osborne, E.W. 1987; and Osborne, E.W. & Hamzah, R. 1989). Through its wide use in school systems across the nation, methods employed towards agricultural students should be analyzed to understand their impact. Because students have identified diverse needs and ways of learning, research regarding methods of instruction for today's secondary professionals of education is extremely important.

It is perceived unlikely that agricultural science teachers are hired who lack the skills to effectively instruct students. Many teachers have been prepared and certified to be experts in their respective fields. Congruently, there has been anecdotal evidence that teacher preparation and the ability to design instruction once engaged in the profession is a high concern for these individuals (Newcomb, McCracken, Warmbrod, & Whittington, 2004). Thus, the need to identify effective instructional techniques is imperative. Furthermore, it should be noted that this study will not answer the question of what is the best technique for all instances of teaching in agricultural science but the effects of teaching towards an identified topic which is gaining importance in today's society.

Technical Curriculum

It is critical for teachers to determine best teaching strategies in today's diverse curriculum needs. Today's agricultural science classrooms disseminate knowledge from biotechnology to sustainable energy. It is imperative, regarding the diverse nature of information taught, that teachers determine best practices in the classroom or laboratory. With the influx of bioenergy and its affect towards producers and consumers, knowledge and practices associated should be evaluated.

Most of the energy used presently comes from fossil fuels: petroleum, coal, and natural gas (Demirbas, 2007). Worldwide energy consumption has "increased 17 fold in the last century" (Demirbas, 2008, p. 177). In recent years there has been a concern of diminishing petroleum reserves and future energy supplies (Akbas & Ozgur, 2008; Vasudevan & Biggs, 2008). According to the Department of Energy's Annual Energy Review (2008), the world consumed 85.9 million barrels of petroleum per day with the United States consuming 20.6 million barrels per day in 2007, compared to 76.1 million barrels per day and 19.7 million barrels per day respectively in 2000.

Biodiesel is an efficient, renewable, biodegradable and 100 percent natural energy alternative to petroleum fuels (Akbas & Ozgur, 2008; Demirbas, 2008; Hunt, 2008; Vasudevan & Briggs, 2008). Biodiesel has many advantages over diesel including, lowered greenhouse gasses and is manufactured from renewable sources (Akbas & Ozgur, 2008; Demirbas, 2008; Hunt, 2008; Vasudevan & Briggs, 2008). According to the Department of Energy's Annual Energy Review (2008) carbon dioxide emission in the United States stood at 6 billion metric tons in 2007 which is 20 percent higher than in 1990. Therefore, biodiesel will be a valuable alternative to ultra-low sulfur diesel because of lower emissions properties (Demirbas, 2008).

Instructional Strategies

Biodiesel production has been around since the invention of the diesel engine. Even though biodiesel had been around for over one hundred years, many of today's students do not know how it is produced. Adequate curriculum should be developed and presented to students in order to impact their learning. The question is therefore evoked, what is the best method for instructors to employ? "The earliest form of systematic curriculum building in vocational education may be attributed to Victor Della Vos" (Finch & Crunkilton, 1999, p. 5). Vos changed curriculum development from "conscious imitation" to "formal instruction in the mechanical arts" (Finch & Crunkilton, 1999, p. 5). Vos postulated that students would learn best through guided instruction. This new system of education, adopted by many in the United States, made students think about the process instead of just repeating unconsciously what had been told.

According to the National Research Agenda (Osborne, 2007), there is a need to "systematically identify and develop instructional systems to meet industry needs" (p. 19). Agricultural science programs should assess the needs of involved students and determine proficiencies needed through program completion. Acker (2008) stated that to achieve the 25x25 Renewable Energy Vision of expanding renewable energies, education of consumers must occur. There is a need for "renewable energy curriculum materials for secondary, middle, and primary schools" (Acker, 2008, p. 59). Teaching agriculture science students about alternative energies is new in secondary programs. Curriculum must be tested to ensure information is conveyed and retained in future energy consumers. As an emerging need in an economy devastated with reliance towards other countries, students in the United States should be educated about alternative solutions such as biofuel production, performance, and environ-mental effects.

Education results in realization leading towards acknowledgement of the impact of changes occurring in society and resulting effects on individuals involved. The education of people in all fields of renewable energies is vital to the growth and expansion of renewable energy. Furthermore, there is also a need for curriculum materials for students (Newcomb, et al., 2004; Acker, 2008). Through this adoption of ideology, the researchers have selected this topic for analysis towards methods of curriculum development and presentation.

Instructional Methods

The purpose of teaching is to instill a desire to learn in students (Rogers & Freiberg, 1994), implant new ideas, and "dispose of or modify old ones" (Kolb, 1984, p. 28). The goal of teaching is to drive students to absorb everything seen, heard, or read about a topic (Rogers & Freiberg, 1994). Engaged students allow teachers to expand student knowledge. According to the National Research Agenda (2007) there is a need to "examine the value of experiential learning in enhancing academic achievement" (p. 19). Experiential learning could prove to be valuable in allowing students *to gain knowledge and understand materials used.*

Lecture is the most common method of passing on information to students (Kindsvatter, Wilen, & Ishler, 1992; Waldron & Moore, 1991). According to Dewey (1938) traditional education is the study of facts and ideas that have occurred in the past. What is taught in the books is motionless, it has little thought about the ways an idea is created and does not think about the changes that will occur in the future (Dewey, 1938). Lecture method instruction is a one-way, teacher centered presentation of information and ideas (Kindsvatter et al., 1992; Waldron & Moore, 1991; Morrison et al., 2004). Lecture method instruction allows for large concepts and ideas to be communicated to the student in a relatively short period of time. This traditional method is caught up in the past and gives "little help in dealing with the issues of the present and future" (Dewey, 1938, p. 22-23). Most lectures deal with ideas that are already developed and give little opportunity for exploitation of new ideas.

"Demonstrations have served as one of the most effective education tools ever developed" (Seevers, Graham, Gamon, & Conklin, 1997, p. 145). According to Seevers et al., (1997) demonstrations limit the number of students engaging in the learning process and are one of the most effective teaching methods. The limitation of students allows for students involved in the educational process to take ownership in the project. Demonstrations are more personal to the student and allow interaction and knowledge acquisition to occur. According to Dewey (1938) demonstrations may have "more multiplied and more intimate contacts" between the instructor and the student than "ever exists" in lecture method education (p. 21). A demonstration allows students to see how something works or is used, operated, or performs (Kindsvatter et al., 1992; Phipps, Osborne, Dyer, and Ball, 2008). Demonstrations also allow students to see how to properly perform a task (Kindsvatter et al., 1992). The increased interaction of seeing how processes and equipment operates allows students to gain greater insight.

Experiential Learning Theory

Guiding the need to understand how methods of instruction are assimilated by secondary students in agricultural science classes is best undertaken through the theory of experiential learning. Experiential learning provides the student with a significant and meaningful learning experience (Rogers & Freiberg, 1994). According to Kolb (1984) experience plays a key role in the learning process. Experiential learning uses both thoughts and feeling to make a connection about what is being taught (Rogers & Freiberg, 1994). Kolb (1984, p. 27) further stated that "knowledge is continuously derived from and tested out in the experiences of the learner". Learning is a continuous process that is grounded in experience and is important in education (Kolb, 1984). This experience will give the learner the information about the subject that they will need and will give them ownership and participation in the learning process. According to Roberts (2006) experiential learning is a cyclical process that is reoccurring. The learner has to take part and have an active role in the educational process before there can be meaning in what is being taught. The final ideas of experiential learning are pervasiveness and evaluation of the event (Rogers & Freiberg, 1994). It is important that the learner look at what has been taught and make a decision about the information. These ideas contribute to the meaning of the learning experience and the meaning is the whole experience (Rogers & Freiberg, 1994).

Tinkering Self-efficacy

Tinkering self-efficacy is a person's experience, competence, and comfort with manual activities (Baker & Krause, 2007). Bandura (1977) observed that persons could gain knowledge through social settings. These observations led to the development of the thought towards self-efficacy. Self-efficacy has been defined as "beliefs in one's capabilities to organize and execute the courses of action required to produce given attainments" (Bandura, 1997, p.3). According to Baker and Krause (2007), tinkering self-efficacy is more specifically one's ability to engage in activities such as manipulating, assembling, disassembling, constructing, modifying, and repairing components and devices. In education tinkering is often encouraged because of its expected educational benefits (Rowe, 1978). Parsons (1995) postulated there are many factors that contribute to a student's tinkering ability. The three most common factors are experimental, social, and personal. Experimental factors are prior experiences that a person has in their everyday life. Social factors are relations that people have with family and friends. The final factor in tinkering is personal, and can be described as a person's like or dislike to a subject, topic, and/or activity (Parsons, 1995).

According to Baker and Krause (2007) males have more tinkering experiences and females lack experience using tools and machinery. Males are more apt to tinker to solve problems but some of their tinkering to solve problem can be counterproductive (Beckwitk et al., 2006; Jones, Brader-Araje, Carboni, Carter, Rua, & Banilower, 2000). Furthermore, Crismond (2001) stated females in technical schools were more apprehensive of mechanical devices unlike their male counterparts and when tinkering in a complex environment female tinkering self-efficacies was perceived to be lower (Beckwitk et al., 2006).

Different methods of instruction suit different individuals in different ways. Method of instruction is important because it helps develop the students' powers and interest (Dewey, 1938). Motivation is a key factor in student learning (Phipps et al., 2008) and is needed for students to gain the most out of instruction. It is extremely important to provide students with instructional methods they will find enjoyable and interesting. This is important because the mind is opposed to learning (Dewey, 1938), and if the method of instruction is not interesting the student will not attempt to acquire the information.

Methodology

The purpose of this study, which was part of a larger study, was to determine if the Arkansas Secondary Biodiesel Education Program ASBEP over alternative fuels had an effect towards student interest. It has been traditional to provide students with a lecture of important information and then provide the students with a method of reinforcement (Waldron & Moore, 1991). Different methods of instruction have different effects on student learning and interest in a subject area. This study evaluated students' interest in the two methods used to present the ASBEP, lecture and demonstration. Additionally, this study also sought to find if knowledge acquisition was correlated to students' tinkering self-efficacy. This study was guided by the following research questions:

1. What are student perceptions of lecture versus demonstration methods in biofuel education?
2. Is students' tinkering self-efficacy related to knowledge acquisition in biofuel education?
3. Is there a relationship between students tinkering self-efficacy and perceptions of lecture versus demonstration methods in biofuel education?

This study sought to address the following hypotheses:

Ho_1: There will be no significant difference in student interest of presentation method after com-pletion of the Arkansas Secondary Biodiesel Education Program.

Ho_2: There will be no significant correlation in students tinkering self-efficacy and posttest know-ledge scores through biofuel education.

Ho_3: There will be no significant correlation between students tinkering self-efficacy and method used through biofuel education.

This study conforms to the design as outlined by Campbell and Stanley (1963) as a pre-experimental design number two (Figure 1). This pre-experimental design is a modified One-Group Pretest-Posttest Design (Campbell & Stanley, 1963). Alpha level was set *a priori* at .05. An outline of this design is as follows:

One-Group Pretest-Posttest Design

O_1 X_1 X_2 O_2

Figure 1. Modified research design from Campbell and Stanley (1963).

According to Campbell and Stanley (1963) threats to internal validity for the one-group pretest-posttest design are history, maturation, testing, instrumentation, regression, and selection-maturation interaction. Threats of history and maturation were minimized in the study. The study was conducted over a relativity short amount of time (two days per class), and therefore, threats of internal validity were minimized. Threats of testing and instrumentation were also minimized. Subjects were provided with a pretest and a posttest following the educational program. Each test covered the same constructs but were reworded and reordered in the final administration. The instrument was pilot tested for internal consistency and stability.

Target population was high school agriculture classes in Arkansas (*N* = 217). The accessible population was all high school agriculture classes in a 40 mile radius of University of Arkansas (*n* = 18). The sample was further mitigated to include agricultural science programs engaged in instructing students in agricultural mechanics courses which limited the sample to the tested population of study (*N* = 91). This identified population allowed researchers to analyze students with advanced knowledge of agricultural mechanical techniques. A sample was drawn of four schools and eight classes were selected. Teachers of selected schools were contacted to determine interest in participating in the research study.

The instruments for this study were constructed from an intense literature review and measured the main constructs found in the curriculum of the ASBEP over alternative fuels. The instruments developed were reviewed by a committee of experts for face and content validity. Changes to wording and possible answers were edited to increase instrument reliability and stability. The pretest was composed of four sections. The first section was comprised of multiple choice questions with four response options (one correct response and three distracters). The second section was composed of seven Likert-type items (1-5 scale: strongly disagree to strongly agree) designed to measure student perceptions of biodiesel. The third section consisted of items (1-5 Likert-type scale: strongly disagree to strongly agree) assessing students' tinkering self-efficacy. The final section contained seven questions covering basic demographic questions.

Additionally, the posttest comprised three sections. The first section consisted of the same 18 multiple choice items as the pretest instrument but were rearranged and reworded. The second section contained the same items measuring student's perceptions about biodiesel. The final section was comprised of seven questions about their perceptions about the educational presentation, measured on a 1-5 Likert-type scale (strongly disagree to strongly agree). Statements were designed to elicit participant perceptions about the method presented to them by the researcher(s). An example of statements used was "I feel I learned more by watching the PowerPoint presentation".

All instruments, materials and instructional methods were pilot-tested using 15 secondary students similar to the subjects in the main study. Minor revisions were made based on the pilot-test. Cronbach coefficient alpha and KR-21 analyses were run on instrument sections (see Table 1).

The pretest question relating to knowledge had a KR-21 score of .13. This analysis signified that knowledge held by participants before implementation of the ASBEP is the result of no or little knowledge about the subject matter and attributed to guessing. Conversely, the posttest questions relating to knowledge held a KR-21 of .76.

Table 1

Instrument Reliability Analyses

Test section	Cronbach Alpha	KR-21	*N*
Pretest Knowledge		.13	91
Posttest Knowledge		.76	91
Pretest Tinkering	.89		88
Pretest Perceptions	.90		88
Posttest Perceptions	.93		88
Posttest Teaching Method	.76		88

All subjects in the study were contacted by a permission letter, sent out through their regular instructor, whereby they and a legal guardian were required to sign before participation. The first day of the educational program consisted of a lecture over alternative fuels. The lecture covered five main constructs. The first construct was differences in biodiesel and ethanol. The second construct was history of biodiesel, followed by how biodiesel is manufactured. The final three constructs were ASTM D6751 (national biodiesel standard) guidelines, blending capabilities with petroleum diesel, and emission characteristics of biodiesel.

The following day subjects were provided a demonstration of the performance differences between D2 diesel and B20 biodiesel. Before the demonstration, safety precautions were outlined about the project. The demonstration utilized a three cylinder Kubota diesel engine mounted on a trailer (see Figure 2). The engine was outfitted with a *Land and Sea* dynamometer to record horsepower and torque. Data were collected with a laptop computer with DYNO-MAX software. Fuel consumption was measured using two portable digital scales. Subjects were given a five minute PowerPoint© presentation over the engine and what data would be collected. Furthermore, the PowerPoint© presentation covered how horsepower, torque, and fuel consumption was collected. Procedures of the demonstration were that the engine was set to operate on diesel fuel and started. The subjects recorded torque and horsepower at idle speed of the engine. The engine RPM was increased to high idle and the subjects recorded horsepower and torque. Load was added to the engine through the engine dynamometer. Once the engine reached pre-designated RPMs, subjects recorded both the horsepower and torque (sweep test). This procedure was repeated in both the D2 diesel and B20 biodiesel. Additional information was gathered from fuel consumption of both fuel types to calculate power and efficiency. The subjects then returned to class where they calculated the fuel consumption and graphed torque and horsepower for the D2 diesel and the B20 biodiesel. Torque and horsepower was exported to Microsoft Excel©. Graphs were made of torque and horsepower between the different fuels.

Data collected in this study were analyzed using descriptive and inferential statistics through SAS 9.1. Class was used as the unit of analysis because instruction was provided on a whole class basis. Descriptive statistics were also reported on participants to further disaggregate data.

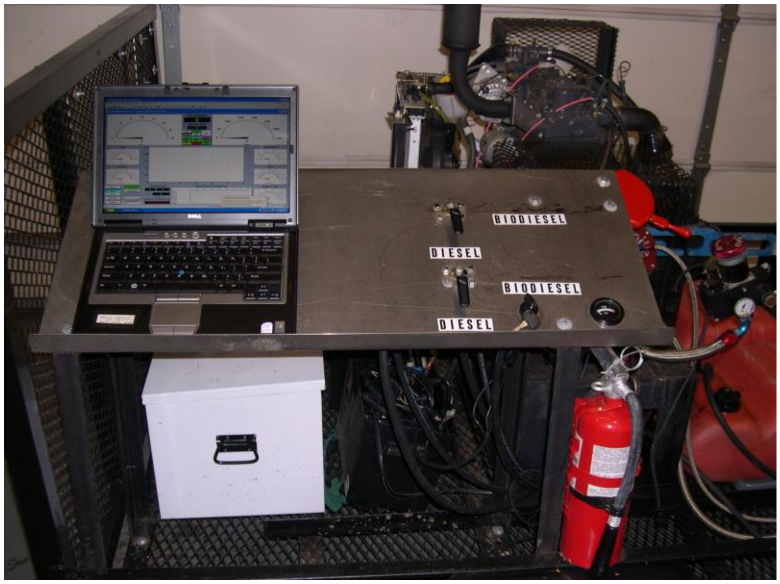

Figure 2. Mobile biodiesel demonstration unit used in ASBEP.

Findings

By class, pretest knowledge scores ranged from 4.15 (23.1%) to 6.20 (34.4%) on the 18 item test. Mean scores for the pretest 18 question knowledge section were 5.12, 4.15, 4.55, 5.60, 5.75, 6.11, 5.62, and 6.20 respectively (see Table 2). The theoretically derived means for all class was 4.5. The percentage of pretest scores did not differ from the theoretically derived mean of guessing, χ^2 (7, N = 91) = 2.24, p > .94.

Table 2

Pretest Knowledge Chi Squared

Class	Observed Mean*	Theoretically Derived Mean	χ^2	p
1	5.12	4.5	2.33	.94
2	4.15	4.5		
3	4.55	4.5		
4	5.60	4.5		
5	5.75	4.5		
6	6.11	4.5		
7	5.62	4.5		
8	6.20	4.5		

Note. *Maximum score = 18, χ^2 (7) = 14.07

There were 91 students who participated in the study; some data sets will describe a smaller size due to unusable data. For all classrooms in the study, 91.56 percent of the students in the study were male and 8.44 percent of the students were female. The mean age for all students in the study was approximately 17 (M = 16.92, SD = .95) with a range of 15-20. The mean grade for all students in the study was 11th (M = 10.95, SD = .66) with a range of 10th through 12th grade. A greater percentage of the students (n = 32, 36.78%) were in the 11th grade, closely followed by 10th graders (n = 31, 35.63%). The mean self-reported grade attained in regular academic classrooms was a "B" (M = 2.40, SD = .91) with a range from an "A" to a "D". Grades in agricultural classes was an "A" (M = 1.65, SD = .88) with a range from an "A" to a "D".

Null Hypothesis One

Null hypothesis one stated there would be no significant difference in student interest of presentation method after completion of the Arkansas Secondary Biodiesel Education Program. The hypothesis was tested using a dependent *t*-test. Data indicated a significant difference between student interest in method of presentation, $t(7) = 8.29$, $p < .0001$. Based on these findings, null hypothesis one was rejected.

The lecture contained a mean score of 3.17 (*SD* = 1.47), with a range from one to five (see Table 3). Mean scores for classes 1 through 8 on student interest in the lecture was 3.25 (*SD* = 1.39), 3.05 (*SD* = 1.41), 3.56 (*SD* = 1.62), 2.80 (*SD* = 1.44), 3.42 (*SD* = 1.22), 2.96 (*SD* = 1.58), 2.83 (*SD* = 1.66), and 3.48 (*SD* = 1.42), respectively. The demonstration contained a mean score of 4.25 (*SD* = 1.07), with a range from one to five. Mean scores for classes 1 through 8 on student interest in the demonstration was 4.43 (*SD* = .79), 4.00 (*SD* = 1.19), 4.67 (*SD* = .86), 4.27 (*SD* = 1.16), 3.82 (*SD* = 1.03), 4.10 (*SD* = 1.24), 4.33 (*SD* = 1.17), and 4.36 (*SD* = 1.13), respectively.

Table 3

Student Perception of Teaching Method (*N* = 83)

	Lecture		Demonstration	
Class	*M**	*SD*	*M**	*SD*
1	3.25	1.39	4.43	.79
2	3.05	1.41	4.00	1.19
3	3.56	1.62	4.67	.86
4	2.80	1.44	4.27	1.16
5	3.42	1.22	3.82	1.03
6	2.96	1.58	4.10	1.24
7	2.83	1.66	4.33	1.17
8	3.48	1.42	4.36	1.13
Total	3.17	1.47	4.25	1.07

Note. *Mean (1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree).

Null Hypothesis Two

Null hypothesis two stated no significant correlation between students tinkering self-efficacy and posttest scores would exist. Table 4 presents the correlation between posttest scores and students tinkering self-efficacy scores (*N=91*). There was a strong positive correlation of .73 between posttest scores and student tinkering self-efficacy. Null hypothesis two was rejected.

Table 4

Correlations between posttest scores and tinkering self-efficacy (*N* = 91)

Subscale	1	2
Posttest Score (1)	1.00	.73*
Tinkering Self-efficacy (2)		1.00

Note. * $p < .05$; $r^2 = .53$

For all classrooms in the study, 84 subjects were described in students tinkering self-efficacy (see Table 5). Tinkering self-efficacy score was 4.08 (*SD* = .77), with a range from one to five. Mean tinkering self-efficacy scores for classes 1 through 8 on the pretest were 4.55 (*SD* = .63), 3.84 (*SD* = 1.18), 4.03 (*SD* = 1.18), 3.66 (*SD* = .41), 3.94 (*SD* = .85), 3.65 (*SD* = 1.12), 4.63 (*SD* = .20), and 4.31 (*SD* = .55), respectively.

Table 5

Tinkering self-efficacy scores in relation to class

Class	*n*	%	*M**	*SD*
1	7	8.33	4.55	.63
2	11	13.10	3.84	1.18
3	9	10.71	4.03	1.18
4	5	5.95	3.66	.41
5	15	17.86	3.94	.85
6	15	17.86	3.65	1.12
7	7	8.33	4.63	.20
8	15	17.86	4.31	.55
Total	84	100.00	4.08	.77

Note. *Mean (1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree).

Null Hypothesis Three

Null hypothesis three stated that no significant correlation between students tinkering self-efficacy and method used through biofuel education. Data were analyzed through Pearson Product Moment correlations and *t* test analyses. A significant positive moderate correlation (Davis, 1971) was found (Table 6) between the two methods of instruction (PowerPoint© and Demonstration). A low relationship (Davis, 1971) was found between tinkering self-efficacy and the method of instruction relating to the demonstration method (*r* = .19). Further analysis based on this finding showed a significant *t* value based on students' tinkering self-efficacy and the demonstration method (see Table 7). Analysis of the upper and lower quartile of participants with respect to tinkering self-efficacy and method of instruction revealed *t*(41) = -2.58 and *p* = .01. Effect size was calculated at *d* = .80 describing a large effect size (Cohen, 1988). Null hypothesis three was rejected.

Table 6

Correlations between tinkering self-efficacy and methods of instruction

Subscale	1	2	3
Tinkering (1)	—	.03	.19
PowerPoint© (2)		—	.42*
Demonstration (3)			—

Note. *Value significant at the .05 level

Table 7

Tinkering self-efficacy influence on perceptions of method of instruction

	Upper Quartile		Lower Quartile			
	M	*SD*	*M*	*SD*	*t* value	*p*
PowerPoint©	3.48	1.12	2.98	1.07	-1.50	.14
Demonstration	4.85	.53	4.37	.89	-2.58	.01*

Note. *Significant at $p < .05$

Conclusions, Recommendations & Discussion

The majority of subjects in the study were males (91.56%), with an age of 17 (M=16.92), 11th grade students who made "B's" in all secondary classes and "A's" in agricultural classes. Through analysis conducted in this study, it is apparent that correct knowledge held by participants about biofuel is negligible. Pretest knowledge were calculated at M = 5.39. The theoretically derived pretest mean score for all classes were 4.50. The percentage of pretest scores did not differ from the theoretically derived mean of guessing (Table 2). Data indicated knowledge held is low thus demonstrating the need for education about biofuel (Acker, 2008). Furthermore, posttest knowledge score held an M = 10.36. The implementation of the Arkansas Secondary Biodiesel Education Program ASBEP indicated statistically significant gain in knowledge scores after the two day educational program. Though not a statistically significant increase in knowledge held by participants, it can be concluded that participants did gain in knowledge based on the implementation of the Arkansas Secondary Biodiesel Education Program.

To further demonstrate the basis of the study, participants were measured based on their interest towards presentation method of the ASBEP. Findings concluded (t (7) = 8.29, p < .0001) a significant difference held by students towards their preferred method of presentation. Therefore, it is concluded that presentation methods used by instructors can significantly affect student interest in subject matter (Dewey, 1938; Kindsvatter et al., 1992; Severs et al., 1997). The use of the demonstration method gained student interest over the use of the lecture method in all participant classes involved in the ASBEP.

Additional data was gathered to explore interest held in agricultural mechanization areas of agricultural science instruction by participants. To determine the basis for this question, knowledge about student tinkering self-efficacy were analyzed. It was found that students (N = 91) who held a positive tinkering self-efficacy score were positively correlated to post-test scores (r = .73) through the ASBEP. Based on the demographics of the sample (males = 91.56%), a large proportion of the sample should hold a positive tinkering self-efficacy (Beckwitk, et al., 2006; Jones et al., 2000) which this study agrees with previous aforementioned studies. Although not inclusive that all males hold this quality, it should be noted that tendencies for males to hold tinkering self-efficacy should be addressed when determining best practices towards methods of teaching in classes including large numbers of male students. Based on the high value of the Pearson Correlation Coefficient (r = .73) and common variance held (r^2 = .53) in this statistical procedure (only 47% of extraneous variance unexplained) teachers should consider this finding when teaching based on factors noted in this study.

Congruent with Dewey's (1938) view of learning and the findings of this study, students gained interest resulting in acquisition of knowledge in a subject area with little to no previous experience. Through the implementation of the ASBEP and differentiated teaching methods, students were able to understand unfamiliar subject matter and increase their understanding thus corroborating with (Kinsvatter et al., 1992) that demonstrations allow students to view and understand a properly performed task. Gaining insight(s) of processes through the interaction of the demonstration method teaching technique between students and instructors, it is concluded this method positively affected participants of this study.

Findings of this study revealed that students tinkering self-efficacy positively affected their perceptions towards method of instruction. Students with high tinkering self-efficacy preferred the use of a demonstration method in the context of this study. This finding supports previous research (Kindsvatter et al., 1992) concluding that demonstrations allow students to better view and process skills associated with performing a task. It is concluded that students tinkering self-efficacy does have a significant correlation between methods used to educate students about biofuel in this study. Furthermore, it should be noted that students having a higher self-perceived ability towards tinkering self-efficacy prefer methods of instruction towards biofuel education when taught via the demonstration method. Impacting knowledge through laboratory exercises is a main stay in agricultural science education through the problem solving method (Flowers, J. et al., 1987; Osborne, E.W. et al., 1989; Boone, . et al., 1990). Through knowledge gained about student tinkering self-efficacy, professional educators can choose methods of instruction aligning with preferred methods of students who are more inclined to possess high tinkering ability.

Recommendations based on the findings of this study include using the demonstration methods when presenting material when deemed appropriate to gain student interest. This recommendation is further refined to include areas of study when classroom participants are heavily weighted towards male percentages based on their tinkering self-efficacy preferences. Furthermore, understanding of the interest gained through the demonstration method will allow instructors to capitalize and further knowledge acquisition. Additional research should be undertaken to determine tinkering self-efficacy and its result in cognitive processing of complex tasks undertaken in laboratory settings. This study should be replicated in demographically diverse areas (male and female populations more congruent with state/national norms) and in other states to determine its relevance in other settings.

The researchers further recommend that investigation into the effects of student interest and tinkering self-efficacy should be studied in other educational content areas to discover if these findings are similar based solely on method or differences exist based on the content area. Based on the findings of this study, demonstrations are a preferred method of instruction for students possessing a high level of tinkering efficacy the relationship (if it exists) should be investigated in other settings commonly seen in secondary settings such as biology, chemistry, and physics to illustrate a few.

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This project was supported in part by the Arkansas Soybean Promotion Board #32881 and #DE-FG36-08G088036 from the United States Department of Energy.