

# Perceptions of Critical Thinking, Task Value, Autonomy and Science Lab Self-efficacy: A Longitudinal Examination of Students' CASE Experience

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## Abstract

*The purpose of this study was to begin examining the impact of the Curriculum for Agricultural Science Education (CASE). Under development since 2008, the curriculum is intended to integrate core academics and Science, Technology, Engineering, and Math (STEM) into agricultural education programs. This longitudinal descriptive correlational study (N = 173) sought to examine the perceptions of students enrolled in a CASE course specific to the constructs of critical thinking, task value, autonomy, and science lab self-efficacy. Results revealed no differences in construct means between points of assessment. Correlation of the constructs of interest with student characteristics revealed small correlations between gender, English Language Learner status, and activity in the FFA with task value, autonomy, and science lab self-efficacy. Conclusions and recommendations are discussed in light of both the findings and the exploratory nature of this study.*

Keywords: Curriculum for Agricultural Science Education; critical thinking; task value; autonomy; science lab self-efficacy

Agricultural Education, vibrant and active in the United States since the early 1900s, has encountered many calls for change specific to the curricula and nature of agricultural education coursework. In 1988, Agricultural Education was spurred to respond to the *A Nation at Risk* (National Commission on Excellence in Education, 1983) publication and the response came in the form of a book entitled *Understanding Agriculture: New Directions for Education*. The Green Book, as it is sometimes referred to by agriculture educators, produced several findings and recommendations by the National Research Council to ensure a bright future for Agricultural Education. Two significant recommendations of the committee were their calls for new career opportunities in the agricultural industry beyond production agriculture, and major revisions in the current curricula with more emphasis on agricultural sciences, agribusiness, marketing, and food production (National Research Council, 1988).

More recently, the No Child Left Behind Act and the 2006 Perkins Act have placed an increased focus on the integration of academics into the curriculum of Career and Technical Education programs. In 2006, the Association for Career and Technical Education (ACTE) outlined several main themes in the 2006 Perkins Act. The final theme encouraged academic and technical integration within CTE programs. This emphasis, while present in prior authorizations of the bill,

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was strengthened in the 2006 version, and demands that all CTE programs, including agriculture, increase their level of academic rigor, in addition to expanding their cooperation with core content teachers. The act goes on to address professional development as one potential means to attain increased academic integration within the CTE arena (109<sup>th</sup> U.S. Congress, 2006).

In Agricultural Education in 2008, The National Council for Agricultural Education spearheaded the development of national agriculture content standards. The new standards included a crosswalk to the national core content standards. The identification of the two sets of standards provided teachers a framework for teaching core content in their agriculture classrooms. During the same time, the National Council for Agricultural Education led the development of the Curriculum for Agricultural Sciences Education, or CASE (CASE, 2011).

The CASE philosophy is to “empower the student by providing students an active role in their learning rather than learning being a product of teacher led instruction” (CASE, 2011, p. 4) and the curriculum is intended to be an inquiry-based, scientific approach to teaching in school-based secondary agriculture programs that is aligned with Science, Technology, Engineering and Math (STEM) (CASE, 2011). In addition to curriculum, the CASE support system is intended to provide professional development, assessment, and certification (CASE, 2011).

The CASE curriculum purports to be a “system of instructional support for the classroom teacher like no other resource in agricultural education today” (CASE 2011, p. 1). As agricultural education continues to wrestle with the integration of academics and seeks to identify effective methods thereof, research examining CASE is warranted. The 2011-2015 National Research Agenda calls for research that examines the “design, development, and assessment of the meaningful learning environments which produce positive learner outcomes” (Doerfert, 2011, p. 9). Specifically, priority four seeks research which can promote “meaningful, engaged learning in all environments” (Doerfert, 2011, p. 9), and priority five states “Agricultural education has the obligation to show that its curriculum can be used to meet the academic challenges of today’s school system while preparing students for a career in the agriculture industry,” (p. 26). The current study seeks to add to the knowledge base regarding the relatively new CASE curriculum.

### **Theoretical and Conceptual Foundation**

The theoretical foundation for this research was based on Self-determination Theory (Deci & Ryan, 1985). Self-determination theory is a macro-theory which focuses primarily on the development of personality within social contexts and the relationship to motivation (Ryan & Deci, 2007). Self-determination focuses on whether behaviors are volitional or self-determined as opposed to controlled. The theory postulates that those who have choices will have a greater internal locus of control and therefore be more motivated and determined. Moreover, the theory posits if students are engaged in environments that are autonomy-supportive, they will have increased intrinsic motivation, resulting in more sustained and purposeful engagement (Deci & Ryan, 2002). Research results revealed that students in a more autonomous environment had a greater likelihood of remaining in school (Vallerand & Bissonnette, 1992), tended to be more curious, and participate in and enjoy school tasks (Miserandino, 1996). Grolnick, Ryan, and Deci (1991) reported that students who are more autonomous showed increased motivation to complete schoolwork and evidenced greater conceptual learning and memory retention.

Specifically, self-determination theory focuses on the three basic human needs for competence, relatedness, and autonomy (or self-determination) (Deci, Vallerand, Pelletier, & Ryan, 1991). This research study focused on the competence and autonomy aspects of self-determination theory with competence including the constructs of critical thinking and self-efficacy and autonomy including both task value and autonomy.

Deci et al. (1991) described competence as the need for students to know how to attain various outcomes and their belief in their ability to perform the requisite action. In this research, two of the constructs relate to competence, namely critical thinking and science lab self-efficacy.

Both constructs entail the students' determination of their ability to meet specific outcomes and their belief in their capabilities to be successful.

The term critical thinking has several definitions, but for the purpose of this research, the authors have adopted the Scriven and Paul (2004) definition of critical thinking as cited and modified by Peirce (2005) as:

Sound thinking within a discipline that is needed and relied upon by practitioners in that discipline—thinking that is accurate, relevant, reasonable, and rigorous, whether it be analyzing, synthesizing, generalizing, applying concepts, interpreting, analyzing, evaluating, supporting arguments and hypotheses, solving problems, or making decisions (p. 81).

Critical thinking has been linked with good grades (Williams, Oliver, Allin, Winn, & Booher, 2003), management of interpersonal relationships (Kegan, 1994), leadership (Heifitz, 1994) and the ability to manage complex problems (Kolb, 1984).

Self-efficacy, the second measured construct under the competence domain, is commonly defined as judgments about one's ability to organize and execute specific courses of action (Bandura, 1997). It is a motivational construct that has been directly linked with academic achievement — both short-term and long-term (Pajares, 1996; Schunk, Pintrich, & Meece, 2008). Bandura (1997) believed self-efficacy would influence the choices individuals make in terms of goals, effort, and persistence. All of which can shape students' intent to enter a science-related career field. Self-efficacy has also shown to be positively correlated with student goals and persistence (Bandura & Locke, 2003; Britner & Pajares, 2006; Eccles, 1994).

Autonomy refers to being self-initiating and self-regulating in ones actions (Deci et al., 1991). In this research, autonomy was related to both task value and student autonomy.

The task value construct was intended to assess the motivational value students place in what they are learning. Eccles et al. (1983) and Wigfield and Eccles (2000) identified task value as a critical determinant for student task engagement. Students who possess a greater degree of task value will be more likely to engage and persist in a given task (Pintrich, 1994). Task value therefore, provides the impetus and is the catalyst for attempting a task. The CASE curriculum encourages students to guide their learning in a self-directed manner, thus, student task value would presumably be a meaningful construct.

The autonomy measure utilized was a measure of students' sense of their autonomy in the classroom. Typically a classroom can either be controlling or autonomy supportive. The designers of the CASE curriculum espouse it as a student-direct curriculum that allows students to pursue answers through inquiry learning. An autonomy supportive environment has been shown to increase perceived confidence and enhance intrinsic motivation (Deci et al., 1991). Students who interact with non-autonomy supportive teachers (controlling) tend to assume passive, cognitively disconnected, extrinsically motivated classroom roles (Reeve, 2002).

This research, grounded in the self-determination theory, sought to examine some of the competence and autonomy aspects of student involvement in CASE. Since this research examines a newer curriculum (CASE) and there is minimal record of prior research, the authors purposefully selected constructs that were broad and inclusive—constructs perceived to capture levels of competence and autonomy. The authors recognize that each of the constructs of critical thinking, science lab self-efficacy, task value and autonomy, in and of themselves, are distinctive and worthy of individual analysis. In fact, many have and are currently being researched in an intensive manner. However, in the current research, in an effort to cast a wide net and begin a broad examination of CASE, the authors chose to initially examine all four constructs.

Potentially, future studies may dive further into the individual constructs once there is more research available concerning the CASE curriculum. While research has been conducted on the integration of science into Agricultural Education (Connors & Elliot, 1993, 1994; Miller, 2000; Myers & Thompson, 2009; Thompson & Balschweid, 1998, 1999), there is little scholarship specific to the student impact of CASE curriculum.

### Purpose and Research Objectives

The overall purpose of this longitudinal assessment was to examine student perceptions of critical thinking, autonomy, task value, and science lab self-efficacy. In addition, selected demographic information was collected for the purposes of further understanding the students enrolled in the selected CASE courses. The research objectives are as follows:

- 1.) Identify the demographic characteristics of students enrolled in CASE courses.
- 2.) Identify the means of the constructs of interest for all the first, second, and third points of assessment.
- 3.) Examine the relationships between constructs and respondent characteristics.

### Methods and Procedures

It is important to note that this study is part of a larger, comprehensive study examining the programmatic impacts of CASE. The population for this research consisted of four selected high schools within Oregon. This purposive sample was selected based on recent CASE training of the teachers and their intent to teach CASE courses during the year of study. According to Ary, Jacobs, Razavieh and Sorensen (2006), a purposive sample is one in which, "sample elements judged to be typical, or representative, are chosen from the population" (p. 174). The researchers identified one small rural school, two large suburban schools, and one large urban school that fit the criteria of recent CASE training and intent to implement CASE for the duration of the study. As a result of the sampling method, and due to the many extraneous variables that comprise high school education, the results of this research are generalizable only to the respondents of this study.

In an effort to assess student changes over time, the researchers conducted a longitudinal, year-long multipoint assessment. Participants were assessed in September, December, and May during the year they were enrolled in a CASE course. Of the 353 eligible students in this study, the first collection had a total of 276 (78.19%) respondents, the second had 268 (75.92%), and the third had 231 respondents (65.44%).

### Instrumentation

The research instrument examined four distinct constructs of critical thinking, autonomy, task value, and science lab self-efficacy as well as captured selected respondent characteristics. The instrument descriptions and reliabilities are described in detail and the reliabilities are presented in a range due to the nature of a longitudinal study and several points of assessment.

**Critical thinking.** Critical thinking was assessed using the Motivated Strategies for Learning Questionnaire (MSLQ) (Pintrich, Smith, García, & McKeachie, 1991). This questionnaire contained five questions, scaled from 1 (strongly disagree) to 6 (strongly agree), directed at assessing student critical thinking. Examples include "I treat the course material as a starting point and try to develop my own ideas about it," and "whenever I read or hear an assertion or conclusion in this class, I think about possible alternatives." This instrument has been commonly used with both college and high school students and generally reports reliabilities between .70 and .84 (Duncan & McKeachie, 2005). The reliabilities for this current assessment ranged from .72-.75.

**Task value.** The task value assessment was also a component of the MSLQ (Pintrich et al., 1991), and was intended to assess task value in light of interest (intrinsic) value, importance (attainment) value, and utility value. The six questions regarding task value were scaled from 1 (strongly disagree) to 6 (strongly agree). Example questions include "I think I will be able to use what I learn in this course in other courses," and "I am very interested in the subject matter of this course." Similar to the critical thinking assessment, this instrument has been widely used with both college and high school students and reports reliabilities between .83-.90 (Duncan & McKeachie, 2005). In the current study, the Cronbach reliability estimates ranged from .86-.89.

**Autonomy.** The researchers utilized the Learning Climate Questionnaire (LCQ) developed by Deci and Ryan (1985) and revised by Deci et al. (1991). The LCQ short version consisted of six questions scaled from 1 (strongly disagree) to 6 (strongly agree). Example questions include “I feel that my instructor provides me choices and options,” and “My instructor listens to how I would like to do things.” Previous research reported reliability coefficients generally ranging above .90 (Black & Deci, 2000; Williams & Deci, 1996). In the current study, the Cronbach reliability estimates ranged from .88-.90.

**Science Lab Self-efficacy.** To measure science lab self-efficacy, the Science Lab Self-Efficacy instrument developed by Britner (2000) was utilized. The instrument consisted of six questions scaled from 1 (strongly disagree) to 6 (strongly agree). Example questions include “I am confident in my ability to identify sources of error that might affect the results of a science lab activity,” and “I am confident in my ability to draw correct conclusions from scientific projects.” Previous research reported reliabilities of .84 (Britner, 2000). The current research revealed Cronbach reliability estimates ranging from .86-.90.

### Data Analysis

Correlational analysis was performed on summated means in order to address relationships between the constructs of interest. The effect size was reported using Hopkins (1997) descriptors.

### Results

Research objective one sought to determine the characteristics of students enrolled in the CASE courses. The overall student population for these studies was 353 students. While this was the overall number of all participants, it should be noted that the length of this assessment (one year) made it difficult to retain all students. Some students transferred, dropped, or simply chose not to fill out the research instruments. In addition, for the students engaged in the longitudinal study, there were three primary points of assessment and the numbers of respondents varied. Of the entire population of 353 students, there were 173 students who completed all three points of assessment.

The 353 total respondents to these assessments indicated coming from four different schools: Two larger schools with CASE enrollments of 125 and 136 students and two smaller schools with 69 and 23 students. Of the 353 students engaged in this assessment, 315 students indicated gender, with 155 (43.78 %) females and 160 (45.19 %) males. There were 70 freshmen (19.77 %), 70 sophomores (19.77 %), 95 juniors (26.83 %), and 80 seniors (22.59 %) enrolled in CASE courses. Of these students, 47 (13.27 %) were on an Individualized Education Plan (IEP), 15 (4.23 %) were on a 504 plan, 45 (12.71 %) were English Language Learner (ELL) students, and 13 (3.67 %) were Talented and Gifted (TAG) students. There were 108 (30.50 %) students who were actively involved in FFA, 230 (64.97 %) who were receiving science credit, and 26 (7.34 %) who were receiving College Now credit.

The population consisted of three different CASE courses: Introduction to Agriculture, Food, and Natural Resources (AFNR), Principles of Agricultural Science - Animal, and Principles of Agricultural Science - Plant. The AFNR courses had 87 student participants, the Animal course had 59 students, and the Plant course had 207 students. Science credit was received by 124 students from the Plant course and 59 students from the Animal course. No students from the AFNR course received science credit.

The intent of the second research objective was to examine the construct means for the four constructs of interest. Figure 1 depicts the construct means for autonomy, task value, critical thinking, and science lab self-efficacy for all three points of assessment. The overall means are only reflective of those students who completed all three points of assessment. Student perceptions in

all four construct areas remained relatively unchanged throughout the exposure to the CASE curriculum. All constructs evidenced a slight decrease ranging from science lab self-efficacy (.11) to autonomy (.26).

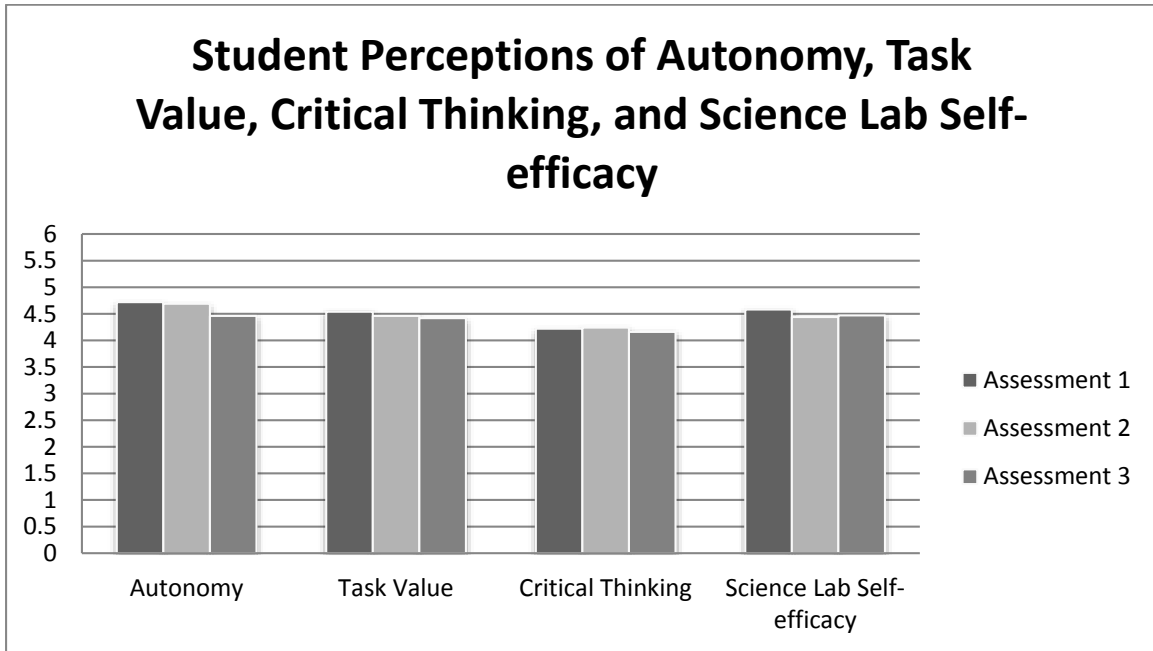


Figure 1. Student Perceptions of Autonomy, Task Value, Critical Thinking, and Science Lab Self-efficacy (N = 173)

The third research question was intended to examine the relationships between the constructs of interest and student characteristics. The characteristics included student gender, student grade, Individual Education Plan (IEP), 504 Plan, English Language Learner (ELL), and Talented and Gifted (TAG) status. In addition, the researchers also examined FFA participation levels and whether or not the students were receiving science credit. Table 4 examines the relationships between grade level and the constructs of interest. Hopkins (1997) correlation coefficients descriptors were utilized. Hopkins labeled his indicators as: .00-.10 = trivial, .10-.30 =small, .30-.50 =moderate, .50-.70 = large, .70-.90 = very large, and .90-1.00 = nearly perfect. Results indicated a positive relationship between autonomy and grade level with a small effect size. Task value, critical thinking, and science lab self-efficacy all yield trivial effect sizes.

Table 4

Spearman’s Rho Correlations between Grade Level and the Constructs of Interest (N = 173)

Ordinal Variable		Interval Variable	Value
Grade Level			
	X	Autonomy	.12 <sup>b</sup>
	X	Task Value	-.01 <sup>a</sup>
	X	Critical Thinking	-.06 <sup>a</sup>
	X	Science Lab Self-efficacy	.02 <sup>a</sup>

*Note.* All correlations and effect sizes are less than  $r = .20$  ( $<.04$ ). Grade level was coded 1 = Freshman, 2 = Sophomore, 3 = Junior, 4 = Senior

<sup>a</sup>=trivial, <sup>b</sup>=small

Table 5 examines the point-biserial correlations between the dichotomous nominal variables and the constructs of interest. Individualized Education Plans (IEP's) evidence one noteworthy negative association with science lab self-efficacy ( $r_{pb} = -.19$ ,  $M = 4.50$ ,  $SD = .63$ ) indicating students with IEP's had lower science lab self-efficacy.

Table 5

*Point-biserial Correlations and Coefficients of Determination between Dichotomous Nominal and Interval Variables (N = 173)*

		Autonomy	Task Value	Critical Thinking	Science Lab Self-efficacy
Gender	$r_{pb}$	-.25	-.21	-.08	-.15
	$r^2$	.13	.04	.01	.02
IEP	$r_{pb}$	-.12	-.10	-.04	-.19
	$r^2$	.01	.01	.01	.04
504	$r_{pb}$	.08	-.00	-.04	.00
	$r^2$	.01	.00	.01	.00
ELL	$r_{pb}$	-.21	-.24	-.10	-.19
	$r^2$	.04	.06	.01	.04
TAG	$r_{pb}$	.15	.12	.15	.08
	$r^2$	.02	.01	.02	.01
Active in FFA	$r_{pb}$	.25	.21	.15	.24
	$r^2$	.06	.04	.02	.06
Science Credit	$r_{pb}$	.16	.00	-.06	.02
	$r^2$	.03	.00	.01	.01

*Note.* All effect size descriptors for correlations fall within the small (.10-.30) designation. All dichotomous variables were coded 0 = no, 1 = yes. Gender was coded 0 = females, 1 = males.

Gender, ELL status, and activity level in the FFA all showed multiple correlations with a coefficient of determination above .04, including the three constructs—autonomy, task value, and Science lab self-efficacy. As a result, to further describe the relationships, tables 6-8 detail the mean scores in the three constructs for gender, ELL, and active FFA participation.

Table 6

*Gender Comparisons by Constructs*

Construct	Gender			
	Males ( <i>n</i> = 87)		Females ( <i>n</i> = 86)	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Autonomy	4.29	0.67	4.64	0.58
Task Value	4.21	0.69	4.63	0.72
Science lab Self-efficacy	4.31	0.66	4.64	0.58

Table 7

*ELL Comparisons by Construct*

Construct	English Language Learners (ELL)			
	ELL ( <i>n</i> = 10)		Non-ELL ( <i>n</i> = 163)	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Autonomy	4.08	0.79	4.66	0.62
Task Value	3.79	1.07	4.52	0.67
Science lab Self-efficacy	4.02	0.90	4.53	0.60

Table 8

*FFA Participation Levels by Construct*

Construct	Active in FFA			
	Active ( <i>n</i> = 83)		Inactive ( <i>n</i> = 90)	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Autonomy	4.80	0.59	4.47	0.67
Task Value	4.63	0.68	4.33	0.72
Science lab Self-efficacy	4.66	0.59	4.36	0.64

### Conclusions, Implications, and Recommendations

Examination of the participant characteristics revealed a relatively heterogeneous mix of grade levels. Most of the participants were enrolled in the CASE Plant Sciences course (*n* = 207) and 124 of those students were receiving science credit. The respondents were heterogeneous with 155 females and 160 males in the sample.

In our second research objective, we sought to examine the mean scores for all three points of assessment. Results indicated there was little variation between the first, second, and third assessment points as it relates to the constructs of interest. From a practical sense, the students only varied slightly between points of assessment with summated mean scores dipping from first through third points of assessment. In analyzing the results, it is clear that CASE implementation, and the potential effects on student variables, is very much context specific. The school, teachers, materials, students, class size, and a host of other variables potentially interact throughout the year to impact the autonomy, critical thinking, task value, and science lab self-efficacy of the students. With this in mind, we separated the mean scores for the four high schools to see if there was any difference in the mean scores. Two of the schools showed slight gains in all the constructs of interest and two



of the schools showed decreases in all the constructs of interest. Once the scores were averaged together any potential variations by school were hidden.

We recommend further research which is able to control for some of the confounding variables. In particular, as more teachers move to adopt and implement CASE in the classroom, more potential sites of assessment will be available. This will allow for options in selection method and the potential to control for some of the confounding variables.

The third objective was to examine the relationships between the constructs and the respondent characteristics. Results indicated trivial to small correlations between grade level and the constructs of interest. Results of the correlations between the constructs of interest and the other dichotomous variables yielded similar trivial to small correlations. While we did not use statistical significance as our measure, three characteristics yielded coefficients of determination large enough to pique our interest in three of the four construct areas. Gender, ELL status, and whether or not the student was active in the FFA all showed small correlations with autonomy, task value, and science lab self-efficacy. As might be expected, the construct of critical thinking showed only one noteworthy and that was with students in the Talented and Gifted (TAG) category.

An analysis of the mean scores by gender, ELL, and FFA activity level provided further clarity as to the correlations. Students who were active in FFA ( $n = 108$ ) showed slightly higher mean scores in autonomy, task value, and science lab self-efficacy. FFA purports to be a co-curricular (Talbert, Vaughn, & Croom, 2006) program and thus it is positive to see that students active in FFA perceive themselves to have more autonomy and competence in their CASE coursework.

Students, enrolled in CASE courses, who were also in FFA evidenced more self-determined motivation than their non-FFA peers. Given the research linking self-determined motivation with good grades, management of interpersonal relationships, and persistence in a given task, the increased scores are encouraging (Kegan, 1994; Pintrich, 1994; Williams et al., 2003). However, this descriptive correlational research does not provide any avenue to examine causation. Therefore, we are left to wonder if involvement in FFA is causing the difference or if perhaps students who are more motivated to begin with chose FFA as an avenue for involvement. Further research should examine with detail the student perceptions of autonomy and competence from those who are active in FFA and those who are not. Involvement in FFA may be an important component to engaging students in CASE as well as engaging them in their non-CASE courses.

Mean scores by gender revealed higher mean scores for females than males. Across the board, females perceived themselves as higher in autonomy, critical thinking, task value, and science lab self-efficacy as compared to their male counterparts. Based on self-determination theory, the female students higher in autonomy and competence have greater likelihood of attaining both internal and external outcomes, being efficacious in performing action, and demonstrating self-initiating and self-regulating behaviors (Deci et al., 1991). We recommend additional research to explore the interactions between gender and the CASE curriculum. Given the philosophy of CASE to, “empower the student by providing students an active role in their learning”, it is important to consider whether female students who show more self-initiating and self-regulating behaviors are better suited or better able to be successful in a CASE course (CASE, 2011p. 4). In this study, given the limitations of working with high school students, we were unable to utilize mid-term and final term grades in our analysis. Further research should explore both content knowledge test scores and final grades to determine if females are achieving greater academic success than their male counterparts.

Students who were ELL also evidenced lower mean scores compared to their non-ELL counterparts with the largest mean difference in task value. These results are not surprising when considering that ELL students may struggle in their understanding and processing of the English language and thus display decreased task value. While the CASE curriculum is reading-heavy, it is also very hands-on and the pairing of these two elements may influence the mean scores. Further

research should examine the task value of ELL students in other classrooms and determine if the CASE curriculum is impacting their task value.

We recommend increasing the number of schools involved and including measurement and control for confounding variables. Given the exploratory nature of this research, we limited our scope to four schools and only collected data on the variables of interest and a few basic characteristics. The characteristics pertained specifically to variables we felt might influence the students' motivational interaction with CASE (i.e. gender, IEP, 504, ELL, TAG, FFA involvement and science credit). We did not collect data to access actual student content knowledge or in any way examine teacher "effectiveness", pedagogical strategies, or the rate at which teachers implemented the CASE curriculum.

It is important to recognize that this research was not intended to examine the CASE curriculum directly or assess academic gains. It is simply a longitudinal assessment of student perceptions while engaged in a CASE course. Since CASE itself is new, and very little research exists on the curriculum's impact to high school students, the researchers attempted to begin a broad examination of CASE and highlight potential areas for further research. As researchers move forward to begin examining CASE, they must keep in mind, identify, and control for the extraneous variables associated with conducting social science research in an active high school classroom.

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