Locus of Control and Pedagogy in Skill-Based Agricultural Mechanics

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Abstract

Teachers of agriculture have used project-based learning as a primary teaching method in agricultural mechanics since the 19th century. These methods teach the information and motivate students to engage the content. Locus of Control (LOC) categorizes the relationship with decision-making and motivation. Internal LOC have a higher level of internal motivation and desire a central role in decision-making processes. External LOC typically do not seek out opportunities for decision making. A student with an internal LOC acts on the world and a student with an external LOC believes the world acts on them. This research was to determine if students' LOC differentiated between hands-on compared to lecture-based teaching. Students in an agricultural mechanics course at Auburn University (N = 38) were neither internal nor external (f =16) LOC, those with a tendency towards one or the other were more internal (f = 15) and (f = 7) were external LOC. Most students felt slightly positive toward project-based learning (M = 3.61, SD = 0.70) and slightly negative toward lecture-based learning (M = 2.78, SD = 0.85). Either LOC plays no role in students' feelings toward project-based methods or there are so few internal students that no correlation could be detected.

Keywords: experiential learning, external control, internal control, behavioral science

The use of projects as a tangible force for learning has been part of teaching in agriculture since the formalization of home projects by Stimson (Moore, 1988). The primary tenants of projects as educational devices in project-based learning were outlined by Krajcik and Blumenfeld (2006) as involving: (1) a driving question or problem to solve, (2) authentic, situated inquiry for students to explore the driving question, (3) collaborative activities between students, teachers, and community members, (4) educational scaffolds made up of technologies that assist students in growth, and (5) tangible products created by students that answer or address the original driving question. Each tenant has a separate role in assisting students' movement toward answering their driving questions throughout the

learning segment. Krajcik and Blumenfeld (2006) studied the roots of project-based learning and traced those roots back to Dewey's (1938) at the University of Chicago. Krajcik and Blumenfeld (2006) built upon four ideas that influenced Dewey's work and have led to the rise in project-based learning: (1) active construction, (2) situated learning, (3) cognitive tools, and (4) social learning. They explain active construction as part of the constructivist mindset when students can construct personal meaning and knowledge based on experiences and interactions with the world. They also stated that this is typically used to increase engagement and motivation toward the content. [NAME] University found that their college undergraduates in construction programs saw enhanced learning and engagement when presented with an opportunity to participate in an active construction learning lab (Farrow & Wetzel, 2020; Wetzel & Farrow, 2021). Active construction often includes collaborative efforts by teams of students working towards a common goal. This higher quality instruction came from students' ability to better interact with the content.

Active construction is based in the application of what students learn during their class considering what background knowledge and experience students have prior to class (Farrow & Wetzel, 2020; Wetzel & Farrow, 2021). Increased prior knowledge has been shown to increase students' intrinsic goal orientation towards tasks (Araz & Sungur, 2007). Understanding what background knowledge students bring to actively construct new knowledge plays an important role, as does the meaning that students create for content between themselves, the teacher, and other students (Stein et al., 1994). Project-based learning exemplifies active construction by putting students into collaborative groups where they actively seek the answers to their driving questions and projects. In this study, researchers knew that some students had some level of experience with woodworking and metal fabrication, but they still had knowledge and space to learn through the active construction of the project-based learning course.

Situated learning is significant in the creation of project-based learning methods and modalities (Krajcik & Blumenfeld, 2006). Situated learning states that students succeed when they learn skills in an environment authentic to the situation in which they will use the skill. This style of contextual learning gives students an opportunity to generalize skills from the classroom to the real-world (Stein, 1998). The four pillars to situated learning include: (1) having experiences that mimic everyday situations, (2) understanding that information learned can be transferred only to similar situations, (3) knowing learning results from a social process, and (4) that learning exists in a complex, robust, world full of many people, actions, and situations (Stein, 1998). Project-based learning is seen as exemplifying situated learning because students are hypothesizing, testing, collecting data, and gaining knowledge through life-mimicking scenarios. Students gain experience doing the actual tasks and practicing the real skills in a mock environment that will be required of them in the post-classroom environment. In this study, students were utilizing the real tools, skills, and materials that will be required of them as they teach their own metal fabrication or woodworking class after graduation.

Theoretical Framework

Bandura (1971) in his description of social learning theory suggests that people can avoid endless trial and error by observing others. Bandura goes on to say that watching others go through fearful, joyful, pleasurable, or painful experiences can shape the observer's behavior around those experiences. So not only do people learn through direct experience, but people can learn simply through observing others through their own experiences.

Based on the earlier work of Bandura that led to social learning theory, Rotter (1966) developed the concept of Locus of Control (LOC). Social learning theory asserts that life is a continuous cycle of behaviors and reinforcements both internal to the individual and externally viewed or experienced by that individual (Bandura, 1971; Rotter, 1966, 1990). Reinforcement can act to strengthen or deter people from repeating certain behaviors by experiencing them firsthand or watching others experience them (Bandura, 1971; Rotter, 1966). Rotter (1966, 1990) postulated that people have a tendency towards reliance on internal or external motivating factors.

People who have an "internal" LOC tend to believe that there are more internal factors contributing to the reinforcement/reward of behaviors (Rotter, 1966). Internal factors include one's own characteristics or behaviors. Meaning that those with strong internal LOC believe they have a high level of control over the rewards/reinforcements available to them based on their own actions and behaviors. A study of academic success, standardized test scores, and grade point average found that students with an internal LOC had higher grade point averages (Gifford et al., 2006; Shepherd et al., 2006). Similar studies found that students with an internal LOC had decreased academic procrastination, less test anxiety, and overall increased academic achievement (Carden, et al., 2004). One can conclude that students who had an internal LOC have a stronger sense of personal responsibility for the rewards and reinforcements available to them. For students with an internal LOC, project-based learning as described by Krajcik and Blumenfeld (2006), should provide the autonomy that allows students to control the rewards and reinforcements available to them as Rotter suggests being the preference of those with internal LOC. They can work on projects at their own pace as they search for the answer to their guiding questions.

People who have a tendency towards "external" LOC tend to believe that there are more external factors contributing to reinforcement/reward of behaviors than internal; external factors can include luck, fate, "powerful others," or unpredictability (Rotter, 1966). Attributing rewards or reinforcements to those outside of one's own self relinquishes some level of responsibility to those external factors for the rewards and reinforcements available. In studies of people with internal and external LOCs, students with external LOC struggled with decision-making processes due to lack of necessary information and/or inconsistent information (Kirdök & Harmon, 2018). Moreover, people with an external LOC were found to be more "helpless" than those with an internal LOC (Hiroto, 1974). Overall, people

with an external LOC perceive a lack of control over the circumstances, rewards, and reinforcements available to them.

Typically, people tend to observe and act in situations based on their beliefs about their own LOC (Rotter, 1966). LOC is foundational to how students interact with project-based learning because it determines how likely learners are to attribute their own behaviors and actions to the rewards or reinforcements (Rotter, 1966). LOC asserts that students who have an external LOC would be more likely to believe that their team members, the instructors, and other external factors would influence their success in the course. However, students with an internal LOC would believe that their own actions and skills would more influence their success in a project-based learning course. Project-based learning courses, due to their tendency to be more student-directed decision making and less instructor-centered instruction than lecture-based courses, give students much more control over their own learning process.

Purpose and Objectives

The purpose of this study was to determine if students' LOC had an effect on their perceptions of project-based learning as it was used in an agricultural mechanics course. This study addressed four objectives: (1) to describe students' LOC, (2) describe students' feelings toward project-based learning, (3) describe students' feelings toward lecture-based learning, and (4) determine if there is a relationship between a student's LOC and their beliefs about project-based learning.

Methods

This descriptive study was conducted to better understand LOC and its effect in a project-based learning-centered class using descriptive research methods as described by Gall et al. (2007). The target population for this study was all students taking an introduction level agricultural mechanics course at Auburn University in the fall of 2020. Open to all students in the university, this course is primarily taken by agricultural science students in both teacher preparation and non-teacher preparation tracks. There are also a minimal number of students from outside majors taking this course. The introduction to agricultural mechanics course was chosen because of its long-standing implementation of project-based learning pedagogy as a primary teaching mode. Students in the course are given basic instructions on personal safety and safe operation of tools along with plans for various projects. Students were guided through safe operation of the tools needed in the construction of the projects. The projects and their plans are designed in such a way as to ensure the students experience the tools and systems outlined in the course objectives. Little direct instruction, outside of safety, is done in the course. The semester this study was conducted, students completed a small individual project of building a carrying case suitable for tools (tool box) and a larger team project of constructing a table and benches. After safety instruction on each tool and the completion of a basic safe operation exam, students were given plans that provided the dimensions, a list of tools available, and enough material to be able to complete the project with small errors taken into account (i.e. they only need 6 feet of 1 x 10 and they are given 8 feet). Instructors were present as assistants to facilitate the student's and facility/equipment safety, but not as primary deliverers of information (Dewey, 1939).

As part of the PBL experience students were assigned the project and given the basic plans which contain a picture and dimensions, but they were required to complete and cut list, tools used list, materials used list, provide photographs of each step of the project, and a basic reflection on their experience with the project. They are given the guidance that this portfolio should be something a future student could use to replicate the project easily. They are told what a cut list is, what a materials list is, and told that the best course of action is to plan these cut and materials lists in advance, editing them as they complete the project. The instructors allow students to determine the best course of action in achieving the goal of building the project and completing the portfolio. However, they are never given a cut list or materials list for the project. Students are not given teacher led instruction as to which cut to make first, how to plan out construction, or which tools would be "best" to use. The plans for the project are designed so that following the safety rules of the laboratory, students must use each tool to complete the project. Safety rules of the laboratory include; we dont allow for cross grain cuts on boards or lumber more than 16 inches using a table saw, nothing smaller than six inches is allowed to be cut on the powerd miter box, reciprocating saws and the band saw outfitted with the small blade are the only tools allowed to be used on curved cuts, no "free hand" cutting with a hand held circular saw, drills are for drilling holes, impact guns are for driving screws, split wood is not allowed in the final project.

A questionnaire was divided into three parts and delivered to students via the course learning management system (Canvas). Part one of the instrument consisted of 11 items using five-point Likert scale responses (1 = strongly disagree, 5 = strongly agree) that attempted to determine a student's overall feelings towards project-based learning. Part two was a similar section of 11 items using five-point Likert scale responses which sought to determine the students' feelings towards lecture-based methods. The third section was 29 binary response items based on the work by Rotter (1966, 1990) to determine a student's LOC. A reliability coefficient was calculated on the summated scale questions by construct, and it was determined that the instrument had sufficient reliability to report the results (PBL construct 11 items, $\alpha = .76$: Lecture construct 11 items, $\alpha = .76$)

This study yielded a census of students enrolled in an introduction to agricultural mechanics course (N = 38) taught across three sections. The demographic makeup of the respondents were, female (n = 13), male (n = 24), ranging in ages from 20 - 34 with 21 being the most common response, most were not seeking teacher certification (n = 27), most were either Juniors (n = 17) or Seniors (n = 17), and most had taken "shop" type classes in high school (n = 24).

Results

The purpose of this descriptive study was to determine if LOC had an effect on students' perceptions of project-based learning as it was used in an agricultural mechanics course at Auburn University. The study addressed four objectives: (1) to describe students' LOC, (2) describe students' feelings toward project-based learning, (3) describe students' feelings toward lecture-based learning, and (4) determine if there is a relationship between a student's LOC and their beliefs about project-based learning.

The first objective was to describe students' indicated LOC. Students predominantly expressed a medium to high LOC (Table 1). The higher the students scored on this instrument the more internal their LOC tends to be. Fifteen students expressed an internal LOC and 16 scored as having neither internal nor external. Only seven students indicated having a moderate or strong propensity towards external LOC.

Table 1.

Locus of Control

Raw Score	*f*	LOC	*f*
1	1	Strongly Ext	1
3	1	Moderately Ext.	
4	2	Moderately Ext.	6
5	3	Moderately Ext.	
6	4	Neither Int. nor Ext.	
7	3	Neither Int. nor Ext.	16
8	6	Neither Int. nor Ext.	
9	3	Neither Int. nor Ext.	
10	6	Moderately Int.	
11	1	Moderately Int.	12
12	4	Moderately Int.	
13	1	Moderately Int.	
14	2	Strongly Int.	3
16	1	Strongly Int.	
Total	38		38

Note. Int. = internal locus of control, Ext. = external locus of control

Objective two was to describe students' feelings towards project-based learning. When a grand mean was calculated for project-based learning preference, students (n = 38) showed a positive, opinion of project-based learning (M = 3.61, SD = 0.70) with a possible range of one to five. The largest group of students (n = 17) construct score placed them in the middle of the scale (mode = 3).

Objective three was to describe students' feelings toward lecture-based learning. When a grand mean was calculated for lecture-based learning preference, students (n = 38) show a negative view toward lecture-based learning (M = 2.78, SD = 0.85) with a possible range of one to five (mode = 2).

Objective four was the impetus and driving objective of the study. Objective four was to determine if there is a relationship between a student's LOC and their beliefs about project-based learning. To achieve this objective a Pearson Correlation was calculated. LOC and feelings toward project-based learning were not correlated in a statistically significant manner r (37) = -.258, p = 0.12). In addition, a student's LOC score and feelings toward lecture-based learning was also not correlated in a statistically significant manner to r (37) = 0.09, p = 0.59).

Discussion

Rotter (1966, 1990) suggested that a person's LOC dictates whether that person had the propensity to treat the things external things as something they can more affect (internal) or something that can more affect them (external). This research was conducted to examine if a relationship existed between LOC and feelings toward a commonly used teaching method. It was found that students in the agricultural mechanics course at Auburn University were predominantly neither internal nor external in their LOC with a substantial portion leaning towards an internal LOC. Of the few students who did score outside of the middle range, few scored as having an external LOC. This fits with Rotter's understanding of Bandura's social learning theory (1971). Rotter predicted and Gifford, et. al. (2006) showed that those with predominantly external LOC would not be as successful with formal schooling. We could surmise those external LOC students would be missing from the university population.

The findings of this descriptive study lead us to believe that the population of students in colleges of agriculture are predominantly neither external nor internal and lean towards having an internal LOC, as has been suggested elsewhere. This propensity towards internal LOC should affect the way our colleges interact with students. Having an internal, or at least more internal than external LOC students, should inform our actions toward giving students more control or power in the decisions that affect them.

The results indicated slight movement towards an internal LOC indicating that students may be indifferent to the material and only focus on instructor influences to define their own success. Ideally, instruction is designed for developing interest, self-management, and responsibility towards the students' own learning. These findings may suggest continuing to use direct teaching methods may reinforce apathy experienced by students related to their coursework.

The most salient finding is the clear feeling students have toward lecture-based compared to project-based courses. Students, no matter their LOC had much stronger positive feelings towards courses that utilize project-based pedagogy in comparison to lecture-based. While this connection has been well explored by those studying secondary agricultural education, there is a lack of research

into the purposeful incorporation of project-based learning and project-based learning pedagogies in colleges of agriculture as has been done in colleges of engineering and business. The larger implication of this finding is the approach used in colleges of engineering and business. Do these fields align more closely to project-based learning activities or have instructors in those fields been prepared differently than their college of agriculture counterparts?

The argument can be made where both fields of study employ technical components of study with practical learning applications, so where is the disconnect between engineering, business, and agriculture students? Ironically, agriculture is historically viewed as a "hands on" industry replete with impactful problems and proactive solutions for the well-being of our citizenry. A review of current pedagogical practices and preparation may illuminate the disparity between professional fields of instruction delivery.

Summary

Using Rotter's (1990) perspective on LOC and its relationship to social learning theory, the supposition was that students who have a more internal locus of control would prefer to be taught agricultural mechanics using project-based learning methods because they would have more control over the outcomes and be able to easily effect change in their environment. While students on whole did have slightly more positive feelings about project-based learning than they did about lecture-based learning, these differences did not seem to correlate to their score on the LOC portion of the instrument. This could be due to an actual lack of correlation or could be caused by the heavily skewed data set due to uneven cell sizes. A larger sample or stratified sample needs to be taken to investigate if this is a lack of difference or if it was caused by the lack of adequate group sizes. More work needs to be done on the use of PBL in post-secondary teaching of agriculture, specifically in skill-based areas of agriculture. Also, work needs to be done concerning the pedagogical decisions college teachers make and the effect those decisions make on learning skill-based content.

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