Using self-reported data collection and analysis to facilitate student learning: A case study

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Abstract: As part of an undergraduate course in agricultural economics, students recorded their own fruit and vegetable consumption over a 7-week period. The aggregate data were used by the students to test their own hypothesis regarding fruit and vegetable consumption. This paper discusses the benefits and drawbacks to this teaching approach.

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Teaching undergraduate agricultural economics presents certain challenges as students are faced with not only learning economic theory, but the context in which it is applied. Students must grasp the learning context (environment, food, resources, etc.) beyond a discussion of *widgets*. In addition, as more students in Ag departments are coming from unrelated personal backgrounds, the relevance of applied topics can be difficult to convey to some. As such, it is becoming increasingly important to create appropriate learning environments for students in agricultural economics.

In the spring of 2013, I taught agricultural and resource economics to a class of undergraduate agricultural and resource economics and general economics majors. The content was similar to traditional intermediate microeconomics. As a part of the class curriculum, the students were also exposed to introductory data analysis and econometrics. There were 53 students, making this a medium size class.

To facilitate their understanding of the applied microeconomics and data analysis, I had the students provide responses to numerous survey questions at the beginning of the semester. Then, I had them collect weekly self-reported survey data of their fruit and vegetable (FV) consumption for a total of 7 weeks. At the end of 7 weeks, I cleaned and aggregated the data, creating a panel data set of over 350 observations. For a class project, the students developed their own research hypotheses regarding factors that affect FV consumption of college undergraduates. They then used regression analyses to test their hypotheses.

The remainder of this article explicitly describes the entire data collection and analysis (DCA) approach I employed; my motivation for implementing this

process; an evaluation of this process; and a discussion of such experiential learning, including potential for future extensions.

Data collection approach

In the first week of class, students were provided a demographic survey via and Excel spreadsheet on the University Blackboard system. There were a total of 52 questions regarding various demographic characteristics including age, GPA, student residence. In addition, questions were asked regarding their shopping and cooking habits and their nutritional preferences. Students that lived off campus were asked to complete six additional questions. The students were asked to complete the survey by the following week. Several reminders were sent to the class and over 93 percent of the class completed the survey on-time. The others completed the survey before the midterm break.

At the beginning of the second week, students were asked to record their FV consumption from Monday through Wednesday using an electronic diary and submit this information via Blackboard by Thursday night. In addition, students were asked to describe where they obtained their groceries, how often they ate out, how often they exercised and whether they were ill (Table 1). Prior to completing the survey, students were instructed on how to measure a serving size using a standard measure provided by Produce for Better Health Foundation (taken from http://www.fruitsandveggiesmorematters.org/archives/16223). The exact measures are described in Table 2. This information was also provided on each survey for reference. Again, reminders were sent to the students and completion rates were over 90 percent each week.

The weekly food diaries were completed for seven weeks, until spring break. During the fourth week, I introduced an "experimental treatment". I randomly selected half of the class and provided those students with an informational sheet regarding ways to increase their FV consumption and included no other instructions or comments.

Students that completed all of their surveys on-time (or reasonably on-time) received points towards their project for data collection and were allowed to drop their lowest test grade during the semester. At the end of the 7 weeks, I removed any personal identifiers and combined all the demographic data and weekly diaries into a panel data set.

Data analysis

In the first section of the course, we discussed consumer demand. To facilitate this topic, I solicited student input regarding factors that affect their own FV demand, both quantity and quantity. Students were able to easily discuss price and income effects as well as tastes and preferences. In addition, they discussed less traditional topics such as food access and food marketing. Through discussion, we also discussed behavioral factors that might impact FV consumption such as commitment mechanisms (e.g. being part of a University team), hyperbolic discounting, and peer effects (e.g. being part of a social group or club). I also described the policy implications of FV consumption.

For the final section of the course, students were required to: 1. Develop a theoretical hypothesis based on demand theory regarding specific factors that might affect class FV demand; 2. Test their hypothesis using basic regression

framework; and 3. Write up their analysis in a short report. During this section, we discussed empirical methods and I often referred back to our initial discussion in the first week. In addition, I used the class data set to provide examples of analytical methods in class.

Motivation for developing DCA approach

There are numerous challenges facing undergraduate students of agricultural economics. First, they have to have at least some cursory interest in learning economics, both theory and applications. As many are drawn to agricultural economics programs for their "practical" focus on agricultural, food, natural resources or the environment, interest in theory can be a difficult barrier. Given that the student can deal with some amount of theory, their next potential challenge is to learn how to apply the theory to the practical foci of agricultural economics. That is, they have to understand conceptual how markets work and how practically economics is used to evaluate actual markets. For the instructor of agricultural economics, this creates numerous difficulties and opportunities, which at a minimum, keep the profession interesting. To make this process more challenging, students often don't come from a background that equips them to understand agricultural markets. Further, those with food industry experience (generally low level) often have distaste for the food industry (Litzenberg 2010). Finally, students are balancing other aspects of their life, perhaps to a greater degree than previous generations. Consequently, students offer lack in enthusiasm and are "pulled" in other directions by life itself.

In the spring of 2013, I was assigned to teaching an undergraduate course in agricultural and resource economics at a Research University. While the primary focus of the class was teaching intermediate microeconomics, I was also charged with exposing the students to some empirical analysis. The motivation was to prepare the students for more applied work in higher level courses and to increase undergraduate interest in agricultural economics. As both intermediate microeconomics and empirical analysis generally command and deserve their own courses, this presented a special challenge. To try and engage the students and prepare them to be budding economists, I decided to implement an experiential learning activity for the class. This ended up being the previously described DCA process

Experiential learning can generally be described as a process where a person engages in some activity, reflects on the activity in a critical manner and attempts to derive insights from the reflective analysis (Pfeiffer and Jones 1981). Such a "learning by doing process" in a classroom setting relies on the students actively engaging the activity presented to them, learning from the engagement and applying it later. As experiential learning has been in development since the late 1940's, there is a wealth of resources to build and learn from. The key considerations in developing this process were: activity, learning and application.

Activity and Learning

The DCA process I developed was intended to serve several purposes. First, I wanted the students to be more observant of the market environment where they acquired and purchased food. Prior to earning your own self-sustaining wage, it is

easy to be oblivious to the entire process of how food arrives in your stomach. Interestingly, however, college students often live in a dense food marketing environment. They are given a multitude of choices in confined areas. Further, they are presented with a large number of informational and promotional marketing materials.

The second purpose of the DCA process was to encourage the students to conceptualize the market forces that may impact their decision making process. Admittedly, I tried to direct some of this thought process with my initial inquiry at the beginning of the semester regarding the factors that affect food consumption as well as my subsequent lectures. Still, my hope was that by collecting data on their own behavior, they would begin to consider *why* consumed consumed what they did.

After the data collection was complete, my objective was to help students better understand data in general. First and foremost, I wanted them to understand that all data is the result of some data generation process. Further, all the data sources that they may encounter in their future studies or careers were also generated by some activity or process. Having used secondary data before with undergraduates, I have observed that they can have a difficult time understanding what the data mean (e.g. Census data, Labor data, etc.). Even after explaining the data, I would often hear: Where did the data come from? What exactly do the data measure? I believe that such confusion was not because secondary data sources are so abstract. Rather, undergraduate students have never taken the time to consider these data outside the formal structure of the classroom.

By collecting their own data, students' basic understanding of the data should increase as well as their time and ability to focus on analysis of the data. For example, students often have a hard time understanding or remembering certain governmental constructs. With regards to their own data, there was no confusion because they were part of the data collection procedure. As noted by Spencer and van Eynde (1986, p. 291), "Teaching through experiential learning obviously is easiest in subject areas where students have at least some degree of familiarity with the subject".

Finally, as a minor addendum, the "experimental treatment" was intended to motivate the students to consider how the introduction of information might ultimately change the behavior of individuals

Application

After the students spent almost 2 months collecting and, potentially, thinking about the data, I wanted them to apply what they had learned by testing their own hypothesis. Clearly this can be done with other secondary data sets as well. My desire, however, was that after collecting the data, the students would become more inquisitive and creative regarding the formulation of hypotheses. Further, by testing their own hypotheses with their own data, I hoped that students would reflect about their own learning and knowledge. As intended with experiential learning, I wanted students to ultimately carry this experience with them beyond this course.

Evaluation of DCA approach

Within the context of agricultural economics, there is a long history of developing experiential learning techniques. Wilson and Nelson (2009) cite an extensive list of examples. While proponents of what they term active learning, the authors argue that a weakness of active learning in a theory based curricula, such as economics, is the lack of theoretical orientation. By heavily or solely focusing on the activity implemented for the learning process, there is clearly a concern that students may miss the more important conceptual aspect of the learning process. That is, they can miss the intellectual forest for the trees. To that point, I consider why the DCA process might be a relevant exercise for an agricultural economics class.

To facilitate my evaluation of the DCA process as a relevant exercise for an agricultural economics class, I refer to Kolb's theory of experiential learning, summarized by Spencer and van Eynde (1986). According to Kolb, experiential learning is a four-step process. In the first step, learners are involved in a structured activity designed to generate data related to the class learning objective. At this point, the learner reserves judgment and focuses on the task at hand. Clearly, the DCA process meets the first requirement. Whether or not students "reserved judgment" is questionable. In particular, as students collected data, they may begin to consider the factors that influence the data collection procedure. As previously mentioned, I encouraged this to some extent during lecture.

In the second step learners reflect on what happened during the experience stage and attempt to explain outcomes of their participation. This took place after data collection in several ways. First, I used the data to motivate

analytical methods during subsequent lectures. Second, the class project required them to consider what they could examine or explain with the data.

As a result of the reflections, in the third step the learners make generalizations about what they learned. In particular, this involves developing more abstract thought and incorporating theory. To this end, the formal hypothesis the students created required they not only make generalizations and incorporate some economic theory, but also think more abstractly about the data.

In the final step, the principles and findings are to be used beyond the immediate learning experience. This often involves testing implications of the concepts that were learned in new situations or applying the principles. The analytical methods we employed (mean comparisons, creating charts and graphs, least squares regression) tested the students' theories directly. Further, the students had to extrapolate from their results to demonstrate their understanding of their findings.

Overall, I contend that the DCA approach has the structure and favorable attributes of experiential learning. Because of this, the DCA approach has the potential to help improve and enhance the student learning process. As noted by Hawtrey (2007), an important benefit of experiential learning is that it explicitly shifts responsibility for learning from the instructor to the student. In turn, this should encourage better, lifelong learning. Having said that, I made no measurements of learning between comparison groups to examine to what extent this process improved learning.

Costs and Benefits

A natural way for agricultural economists to evaluate the merit of some decision is to consider the costs and benefits. I did not measure the costs and benefits of the DCA approach. I can, however, consider them qualitatively.

As an instructor, there is the very real opportunity cost of time required to develop and administer the DCA process. Due to software and technology, however, this process is manageable and has near zero marginal cost. The start-up costs can be significant, depending on the nature of the data being collected. Prior to providing my survey, I had the questions vetted by several grad students, a post doc and a fellow assistant professor. This greatly improved the quality of the survey, but also *stole* others' time. There is also a significant procedural learning curve that has to be overcome. Fortunately, subsequent versions of this activity benefit from any initial investments. Still, for an assistant professor these investments must be balanced with the looming tenure requirements.

There are also other intangible costs to be considered as well. As pointed out by Wilson and Nelson (2009), there is the potential loss of reputation associated with experiments that don't work as planned. In the case of the DCA approach, there were many, generally minor, difficulties that could have easily translated into lower class learning outcomes or class satisfaction. Overall, such little difficulties can add up and make a course seem unorganized or unstructured. This can ultimately impact class ratings and enrollment.

The costs to the students are another important consideration that the instructor should consider. For one, certain students may have a difficult time with an experiential learning activity. Several authors find experiential learning leading to reduced achievement among students with certain personalities or

learning styles (Dickie 2006, Emerson and Taylor 2004, Hawtrey 2007). In addition, the DCA process itself required external efforts, which certain students are hesitant to invest. While students were compensated with completion grades, they may resent the deviation from the traditional lecture-exam framework. Students often develop pre-conceived notions about what a college classroom environment should be like. Deviation from such expectations could lead to anxiety or discomfort for certain students. Although Hawtrey (2006) suggests that students are not satisfied with a pure lecture classroom environment in economics.

At the same time, certain student types will flourish in experiential learning environments and become more excited about such classroom environments. Hawtrey (2007) found in her survey of student, a preference for experiential learning activities. Further, by diversifying the type of assessments used for grading by incorporating something like the DCA approach, students have more opportunities for success. This can benefit students who do not perform well on tests.

Importantly, there are many benefits to the instructor as well. Implementing experiential learning activities can make teaching more enjoyable and provide inspiration and a sense of focus for instructors. If effectively executed, they can lead to better student evaluations and a higher classroom reputation as well. As my DCA approach was designed to mirror my own research agenda, this provided greater opportunity to discuss topics I was more familiar with and a chance to explore more of my own research interests as well.

Student evaluation of process

To try and directly measure how the students of my class perceived the inaugural implementation of the DCA approach, I provided an anonymous survey at the end of class that was administered and collected by a teaching assistant. There were 44 of 52 students that either attended or responded. I asked 5 questions:

1. *Please rate your level of interest with the data analysis section*
2. *To what extent did collecting data for the class project help you with your analysis for the class project?*
3. *Please rate your level of interest with the data collection process*
4. *Please rate your level of interest with the data analysis*
5. *To what extent has the data analysis section helped your understanding of microeconomics?*

Questions 1, 3 and 4 were scored with a Likert scale response system: 1. Not interesting, 2. A little interesting, 3. Interesting and 4. Very Interesting. Questions 2 and 5 were scored with questions: 1. Not at all, 2. A little, 3. A good amount, 4. A lot. The results of the survey are provided in Table 3.

The average value of responses for each question was greater than the midpoint, which is encouraging. Further, the standard deviation was less than a full step. The score for the data analysis section of class (Q1) is high as well as the score for how data collection helped with data analysis (Q2). So even though students disliked collecting the data, it may have helped them with the learning objectives of data analysis. Further, there were many more high scores (Q1 = 7, Q2 = 10) than low scores (Q1 and Q2 = 1).

Students seemed to have a strong interest in the DCA approach (Q 4), although the data collection itself was rated the lowest (Q3), which is not overly surprising given the extra work it required (even though they received points for doing so). This may be consistent with Dickie (2006) who found that economic experiments increase learning whereas grade incentives to participate do not. Additionally, the lowest response for Q4 was, *A little interesting*, suggesting that the DCA approach was appealing to a fair number of students.

A little concerning is that Q5 had the lowest number of high scores (5) and its mean score was the second lowest (2.82). This could indicate that students had a difficult time relating the data analysis to microeconomics. This could be due to the instruction itself or because combining microeconomics and analytics in one undergraduate class is too difficult.

The correlation of the questions suggests that scores for Q1 and Q3, Q4 are the most highly correlated. Further scores for Q2 and Q3 are highly correlated as well. Given the nature of these questions, this is not surprising.

Discussion

Experiential learning is becoming increasingly important in university teaching. Hawtrey (2006) suggests that this is particularly true as the mission of universities reflects a commitment to developing more generic student skills and vocational learning. Further, students as customers are demanding a greater level of quality. As most agricultural economics departments are at Land Grant universities, this mission-focus may be even more prevalent.

The DCA approach I discuss here attempts to improve the quality of classroom instruction by engaging students with an experiential learning experience. That does not necessarily mean the approach is ideal or even effective. To that point, there are (at least) two important questions regarding the use of a classroom experience: 1. Does it work? and 2. Why does it work? With regards to point 1, my analysis does not explore whether or not the approach works. The small sample survey suggests a positive experience for the students, but this is not compared to a baseline group. This calls for future exploration into this question.

While I cannot directly answer question 2 either, the survey results again suggest that the DCA approach helped increase students interest in data analysis. Improvements can still be made with connecting the DCA approach to microeconomics. An implication is that this DCA approach may be more appropriate or relevant in an undergraduate quantitative analysis course or a more topical applied economics course. Learning consumer demand theory while collecting data for analysis may be an excessive load for students.

There is room for improvement with this DCA approach. For one, it could help to find a better fitting class for implementing the project. Further, there are numerous *small* details that could make implementation go more smoothly. Clearly, more versions of this approach would help to flesh out additional issues.

Optimistically, I envision many potential applications with this approach. In terms of what data to collect, I focused on FV consumption as it mirrors my own research interests. The DCA approach could easily be constructed to facilitate hedonic pricing models as well. For example, students could

individually or in teams monitor different sets of prices over time and space. This could be for anything ranging from food to housing to gas prices. Given the amount of information available online, an industrious student could easily put together an interesting and worthwhile data set with limited instruction or guidance.

This approach could also be used as an application for an environmental or natural resource course. With some creativity and the benefit of sufficient numbers, an interesting data set could be created and analyzed, allowing students to explore their hypotheses of interest.

References

Dickie, Mark. "Do classroom experiments increase learning in introductory microeconomics?." The Journal of Economic Education 37.3 (2006): 267-288.

Emerson, Tisha LN, and Beck A. Taylor. "Comparing student achievement across experimental and lecture-oriented sections of a principles of microeconomics course." Southern Economic Journal (2004): 672-693.

Hawtrey, Kim. "Using experiential learning techniques." The Journal of Economic Education 38.2 (2007): 143-152.

Litzenberg, Kerry K. "Great teaching: Undergraduate agricultural economics millennial students." Journal of Agricultural & Applied Economics 42.3 (2010): 407.

Spencer, Roger W., and Donald F. Van Eynde. "Experiential learning in economics." Journal of Economic Education (1986): 289-294.

Wilson, Norbert LW, and Robert G. Nelson. "A Laboratory Science Approach to Teaching in the Agricultural Economics Curriculum." Applied Economic Perspectives and Policy 31.2 (2009): 331-343.

Tables

Table 1. Weekly Food Diary Questions

	Questions
1	Over the past 7 days, approximately how many bags of groceries did someone else provide to you? (Check on box onl *0 bags* *< 1 bag* *1 - 2 bags* *2+ bags*
2	From Monday to Wednesday, how many times did you eat at each of the dining facilities on campus? *Location A* *Location B* *etc.*
3	From Monday to Wednesday, how many times did you eat at a restaurant off campus?
4	From Monday to Wednesday, how many times did you buy grocery items on campus?
5	From Monday to Wednesday, how many times did you buy grocery items off campus?
6	From Monday to Wednesday, how many hours did you spend doing any kind of exercise? This includes cardio vascular exercise, lifting weights, playing sports, etc.
7	From Monday to Wednesday, how many days did you feel physicially ill such as from a cold or fever?
8	From Monday to Wednesday, how many servings of fresh fruit did you eat (see definition of a serving below)?
9	From Monday to Wednesday, how many servings of dried fruit did you eat (see definition of a serving below)?
10	From Monday to Wednesday, how many servings of fruit or vegetable juice did you drink (see definition of a serving
11	From Monday to Wednesday, how many servings of vegetables did you eat (see definition of a serving below)?

Table 2. Fruit and vegetable measurement instructions

Consider 1 cup as the size of a baseball

We define one serving of fresh fruit/vegetables as:
One medium piece of fruit (1 medium apple or orange)
½ cup cut-up raw or cooked fruit/vegetable
½ cup cooked dry peas, beans, lentils
1 cup leafy greens
¼ cup dried fruit or vegetables

We define one serving of dried fruit/vegetables as:
¼ cup cut-up dried fruit/vegetable

We define one serving of fruit/vegetable juice as:
4 oz (1/2 cup) of 100% juice

For more information, go to:
http://www.fruitsandveggiesmorematters.org/archives/16223

Table 3. Class survey results

	Q1	*Q2*	*Q3*	*Q4*	*Q5*
Average	2.95	2.91	2.64	3.10	2.82
St. Dev	0.6454	0.7721	0.8916	0.5865	0.6567
Max	4	4	4	4	4
Min	1	1	1	2	1
Count of 1's	1	1	5	0	1
Count of 4's	7	10	7	10	5
Correlation					
Q1	1.000				
Q2	0.085	1.000			
Q3	**0.334**	**0.356**	1.000		
Q4	**0.381**	0.047	0.073	1.000	
Q5	0.309	0.013	0.282	0.261	1.000

Scoring for Q1, Q3 and Q4:

1. Not interesting, 2. A little interesting, 3. Interesting and 4. Very Interesting.

Scoring for Q2 and Q5:

1. Not at all, 2. A little, 3. A good amount, 4. A lot. The results of the survey are provided in Table 4.