Problem Based Learning in an Applied Econometric Curriculum

by
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Abstract

This paper discusses the introduction of Problem Based Learning (PBL) into a graduate (M.A. level) econometrics curriculum and reports the lessons learned. This paper reports what is PBL, how to implement it, and why it is suitable for learning econometrics. In the particular case discussed, graduate students were formed into two teams of four students each and provided with supportive and enabling technology. Students had to learn to cooperate and collaborate to reach a solution which was reported in a co-authored research paper that was delivered in front of three faculty members for their review. This paper also reports on students' views on the process and on their learning and concludes that PBL is an essential tool for the instructing of applied econometricians.

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Introduction

> *Problem Based Learning "is an instructional (and curricular) learner-centered approach that empowers learners to conduct research, integrate theory and practice, and apply knowledge and skills to develop a viable solution to a defined problem. Critical to the success of this approach is the selection of ill-structured problems (often interdisciplinary) and a tutor who guides the learning process … (Savery (2006, p. 12))."*

Outcome goals of the econometrics curriculum at the master's level are different than that at the doctoral level. In the later case, students learn econometrics for futures in scholarly research and most curriculum focuses on the theoretical advances most current in the literature. Masters

students need to be prepared for careers in applied econometrics and the ability to do economic analysis in a variety of employment settings.

These practitioners of econometrics need guidelines to do applied work (Kennedy (2002)) and to know what to do if they get the wrong sign (Kennedy (2005)). They often need these more than the high level theory and the latest technique. The students that enter the real world must master the art of applied econometric research much more than the fringe advances in the science of theoretical econometrics. Students will be called on by their bosses to conduct empirical research on ill-structured problems that will require them without the aid of professor or of school-support to not only solve the problem, but often to define what that problem is before they can begin. Problem Based Learning is a method of instruction that prepares students for that real world experience and causes them to learn how to do research. What's valued in the market place for research is authentic learning about real world, thorny, ill-structured and ill-defined problems.[1]

Authentic applied econometrics may be more difficult to teach than theoretical econometrics. It is the application of econometrics with authentic problems that economic students need and employers desire. Peter Kennedy (Guide to Econometrics, 5th, Chapter 21, pp 389-90) posits principles of learning applied econometrics. Classical and theoretical econometrics concentrates on estimation and inference, and while essential, the skills of a good applied econometrician go beyond rigorous mathematical and statistical techniques, and beyond typical computer projects and problem solving skills (see Table 1). Kennedy's Guide to learning applied econometrics emphasizes three pillars of problem articulation, data cleaning and model specification. It also includes sections on the ten commandments of applied econometrics, what to do if you get a wrong sign, a list of common mistakes and what every practitioner should know. The Guide is a perfect accompaniment for a PBL exercise and from day one, the students were focused on the applied econometrics chapter and Kennedy's three pillars.

[1] See Windham (2007) for a discussion of why students value authentic learning, which builds on the concept of "learning by doing" and has students move beyond simply playing a role. Muller (2005) approaches the same authentic learning from an assessment approach. One of the characteristics of authentic learning is the desired outcome creates the curriculum, rather than the more traditional curriculum that tests what it teaches.

Table 1: Theoretical and Applied Econometrics

Theoretical Econometrics (classical)
■ Estimation
■ Statistical Inference
Applied Econometrics (Kennedy)
■ Problem Articulation
■ Data Cleaning
■ Model Specification

Source: Kennedy (2003), Chapter 21.

PBL with quality problems defined on these three pillars gives students an opportunity to get involved with ill structured problems and dirty data and most importantly, to learn how to learn and perform econometric research. [2] Research shows that students using PBL learn more (Mergendoller (2006) and have better problem solving skills. Arts (2002) show that at Maastricht University, students in Business and Economics had higher cognitive gains over traditional PBL classes when computers were used to support student collaboration on problem solving and information delivery. A reading of Savery (2006) shows the results of research on student learning to be mixed, but he clarifies that PBL, when properly designed and applied, rejects a "naïve view of the rigor required to teach with this learner-centered approach." Stinson and Miltner (1996) report on a successful masters (MBA) program based totally on problem based learning and comment on the problems of comparing traditionally-taught with authentic based curriculum. Thus, the jury is still out on its effectiveness and casual evidence of its effectiveness is evidenced by how many institutions of higher learning are adopting PBL.

Critical to the success of PBL is the use of ill-structured, but authentic problems, a tutor who guides the learning process, provides needed scaffolding and who conducts a thorough debriefing at the conclusion of the PBL experience.

In PBL, teams of students are used to explore an ill-defined problem in economics. These teams have to go through the growth stages of forming, storming, norming and performing. These teams grow from a forming team with high enthusiasm and little skills into a high performance team in order to collaborate on a high quality research study. One critical component of PBL is the tutor's role of coaching and mentoring of the student teams through the storming and norming stages of team development. The role of the professor or instructor is to be the tutor, knowing when to be a guide on the side or metacognitive coach and when to provide the scaffolding needed for the individual teams to succeed. This is hard for instructors raised in the

[2] In a communication with Peter Kennedy he indicated he has been keen on PBL for a long time, but indicates the writing of a quality problem really hard.

chalk-and-talk world and not altogether easy for those who have been using active learning techniques in their classes. Piggott (2005) found this role of the tutor to be not unlike the role of a seminar instructor at first. At Maastricht she saw an impressive demonstration. Quoting her

> *"The 'conservative' in me felt the tutor took a back seat a little too much. I expressed concern over the fact that the students, to my mind, had missed a major point of definition which caused confusion in much of the discussion, yet the tutor did not step in. The tutor did not see it that way. … acting as a tutor to the group showed it is very hard to achieve the correct balance between too much intervention and too little."*[3]

When the outcomes are ill-defined, learners need to set their own goals. In Kennedy's terms this is the skill of problem articulation, that is, the student team members have to take the defined problem and then articulate the goals of their research and make a plan to achieve those goals including the discovery and learning of what tools and techniques are necessary for success. The need for students to learn how to research within an ill-defined problem and under a severe deadline is the kind of authentic learning that students need to fulfill the authentic demands of employers.

Mueller (2005) defines authentic assessment (AA) as a means to design the appropriate curricular approach to achieve this authenticity. He suggests that AA is used because it contains direct measures, supports constructive methods of learning, integrates teaching learning and assessment, and provides multiple paths to demonstrate the skills desired. Authentic assessment is student centered and not teacher centered. The curriculum is built backwards from the end result desired and from real life as opposed to contrived tasks. Students are expected to be able to do economics and econometrics after the experience and not just be tested on a set of skills. This holistic approach includes the skills not only across econometrics and statistics, but from the sub-disciplines of economic theory and application areas.

Windham (2007) cites 10 points for authentic learning and Savery and Duffy (1996) show how Problem Based Learning is one of the best exemplars of a constructivist learning environment

[3] The patience and mentoring of over 15 years as a Scoutmaster trying to facilitate boys in being their own leaders and running their own program with a minimal of adult intervention has certainly paid off as I take the role of tutor in the econometric laboratory. It is true that as one ages the most surprising syntheses arise. The group dynamics explained in this article I also first learned in our adult leader training and we teach it to our best boy leaders.

and offer eight principles of instructional design. Piggott (2007) reports the seven-step process of PBL as practiced at Maastricht University in the teaching of economics.[4]

What Problem Based Learning Is Not

There are various learning strategies. Becker and Watts (1996,1998) have discussed the *Chalk-and-Talk* method of teaching which is teacher centered, often using testing that is based on checking students recognition and recall of a set of facts or analysis of problems set forth after motivation and lecture in class. This mostly passive activity is driven from the teacher down to the student and may with the right lecturer and the appropriately motivated students lead to great acquisition of the knowledge desired. However, this is not problem based learning even if problems are presented in class as part of the assignments unless as specified below.

Case-based learning uses examples from the past to study and reflect on the experiences of the economic actors involved so that students can learn the important elements and may be able to forecast the future by knowing the past. This is not problem based learning.

Project-based learning is typically used in econometrics. Students have to undertake projects that have explicit outcomes and a desired end product. The correct answer is known by the instructor or (s)he will know the correct answer from the correct process being used. The teacher in this case is the arbitrator of whether the outcomes are correct and based on a correct process. This is not problem based learning even if we assign problems for students to complete.

An *inquiry-based learning* has the teacher facilitating the learning such as in PBL, but this teacher is the provider of information to the solution and many times even the solution. As valuable a tool as inquiry based learning, it falls sort of PBL.

What is Problem Based Learning?

Problem based learning exists on a continuum within an experiential learning paradigm. One can find different definitions in the literature, although they are very similar and have similar characteristics. This paper regards PBL in a general sense, not anxious to debate the finer points, e.g., whether collaborative learning groups are "generally" required or "essential." In my case I went with essential, also finding computing support to be essential based on my analysis if what

[4] See Maastricht University PBL website at http://www.unimaas.nl/pbl/

is most necessary to accomplish the desired learning outcomes for a graduate econometric sequence.

Problem based learning has certain definite characteristics. Table 2 gives an overview showing that PBL consists of ill-structured and ill-defined problems. The other characteristic is that there is a practically unlimited amount of material which can quickly make PBL not very useful if the students drown in the content. There are two solutions to this. First, is the use of collaborative groups to share the workload and to learn to form as a high performance team.

Table 2: Problem Based Learning Overview

- Problem Based Learning
  - Ill-defined, ill-structured big problem
    - Authentic
  - So much material
    - Computing essential
      - Tablet PCs
      - DyKnow
    - Collaboration essential
      - Groups
      - Group formation

The second is the use of computers to reduce the costs of acquiring and organizing data. In this case students were given exclusive use of Tablet PCs running Microsoft XP Tablet PC edition with MS Office.[5] DyKnow Vision collaborative software was used to tie all of the student workstations together.[6] Both collaboration and computing are essential for an effective and efficient PBL curriculum.

PBL consists of messy real-world and authentic problems with no single correct answer. Critical to the success is the selection and quality of those of ill-structured problems…." Stinson and Milter (1996) list four requirements for a good "problem." The problems must target learning outcomes in a holistic manner, be ill-structured, be authentic, and contemporary. The complexity should be appropriate in line with students' development and an appropriate amount of physical and data resources must be available to solve the problem. Teachers are not the lecturer up front and must coach, model good practice and help students generalize.

[5] A Tablet PC is essentially a laptop with pen which allows using the pen or stylus as a mouse and to write with digital-ink within various applications. For information see http://www.microsoft.com/windowsxp/tabletpc/default.mspx

[6] See http://DyKnow.com for information and a demo of this product.

PBL requires a "guide on the side rather than a sage on the stage" and an appropriate role of the tutor (or professor) is to guide and facilitate. The tutor (or professor) must also provide scaffolding where needed in both econometrics and group dynamics. Scaffolding is the platform on which the students can build. If the student has never experienced maximum likelihood analysis, a problem that will require that tool may seen insurmountable. To that end the tutor may introduce maximum likelihood precisely because he or she knows that scaffold must be in place for the collaborative groups of students to be successful.

This paper adopts the PBL definitions of Savery (2006):[7]

1. Students must be responsible for their own learning
2. The PBL "problem" must be ill-structured problems and allow for free inquiry
3. Learning is integrated across a wide range of disciplines and even across sub-disciplines in economics.
4. Collaboration is essential and without teams you do not have a PBL process
5. Students self-learn and apply this to the problem which leads to reanalysis and resolution
6. A closing analysis of what has been learned must occur
7. Self and peer assessments are used
8. Authentic tasks, valued in the real world, are required
9. Measurement of student progress in knowledge and process.
10. Must be integral to the curriculum

The Econometrics Curriculum and Problem

Our master's students are required to take a two course sequence in econometrics. The first is a course in statistics for econometrics culminating in a final data project using multiple regression and multivariate statistical inference. In the second econometric class, used as a case for this paper, students are expected to meet certain standards among which include what they should know, what they can do and what they can be.[8] Above all students are expected to be able to "Do Applied Econometric" analysis as well as any student in any other program. After all, graduating competent and proficient economic analysts is the bread and butter of our terminal masters program. I extol them to remain economists first, econometricians second and computer programmers last. Getting that out of order leads to disaster in analysis. So too they need to

[7] See Savery (2006, pp. 12-14) for the exact wording and explanation of each.
[8] This Know Be Do trichotomy is from Army Leadership (2002).

think of theory first and data mining last, but be clearly competent in the use, interpretation and manipulation of data. To do all of this they need to understand and use the latest technology, develop problem solving skills, and learn how to learn to be continual learners responsible for their own learning. They need to be able to cooperate and collaborate in teams and learn strong presentation and communication skills. These are the goals of the graduate econometric course and require a curriculum that will allow those desired outcomes to be achieved. In this way they will be sought after by employers.[9]

The curriculum has students produce a series of products that will assist in accomplishing these ends. In particular, professional writing is emphasized in that all of the exercises are to be written up as stand-alone professionally written reports and collected in a portfolio. All students are required to present in class, in a public poster session and the best at regional conferences.[10]

In almost all econometric courses a research paper is required. In our case this paper is for a year touted as their job market paper. In addition to the requirement to write a job market paper, there are 8 assignments all leading to and preparing for the final PBL assignment which is discussed in this paper. The first two are to outline Kennedy's applied econometrics chapter (ch. 21) and to find an applied econometric paper in the literature and write a précis which they orally present to the class. This happens in the first week and by the end of the second week we have highlighted all of the important points (albeit it at a high overview level) in Kennedy's applied economics chapter and the students have heard reports on the econometric problem articulation, data cleaning and model specification of 'n' different papers (where n is the class size). The third and fourth assignments have the students work though a series of problems from the text with SAS computer solutions required and an exercise on replication of a consumption function learning about the temporal and vintage aspects of time-series data using the FRED data base.[11] The fifth assignment has the students work the multiple regression model in matrix notation and to mark-up a SAS output noting every matrix formula. These are concluded about the 6th or 7th week.

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[9] On the day this paragraph is being written our department held a career day with five alumni returning to tell the tale of their job market experience. Much of the qualities listed as desirous for graduate econometric students above were explicitly mentioned in the alumnae talks and in the Q and A session. Specifically they were asked about the importance of PBL and while none knew the term, each supported as critical the elements, especially being able to understand ill-structured problems, working in teams and communication skills.

[10] Of the 8 students in the highlighted class, two have had their papers accepted for presentation at a regional economic association conference.

[11] SAS is a trademark of SAS Institute at http://sas.com FED is the economic databank at http://research.stlouisfed.org/fred2/.

The next assignment is a multisource data project and presentation. Students individually choose a multivariate topic that requires the downloading of at least three different datasets in at least two formats that must be managed in Excel and merged in SAS for analysis. The results are written up as a short paper and students present the results to the class with the class assessing each other. About this time (and around the 9th week) the collaborative groups are formed for the PBL assignments. Another assignment is to exercise the various maximum likelihood estimations which are required to do well on the PLB exercise.

While the PBL came in the last 6 weeks. Everything in the class was designed to complement and make this successful. For example, the individual act of working on a job-market paper and a multisource data assignment sharpens skills for the successful solution to the PBL exercise and vice-a-versa.

The first time I tried PBL was in Spring 2006. I put the students in a data container, that is I assigned the problem based on using the National Longitudinal Surveys of Youth (NLSY).[12] I placed this restriction since part of the learning outcomes is to get students experienced with a large micro dataset. However, I felt most students chose topics that were safe and did not stretch to learn the next level of econometrics. The problem was too general and not directive enough and the topics chosen were similar to what was done in the previous class. So in spring of 2007 I required the data container (still NLSY) and put them in a topic container as well by the expression of the "problem."[13] The problem is shown in Table 3. On reflection, the problem met most, but not all criteria for an ill-structured problem. On the one hand, the problem sounds quite structured, but I argue now as then that the ill-structure comes from the complexity and the messiness of solving that problem. At the time the problem was given the students had not had experience via lecture, demonstration or assignment of maximum likelihood methods so the solution of this problem would take a lot of student self-learning. In the final weeks I gave some scaffolding in maximum likelihood, but the students had to learn probit, tobit and their application to simultaneity and selection problems on their own. One student was reflective on

[12] See the NLS webpage at the Bureau of Labor Statistics at http://www.bls.gov/nls/

[13] I first tried this in 2006 with three teams, but no technology support. The 2006 teams were not given a topic container, only a dataset container. That is, they were to find their topics from the richness of the provided data. This worked with mixed success where some groups retreated to the comfortable and known areas. Topics included papers on "The Model Student," "Are Cocaine and Marijuana Normal or Inferior Goods?" and "Does Color of Skin Matter in Educational Attainment." In 2007 they were given both a dataset container and a topic container. Papers were "Student and Non-Student Labor forces: Decision Making and Job Market Participation" and "School, Work, or Both? An Analysis of Student and Non-Student Labor Markets"

this in the final evaluation saying that while he was frustrated that the professor had not presented the Heckit procedure, he knows that having to learn it in the context of the problem meant more and such knowledge would stay with him longer.

Table 3: The Spring 2007 PBL Problem

Student labor markets are thought to be very different from non-student labor markets. Students' time allocation is divided between work in the market, work in the home, class time, study time and leisure. Hours of work are chosen on a utility function depending on more than the market wage and non-labor income as shown in the Lionel Robbins Labor Supply model. *Define the influences on students' work choice and estimate the probability of enrollment, the hours of work supplied, and the wage rate for student labor and compare to the non-student labor market. Be sure to use appropriate estimation techniques and to understand and control for endogenous and selectivity issues where important.*

Role of technology in facilitating the effectiveness of Problem Based Learning

The task facing students in a PBL assignment at the graduate level can be one that overwhelms and paralyzes. This course made use of technology as a means to overcome some of the problems with PBL. I had decided after the 2006 course to "up" the technology support in 2007, but I do not think I could fully articulate why it was needed and why it seemed to work so well until shortly after the course concluded in May 2007. I also discovered "Using Multimedia to Overcome the Problems with Problem Based Learning" by Hoffman and Ritchie (1997). They recognized that multimedia could overcome certain limitations and I began to wonder how computing could be enhanced to meet my needs. Maxwell (2004) has argued that combining computer simulations and problem based learning enhanced the value of each. The use of computing in that case "helps student and teachers to sift through the overwhelming complexity that can arise in a more pure PBL. (abstract)" Sifting through the complexity was exactly what was needed.

Thanks to a grant we were able to assign each graduate student exclusive use of a Tablet PC for the last 6 weeks of the term, the time that perfectly corresponded to the PBL assignment. With each student having a Tablet PC, the professor can collaborate via scaffolding and guiding and coaching sessions using the DyKnow Vision software. This program allows each student to

receive any notes from the professor in real time and to ink on them or to keep private notes on the side. Polling the students and presenting the results is easy, and panel submission from students allows for lots of questions to be asked and answered in very short order, sometimes live during the class time. This introduced 1:1 computing to the department of economics for the first time.

While many studies of deployments of Tablet PCs have begun to emerge especially as reported in Berque (2006) and Prey (2007) there are none in econometrics and statistics especially at the graduate level.[14] Problem based learning strategies are appropriate for the teaching of econometrics. The use of the Tablet PC in mobile learning environments further enhance the value of this pedagogy to cause students to think critically and learn to perform in authentic tasks. Indeed authentic problems require access to real data, scholarly work and other resources. The computer access granted the students allow this. Replication is assisted by computing power. The exclusive use of the Tablet PC computer gives time on task, equalizing the playing field and allows anywhere anytime work to overcome the initial discomfort of PBL and the sudden freedom of inquiry. On just the second day after the problem was assigned and the Tablet PCs given I noticed a real increase in student engagement. [15]

The Tablet PC computer gives 24/7 access to professor and other teammates. It means there is always time to exercise the lack of skill and help overcome not knowing where to begin. The Tablet PC gives greater flexibility when learning is not linear as in these problems. Pen-based markup programs allow brainstorming sessions to be captured and shared. Digital ink is essential for the trading of equations and graphics.

Assessment both summative and formative is more difficult in PBL. PBL requires greater student time. Tablet PCs especially with DyKnow Vision allow minute papers, anonymous polls, monitoring of understanding, quizzes and replays. Students have a better set of notes accessible from anywhere on the internet. Collaboration is costly and the Tablet PCs help reduce the cost and improve the group dynamics by assisting communication and the sharing of documents especially with handwritten and hand drawn annotations. Finally, PBL requires the

[14] See Dixon, et al. (2006, 2007). They also us DyKnow Vision software and have evaluated the Tablet PC in the economics undergraduate curriculum.

[15] My blog at http://learnecon.blogspot.com/econometrics chronicles the experiment in a diary fashion. The phrase 1:1 computing refers to the professor and every student having a Tablet PC and joined in a collaborative session.

professor be a guide, not a sage. Nevertheless, the professor needs to provide scaffolding at which DyKnow Vision excels by giving each student a unique set of notes that combine the transmission of the professor's screen with the inking and typed comments of the student on theirs.

Group Dynamic Essentials for Problem Based Learning

One of the most difficult parts of the 2006 PBL assignment was the failure of the groups to truly collaborate. The groups either were stitched together with everyone's individual effort not vetted by the other members of the group, or they broke down into dominator take all, with heavy free rider traffic. PBL requires that self-assessment and peer-assessment be used and this was done in both 2006 and 2007. In 2006 it simply documented the failures; in 2007 it seemed to document the successes. The differences included the recognition by the tutor to use more formative assessments as the course PBL unfolded and the better collaborative computing environment. While the small samples of two classes is not enough to describe a causality, I believe that it was the explicit introduction of the high-performance team model that helped the students know what they were going through and that conflict was normal and helped the professor know when to guide and coach, when to dictate and when to step away and let them work.

This high performance team model shows the stages of group development and the appropriate role of the tutor (see Table 4). When beginning a PBL and forming a new group the enthusiasm of the students is often rather high anticipating the tasks ahead, but the skill level in a well designed PBL will be rather low and represent only scaffold level skills on which the needed skills can be built. The

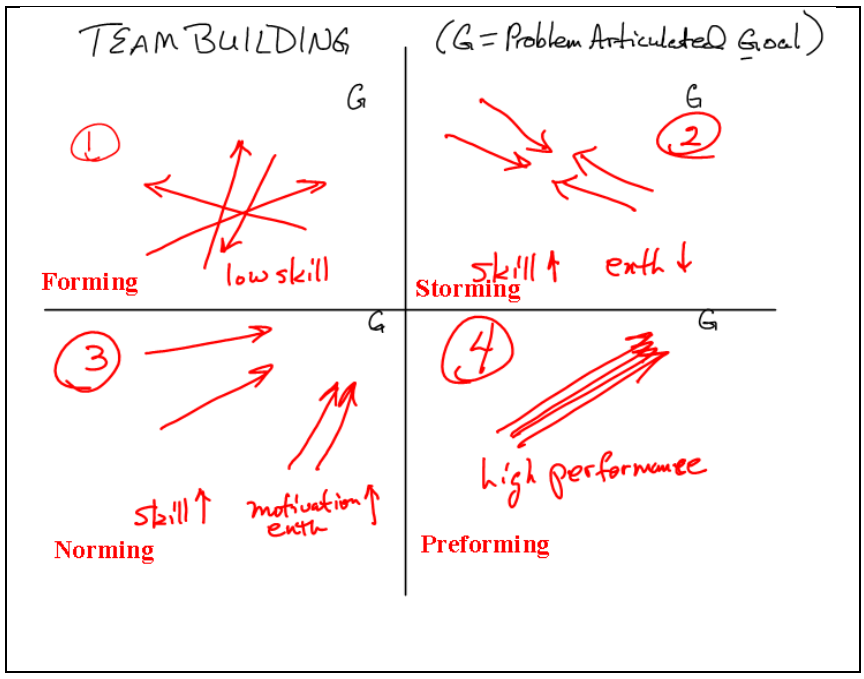
Table 4: Stages of collaborative group formation and the role of the tutor

Stages	Commitment / Enthusiasm	Competency / Skill level	Tutor Style
Forming	High	Low	**Directing**
Storming	Low	Low	**Coaching**
Norming	Variable	Moderate+	**Supporting**
Performing	High	High	**Delegating**

Source: Blanchard, et al. (1986, 2000) and Tuckman (1965)

role of the tutor in this case is very dictatorial while the requirements and descriptions and explanations of the PBL are laid before the students. I described group dynamics to the students in an electronic whiteboard session as shown in Table 5. In the formative stage each member (illustrated by an arrow) is focused on something that is not common and is certainly not the goal (illustrated by a G) of the assignment which is not yet defined and remains too ill-structured. The tutor must be up front of the group, dictating and explaining to the students. This is not a telling of how to solve the problem nor even how to articulate it, but to make sure the students understand the task and answer their initial queries in ways that directs them to work and not to a particular solution. The ideal role of the tutor is the delegation that Piggott (2005) described and the tutor should slip into that role immediately, but there are two other stages before the team is high performing.

Table 5: Whiteboard Illustration of Group Formation



Source: Blanchard, et al. (1986, 2000) and Tuckman (1965)

The storming stage is very common and some groups can never move past it. As students begin to get their arms around the problem and start developing the skills to solve the problem, all too often the focus of the group members is on each other and not on the common goal. That is, the focus on each other remains so strong as to obscure the goal. 'He didn't do his part' and 'she thinks she has the only good ideas' and worse, are heard as the group is in full storming mode.

The tutor role in this stage is critical and requires coaching the students while being careful to use conflict resolution skills that help and do not take sides or alienate members of the group. In a whiteboard illustration I show the tutor-coach in the middle of a huddle. No one has their eyes on the goal and enthusiasm for the problem, the course, the professor and more is crashing. Any evaluations done here reveal very hard feelings. The tutor must coach well to get them though it. The coach is in the middle of the huddle temporarily precisely because the tutor-coach needs to capture their attention, take the students focus and coach them into moving the focus off of each other and towards a common goal. In each step, the coach must not take sides or proffer a right answer, but in this case taking sides is ill-advised. Questions like 'how is this helping you achieve your goal,' 'what is your goal and how can you attain it' are helpful. Again, the tutor must resist the impulse to tell them they are on a right track or completely on a wrong track. The tutor must coach them into creating a focus on a common goal and not each other.

As the team focuses on the goal (and at least not on each other) the tutor's role shifts to become their guide. The tutor-guide seizes on the students own rising skills and increasing motivation to help the group focus on the goal. The guide never tells what the goal is, nor does the guide have any right to ursup their goal setting. Rather, the guide assists the student group members to ask the right questions and to begin to develop their norms about the goal. Since the students have their goal in mind, the tutor can help guide them to discover resources and answers to their questions so that they not only achieve their goal, but they do it to the best of their abilities.

As the team enters the final stage (and they may cycle non-linearly through these fours stages) the common goal is in focus and all are in agreement on how to get there and to solve their problem. The role of the tutor is to let the team work on their own with no intervention. The tutor-delegator monitors the group to see if they are slipping out of the performing box, but needs to do nothing more than to enjoy the ride. Student teams in this last box are considered high performance teams and no problem is too hard for them to accomplish.

Evidence of effectiveness of Problem Based Learning

Teams were formed in the ninth week of classes and a self assessment of the class was conducted before giving out the exclusive use of the Tablet PCs and before introducing the PBL assignment. This assessment asked a lot of questions about the course, the professor, the

technology in place and more. This ninth week assessment is attached to this paper. Once the ninth week assessment was completed a student walked it to the department chair who kept it until after the course ended so as to avoid bias.

At the end of the course and after the problems were completed following the 15th week, a second comprehensive assessment was completed. Again, this was held by the department chair until after grades closed.

The primary evidence was the creation by each team of co-authored papers and an accompanying PowerPoint Presentation. Grades were assigned to both the papers and the presentations. Each team presented their results in front of three faculty members who graded the students using a rubric based on the presentations. Only the course professor graded the papers. Grades are not discussed here since there is no control group and the sample is so small. Nevertheless, both the content grades and the presentation grades were quite good. From that approach alone the PBL was a success. Each student now had a respectable collaborative paper to combine with their individually produced multi-source data paper and their job market paper as they graduate.[16]

Results:

The results of the PBL are from the comparison of the assessments done at the 9th week and the 15th. The students are their own control group. The ninth week student is one who saw only the instructor use a Tablet PC and at that point had no knowledge what was the next assignment, nor did they know they would be in groups or be assigned exclusive use of a computer Tablet PC.

Table 6 shows comparisons of the most relevant of the questions for this paper. Questions 21 through 30 are quite revealing and make me confident that the PBL experiment has been a success. Students report that they feel they are learning econometrics at a higher rate (although it is 6 weeks further along so they should). There is a large increase in the students perception of their ability to articulate a problem and to collect and clean data. They report a large increase in their ability to learn new econometric methods on their own, and they report being better able to do statistical hypothesis testing.

[16] To build the understanding that these three papers are interlinked, I would suggest to each student that they could tell an employer, I can work with data, large and small, from multiple sources, do independent research and research collaboratively with a team. Hand the employer your portfolio and say 'hire me.'

Lessons Learned

This paper highlighted the second attempt at a problem based learning curriculum and the first with a technologically heightened collaborative environment. Some of the lessons learned are:

1. PBL is hard to implement and I remain confident it is the right way to prepare MA students for jobs as economic analysts.
2. Future implementations should introduce PBL sooner and use multiple opportunities to develop critical thinking and problem solving skills. In Fall 2007, I introduced PBL into the first graduate course with a very general problem. This may set up the entire course of Econometrics for a better result, but that remains to be seen.
3. Problems need to be better and continually renewed. In the first year my problem led students to minimize, in the second the problem was too constrained. I take comfort from Stinson and Milter (1996) that after 11 years they still find this difficult.
4. The faculty member's role as tutor during the various stages of group dynamic formation is hard precisely because it is hard to recognize the stage of development without being too involved. Being too involved is stifling on the group's creativity (because they just want answers). The balance is hard.
5. Faculty that attempt PBL need training. Faculty need not only learning theory, but one or more mentors of the process to help guide the tutor through the dynamics. I think this especially important in the creation of problems.

Conclusions

If it weren't for dirty data, economists would not have jobs

Zvi Griliches

Perhaps the example herein and the results reported and the lessons learned will encourage more faculty offer authentic constructivist challenges to their students focusing more on what the students learn and how they learn than on teaching a set of content. The process while not easy can be easily transferred to other courses beyond econometrics.

This paper has described how PBL in a graduate econometrics curriculum can pay off by allowing students to be better prepared to engage in further research, both in school and on their new jobs. Students report very high marks for being able to work and learn collaboratively with their fellow students and they take responsibility for their own learning. What more can a professor ask?

Table 6: Spring 2007 Student Perceptions of PBL

	9th week	15th week	Difference	
	mean	mean	t-stat	Sig.
Q16. My learning of econometrics is enhanced by Lecture	3.63	4.25	0.80	
Q17. My learning of econometrics is enhanced by Demonstrations	4.25	**4.50**	0.54	
Q18. My learning of econometrics is enhanced by Student Presentations	4.38	**4.50**	0.31	
Q19. My learning of econometrics is enhanced by Discussion of Student Presentations	**4.63**	**4.88**	0.68	
Q20. My learning of econometrics is enhanced by Group Work	4.38	**4.63**	0.62	
Q21. I feel I am learning how to do econometrics	4.13	**4.75**	2.40	**
Q22. I understand econometric method	4.00	4.38	0.71	
Q23. I have the ability to articulate a problem clearly	3.75	**4.88**	3.18	***
Q24. I have confidence in my ability to collect and clean data	4.00	**4.63**	2.70	***
Q25. I understand classical statistical hypothesis testing	3.88	**4.50**	1.67	*
Q26. I believe I communicate well	3.75	**4.50**	1.33	
Q27. I actively participate in classroom discussions	3.63	3.75	0.19	
Q28. I believe I am capable of learning new econometric methods on my own	3.38	**4.63**	2.66	***
Q29. I work and learn collaboratively with fellow students	4.38	**4.75**	1.21	
Q30. I am responsible for my own learning	4.38	**4.75**	1.21	
Note the sample size is n=8 and these results can only be suggestive and not definitive. Scales are 1-5 with 5=strongly agree. Means in bold are those indicating 4.5 out of 5.0 or better. * .10 ** .05 *** .01				

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3250:627 Econometrics, The University of Akron, Spring 2007
Dr. Myers

Assignment #8
Research using the National Longitudinal Surveys of Youth
A Problem Based Learning activity.

This is a group assignment which is cooperative within groups and competitive among groups. This is a messy, real world and complex problem without a single correct answer. Remember econometricians are masters of taking messy real world problems and using their skills to come up with creative solutions.

This exercise is a learner centered approach to real world econometric research that empowers the group to conduct research, integrate theory and practice, and apply knowledge and skills to develop a viable solution to a defined problem. (definition liberally taken from John Savery)

This assignment challenges you to

1. think critically to analyze and solve a real world problem,
2. find, evaluate and use appropriate learning resources
3. work cooperatively
4. demonstrate effective communication skills (both verbal and oral), and
5. use content knowledge and intellectual skills to become continual learners.

The problem

Student labor markets are thought to be very different from non-student labor markets. Students' time allocation is divided between work in the market, work in the home, class time, study time and leisure. Hours of work are chosen on a utility function depending on more than the market wage and non-labor income from the Lionel Robbins Labor Supply model.

Define the influences on students' work choice and estimate the probability of enrollment, the hours of work supplied, and the wage rate for student labor and compare to the non-student labor market. Be sure to use appropriate estimation techniques and to understand and control for endogenous and selectivity issues where important.

Deliverables:

In a file folder named NLSY on the recorders' submission space please submit:

by Sunday April 1 (6:00 PM):

- UAnetID_NLSY_proposal.doc --- Please make this proposal as complete as possible and conclude with an assessment of what needs to be done including what questions need to be answered before you can succeed.
- During the week of April 2, each group will schedule a conference with the professor to report on your progress and to discuss the research.

By Monday April 16 (before class):

- UAnetID_NLSY_firstdraft.doc – this extends the research proposal and shows completeness of the literature review and model building. Some results are presented, but final estimation and conclusions are not expected. This document will be shared with the other group.

by Wednesday April 25:

- UAnetID_NLSY_finalpaper_optionalwords_n.sas --- a SAS code file or files that include(s) all SAS code used in the project and appearing in the final paper.
- UAnetID_NLSY_finalpaper_optionalwords_n.doc --- a professionally written paper, jointly authored by the members of the group.
- UAnetID_NLSY_finalpaper_optionalwords_n.ppt --- the PowerPoint slides for presentation to the class.

You many include other files, but these are required. You may omit the optional words or include your own identifier. The last 'n' is for you to indicate replaced versions, that is file2.doc is graded instead of file1.doc since it is received by the deadline and indicates that you made adjustments to the file you want graded.

This is a group activity:
Form groups for this assignment of 3 to 4 persons. Elect one person who is the reporter for the group. This person may or may not be the "leader" but will conduct the conversations on behalf of the group with the professor, will lend their UAnetID to the project (for purpose of identity), and will present the results in class.

You are to use the NLSY from either the 1979 or the 1997 panels.
Main data page: http://www.bls.gov/nls/
Note the data is free and can either be downloaded in total to the server or built by downloading using the online NLS Investigator.

To familiarize yourself with the data, start with reading through the User guides.
NLSY97 2003 Guide to Rounds 1-5: http://www.bls.gov/nls/97guide/nls97usg.htm
NLSY79 User Guide 1979 – 2002 http://www.bls.gov/nls/79guide/nls79usg.htm

To review literature make sure you completely search two places:
- The NLS annotated bibliography at http://nlsbibliography.org/
- And EconLit which can be found from this page (http://www2.uakron.edu/library/alphalist.asp#E) and this URL may get right to it but I do not know if it is stable (http://www2.uakron.edu/library/stat.asp?r=119&p=85).

A few examples of NLS research:

Some of these are on the E drive in the Data folder. Not all are directly related to your problem.

Charles Link; Edward Ratledge; Kenneth Lewis. Black-White Differences in Returns to Schooling: some New Evidence, *The American Economic Review*, Vol. 66, No. 1. (Mar., 1976), pp. 221-223.

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Hoffman, S. D. , Link, Charles, R. Selectivity Bias in Male Wage Equations: Black-White Comparisons, *The Review of Economics and Statistics*, Vol. 66, No. 2, May 1984, 320-324.

Griffin, P. (1996). Evidence on Omitted Variable Bias in Earnings Equations. *Economics of Education Review*, *15*(2), 139-148.

Steps to a solution: (learn to brainstorm)
- Define a problem and articulate it.
- Set the goals of the research.
- Review the literature and cull that literature for previous findings and good models to emulate.
- Access the data and clean it.
- Specify a model that will allow for the testing of the research question.
- Perform adequate econometric estimation to answer or shed light on your question.
- Draw proper conclusions.

This assignment is dynamic:
I may add to this assignment further explanation as questions arise. Please send your emails from your reporter to me about this assignment and I will try to answer them as soon as possible.

Assignment #8
Research using the National Longitudinal Surveys of Youth
A Problem Based Learning activity.

Presentation rubric

Team being evaluated		
Evaluative Criterion	**Traditional Research**	**Your Score 1-5 five is highest**
Clear Goals Problem is Articulated well	Introduction and statement of research question (What are you looking for, why should anyone read the paper?)	
Economic Story	Theory development (A general application of economic reasoning and a generalized economic model for your topic of research.)	
Adequate Preparation through Literature Review	Should be "enough" for an assignment at this point in the course; should use primary resources; describes the existing knowledge base.	
Econometric Modeling	Model development (Detail of the econometric model necessary for the research. In some cases this is a detail of multiple models or a progression of models.)	
Appropriate Methods / choice of estimation technique	Some evidence of moving from simple to complex as the problem warrants.	
Significant Results	Quality of Hypothesis Testing to demonstrate support for the economic story.	
Reasonableness of conclusion		
Overall summary of the paper being presented.		
Evidence of high value collaboration		
Effective Presentation	Author(s) should ensure that their ideas, methodology, and results are presented in clear and well-organized manner.	

Comments:

Department of Economics **UAnetID _____**
The University of Akron
3250:627 Econometrics **March 14, 2007**

Ninth week assessment of learning

This second assessment will not be shared with the professor until the end of the semester and grades are posted.

Study of the Use of a Tablet PC in the Classroom

1. I learn best when the instructor uses a Tablet PC to write directly on a PowerPoint slide or other electronic file type to illustrate the lecture material.
   [ ] strongly agree [ ] agree [ ] neutral [ ] disagree [ ] strongly disagree

2. I am more engaged in the lecture when the instructor uses a Tablet PC to highlight or add material to a projected visual aid.
   [ ] strongly agree [ ] agree [ ] neutral [ ] disagree [ ] strongly disagree

For questions 3 to 5: When my instructor uses the combination of a Tablet PC and overhead projector (as compared to the use of conventional transparency plus overhead lecture or writing on the chalk (or white board)…

3. Visibility of the lecture notes or display is better
   [ ] strongly agree [ ] agree [ ] neutral [ ] disagree [ ] strongly disagree

4. Readability of the lecture notes or display is better
   [ ] strongly agree [ ] agree [ ] neutral [ ] disagree [ ] strongly disagree

5. Lectures are more interactive
   [ ] strongly agree [ ] agree [ ] neutral [ ] disagree [ ] strongly disagree

6. I get a better set of notes because of the technology used in this class.
   [ ] strongly agree [ ] agree [ ] neutral [ ] disagree [ ] strongly disagree

7. Having notes on WebCT is critical for doing well in this class.
   [ ] strongly agree [ ] agree [ ] neutral [ ] disagree [ ] strongly disagree

8. I learn better when my instructor uses the tablet pc and projector than more traditional methods like writing on the white board
   [ ] strongly agree [ ] agree [ ] neutral [ ] disagree [ ] strongly disagree

Comment on the use of the tablet pc by your instructor – you may use the back if necessary.

Course Content

For the next two questions think of 'passive learning' as sitting and listening to lecture or you quietly reading. Think of 'active learning' as actively participating in discussion, feeling engaged with the topic and actually doing econometrics.

9. I believe this course mostly emphasizes passive learning
   [ ] strongly agree [ ] agree [ ] neutral [ ] disagree [ ] strongly disagree

10. I believe this course mostly emphasizes active learning
    [ ] strongly agree [ ] agree [ ] neutral [ ] disagree [ ] strongly disagree

11. Overall quality of this course
    [ ] highest [ ] high [ ] neutral [ ] low [ ] lowest

12. Organization of this course
    [ ] highest [ ] high [ ] neutral [ ] low [ ] lowest

13. Professor's ability to present the subject matter clearly in this course
    [ ] highest [ ] high [ ] neutral [ ] low [ ] lowest

14. Level of encouragement and stimulation of student learning in this course
[ ] highest [ ] high [ ] neutral [ ] low [ ] lowest

15. Usefulness of feedback provided by the instructor in this course
[ ] highest [ ] high [ ] neutral [ ] low [ ] lowest

16. My learning of econometrics is enhanced by Lecture
[ ] strongly agree [ ] agree [ ] neutral [ ] disagree [ ] strongly disagree

17. My learning of econometrics is enhanced by Demonstrations
[ ] strongly agree [ ] agree [ ] neutral [ ] disagree [ ] strongly disagree

18. My learning of econometrics is enhanced by Student presentations
[ ] strongly agree [ ] agree [ ] neutral [ ] disagree [ ] strongly disagree

19. My learning of econometrics is enhanced by Discussion of student presentations
[ ] strongly agree [ ] agree [ ] neutral [ ] disagree [ ] strongly disagree

20. My learning of econometrics is enhanced by Group work
[ ] strongly agree [ ] agree [ ] neutral [ ] disagree [ ] strongly disagree

21. I feel that I am learning how to do econometrics
[ ] strongly agree [ ] agree [ ] neutral [ ] disagree [ ] strongly disagree

22. I understand econometric method
[ ] strongly agree [ ] agree [ ] neutral [ ] disagree [ ] strongly disagree

23. I have the ability to articulate a problem clearly
[ ] strongly agree [ ] agree [ ] neutral [ ] disagree [ ] strongly disagree

24. I have confidence in my ability to collect and clean data
[ ] strongly agree [ ] agree [ ] neutral [ ] disagree [ ] strongly disagree

25. I understand classical hypothesis testing
[ ] strongly agree [ ] agree [ ] neutral [ ] disagree [ ] strongly disagree

26. I communicate well
[ ] strongly agree [ ] agree [ ] neutral [ ] disagree [ ] strongly disagree

27. I actively participate in class room discussions
[ ] strongly agree [ ] agree [ ] neutral [ ] disagree [ ] strongly disagree

28. I believe I am capable of learning new econometric methods on my own
[ ] strongly agree [ ] agree [ ] neutral [ ] disagree [ ] strongly disagree

29. I work and learn collaboratively with fellow students
[ ] strongly agree [ ] agree [ ] neutral [ ] disagree [ ] strongly disagree

30. I am responsible for my own learning
[ ] strongly agree [ ] agree [ ] neutral [ ] disagree [ ] strongly disagree

31. My instructor gives regular feed back
[ ] strongly agree [ ] agree [ ] neutral [ ] disagree [ ] strongly disagree

Comment on the course content (use the back if necessary)

Student Computer access

For the following questions enter a percentage for every one of them from 0 to 100% and make sure that they all add to 100%

What % of time do you use lab and graduate student office computers	[	%]
What % of time do you use home desktop computers	[	%]
What % of time do you borrow a laptop computer	[	%]
What % of time do you use your own laptop computer	[	%]
What % of time do you use a tablet PC	[	%]
What % of time do you use other computer resources	[	%]
TOTAL of all the above	[	%]

32 I feel limited in my ability to work outside of this class because of lack of computer resources
[ ] strongly agree [ ] agree [ ] neutral [ ] disagree [ ] strongly disagree

33. I feel limited in my ability to work outside of this class because of lack of time that computer resources are available
[ ] strongly agree [ ] agree [ ] neutral [ ] disagree [ ] strongly disagree

34. My learning would be enhanced if I had a laptop computer
[ ] strongly agree [ ] agree [ ] neutral [ ] disagree [ ] strongly disagree

35. My learning would be enhanced if I had a Tablet PC
[ ] strongly agree [ ] agree [ ] neutral [ ] disagree [ ] strongly disagree

36. If you were provided a laptop to use freely, do you think this would enhance your ability to learn econometrics?
[ ] strongly agree [ ] agree [ ] neutral [ ] disagree [ ] strongly disagree

37. If you were provided a Tablet PC to use freely, do you think this would enhance your ability to learn econometrics?
[ ] strongly agree [ ] agree [ ] neutral [ ] disagree [ ] strongly disagree

38. Do you wish you had a tablet?
[ ] strongly agree [ ] agree [ ] neutral [ ] disagree [ ] strongly disagree

39. I believe that learning to use a Tablet PC would be costly.
[ ] strongly agree [ ] agree [ ] neutral [ ] disagree [ ] strongly disagree

40. Once I learned to use a Tablet PC I believe that my learning would be more efficient.
[ ] strongly agree [ ] agree [ ] neutral [ ] disagree [ ] strongly disagree

Comment on your Computer Access (use the back is necessary)

Department of Economics **UAnetID _____**
The University of Akron
3250:627 Econometrics **May 10, 2007**

Many of these questions (Questions 1 through 31) you have answered before. I am interested in how your answers will differ now that the course is complete. Questions numbered 39 and higher are new.

None of your responses made today or during the term will ever be used in a way to identify you as an individual student. All reporting of these results will be on the entire class.

Study of the Use of a Tablet PC in the Classroom

1. I learn best when the instructor uses a Tablet PC to write directly on a PowerPoint slide or other electronic file type to illustrate the lecture material.
   [ ] strongly agree [ ] agree [ ] neutral [ ] disagree [ ] strongly disagree

2. I am more engaged in the lecture when the instructor uses a Tablet PC to highlight or add material to a projected visual aid.
   [ ] strongly agree [ ] agree [ ] neutral [ ] disagree [ ] strongly disagree

39a. Learning to use a Tablet PC has been costly.
   [ ] strongly agree [ ] agree [ ] neutral [ ] disagree [ ] strongly disagree

40a. Once I learned to use a Tablet PC I believe that my learning was more efficient.
   [ ] strongly agree [ ] agree [ ] neutral [ ] disagree [ ] strongly disagree

41. I believe that having each student and the professor having Tablet PCs has enhanced my learning in a way not otherwise possible.
   [ ] strongly agree [ ] agree [ ] neutral [ ] disagree [ ] strongly disagree

42 . I think having a laptop would add to my learning of econometrics just as much as a Tablet PC.
   [ ] strongly agree [ ] agree [ ] neutral [ ] disagree [ ] strongly disagree

43. I had significant problems with the Tablet PC from a hardware basis.
   [ ] strongly agree [ ] agree [ ] neutral [ ] disagree [ ] strongly disagree

44. Tablets for students should be used in Fall in Statistics for Econometrics.
   [ ] strongly agree [ ] agree [ ] neutral [ ] disagree [ ] strongly disagree

45. Tablets for students should be used next Spring for Econometrics.
   [ ] strongly agree [ ] agree [ ] neutral [ ] disagree [ ] strongly disagree

46. Future students to this graduate program should have to buy Tablet PCs.
   [ ] strongly agree [ ] agree [ ] neutral [ ] disagree [ ] strongly disagree

47. I used my Tablet PC to support my other classes.
   [ ] strongly agree [ ] agree [ ] neutral [ ] disagree [ ] strongly disagree

48. To benefit from use of Tablet PCs and DyKnow students have to have exclusive use of a Tablet PC like we did this term.
   [ ] strongly agree [ ] agree [ ] neutral [ ] disagree [ ] strongly disagree

49. If the Tablet PCs were not assigned to you exclusively, but shared with other students in other classes, and you had to check out the Tablet from the front office each day you wanted to use it, you would have benefited from the use of the Tablet PC as much.
   [ ] strongly agree [ ] agree [ ] neutral [ ] disagree [ ] strongly disagree

Student Computer access

For the following questions enter a percentage for every one of them from 0 to 100% and make sure that they all add to 100%

In the last few weeks:

What % of time do you use lab and graduate student office computers	[	%]
What % of time do you use home desktop computers	[	%]
What % of time do you borrow a laptop computer	[	%]
What % of time do you use your own laptop computer	[	%]
What % of time do you use a tablet PC	[	%]
What % of time do you use other computer resources	[	%]
TOTAL of all the above	[	%]

DyKnow Vision

51. Using DyKnow Vision is enjoyable.
[ ] strongly agree [ ] agree [ ] neutral [ ] disagree [ ] strongly disagree

52. Using DyKnow Vision is stressful.
[ ] strongly agree [ ] agree [ ] neutral [ ] disagree [ ] strongly disagree

53. Using DyKnow Vision enhances my understanding of the course material.
[ ] strongly agree [ ] agree [ ] neutral [ ] disagree [ ] strongly disagree

54. Using DyKnow Vision provides me with a better set of notes.
[ ] strongly agree [ ] agree [ ] neutral [ ] disagree [ ] strongly disagree

55. I am more attentive during class because DyKnow Vision is used.
[ ] strongly agree [ ] agree [ ] neutral [ ] disagree [ ] strongly disagree

58. I prefer class days when we use DyKnow Vision as compared to class days when we do not use DyKnow Vision.
[ ] strongly agree [ ] agree [ ] neutral [ ] disagree [ ] strongly disagree

59. I learn more on class days when we use DyKnow Vision as compared to those days when we do not use DyKnow Vision.
[ ] strongly agree [ ] agree [ ] neutral [ ] disagree [ ] strongly disagree

60. I am more confident during exams when I have studied material from my DyKnow Vision notes as compared to when I have studied from paper notes.
[ ] strongly agree [ ] agree [ ] neutral [ ] disagree [ ] strongly disagree

IIII. Please answer the following questions.

62. What have been the biggest advantages, if any, of using DyKnow Vision?

63. What have been the biggest disadvantages, if any, of using DyKnow Vision?

64. If you were on the team that develops DyKnow Vision, what feature(s) would you add and/or what problems would you fix?

65. Feel free to make any other comments you wish to make below or on the back of this sheet.

Course Content

For the next two questions think of 'passive learning' as sitting and listening to lecture or you quietly reading. Think of 'active learning' as actively participating in discussion, feeling engaged with the topic and actually doing econometrics.

9. I believe this course mostly emphasizes passive learning
[ ] strongly agree [ ] agree [ ] neutral [ ] disagree [ ] strongly disagree

10. I believe this course mostly emphasizes active learning
[ ] strongly agree [ ] agree [ ] neutral [ ] disagree [ ] strongly disagree

11. Overall quality of this course
[ ] highest [ ] high [ ] neutral [ ] low [ ] lowest

12. Organization of this course
[ ] highest [ ] high [ ] neutral [ ] low [ ] lowest

13. Professor's ability to present the subject matter clearly in this course
[ ] highest [ ] high [ ] neutral [ ] low [ ] lowest

14. Level of encouragement and stimulation of student learning in this course
[ ] highest [ ] high [ ] neutral [ ] low [ ] lowest

15. Usefulness of feedback provided by the instructor in this course
[ ] highest [ ] high [ ] neutral [ ] low [ ] lowest

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17. My learning of econometrics is enhanced by Demonstrations
[ ] strongly agree [ ] agree [ ] neutral [ ] disagree [ ] strongly disagree

18. My learning of econometrics is enhanced by Student presentations
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19. My learning of econometrics is enhanced by Discussion of student presentations
[ ] strongly agree [ ] agree [ ] neutral [ ] disagree [ ] strongly disagree

20. My learning of econometrics is enhanced by Group work
[ ] strongly agree [ ] agree [ ] neutral [ ] disagree [ ] strongly disagree

21. I feel that I am learning how to do econometrics
[ ] strongly agree [ ] agree [ ] neutral [ ] disagree [ ] strongly disagree

22. I understand econometric method
[ ] strongly agree [ ] agree [ ] neutral [ ] disagree [ ] strongly disagree

23. I have the ability to articulate a problem clearly
[ ] strongly agree [ ] agree [ ] neutral [ ] disagree [ ] strongly disagree

24. I have confidence in my ability to collect and clean data
[ ] strongly agree [ ] agree [ ] neutral [ ] disagree [ ] strongly disagree

25. I understand classical hypothesis testing
[ ] strongly agree [ ] agree [ ] neutral [ ] disagree [ ] strongly disagree

26. I communicate well
[ ] strongly agree [ ] agree [ ] neutral [ ] disagree [ ] strongly disagree

27. I actively participate in class room discussions
[ ] strongly agree [ ] agree [ ] neutral [ ] disagree [ ] strongly disagree

28. I believe I am capable of learning new econometric methods on my own
[ ] strongly agree [ ] agree [ ] neutral [ ] disagree [ ] strongly disagree

29. I work and learn collaboratively with fellow students
[ ] strongly agree [ ] agree [ ] neutral [ ] disagree [ ] strongly disagree

30. I am responsible for my own learning
[ ] strongly agree [ ] agree [ ] neutral [ ] disagree [ ] strongly disagree

31. My instructor gives regular feed back
[ ] strongly agree [ ] agree [ ] neutral [ ] disagree [ ] strongly disagree

Comment on the course content (use the back if necessary)