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# Economic Instruction

In this section, the *Journal of Economic Education* publishes articles, notes, and communications describing innovations in pedagogy, hardware, materials, and methods for treating traditional subject matter. Issues involving the way economics is taught are emphasized.

MICHAEL WATTS, Section Editor

## Inverting the Classroom: A Gateway to Creating an Inclusive Learning Environment

Maureen J. Lage, Glenn J. Platt,  
and Michael Treglia

Recent evidence has shown that a mismatch between an instructor's teaching style and a student's learning style can result in the student learning less and being less interested in the subject matter (Borg and Shapiro 1996; Ziegert forthcoming). This finding implies that either educational administrators should strive to ensure a good match between the instructor's teaching style and the students' learning styles (a difficult task) or that concerned instructors should use a portfolio of teaching styles so as to appeal to a variety of student learning types. Unfortunately, a majority of introductory economics courses are taught using only one teaching style—the traditional lecture format (Becker and Watts 1995).

The ability of instructors to vary teaching styles in introductory economics courses is seemingly limited by time constraints. If an instructor wanted to lecture for those students who learn best via lecturing, conduct experiments for the experiential learners, give group assignments for the collaborative and cooperative learners, and oversee self-directed study for the independent learners, then he would need to increase student contact time fourfold. However, both the proliferation of students' access to multimedia and the advances in ease of multimedia development for faculty have created an environment where these layers of

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learning can be integrated without inordinately increasing contact time or sacrificing course coverage. We outline a strategy for teaching that appeals to a broad range of learning styles without violating the constraints typically faced by instructors at most institutions. In addition, we present student and faculty perceptions of such a course.

## WAYS OF LEARNING

A wide range of psychological, sociological, and pedagogical literature has documented that student populations are composed of individuals with distinctly different learning styles. Unfortunately, students do not explicitly select classes based on instructor teaching style; nor can the instructors be expected to change their personality types to accommodate all students. Consequently, classes that use a variety of teaching styles are more likely to increase student performance, diversity, and interest in economics.<sup>1</sup> By varying the ways in which it is taught, economics can be made approachable for more types of learners (Becker and Watts 1995, 1996; Siegfried et al. 1991). As Becker and Watts (1995, 699) explain,

Great orators should lecture. The rest of us should consider using a variety of teaching methods to actively engage our students. Variety in the pace and format of undergraduate classroom instruction—across different class periods and even within a particular class—may well be the missing spice of good teaching and enthusiastic learning.

The literature on learning styles and their resulting implications for the classroom contains at least three general systems for classification of learning styles (Reichmann and Grasha 1974; Keirsey and Bates 1984; Kolb 1981). The Grasha-Reichmann learning styles questionnaire (GRLSQ) categorizes students as either dependent, collaborative, or independent learners. *Dependent learners* require a large amount of direction from the teacher, whereas *collaborative learners* work best when learning as part of a team. The *independent learner* learns best when left to his or her own devices. Charkins, O'Toole, and Wetzel (1985) used the GRLSQ in an examination of how students with alternative learning styles performed in economics and how that performance was related to the teaching styles of the faculty. In general, the larger the divergence between teaching style and student learning style, the worse the student's performance in economics and the less positive the student's attitude toward economics. The authors concluded that "instructors who use only the dependent teaching style can improve economic understanding and attitudes toward economics by utilizing other teaching methods" (Charkins et al. 1985, 112).

The Keirsey-Bates categorization of learning styles is based on personality types as measured by the Myers-Briggs Type Indicator (MBTI). The MBTI classifies all individuals along four different personality scales. The scales identify how the individual relates to the world (Introvert or Extrovert); processes information (Sensing or Intuitive); makes decisions (Thinking or Feeling); and evaluates the environment (Judging or Perceiving). These personality traits affect an individual's learning style and preferred teaching style (Lawrence 1993; Keirsey and Bates 1984). Borg and Shapiro (1996) and Ziegert (forthcoming) show that a match between a stu-

dent's and the professor's MBTI classifications results in improved student performance. They suggest that instructors should consider alternatives to the traditional lecture when presenting course material in class.

The third classification of learning styles focuses on how students both take in and process information (Kolb 1981). On the basis of these two criteria, learners are divided into four categories: assimilators, convergers, divergers, and accommodators. *Assimilators* and *convergers* take in information through abstract conceptualization, whereas *divergers* and *accommodators* take in information through concrete experiences. Convergers and accommodators process information via active experimentation, but divergers and assimilators process information through observation and reflection. Researchers employing this theory of learning conclude that students are more likely to major in a field where teaching and learning styles match (Fry and Kolb 1979). The importance of matching teacher and student learning styles within the Kolb framework is emphasized in Bartlett (1997, 148), who argues that

[l]earning styles are like being left- or right-handed. Both hands can perform the task, but one has more practice. There is no justification for teaching introductory economics so that it appeals only to those who are more proficient in a particular learning style, as is often done.

We describe a method of teaching introductory economics that was used at Miami University that can appeal to *all* types of learners. This method uses a variety of teaching styles, although multimedia (in the broadest of definitions) is the cornerstone. As Veenema and Gardner (1996, 72) argue, multimedia presentation of course materials gives "maximum opportunities for students to draw on their own distinctive blend of intelligences, thereby. . . giving them new venues for demonstrating their understandings. . . ." This strategy does not require sacrifice of course coverage relative to traditional methods.

## THE INVERTED CLASSROOM

Inverting the classroom means that events that have traditionally taken place *inside* the classroom now take place *outside* the classroom and vice versa. The use of learning technologies, particularly multimedia, provide new opportunities for students to learn, opportunities that are not possible with other media (Alexander 1995). For example, the use of the World Wide Web and multimedia computers (and/or VCRs) enables students to view lectures either in computer labs or at home, whereas homework assignments can be done in class, in groups. The general principle is to provide a menu of options for the students to use in learning. The instructors focus on the desired outcome (for instance, having the student prepared for discussion) and allow the student to choose the best method to reach that outcome.

As in the traditional class, the inverted class met twice a week for a period of 75 minutes per session. The course material was divided into topics that corresponded to chapters in the textbook. In most cases, one week was devoted to each topic. Students were expected to read about a topic in *Microeconomics* (Arnold 1998) before the first day of discussion. In addition, students were encouraged to

view lectures of the topic being discussed. These lectures could be accessed in a variety of formats. For example, videotaped lectures offered the traditional presentation of the course material. Videotaped lectures were available for viewing in labs, or, if students brought in blank tapes, the university's audio-visual department made copies for home viewing.<sup>2</sup> Alternatively, lectures in PowerPoint, with sound, were available for copying or listening in the School of Business computer labs.<sup>3</sup> The PowerPoint slides covered the same material as the traditional lectures; the sound feature walked the students through the material. For each unit of material, students could also download PowerPoint slides from the Web or purchase a printed copy of the slides. These handouts were often used as the basis for taking notes while watching the videotapes, listening to the PowerPoint with sound presentations, or finding a reference point.

Students were expected to come to class prepared to discuss the relevant material. Instructors started class every day by asking if there were any questions. If a student had not understood something in the book or on the videotape or wanted an additional example, this time provided the opportunity to ask such questions. Student questions generally led to a mini-lecture of approximately 10 minutes. If there were no questions, the instructors would not lecture. Students were informed that their lack of questions would be interpreted as a sign that they clearly understood the assigned material.

After the instructor answered student questions, the instructor and the students would conduct an economic experiment or lab that corresponded to the topic being covered. These economic experiments provided students with an opportunity to see the economic principles in action.<sup>4</sup> The labs consisted of hands-on activities that varied in level of complexity. For instance, a simple experiment consisted of holding an auction for a can of cola. Bidding began at five cents and increased in five-cent increments; count was taken of how many people wanted to buy the can at each price. Eventually, the can was sold to the only person still willing to pay. A simple graph of the data gave the students their first demand curve. A more complex experiment consisted of having the students make peanut butter and jelly sandwiches in a fixed period of time with two knives. By having additional students participate and then graphing the number of sandwiches produced against the units of "labor," production functions were derived. Assuming prices for labor and capital (the knives), the short-run cost curves were constructed as well. This experiment also served as a point of reference for the law of diminishing marginal returns.<sup>5</sup>

The remainder of class time for each topic was typically devoted to worksheets and review questions. The worksheets were simple exercises designed to give students a first pass at the material. Students were expected to have completed these worksheets before attending the first class period on a topic. Often students then got into groups, discussed their answers, and presented their work to the rest of the class.<sup>6</sup> To ensure that students were coming to class prepared, these worksheets would periodically and randomly be collected and graded for completeness but not correctness. The review questions were more difficult. They were specifically designed to have students apply the concepts being discussed. Students would work in small groups on these review questions and then present

their results to the class as a whole. Periodically, a subset of the review questions was collected and graded. The unit was completed in the same way it began, with the instructor asking if there were any final questions.

Given the increased responsibility placed on the student in the inverted classroom, we also created some additional resources that students could use as aids in their study of the material. The course homepage, <http://www.sba.muohio.edu/plattgj/eco201>, provided student access to most of these support materials such as the PowerPoint lectures, assignments, and old exams from the course homepage. In addition, the homepage had an Internet chat room where, during certain hours of the week, the instructors would be available online to answer any questions. The homepage also contained a bulletin board for each section of the course so students could discuss applications of the course material in more detail than class time allowed. The course homepage contained a library of additional (online and offline) resources for students as well as optional, interactive quizzes on each topic for students to test their knowledge of the material.

## STUDENT AND FACULTY PERCEPTIONS

Miami University is a public university with approximately 16,000 undergraduates. The typical undergraduate student is Caucasian, is upper-middle class, and resides either on campus or in nearby off-campus housing. The average age of the incoming freshman class was 18 and, for the middle 50 percent of these students, the combined verbal and math SAT scores ranged between 1110 and 1260.<sup>7</sup> Students typically enroll in principles of microeconomics in the first semester of their sophomore year with little or no prior economics background.<sup>8</sup> Miami University offers approximately 35 sections of principles of microeconomics during the fall semester, with a median class size of 40 students. The 5 sections taught using the inverted classroom were typical in terms of enrollment.<sup>9</sup> There are a number of computer labs across the campus, and all dorm rooms have been wired into the university computer network. We were thus able to assign Internet/computer-based "lectures" with relatively little difficulty.

Two instructors taught principles of microeconomics during the fall 1996 semester using the inverted classroom for the first time. The instructors were a female associate professor with 10 years of teaching experience and a male assistant professor with 6 years of teaching experience. Although the instructors had different personality types, as determined by an MBTI analysis, both rank principles of microeconomics as their favorite class to teach. To a large extent, it did not matter which of the two instructors the students had in class, because all assignments, tests, and exercises were identical in both instructors' classrooms.

The instructors did not formally assess student learning styles. They felt that telling students what types of learners they are and then telling them the best learning tools for that style would be too directive. Students might feel pressured to use a particular method or feel competitive with other students based on these assessments. Given that students came to the class with over 18 years of learning experience, we felt confident that they could choose the method of course content delivery based upon experimentation, lifetime experience, and intuition. It

was clear that students quickly chose a predominant tool that they felt worked best for them. By the second or third unit, most students indicated that they were using specific learning tools predominantly. Some watched the videos repeatedly, whereas others never used them. Some found the group work less than satisfying, but others relied on the group work for understanding.

## Student Perceptions

To examine students' perceptions of the class, the instructors administered an end of the semester survey in all sections of principles of microeconomics taught using the inverted classroom. The survey questions asked of students and the data collected are described in Table 1. The typical student enrolled in the course was a sophomore who had a B average and who expected to get a grade of B in the course.<sup>10</sup> The course had approximately the same number of female and male students.

The majority of students were favorably impressed by the course. For example, the average score for the statements "I prefer this classroom format to a traditional lecture," "I would prefer to take Principles of Macro with this type of classroom format," and "I believe that I learned more economics with this classroom format" was 3.9 on a scale ranging from 1 to 5. Students also had favorable reactions to the peer group-work component of the course. Most students stated that they "enjoyed working in groups," and "learned a lot working in groups, in class," as indicated by an average score for those two questions of 3.7. Examination of the individual components of the group work also showed positive results. On average, students rated the worksheets and review questions 4.1. Similarly, students viewed the in-class experiments as beneficial. The statement "The experiments illustrated basic economic concepts" received an average score of 4.2. It should also be noted that students did not appear to view this type of class as an "easier" class. For example, the average score on the statement "I worked more in this class than my other classes this semester" was a 3.3.

Students' open-ended comments were largely consistent with the numerical scores from the survey instrument. The following are representative samples:

I enjoyed this class very much. I learned more than I ever thought I would in a new, creative, and inspiring way. I encourage this class to be continued in the same way. The instructor might have made my decision easier to major in Econ! Thanks!

The experiments were effective in helping me understand the material. I felt I learned a lot from this class. The video lectures were really good in helping me with the chapters too.

I really liked the demonstrations and the group work—they helped me to really *see* the concepts, much better than a lecture would, and I could better visualize something I'd seen rather than heard—that was a big plus for tests.

As for the class itself, I loved the way it was run! The groups were very effective—it helped to have your peers explain things to you in a different way that sometimes made more sense. Also, it was easier to get to know your classmates and made for a very comfortable environment. I liked the "hands on" approach.

I really enjoyed the class setup and structure. I was a little nervous after the first day of class when we talked about how much responsibility is required for this class, but

it wasn't as bad as I thought. I really enjoyed the labs and worksheets that we do in class because it [they] really helped me understand the chapters. It also really helped as a study-guide for exams. I also like the way the class is sort of informal because it makes me feel more comfortable asking questions.

## Instructors' Perceptions

The instructors' perceptions of the course were also positive. One noticeable benefit was that students appeared to be more motivated in the inverted class-

**TABLE 1**  
**Descriptive Statistics**

Variable	Definition	Female mean	Male mean
Professor	Indicator for gender of faculty; 0 for female and 1 for male	0.385 (0.489)	0.400 (0.492)
Year	Number of years student enrolled at Miami University	2.168 (0.498)	2.075 (0.423)
CGPA <sup>a</sup>	Student's GPA at time of enrollment in principles of microeconomics	3.133 (0.481)	2.983 (0.467)
ExpGrade	Student's expected grade in the course	2.933 (0.716)	2.898 (0.865)
<i>Range 1 (strongly disagree) to 5 (strongly agree)</i>			
Prefer	I prefer this classroom format to a "traditional" lecture format.	3.948 (1.217)	3.853 (1.203)
Learn <sup>a</sup>	I believe that I learned more economics with this classroom format.	4.083 (1.102)	3.745 (1.067)
Macro	I would prefer to take principles of macroeconomics with this type of classroom format.	4.073 (1.216)	3.811 (1.188)
Group-enjoy	I enjoyed working in groups, in class.	3.958 (0.972)	3.811 (0.982)
Group-learn	I learned a lot working in groups, in class.	3.625 (1.145)	3.547 (0.987)
Experiments <sup>b</sup>	The experiments illustrated basic economic concepts.	4.354 (0.680)	4.063 (0.697)
Work-outside	There is too much work to do outside of class for this course.	2.573 (0.981)	2.547 (0.884)
Work-relative	I worked more in this class than in my other classes this semester.	3.440 (1.068)	3.239 (1.039)
<i>Range 1 (poor) to 5 (excellent)</i>			
Worksheet <sup>b</sup>	Worksheet assignments	4.326 (0.736)	3.974 (0.843)
Review Qs	Review questions	4.147 (0.812)	3.989 (0.836)
Lab <sup>b</sup>	In class "experiments" or "lab" sessions	4.063 (0.916)	3.663 (1.088)
ICGW	In class group work	3.719 (1.002)	3.558 (0.964)

Notes: Standard deviations are shown in parentheses.

N = 95 for female and 94 for male.

<sup>a</sup>Indicates statistical difference across gender at the 5 percent level.

<sup>b</sup>Indicates statistical difference across gender at the 1 percent level.

room. One possible explanation for this behavior is that this type of classroom demanded that students take ownership of their learning. Because the flow of instruction was determined by the student, they felt more responsible for their learning. In general, Miami University students are easily motivated by grades, and given the classroom structure, it quickly became clear that they had to work continually and keep up with the material to earn a high grade in the course. Finally, on the first day of the semester, the instructors were clear about the effort required by the students. Students who knew that they would not perform optimally in such an environment were encouraged to change sections.<sup>11</sup>

Both instructors also noted that students generally enjoyed working together and seemed to learn from having other students explain concepts in different ways. An integration of knowledge was clearly demonstrated. For instance, it was common for students to refer to the in-class experiments when writing their exams. In general, students were more comfortable asking questions in class, probably because of the many opportunities for one-on-one interaction with the instructor (as well as the large amount of class time when students were presenting material to the class). From the instructors' perspective, the course was considerably more stimulating to teach. Every day was different and required active involvement with the students. Course coverage was not sacrificed, and there was more time for one-on-one interaction with students in the classroom.

Both student and instructor perceptions indicate some differences between female and male students (Table 1).<sup>12</sup> For female students, the mean scores on the statements "I believe I learned more in this format," and "The experiments illustrated basic economic concepts" were higher than for men in our sample. In addition, on the average, female students self-reported greater satisfaction with the worksheets and in-class experiments. Both instructors also noted that women were clearly more active participants in class than in the traditional classroom.

## COMPARISONS WITH THE TRADITIONAL CLASSROOM

Compared with a traditional "chalk and talk" class (Becker and Watts 1996), it may be that the inverted classroom requires lower student enrollment. One of the strengths of the inverted classroom is the opportunity for faculty–student interaction. This interaction is beneficial in two ways: the student is able to clear up any confusion immediately, and the instructor is able to monitor performance and comprehension. Although we have only taught the inverted class in sections of 40 students, we believe it could be successfully implemented for somewhat larger sections. At some point, however, it would be necessary to modify the inverted classroom for large section size, for example, with large lecture and smaller recitation sections. Alternatively, institutions could employ upper-division undergraduate economics majors to help the instructor facilitate larger sections.

Relative to a traditional classroom, the inverted classroom obviously entails a considerable number of fixed costs. However, these costs were controlled in a number of ways. We used worksheets and PowerPoint lectures that we had developed for our earlier courses. We also used some classroom experiments from Delemeester and Neral (1995), which reduced our costs considerably. However,

it was necessary for us to construct a Web site, PowerPoint with sound, videotapes, and review questions in order to implement this version of the inverted classroom. During the summer, we spent approximately two hours per topic constructing PowerPoint with sound and an additional two hours per topic videotaping lectures. Review questions were largely taken from old exams and hence were relatively easy to construct. The Web site was developed with the aid of a graduate student in communications, who received independent study credit for his work. Presently, software packages such as Microsoft's FrontPage that allow a faculty member to create a Web site for the inverted classroom in one weekend and require little more knowledge than basic word processing. Furthermore, "canned" packages such as Web Class in a Box and Web CT automatically set up Web sites specifically designed for a college course and require little or no knowledge about the Internet.

The fixed costs of developing course supplements may be further reduced. First, work with a colleague to divide the labor. Second, spend some time examining what resources already exist. For example, the textbook study guide could be substituted for course worksheets. In addition, the Web provides an abundance of resources for teaching. For example, at the Web site for this course, all PowerPoint lectures can be downloaded and then modified to an instructor's specifications. Classroom experiments are also available on the Internet.<sup>13</sup> Third, instructors who want to develop this type of course in the future could arrange to have the lectures they are presently giving videotaped. Students in the inverted classroom can then use these previously taped lectures. Fourth, consider soliciting help from students in a university degree program that emphasizes Web development, such as technical writing or computer science, as an independent study project. If an instructor is interested in creating a simple homepage for an inverted classroom with little effort, then he or she might simply create links from that homepage to pages already created by the many other faculty members who are teaching the same material. The World Lecture Hall, Bill Goffe's Page, and the EcEd Home Page are three excellent resources.<sup>14</sup>

Alternatively, one could choose to teach an inverted classroom using fewer supplements than discussed previously. For example, the videotapes, PowerPoint with sound, and PowerPoint handouts are all resources that reinforce the textbook. Although we elected to have these resources available in a variety of different formats so students could choose which ones they wanted to use, it is not necessary to have all these resources. Instead, one could tape one's lectures during the previous semester and only use videotaped lectures to supplement the textbook. This option would not only reduce instructor preparation time but may also be optimal for faculty who teach where there is not ready access to technology. In addition, the instructor could use the reserve desk of the library or a course packet at a copy center instead of the Web as a repository for the course material. The resources and technical knowledge needed to provide the supplements described above are relatively minimal. Students need access to a VCR and the faculty needs to have a rudimentary knowledge of word processing and presentation software. By using previously videotaped lectures, substituting a course homepage with a packet of material, and using worksheets, study guides,

and experiments already available, an instructor could teach a version of the inverted classroom that would entail relatively low fixed costs.

Although the set-up costs of an inverted classroom are typically higher than in a traditional classroom, this format has a number of benefits. First, the inverted classroom allows for an introduction of a large component of group work and active learning into the classroom without sacrificing course coverage.<sup>15</sup> In addition, the marginal costs are lower in an inverted class relative to a traditional lecture format. Although having the same number of contact hours with students, both instructors spent significantly less time “prepping” for each class period during the semester. This reduced preparation time could be attributed to the small lecture component of the course, as well as to the significant amount of work that was completed before the start of the semester.

Moreover, the inverted classroom explicitly allows for students of all learning styles to use a method or methods that are best for them. Links between each of the components of the inverted classroom and various learning styles are illustrated in Table 2. For example, the traditional economics class would appeal to dependent learners through the large lecture component and independent learners through the individual outside assignments. However, a collaborative learner would find little help in such a framework. In contrast, the inverted classroom explicitly incorporates experiments and group work exercises for collaborative learners, while maintaining the strengths of the traditional classroom. In general, students have many opportunities to “see” and experience economics principles through the experiments, collaborate with other students, hear traditional lectures, and further their learning through independent reading and use of the other materials. The students can also develop communication skills and a command over the subject material through small group interaction, the presentation of results to the entire class, and the use of electronic media. The classroom setup, therefore, allows students to learn economics in a way that best matches their preferred learning style.

The results of research that has examined the benefits of using technology in teaching are consistent with the goals of the inverted classroom. For example, Simkins (1999) and Sosin (1997) have addressed the benefits of using the Internet in economics education. Both of these authors suggest that some potential benefits to students of using the Internet in courses include increased participation and motivation, improved potential job skills, and increased opportunities for critical analysis of recent data and policy perspectives. Furthermore, they suggest that the use of the Internet allows for more faculty-student interaction and for increased information-sharing among faculty. Recent work by Agarwal and Day (1998) demonstrates, using the TUCE II, that Internet-based learning technologies (all of which are part of the inverted classroom) have a positive and significant impact on economic education.<sup>16</sup> This body of research, although not directly showing that the inverted classroom can improve learning, does show that there are demonstrable benefits to using the components of the inverted classroom.

The inverted classroom also has important implications for the gender imbalance reported among economics majors (Ferber and Nelson 1993). For example, the extensive use of cooperative learning in the inverted classroom is compatible



with research that has found that women prefer cooperative environments. As Madison (1995, 158) summarizes, "The literature is consistent; women are more comfortable working in collaborative environments than competitive environments, and they are more successful and more persistent when they are comfortable." Consistent with the research on women and collaborative learning, female students in the inverted classrooms placed a higher value on the worksheets than did the men (Table 1). Faculty perceptions of the inverted classroom reinforce the survey data on this point. Both instructors noted that women students were more active participants in the inverted class than in traditional classes, suggesting they were more comfortable in the cooperative classroom environment.<sup>17</sup>

Bartlett (1996) and Baxter Magolda (1992) explain that, in general, female students prefer concrete experiences to abstract conceptualization. Similarly, Sandler, Silverberg, and Hall (1996) argue that women prefer opportunities to relate material to their own lives. The classroom experiments used in the inverted classroom give students the opportunity to relate experientially to the abstract concepts discussed in the textbook. Female students perceived a significantly higher educational value on the classroom experiments than male students did (Table 1). This result suggests that the inverted classroom may aid experiential learners, particularly women, in understanding basic economic concepts.

Finally, female students responded significantly higher than male students did to the statement "I believe that I learned more economics with this classroom format." This finding, combined with the gender implications discussed above, suggests that in order to increase interest in economics among a more diverse group of students, one might consider teaching with a variety of methods. Given that learning styles do not appear to be randomly distributed across demographic groups (Bartlett 1996), it is not surprising that a traditional lecture classroom appeals to a relatively narrow and homogenous subset of students. A more inclusive classroom environment, such as the inverted classroom, allows students who do not learn best in the traditional format to learn in alternative ways.

## CONCLUSIONS

Although it is difficult to appeal to the learning styles of every student in the classroom, the inverted classroom implements a strategy of teaching that engages a wide spectrum of learners. New learning technologies make it possible for events such as lectures, which have traditionally taken place inside the classroom, to occur outside the classroom and events which possibly occurred outside the classroom to occur inside the classroom under the guidance of the instructor. The course format described in this article allows the instructor to present options that appeal to most learning styles while still maintaining control over course coverage and content.

Evidence suggests that students generally preferred the inverted classroom to a traditional lecture and would prefer to take future economics classes using the same format. In addition, evidence from student and faculty perceptions suggests that such a course may help attract female students, who have been traditionally underrepresented in the field of economics. If we are to strive for a future of

diverse economists instead of a community of similar learners, then this approach offers preliminary evidence in support of this goal.

### NOTES

1. Bartlett (1996) concludes that using teaching techniques that reach all learning styles will improve student performance (see also Claxton and Murrell 1987).
2. As of fall 1998, videotaped lectures are played from Miami University's television station to dormitories and other campus buildings.
3. Students will soon be able to purchase a CD-ROM that contains a PowerPoint viewer, all PowerPoint with sound lectures, and all the required course handouts (syllabus, assignments, etc.).
4. The experiments used in this class were mostly taken from Delemeester and Neral (1995). A number of textbooks currently offer experiments for each of the major portions of a principles course along with all of the paperwork for students to use already prepared.
5. In fact, a large number of essay exam answers regarding these topics will make direct references to this experiment, such as "this is like when we added that fourth guy to the sandwich company, but all the knives were being used."
6. In our classes, students had movable chairs. Although group work can be done with fixed seating, in general, it will increase the amount of time students need to complete the assignment. In addition, it may hinder student interaction.
7. Source: Miami University's Web page at <http://www.muohio.edu/admission/1People.html#RTFToC2>.
8. A small percentage of the students may have been exposed to some basic economics concepts in high school.
9. The enrollment of students in the inverted classroom was typical of other sections of principles of microeconomics, the persistence of students enrolled in the inverted classroom was slightly higher. Specifically, of the 5 sections taught using the inverted classroom, an average of 1.4 majors were declared (and later completed) per section. In comparison, the overall average for the 31 traditional sections of principles of microeconomics that were taught in a traditional framework was .87 majors per section. Although the number of majors declared is still low, this increase is an indication that the inverted classroom may improve the ability of the instructor to pique the interest of students who were uninterested in the traditional classroom.
10. Interestingly, the actual grade average for the course was lower than the students' expected grade average (2.6 vs 2.9) despite students having full information concerning 95 percent of their course grade at the time the survey was filled out.
11. Two students requested section changes to enroll in lecture-oriented classes.
12. Statistical differences between male and female responses to the survey were conducted via *t* tests. A discussion of these results is available from the authors upon request.
13. Classroom Experiments at <http://www.marietta.edu/~delemeeg/expnom.html> and Experiments with Economic Principles at <http://zia.hss.cmu.edu/miller/eep/eep.html> are two excellent starting points.
14. The addresses for these sites are <http://www.utexas.edu/world/lecture/eco/>; <http://econwpa.wustl.edu/other/www/EconFAQ/EconFAQ.html>; and <http://ecedweb.unomaha.edu/>, respectively.
15. There is a large body of research that discusses and demonstrates the benefits of these learning methods (Slavin 1986; Chickering and Gamsen 1987; and Cross 1987).
16. Sosin (1997) and Simkins (1999) address some of the empirical work assessing learning using Internet technologies. A recent issue of *Active Learning* (July 1998) also examines evidence assessing learning with technology.
17. Although only a small percentage of minority students enrolled in the class, they also showed noted increased participation.

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