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Enhancing Student Learning at the Principles Level Using Undergraduate Teaching Assistance

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The trend in economics education methods in recent years has been away from 'chalk and talk' lectures and toward innovative teaching methods. The goal of using more innovative teaching techniques is to increase student knowledge, engagement, and interest in economics. Some of these interactive teaching methods proposed are the inverted classroom, cooperative learning, classroom experiments, the use of technology, undergraduate research, undergraduate-led recitation classes, and supplemental instruction.

In this paper we propose an innovation in interactive learning—undergraduate-led supplemental instruction (SI). Undergraduate-led SI is a more cost-effective way to implement SI, as the undergraduate student takes on responsibilities so the instructor doesn't have to. Because SI is led by an undergraduate student, other students might find them more approachable. It can also be a more hands-on way to engage students, as students may feel more comfortable interacting with other students. We have undertaken an experiment to measure student selection into SI and student learning as a result of attending SI. Undergraduate-led SI, however, provides a two-fold interactive learning opportunity, as it provides experience to the undergraduate leader. A senior, undergraduate student can gain teaching skills, develop a greater understanding of economic principles, enhance communication skills and relationships with faculty, and clarify career objectives through becoming a SI leader.

This introduction is followed by a review of the relevant literature of teaching techniques. Section three describes the methods used for the analysis of this paper. Section four describes the data and provides summary statistics. Section five presents the analysis of the data and findings of this study. Section six discusses the limitations of this study, followed by the conclusion in section seven.

II. Literature Review

Despite increased interest in teaching methods over the last decade, economics classrooms are still dominated by 'chalk and talk' lectures (Becker and Watts 2001). Surveys given by Becker and Watts (2001) in 1995 and 2000 confirm that economics professors are refocusing on effective teaching methods. Their study found that conference meetings, books, and online education journal searches are increasingly focusing on economics education. Yet their survey confirms that, despite the emphasis on economics education, most instructors are still predominately using the chalk and talk method of lecture rather than innovative, alternative teaching methods. Cooperative and active learning methods are rarely used, despite recent emphasis on their effectiveness in student learning outcomes. Student-to-student discussions and classroom discussions are rarely implemented in economics classrooms. Most instructors also rely primarily on textbooks and do not supplement them with data, scholarly articles, or current, real-world examples. Technology is also used very little in economics classrooms, as computer labs, simulations, displays, and experiments are rarely implemented (Becker and Watts 2001).

Economics instructors choose to rely on lecture due to the constraints of alternative teaching methods, classroom efficiency, and perceptions of student learning (Becker and Watts 2001; Goffe and Kauper 2014). Becker and Watts (2001) suggest that lecture is dominant because classroom efficiency, which reflects instructors' constraints and student passiveness, is valued over classroom effectiveness. Because of this, many teachers stick to the status quo of lecture. Goffe and Kauper (2014) surveyed economics principles instructors to determine why lecture prevails as the dominant teaching method. Around 1/3 of the respondents claim they predominantly use lecture in the classroom because students learn best when instructors can control the delivery and coverage of content. Another 1/3 of respondents claim students do not learn best from lecture, but that it is the most cost-effective teaching method. For these respondents, the time costs for preparing alternative teaching methods is the leading rationale. The last third of the respondents prefer alternative teaching methods to lecture.

Research shows that alternatives to lecture are more effective for student learning (Deslauriers, Schelew, and Weiman 2011; Miller and Rebelein 2012; Buckles, Hoyt, and Imazeki 2012; Goffe and Kauper 2014). Alternative methods such as active learning, labs, discussions, the inverted classroom, and cooperative learning result in students scoring higher on evaluations and gaining better application skills (Goffe and Kauper 2014). Deslauriers, Schelew, and Weiman (2011) found in their physics classes that when more time was devoted to "deliberate practice"—thinking critically, problem solving, peer and instructor feedback, group and class discussions, etc.—student engagement doubled, attendance increased by 20%, and students did twice as well on the exam as the control group. Student perception of the active learning techniques was also positive, with 90% indicating that they enjoyed the interactive methods. These results can also be applied to teaching economics. Students learn best when engaged in active learning, rather than remaining passive (Miller and Rebelein 2012; Buckles, Hoyt, and Imazeki 2012). During lectures the students are passively learning, which does not facilitate a deep understanding of the subject matter. Active learning, on the other hand, engages students in the learning process. Through methods such as cooperative learning, class discussions, application and real-world examples, demonstrations, and experiments, active learning helps students better understand learning objectives and enhances their interest in economics.

One effective interactive teaching technique is through the inverted classroom (Lage, Platt, and Treglia 2010). In an inverted classroom, students view lectures and are introduced to content at home while classroom time is devoted to application of the material through group activities, experiments, labs, etc. Because a wide variety of resources and activities are provided, the inverted classroom can appeal to all learning types. This leads to increases in student performance and interest in economics. Lage, Platt, and Treglia (2010) found that the majority of students ranked their experience with the inverted classroom favorably and preferred over lecture. Most students enjoyed working in groups and completing experiments. Instructors perceived that students were more motivated and enjoyed working together. Students also showed evidence of integrating knowledge, as they would refer to experiments and activities on their exams. They were also more willing to ask questions. The instructors found that the inverted classroom was more stimulating to teach, found the active involvement rewarding, and did not have to sacrifice course coverage. An additional outcome was increased involvement from female students. Compared with lecture, the inverted classroom does have substantial fixed costs as instructors must prepare ahead of time each experiment, lab, exercise, etc. for every lesson. To alleviate these costs instructors can re-use presentations, use experiments created by

others, and take advantage of the plethora of resources available to make the transition easier. Despite the high set up cost, the benefits of the inverted classroom in terms of active learning, inclusiveness of learning styles, and course coverage just might outweigh the costs.

Cooperative learning is another form of interactive learning that improves student learning objectives (Miller and Rebelein 2012; McGoldrick 2012). Miller and Rebelein found that cooperative or group learning resulted in a 3-4% increase on exam scores. Compared to the control group, students were not disadvantaged by the decrease in lecture time. Students had increased understanding of concepts and improved critical thinking and application skills. Student performance was increased, particularly on written assignments that required critical analysis and application of economic theory. McGoldrick (2012) found that the many benefits of cooperative learning include higher achievement, increased understanding and recall, increased engagement and willingness to ask questions, and enhanced enjoyment and self-esteem. Students showed improvement on questions that required analysis and application and scored higher on tests due to increased instructor-student interaction, student study groups, and increased interest in economics.

Classroom experiments can also be used to improve student learning (Miller and Rebelein 2012; Emerson and Hazlett 2012). Classroom experiments are consistently shown to have a positive impact on students, with improved understanding of concepts, enhanced application skills, and sustained knowledge. Because students engage in decision-making, analysis, discussion, etc. they are better able to engage and retain the material. Evidence also shows that students and instructors enjoy classroom experiments and report better attitudes about economics and the classroom experience. The foregone lecture time is replaced by the benefits to students, and instructors can cut costs by using existing experiments and resources.

To enhance interactive learning in the classroom, the use of technology for classroom activities has been increasing (Miller and Rebelein 2012; Buckles, Hoyt, and Imazeki 2012; Al-Bahrani and Patel 2014). Miller and Rebelein (2012) found the use of the internet as a classroom tool had a positive effect on student's Test of Understanding of College Economics (TUCE) scores and grades. They also found that the use of technology in the classroom had a positive effect on student performance. Technology can supplement the classroom experience through presentation hardware that makes covering the material easier. It also provides more opportunity for engagement and interactive learning, such as through short clips, group "clicker" questions, interactive media, and other methods. Technology can also be used for content delivery outside of class, as students can view recorded lectures, podcasts, video clips, etc. Assessment, while usually time-consuming, can also be made easier through technology via online assignments, quizzes, and grading technologies. Al-Bahrani and Patel (2014) propose that the use of technology and media in the classroom contributed to active learning by stimulating discussion, enhancing interest, and allowing students to gain a deeper understanding of economic concepts. By viewing and discussing ESPN 30 for 30 short clips and movies, students were able to analyze real-world examples of economic concepts. Because the clips merged film, sports, history, and other diverse content, students were able to develop an economic way of thinking and had better retention of the concepts. Using the clips to complement lectures also resulted in increased student participation and enjoyment. Active learning can be enhanced through media, literature, pop culture, drama, poetry, TV clips, movies, and music that enhance learning and motivation and engage students in different ways of thinking. Resources to enhance the classroom

experience and incorporate interactive teaching methods are now more available than ever to instructors due to technology.

Undergraduate research is another interactive learning method that instructors can utilize (Miller and Rebelein 2012). Miller and Rebelein propose that pursuing independent research can increase self-confidence, enhance students' ability to think and work like a scientist, and deepen their understanding of the discipline. Undergraduates also gain better communication skills, relationships with faculty, and can clarify their career objectives. In addition, students who participate in undergraduate research are more likely to pursue graduate degrees (Miller and Rebelein 2012).

One study found proposed an undergraduate-led recitation class concurrent with an introductory economics course as another innovative teaching method (Stock et al. 2013). The recitation class was a one-credit course limited to 25 students who were graded on attendance, participation, in-class exercises, and in-class problems. Undergraduate leaders prepared and facilitated the recitation class alongside completing a pedagogical research paper. Stock et al., 2013, found that students who enrolled in the recitation class earned higher final grades and were no more likely to drop the intro-level course even though they had lower ACT scores. In addition, the undergraduate leaders presented a low-cost option for facilitating the recitation class while simultaneously offering another innovative learning opportunity (Stock et al. 2013).

Yet another interactive method is through supplemental instruction (SI). Blanc, DeBuhr, and Martin (1983) explain that SI programs are designed to target high risk courses, rather than high risk students. Other learning assistance programs can influence retention but serve few students at high cost, with little data on effectiveness. SI can be effective because it is a proactive way to engage students. The SI leader can attend to reasoning and questioning skills to help students improve their ability to learn new concepts. The leader can help students with learning the material, note-taking skills, study schedules, study groups, tutoring, etc. Blanc, DeBuhr, and Martin (1983) also assert the advantage of SI is that it is attached to the class, providing students with more resources. Because SI is not viewed as remedial by students, more students are encouraged to participate. SI provides a high degree of interaction and mutual support, which can particularly influence minority and disadvantaged students. SI also provides an opportunity for the instructor to receive feedback about any problems students are facing. Students who attended SI had higher grades, GPA's, and enrollment and fewer Ds, Fs, and withdrawals than students who did not attend. Students in the high-risk group who attended SI also improved grades and retention more than the non-SI group (Blanc, DeBuhr, and Martin 1983).

As these interactive teaching methods demonstrate, student learning outcomes improve as instructors move away from lecture. When students participate in less "chalk and talk" and more interactive, engaging classroom activities, they are better able to learn and retain economic concepts. The use of interactive learning activities can also reach more student learning types, therefore engaging more students. Interactive learning has also been shown to improve both student and instructor enjoyment and increase students' interest in economics.

III. Methodology

The goal of this research is to measure the effectiveness of undergraduate-led supplemental instruction in terms of student engagement, student learning, and undergraduate research. This paper studied two microeconomics classes taught by one instructor. Microeconomics was arbitrarily chosen over macroeconomics at random. There were two sections of classes; one met twice a week and the other met once a week. Each class was graded on a scale of 500 points. 20% of the points comprised of in-class quizzes while the remaining 80% comprised of a total of four exams, including a comprehensive final. Once the drop/add a class deadline for the semester had passed students completed a survey in which they ranked Supplemental Instruction timeslots in order of their preference. The SI time slots that the most students could attend were chosen. This survey also collected demographic data for the purpose of analyzing correlates and determining whether demographic data impacts student performance. During the same week of the survey, students were given the TUCE to measure economic knowledge at the beginning of semester. The next week, SI began. SI was scheduled twice a week for the duration of an hour each. The time slots occurred at different times to ensure SI was open to more students. During the SI sessions students could ask the undergraduate instructor questions about concepts, review sample questions for each section, and communicate any problems they were having with the class. Attendance for SI was collected and merged with all other data to measure student selection into SI. Three weeks before the end of the semester students were given the TUCE exam again, in order to determine the change in their knowledge of economics. Students then also completed a survey to measure their engagement in order to gain insight on student selection into SI. This survey was formatted to reflect the National Survey of Student Engagement (http://nsse.iub.edu/).

IV. Data

Table 1 presents the results of the TUCE exams and final grades. The average final grade was 77.16%, with a minimum of 38% and a maximum of 96.8%. However, the average TUCE scores were lower than final grades. The pre-TUCE average was 32.91% while the post-TUCE average was 41.09%. The post-TUCE mean, minimum, and maximum were all higher than the pre-TUCE, meaning student understanding of economics improved after taking Principles level Microeconomics.

The demographics of the students are also presented in Table 1. Of the students who completed the survey, 35% are female, 63% are male, and 1% indicated another gender identification. The students are 9.6% Black and 78.1% white, with the rest being Asian, Hispanic, and other ethnicities. These gender and ethnicity findings reflect the fact that a majority of students are white males. The mean age is 22, with a range from 20—40. 43.8% of the students are sophomores and 42.5% are juniors. These findings are expected since at NKU Principles level courses require a minimum of 30 credit hours. Of these students, 87.7% are majors within the College of Business, meaning Principles level economics courses are mostly drawing students from similar fields.

Table 1

Variable	Observations	Mean	Standard Deviation	Minimum	Maximum
TUCE1	69	32.91	9.43	15.2	66.7
TUCE2	57	41.09	13.83	18.2	72.7
FinalGrade	71	77.16	9.40	38	96.8
TransferSt~t	73	0.23	0.43	0	1
Internatio~t	72	0.10	0.30	0	1
InstateStu~t	73	0.63	0.49	0	1
Oncampus	73	0.22	0.42	0	1
SemesterHo~s	71	14.55	1.89	6	18
HoursCompl~d	70	53.59	26.02	3	150
FirstTimeM~o	73	1.15	0.36	1	2
Timestakin~o	73	0.14	0.38	0	2
Macro	73	1.53	0.50	1	2
OtherEcon~ss	73	1.96	0.20	1	2
Job	73	1.27	0.45	1	2
HoursWorked	51	24.48	9.71	8	48
ACT	55	23.75	3.30	17	32
Ethnicity	73	2.93	0.82	1	5
Age	72	22.72	4.09	20	40
fatherEduc~n	71	4.58	1.75	1	7
motherEduc~n	72	4.46	1.67	1	7
CollegeGPA	69	3.06	0.54	1.5	4
Highschool~A	67	3.33	0.48	1.8	4
Siopinion	73	1.51	0.63	1	3
SIAttend	73	1.60	0.64	1	3
RankMO12	66	2.98	1.87	0	6
RankMO1	63	2.81	1.59	0	6
RankWE12	62	3.26	1.55	0	6
RankWE1	63	3.32	1.62	0	6
RankTU3	57	3.74	1.89	1	7
RankTH3	56	4.21	2.02	1	8
Siattendence	73	0.12	0.60	0	4
freshman	73	0.01	0.12	0	1
sophmore	73	0.44	0.50	0	1
junior	73	0.42	0.50	0	1
senior	73	0.12	0.33	0	1
male	73	0.63	0.49	0	1
female	73	0.36	0.48	0	1
other_gender	73	0.01	0.12	0	1
black	73	0.10	0.30	0	1
asian	73	0.03	0.16	0	1
white	73	0.78	0.42	0	1
hispanic	73	0.04	0.20	0	1
other_race	73	0.05	0.23	0	1

In order to reach as many students as possible, six time slots were suggested for SI. The students were then asked to rank the time slots in order of preference. The highest ranked time slots were Monday 12-1, Monday 1-2, and Tuesday 3-4. To allow students different dates to attend SI, we offered two different time slots.

V. Analysis

This particular study did not yield enough SI participants to have a statistically significant sample size. The low participation rate was likely because SI was optional for students. Therefore we could not measure the differences in student learning between the students that attended SI and those that did not. The survey and attendance do give us some insight into student engagement. Of the students surveyed, 41 indicated that they thought SI would be helpful, while 27 said maybe and 5 said no—a clear majority of students place some value on SI. When asked if they would attend SI, 35 said yes, 32 said maybe, and 6 said no. Of the students that said maybe, 8 indicated time was the deciding factor while 15 indicated the difficulty of class would determine whether they would attend. We hoped to have mitigated the time factor by allowing the students to rank the time slots. In terms of attendance, four students attended SI throughout the semester. Two students attended once, one student attended three times, and one student attended four times. Here we encountered a hypothetical bias—students indicated that they wanted SI to be available yet didn't actually choose to participate.

SI serves a dual purpose of engaging the students in introductory economics courses and the undergraduate SI leader. Engaging an undergraduate student with SI offers another opportunity for innovative learning. The SI leader received three credit hours for facilitating SI sessions and completing a pedagogical research paper. They were able to solidify their understanding of economic principles while gaining valuable teaching experience. Working closely with faculty to develop the SI sessions and complete the research paper also offered an additional avenue for student learning.

VI. Limitations: Perspective of the Undergraduate SI Leader

This experiment was limited by the small sample size of the students who attended SI. We had hoped to compare the TUCE and final grades of the students who attended SI with those who did not elect to attend to ask if there was a significant difference between student learning and success. Another important limitation was the structure of the SI sessions. Before each week's SI, the undergraduate instructor would review the lectures and notes to prepare for students' questions. When students attended SI, it was mostly a friendly, informal discussion about topics they were having trouble understanding. The students would ask the undergraduate instructor questions about concepts, and the instructor would try to understand the reason they were having trouble and provide another explanation accordingly. Then they would work out some practice problems or examples. While this structure may be appropriate for small study groups, if the undergraduate instructor could start this experiment again they would approach it differently.

The undergraduate instructor was very inspired when reading about innovative teaching methods, especially the inverted classroom and class experiments. If we were to conduct another semester of SI, the sessions would be much more structured and purposeful. Experiments, group

work, demonstrations, real-world examples, and online, interactive resources would be scheduled ahead of time for each topic. There is a possibility that having a more structured, and therefore more effective, SI program would have resulted in increased attendance due to the many demonstrated benefits of innovative teaching methods. A more structured SI would have enhanced student interest in economics by providing more interesting and effective examples and applications while also contributing to the experience and skills of the undergraduate SI leader.

In this study, the returns to the undergraduate instructor were greater than those to the students. The undergraduate instructor learned about innovative teaching methods, gained an understanding of managing students, and increased comprehension of the principles level economics content. Our opinion is that further research should examine the returns to the SI leader as well as the students.

VII. Conclusion

The trend toward innovative teaching methods and away from 'chalk and talk' lectures has been demonstrated to improve student knowledge, engagement, and interest in economics. Innovative and interactive teaching methods such as the inverted classroom, cooperative learning, classroom experiments, the use of technology, undergraduate research, undergraduate-led recitation classes, and supplemental instruction can and should be adopted by more professors of economics. Undergraduate-led SI can present this opportunity, as it is a cost-effective method for implementing innovative teaching methods. It also provides interactive capabilities to the undergraduate SI leader that will provide experience they can utilize in the future.

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