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Abstract

Most Economics teaching still takes place exclusively in a traditional lecture format, even though internet technology enabled alternatives are increasingly available. This study investigates the impact of the Econland Macroeconomics simulation game on levels of student engagement and performance. Econland is a simulation game and learning platform in which students practice their understanding of monetary and fiscal policy and other economic concepts by making economic policy decisions for a fictional country for seven years. Results of the study show that simulation games can be an effective way to improve student engagement levels and quiz performance in undergraduate introductory Macroeconomics classes.

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Introduction

The growing use of business simulation games in higher education is supported by enabling technologies, an increasing supply of relevant simulations and an increase in online and blended learning programs. Instructors are realizing that online games can bring variety and energy to the classroom compared to traditional lectures or case discussions. Using simulations in class responds to a growing demand for experiential learning activities which makes students active learners in the classroom.

Although simulation games are increasingly used in business education generally, the most recent survey of teaching methods in undergraduate Economics (Watts and Schaur, 2011) shows that Economics teaching is still dominated by the lecture format, with traditional lectures accounting for 83 per cent of class time. The same study finds that games, simulations and experiments are almost never used in Economics teaching. Goffe and Kauper (2014) investigated why the lecture format prevails, finding that only one third of instructors think that students learn best from lectures, with another third using lectures because they are judged cost effective and a final third who are looking for alternatives to lectures. Allgood, Walstad and Siegfried (2015) emphasized the adoption costs of new teaching methods for instructors as an obstacle to innovation, both regarding the learning about the innovation and how to best apply it. Faria & Wellington (2004) found that while simulation games were used by over half of instructors in the strategic management discipline and over forty per

cent in marketing and management, the adoption rate was less than fifteen per cent in Economics. The question arises as to whether simulation games can be effective teaching tools in disciplines where their usage is still very low and innovative teaching methods are not prevalent.

There are no widely used simulations to support Macroeconomics teaching and almost no published research on their effectiveness. This is surprising since the study of Macroeconomics appears to lend itself well to be supported by simulation models, particularly in the context of monetary and fiscal policy and the Aggregate Demand Aggregate Supply (AD-AS) framework which are both at the core of introductory Macroeconomics courses. Simulations have the potential to bring to life the AD-AS framework which many students find abstract and difficult to work with (Snarr and Gold, 2006).

This paper investigates the impact of the Econland Macroeconomics simulation on student engagement and performance in introductory Macroeconomics classes. The paper contributes to the existing research on the use of simulation games in higher education by testing the effectiveness of simulation games in Economics, a subject where teaching is still dominated by the lecture format. Nearly all studies on the effectiveness of simulations in business education are focused on disciplines where the adoption rates are already high, such as strategic management and marketing. Developing an understanding of the potential for simulation games in disciplines where traditional teaching methods prevail can encourage the development and adaptation of teaching innovations.

The remaining sections of the paper provide a literature review, a brief overview of the Econland simulation game, a description of the research methodology, a discussion of the results and a conclusion.

Literature Review

Business simulations are defined in the literature as "Internet-based, synthetic learning environments where decisions are made within a complex and dynamic setting, and where students experience real-time information and feedback" (Lovelace, Eggers & Dyck, 2016). Student-centered experiential learning activities, such as management simulations, have received increased attention due to the potential of simulations to motivate student learning and replicate the dynamic and interdependent environments found in the workplace (Bell, Kanar, & Kozlowski, 2008; Salas, Wildman, & Piccolo, 2009; Sitzmann, 2011).

In order to determine the effectiveness of business simulation games, several constructs for measuring effectiveness have been used. The ultimate interest of an educator may be the impact of simulations on student performance or learning outcomes. Student performance can be measured by exam results, where the results of an experimental group are compared to those of a control group. For example, Ball, Eckel and Rojas (2006) investigated the impact on student performance of using class exercises with wireless handheld devices in a Microeconomics course. They found a positive impact on both students' exam performance and student evaluations of the course compared to a control group. Lovelace et al (2016) investigated the impact of

the use of simulation games on the development of critical thinking skills, which they define as "the ability to thoughtfully analyze and evaluate situations and recommend courses of action that consider stakeholders, implications, and consequences". They found a positive relationship between use of simulations and the development of critical thinking skills. Taking the objectives of education one step further to the workplace, Gosen & Washbush (2004) found that for web-based strategy simulations, students' simulation performance was positively correlated with future workplace salaries and promotions. Naturally, in longer term studies it becomes more difficult to make the link between the simulation game and improvements in learning performance. Mohsen, Abdollahi & Omar (2018) investigate the impact of a simulation game on different constructs in one study, on the basis of a mixed methods approach.

Measuring the effectiveness of the use of simulation games through the assessment of learning outcomes has significant challenges in terms of the definition of effectiveness, as well as the determination and treatment of control groups. In order to deal with these challenges, a growing number of studies have evaluated simulation games in terms of their impact on student engagement. Student engagement is an increasingly relevant topic in education, particularly in the context of low completion rates for MOOCs, as well as high drop-out rates in online education and in higher education generally. For the purpose of this study, student engagement is defined as the "commitment, participation, and effortful involvement in learning" (Henrie, Halverson and Graham, 2015). Allgood, Walstad and Siegfried (2015) pointed out that the usual reason for adopting alternative teaching methods in Economics courses is to get students actively engaged in the learning process because a traditional lecture

class is viewed as too passive a form of instruction. More active forms of instruction may therefore have the potential to increase student engagement. Previous research shows that higher levels of student engagement lead to improved learning outcomes (Gunuc 2014).

Within the context of Macroeconomics, few learning simulations exist and little research is done on their effectiveness. Snarr and Gold (2006), Woltjer (2005) and Cameron (1997) describe their own experiences in designing Macroeconomics simulations and their use in the classroom. Among these, only the simulation discussed in Snarr and Gold (2006) allows students to make economic policy decisions. The other two papers discuss simulations in which students make corporate decisions in response to macroeconomic developments. As such, these simulations are more akin to business strategy games, which have already been researched extensively. Only Snarr and Gold (2006) report results on the effectiveness of the simulations, concluding that the use of a simulation allowed them to incorporate more sophisticated mathematical concepts in a course, while maintaining student course evaluation scores. The dearth of currently used Macroeconomics simulations is illustrated by the fact that a review on the use of simulations in teaching Economics by Porter, Riley and Ruffer (2004) lists several Macroeconomics simulations that are no longer in use.

In short, simulation games have the potential to enhance student engagement and performance in Macroeconomics courses, but their impact has not yet been tested extensively.

The Econland Simulation Game

Econland is a learning platform with a browser based Macroeconomics simulation game designed to support the teaching of introductory Macroeconomics at the university level. The main learning objective of the game is to practice student understanding of the Aggregate Demand / Aggregate Supply framework and the impact monetary and fiscal policy have on various outcomes for the economy (described below). The simulation game also consolidates student understanding of the more basic Macroeconomics concepts such as Gross Domestic Product, inflation, unemployment, budget deficits, productivity and exchange rates. At a deeper level, students develop their analytical and critical thinking skills and can start to develop economic modeling skills. The game is designed to be used towards the end of the Macroeconomics course as an integrative exercise for the duration of one or two class sessions.

In the game, students make one decision related to monetary policy (interest rates) and three fiscal policy decisions (income tax rate, corporate tax rate, government expenditure) for a period of seven years, with the purpose of obtaining favorable economic results for their country. The results areas in the game are economic growth, unemployment, inflation and the government budget deficit. Students need to maximize economic growth (as measured by growth of the country's Gross Domestic Product) and minimize the unemployment rate, the inflation rate and the budget deficit as a proportion of GDP. Each year, students receive 0, 10 or 25 points for the results obtained in each of the four results areas, depending on their performance. The

sum of the results obtained in each of the four results areas represents a fictional approval rating that the population gives to the government for its economic policies.

The results are obtained through a number of intermediary variables, such as the value of the country's currency, levels of productivity growth and values for each of the components of Gross Domestic Product (Consumption, Government Expenditure, Investment, Exports, Imports), which are available to students through detailed online reports. In this way, students can learn to understand the mechanisms through which their economic policy decisions lead to economic outcomes.

Every round in the game represents one year in the country's economy. At the start of each round, players are presented with a description of the world economic outlook for the following year and with the level of consumer confidence in the economy. This information needs to be taken into account in the policy decision making of the students. After each round of decisions, students see their results which are summarized in the approval rating which ranges between 0 and 100. The goal of the simulation is to finish the seven rounds of the game with the highest possible average approval rating.

Both students and instructors have the opportunity to tailor the learning experience to their own preferences by playing the simulation under different scenarios for the development of the world economy during the game. The instructor can adjust the settings for the values in the model that is underlying the simulation game and is thereby able to tailor the simulation to the specific circumstances or preferences of the instructor and the students.

Econland has been published by Harvard Business Publishing in August 2018 and has been used by Universities throughout the world.

Research Methodology

The simulation has been used at one University by two different instructors to support a total of five class sections of an introductory Macroeconomics course. The course has a standard Macroeconomics syllabus and used Principles of Economics (Mankiw, 2015) as its textbook.

The student sample consisted of a group of College of Business full-time undergraduate students at one university, all with the same nationality and within the same age group. All students were taking their first Macroeconomics course, following on from their introductory Microeconomics class.

In order to measure the impact of the simulation game on student engagement, a survey instrument based on Whitton (2009) was used. The survey is designed to measure student engagement levels after simulation games and captures five elements of adult student engagement: perception of challenge, perception of control, immersion, interest and purpose (Whitton 2009). During a trial of the survey on a sample of six students, it became clear that not all the questions could be interpreted easily by respondents for both a simulation activity and a classroom lecture. As a result, the survey questions were adapted in order to be relevant to an evaluation of

both a simulation based class and a lecture. The final survey questions used for the research can be found in Appendix 1.

According to Whitton (2009), the outcome of the survey result can be summarized as an engagement score, which is obtained by awarding 2, 1, 0, -1 or -2 points for each answer given by a respondent, according to how questions were answered on the 5 point Likert scale. For most questions, an answer of "Strongly agree" would result in an engagement score of 2 and for others in -2, depending on the phrasing of the question. The survey was administered to students in both the Fall 2016 and Spring 2017 semester. Participation in the survey was voluntary. The survey was administered through Blackboard course management software. Instructors could see who had completed the survey but could not identify individuals' responses to questions.

The survey was administered after two different types of classes for each of the participating class sections. First, students completed the survey after spending one class with the Econland simulation game. During this class, the teacher played the role of a facilitator, going through a brief-play-debrief cycle that is typical when teaching with simulation games. A week later, the same group of students completed the same survey again after a regular, lecture based class with the same instructor that covered similar course topics as those practiced during the simulation game (monetary and fiscal policy). Therefore, the only difference between the two classes was the teaching method (simulation game versus traditional class), with the teacher, students, class location, duration and topic all being the same between the two classes.

The assessment of the impact of the simulation on the level of student engagement can be summarized in the following hypothesis:

Hypothesis 1: The level of student engagement reported by students is higher for a class based on the simulation game exercise than for the traditional lecture based class.

A second part of the research concerned the assessment of student learning. In order to measure student learning performance, students were asked to complete an online quiz with fifteen multiple choice questions taken from a test bank that has been developed specifically to test the knowledge and skills practiced in the simulation game. Topics covered include different aspects of monetary and fiscal policy, the AD-AS framework, as well as the concepts of GDP and each of its components, productivity, unemployment and inflation. Questions in the test bank are similar to those found in typical Principles of Macroeconomics exams but do not cover the entire syllabus of such a course. Only questions that cover concepts practiced in the Econland simulation are included in the test bank. For the students participating in the research project, the test bank consisted of 60 questions and generated 15 questions at random each time the quiz was taken. All questions in the test bank were designed to be of a similar level of difficulty. As a result, the questions presented to students when taking the test before and after using the simulation were different in content but equivalent in terms of difficulty.

Students took the quiz at the end of the class preceding the use of the simulation game and at the end of the class during which the simulation was used. As a result of this

methodology, this particular research project is not be able to come to conclusions about the long term learning impact of the simulation such as critical thinking skills or analytical skills. The only impact that is measured is the immediate effect on student understanding of Macroeconomics concepts.

Research on the impact on student performance of using the simulation game is summarized in the following hypothesis:

Hypothesis 2: Students using the simulation game in class improve their quiz result.

With student level data available for both the scores in the simulation game and in the quizzes, it is possible to investigate whether students who do well in the game (as measured by the highest average approval rating obtained by a student after playing the full seven rounds of the game) also do well in the quiz or whether students who do well in the game improve more in their quiz score than other students. These analyses are summarized in the following hypotheses:

Hypothesis 3: There is a positive relationship between the simulation game score of a student and the quiz score of a student.

Hypothesis 4: There is a positive relationship between the simulation game score of a student and the improvement in the quiz score of a student.

In hypothesis 4, the improvement in the quiz score of a student is measured simply as the difference between the first and second time a student takes the quiz.

Finally, in order to build an understanding of how learner characteristics play a role in determining engagement levels, students also answered questions related to their profile and learning preferences, including their age, GPA, grade in the course so far, major field of study and attitudes towards learning generally and online learning in particular (see Appendix 2). The learner characteristics questions were adapted from Henrie et al (2015).

Results

The initial student engagement surveys yielded 97 valid completed questionnaires for the class using the simulation game and 89 for the traditional class session. The difference in sample sizes is due to a different number of absentees between the two class sessions. The results show that students reported positive engagement levels for both types of classes, with the average survey scores being 0.93 per question for the simulation game class and 0.77 per question for the other class. Carrying out a t-test of significance of the difference of the means of the two samples leads us to accept the hypothesis that the two means are different at a 1 per cent confidence interval, indicating that the reported levels of student engagement were significantly higher for the class sessions that used the simulation.

A total of 50 students took the quiz before and after the simulation game. The lower level of participation in the quiz compared to the surveys can be attributed to the voluntary nature of student participation in the research. Some students elected not to

take the quiz. Students improved their score from an average of 56 per cent correct answers before using Econland to 67 per cent after using the simulation, resulting in an average performance improvement of 11 percentage points. A t-test of significance of the difference of the means of the two quiz sessions leads us to accept the hypothesis that the average quiz scores are different at a 1 per cent confidence interval, indicating that on average the students achieved a significant performance improvement in the quiz after playing the simulation game. It is important to note in this context that the quiz is different each time that a student takes the quiz, since questions are randomly selected from a test bank of relevant questions.

Through the use of an anonymous user id for each student, the quiz results before and after playing the simulation from each student were matched. Out of a total of 50 students who took the quiz both before and after the simulation game, 34 students improved their score, 6 students obtained the same score in both iterations of the quiz and 8 students obtained a worse score after the simulation game.

Hypotheses 3 and 4 assess whether students who do well in the game also tend to do well in the quiz or improve their quiz score more than other students. The correlation coefficient between a student's simulation game performance and quiz results was 0.275, which is significant at the 5 per cent level. This result indicates that there is a positive relationship between how well students do in the simulation game and in the quiz. However, the results are not significant at the 1 per cent level, indicating that there are other significant factors at play that determine a student's level of performance in the quiz.

The correlation coefficient between student improvement on the quiz score and their simulation game score was 0.127, which is not significant at even the 10% level. Therefore, there is no evidence that students who do well in the game improve their quiz score more than other students.

With respect to the impact of learner profile characteristics on the reported levels of student engagement, Table 1 shows the results of the regression analysis with the student's total engagement score as the dependent variable and the set of learner characteristics as independent variables.

Table 1 here

The dependent variables include student answers to questions related to their attitudes to learning, their cumulative GPA, their grade for the last exam in the course and their major field of study. The regression results show that only the students' answer to the question "I am very comfortable doing classwork that is online" is a significant determinant of the reported level of student engagement in the simulation game. All the other potential explanatory variables in the model were not significant even at the 10 per cent level. This means that students' level of engagement does not depend on their grades, age, attitudes to learning or their major. In other words, it is difficult to predict what type of student will find the simulation game most engaging.

Limitations and conclusion

The study demonstrates that the teaching of Macroeconomics can benefit from the use of a simulation game in terms of student engagement levels and learning performance. Engagement levels reported by students were significantly higher than those reported after a traditional class. Higher engagement levels are by themselves an important objective of teaching and have also been found to improve student performance (Gunuc 2014). Students improved their quiz scores by 11 percentage points after one class using the simulation exercise. Although this is a significant improvement, the research did not assess whether this improvement was different from what the quiz score improvement would have been as a result of taking a traditional lecture based class. The issue of defining appropriate control groups in the measurement of student learning remains a challenge. If satisfactory solutions to this issue are found then future studies may also utilize additional ways of measuring student performance that assess a deeper and longer term understanding of the materials than what can be captured with a multiple-choice quiz.

The strong correlation between the student's simulation game performance and quiz results indicates that the same areas of knowledge are practiced in the game and a typical introductory Macroeconomics course, although other explanatory variables such as the general intellectual ability may also be a predictor of both game performance and quiz results.

The lack of a significant relationship between the simulation game scores of individual students and their improvement in the quiz scores indicates that it is not the score obtained in the simulation game that leads to better learning and improved quiz results. Rather, the general act of interacting with the course materials through the

simulation game results in greater engagement and better student performance overall. This finding indicates that all students can benefit from the simulation game, regardless of their level.

Finally, the analysis of student characteristics and engagement levels demonstrates that it is difficult to predict what type of students are most susceptible to find the simulation engaging, other than by considering reported attitudes to online learning overall. This finding shows that potentially a wide variety of students can be engaged through use of the simulation.

This study has provided evidence for the effectiveness of using the simulation game to support the teaching of Macroeconomics, a field with great potential for innovative teaching methods. Reluctance among teachers to use new methods of instruction can be an obstacle to adoption of new tools. Further experimentation and research into the costs and benefits of simulation games in teaching in different contexts can encourage increased use of innovative teaching methods in fields where traditional lectures still dominate the classroom experience.

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Table 1

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	4.931	5.291		.932	.356
	DO WELL	3.173	1.281	.299	2.476	.017
	WORK HARD	-.347	1.029	-.039	-.337	.737
	LIKE SUBJECT	1.039	.944	.141	1.101	.276
	SUBJECT IMPORTANT	.965	1.016	.132	.950	.346
	COMFORTABLE ONLINE	2.749	.641	.437	4.289	.000
	WORK LITTLE	-.455	.439	-.107	-1.036	.305
	GPA	.505	.657	.083	.769	.446
	EXAM GRADE	-.006	.029	-.026	-.226	.822
	AGE (YRS)	-.090	.213	-.056	-.421	.676
	MAJOR ACCTG	-1.412	6.514	-.100	-.217	.829
	MAJOR FINANCE	-1.067	6.273	-.080	-.170	.866
	MAJOR HR	.422	6.615	.030	.064	.949
	MAJOR MKTG	-4.930	6.702	-.184	-.736	.465

a. Dependent Variable: Total

Appendix 1 - Engagement Questionnaire

Adapted from N. Whitton, 2010. Learning with Digital Games – A Practical Guide to Engaging Students in Higher Education. Routledge, NY.

Thinking about the activity you have just undertaken, please indicate the level to which you agree with the following statements. There are no right or wrong answers. Indicate your level of engagement, not what you think others expect of you.

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
1. It was clear what I could learn from the activity					
2. I felt absorbed in the activity					
3. I felt that time passed quickly					
4. I enjoyed the activity/class					
5. Feedback I was given was useful					
6. I found the activity/class frustrating					
7. I felt that I could achieve the goal of the activity/class					
8. I found this activity/class boring					
9. I was interested in exploring the options available					
10. I found the activity satisfying					
11. I believe that this class helped me to achieve the learning objectives of the course					
12. I believe that this class helped me to perform well on the exams for this course					

Appendix 2 – Learner characteristics questions

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
1. I think I will do well in this class					
2. I work hard to do well in this class					
3. I like the subject matter of this course					
4. Understanding the subject matter of this course is very important to me					
5. I am very comfortable doing class work that is online.					
6. My aim is to pass the course while doing as little work as possible.					
7. My cumulative GPA is:					
8. The grade for my last exam in this course is: (out of 100)					
9. My age is (in years):					
10. My Major is:					