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Are Classroom Games Useful for Teaching 'Sticky' Finance Concepts? Evidence from a Swap Game

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Abstract

Despite long list of documented games in economics and other disciplines, a lack of literature on experiments in finance teaching suggests that academics in the field of finance may have been slower to embrace the benefits of experimental learning than academics in other fields. This paper contributes in closing the gap. Firstly, it documents an example of a role-play game, which might be used in teaching a 'sticky' concept of swaps. Secondly, the paper discusses students' experiences of the game and provides a summary of the survey results. Finally, the paper contributes to the thin literature of experimental learning effectiveness by presenting evidence on how the participation in the experiment contributed to the assessment result in the relevant examination question.

JEL classification: A22, G23, G32

Keywords: experimental learning, in-class games, role-playing, finance, swap

1. Introduction

The literature on economic and finance pedagogies is extensive, with publications describing, summarising and critiquing various methods of teaching from the traditional lecture to modular learning, the case method, an experiential and game approach, computer-assisted instruction and tablet technology, while other articles have taken on the task of presenting ways to better explain finance concepts to students (Vihtelic 1996). For example, Horvath (1985) and Kochman (1986) look closer at the concept of discounting, while Dyl (1991), Chan, Weber and Johnson (1995) and Graham and Kocher (1995) show how popular movies assist students to better understand introductory finance concepts. Similarly, Lange (1993) and Yoon (1995) describe how financial concepts can be presented using spreadsheets, while Lawrence (1994) details the case of how students' learning benefits from establishing real as opposed to simulated investment funds in universities. The economics discipline also frequently uses experiments and games to illustrate concepts such as supply and demand, auctions and externalities (Bergstrom and Miller 2002). Brauer and Delemeester (2001) present an extensive compilation of 113 classroom games in the areas of microeconomics and macroeconomics, highlighting their overall strengths and weaknesses as well as some of the costs and benefits to the students and instructors. The use of experiments in finance teaching has been somewhat less well documented. The list of described games/experiments in finance is rather small and their effectiveness as teaching tools is largely unexplored.

The paper aims to fill the gap in a number of areas. Firstly, it compiles a list and brief descriptions of the existing in-class experiments in finance from the academic literature. Secondly, it offers a description of a swap role-play game and, therefore, adds to the catalogue of experimental finance teaching literature. The motivation for the use of a game came from the desire to address the difficulty students experience in learning the basics of swaps. The game was designed and implemented by the authors in a second year undergraduate finance course. Thirdly, the paper adds to the literature in describing students' perception of role games as an alternative/supplement to the traditional teaching methods. Finally, the paper investigates whether the game we employed was effective in helping students to understand the concept of the swap instrument.

The rest of the paper consists of five sections. Section 2 outlines the motivation for experimental teaching and catalogues the literature on in-class experiments and games in teaching finance. Section 3 describes a swap game as it was implemented in an undergraduate course at Griffith University. Section 4 focuses on the evaluation of students' experience with the role-play. Section 5 empirically analyses a potential link between students' performance in the swap question they attempted in the examination and in their participation in the game. The paper concludes with Section 6.

2. Why experiment?

The reason why there is a need for different methods of teaching is that individual students have different learning styles. While it is commonly known among academics that some students tend to be 'concrete' learners and others are more 'abstract' learners, Gardner (1983) identified seven kinds of intelligence: verbal/linguistic, logical/mathematical, spatial, interpersonal, intrapersonal, bodily/kinaesthetic and musical. The traditional classroom teaching style tends to emphasize the first two intelligences and, accordingly, students who learn best by speaking, writing, reading, calculating, questioning and experimenting will benefit most from these approaches (Grinder et. al 1999). Thus, other types of educational experiences are needed to cater for those students that are visual, interpersonal or intrapersonal learners. Furthermore, instructors must also take into consideration the fact that students learn at different cognitive levels. In his seminal work, Bloom (1956) identifies six levels of cognitive domains: knowledge, comprehension and simple application, demonstrated typically in introductory courses, and higher understanding levels such as application, analysis, synthesis and evaluation, which are conveyed in more advanced courses.

In the field of finance and economics, teaching the concepts, theory, mathematics and its applications can be challenging at times. Instructors need to adapt their methods to address not only the continual changes in the mission of universities where generic student skills are strongly emphasised, but also the changes to students' expectations in the classroom (Hawtrey 2007). The last decade has seen a shift from the traditional teaching methods towards experiential learning that includes an active, participatory learning style aimed at improving student motivation, better retention of knowledge and understanding of the content through an enhanced classroom experience (Vihtelic 1996).

Experiential learning has been found to be one of the preferred learning activities in finance and economics as students are transformed from passive listeners to active participants, engaged in communicating opinions and working in teams (Hawtrey, 2007). Experiential Learning Theory (ELT) is built on six propositions based on the work of prominent scholars like Kurt Lewin, Jean Piaget and others, who place 'experience' at the centre of their theories of human learning and development (Kolb and Kolb 2005). In the context of ELT, Kolb (1984, p.41) describes learning as "the process whereby knowledge is created through the transformation of experience. Knowledge results from the combination of grasping and transforming experience." The ELT model combines the modes of *grasping experience* – Concrete Experience (CE) and Abstract Conceptualisation (AC), with the modes of *transforming experience* – Reflective Observation (RO) and Active Experimentation (AE). Thus, an experiential learning sequence is created where the student applies and adapts these four modes - experiencing, reflecting, thinking and acting - to the learning context and situation at hand. Among the principles proposed to enhance the experiential learning in higher education, Kolb

and Kolb (2005) suggest that learning should incorporate more the practices of expressing, demonstrating, applying and critiquing.

Similarly, Hawtrey (2007) suggests that the key element in experiential learning is the personal involvement of the student in the learning process, where learning becomes the product of a practical, personal, thoughtful and lived experience. This is quite different from the traditional 'chalk-and-talk' approach style of teaching that relies on the instructor to describe the theories and concepts and the student to 'take in' the information presented. Another reason for the shift towards active learning is that students remember only a small part of what they hear but they remember a greater part of what they do.

While Kalogeras (1976) defends the traditional lecture method of instruction, Branch (1975) shows that using games in teaching concepts of investing has been successful in stimulating student interest in the subject. Butler (1988) finds that games develop problem-solving competences and help students with their self-confidence, while Whitney (1990) states that through games, instructors reach to students' fundamental level of learning to develop progressively the concepts necessary for total understanding.

Games, simulations and role-play have been used as teaching aids for decades in the finance and economics disciplines. Alden (1999) and Oberhofer (1999) argue that these teaching techniques encourage students to reflect on their knowledge, while Francis and Byrne (1999) emphasize the benefit of simulations, games and role-play in uncovering 'sticking points in student understanding' (p.209). Not only do these techniques allow students to develop a greater appreciation of role and responsibility (Freeman and Capper 1998), but they can also bring life and relevance to abstract and theoretical content (Lowry 1999).

Despite the overwhelming literature in support of experimental and experiential learning, in contrast to the long list of classroom games in economics, the literature on experimental learning in finance discipline teaching is rather limited. There are only a small number of games applicable to finance teaching described in the literature and there is practically no evidence about how enjoyable or useful those games were. Table 1 presents a summary of published articles where games and experiments have been used in teaching finance concepts, showing the student response and feedback to this form of teaching and whether or not these techniques were effective in improving student learning. The small number of publications clearly suggests a gap in the literature. This paper contributes to closing this gap by describing the role-play experiment used in teaching the concept of swap instruments and their hedging application.

Table 1. Survey of games and experiments in finance

Publication	Nature of Experiment/Game	Students' Feedback	Effectiveness of Method	Other Findings
Kassis, Hazlett and Ygosse Battisti (2012)	The experiment explains the role of banks as financial intermediaries and shows how risk affects market interest rates in the presence of asymmetric information, as well as illustrating the concept of diversification and issues associated with the moral-hazard problem of deposit insurance.	Not presented, however students perceived the game experience as fun and exciting.	Not formally assessed. A debriefing discussion encouraged the students to discuss how each role influenced the outcome of the experiment.	The experiment can be run with small classes or with those as large as 75 students.
Dicle and Levendis (2011)	A computerised instructional and assessment trading game where students can buy and sell stocks, options, futures, mutual funds and ETFs, place market and limit orders, trade international stocks, set up different portfolios and set up options trading strategies.	Favourable student comments in teaching evaluations.	Not assessed	Timely feedback tailored to each student plays an important role in the effectiveness of teaching.
Flanegin, Zapalska, Rudd and Litzinger (2010)	Students act as foreign exchange traders having the task of rebalancing and hedging foreign exchange currencies, thus betting on forward and spot rates. The game allows students to observe the strategic behaviour involved in buying and selling, the role of market forces in determining equilibrium prices and provides the experience of planning and implementing hedging strategies.	Not presented	Not formally assessed, however a debriefing session at the conclusion of the game was used to reinforce and enhance the effectiveness of the learning experience through the game.	The game emphasizes higher order learning such as problem-solving and active learning through real world scenarios.
Adams and Kluger (1998)	The game illustrates the concepts of arbitrage, risk and diversification through trading of multiple risky assets and one riskless asset.	Favourable student comments from both undergraduate and MBA teaching evaluations.	Not assessed	The experiment can be run with both individuals and teams.
Cooper and Grinder (1997)	The Black-Scholes option pricing model and put-call parity is used in an interactive Excel spreadsheet game to price options. The game emphasises the factors that cause changes in option prices and the real life limitations of mathematical models.	Positive student feedback showed greater enthusiasm for such an intimidating subject matter.	Not assessed, however a debriefing session at the end of the game discussed the strategy of the winner, highlighting the concepts of market efficiency and risk.	The game must be played for at least two or three iterations for the students to develop an understanding of the option valuation concepts.
Bell (1993)	An asset trading game consisting of three sequences of eight trading rounds where students buy and sell shares of an imaginary financial asset. Students convey their own prices which compels them to apply asset valuation theory and statistics.	Greater class interest and participation.	Strong correlation between student performance in the trading game and performance on tests and written assignments.	To be used only as a supplement to any investment course.
Shrader and Helgeson (1993)	A multi-period double oral auction game consisting of two assets, non-income-earning cash and stock-like certificates, where students trade these assets in order to increase profits.	Students found the experiments fun, stimulating and informative with no statistical difference between the non-monetary and monetary incentive groups.	Not formally assessed, however the authors found that these experiments had a positive effect on student learning experience for the remainder of the course.	Limit the number of participants to 15-20 students.

3. Description of the swap game

Over the years of our experience in teaching various risk management tools for financial institutions, we noticed a considerable difficulty that students encountered in understanding the nature and mechanics of swap instruments. This became evident in the student assessments, which we observed throughout our years of teaching this concept. For example, in the examinations where swap-based questions were optional, the 'take-up' rate of a swap question was typically lower than questions from other topics. Moreover, the quality of responses was also inferior. This has led the authors to refer back to the literature on experimental teaching. As a result of studying prior research in this field, two conclusions were drawn. Firstly, experimental teaching was considered a viable option and worth pursuing and, secondly, there were no documented experiments related to swap topics. As a result, the first step was to design a role-play game focusing on basic plain vanilla swap and its hedging applications.

The game design started with identifying what were the most important points we would like our students to understand from the swap topic. The first goal was to enable students to understand how a 'stand-alone' basic plain vanilla swap works. The second goal was to show students how interest rate volatility (interest rate risk) might impact upon financial institutions if positions were left unhedged. The third goal was to show how swaps assist financial institutions in hedging interest rate positions. To address each of these, an individual scene was set for each goal; participant lists and game tools (including paper money, cheques, labels and instructions to each participant) were prepared.

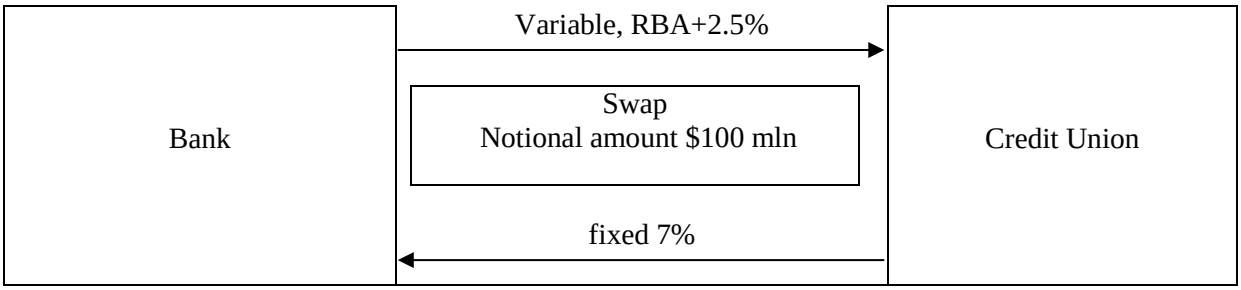
Experiment 1. How does a plain vanilla swap work?

Three students were required to participate in the experiment in addition to the instructor who directed the experiment. The participant roles were represented by a bank, a credit union and a central bank (or any variable interest rate benchmark announcer).

The bank was assumed to have variable rate assets and fixed rate liabilities, the credit union was assumed to have fixed rate assets and variable rate liabilities; the central bank, the Reserve Bank of Australia (RBA) in our case, was used as a provider of the basic variable rate benchmark (RBA cash rate).

The instructor then introduced the concept of swap and offered the participants and the audience to play/observe the mechanics of the swap. The characteristics of the swap were suggested by the instructor including the notional amount, the swap rate and the position of the bank and credit union, which represented the seller and buyer of the swap respectively. The initial variable rate benchmark was set in the manner that no payments would be required on the swap if the interest rate remained unchanged.

The freedom was given to the student representing the RBA to set a cash rate in the next period. The student chose a rate and announced it to the audience. The instructor briefly speculated under what conditions the interest rate could rise or fall and provided an explanation of the working for the outstanding payment on the swap. If the interest rate increased, the bank would then write a cheque for the outstanding amount (net payment) and pass it on to the credit union. Conversely, the credit union would write a cheque and pass it to the bank if the interest rate decreased. The experiment was repeated three times using various interest rate levels and accompanied workings. The students representing the RBA were instructed to show that the interest rate could fall, rise, or remain the same, so that the students could appreciate all scenarios related to holding the swap. The main message to the students was to show that a swap is an instrument for which the direction and size of its cash flows are uncertain and depend on the benchmark interest rate fluctuations. An example of the workings is presented in Figure 1.



RBA rate	*Cash flow*	*Direction*
Initial - 4.5%		
Period 1 - 5%	5% + 2.5% -7% = 0.5% 0.5%*100mln = $0.5mln	Bank pays Credit union $0.5mln
Period 2 – 4.5%	4.5% + 2.5% -7% = 0	No cash flows
Period 3 – 3.9%	3.9% + 2.5% -7% = -0.6% -0.6%*100mln = -$0.6mln	Credit Union pays Bank $0.6mln

Figure 1. Example of calculations in Experiment 1 – plain vanilla swap.

Experiment 2. Impact of interest rate volatility on financial institutions' net interest income.

Seven participants were required for the second experiment in addition to the instructor. These were comprised of a bank, a credit union, a central bank, a bank depositor/lender, a bank borrower, a credit union lender/depositor and a credit union borrower. The rest of the audience was divided into two groups, shareholders of the bank and members of the credit union, who would evaluate the performance of the unhedged financial institutions at the end of each experimented year. The assumption about the bank's and the credit union's position remained unchanged from Experiment 1.

The instructor introduced both financial institutions' balance sheets and income statements. For simplicity, the assumption made was that the values of asset/liability positions were equal to the notional value of the swap in Experiment 1.

In year 0, students were clearly shown their Net Interest Income (NII) based on the current RBA rate (it was set as positive for both institutions in year 0). A student playing the role of the RBA was asked to write higher, lower and unchanged interest rates in years 1, 2 and 3 at random. The instructor showed on the visualiser the workings for the payments due to and from each of the two financial institutions. Paper money was used to show the flow of cash from and to each of the institutions and their lenders and borrowers. The net interest income was calculated for each institution based on their performance; shareholders (rest of the audience) were encouraged to express their approval or disapproval of the performance of each of the financial institutions.

The main message emphasised that without hedging, both financial institutions were unprotected against the negative impacts of interest rate changes. An example of the workings for Experiment 2 is presented in Figure 2.

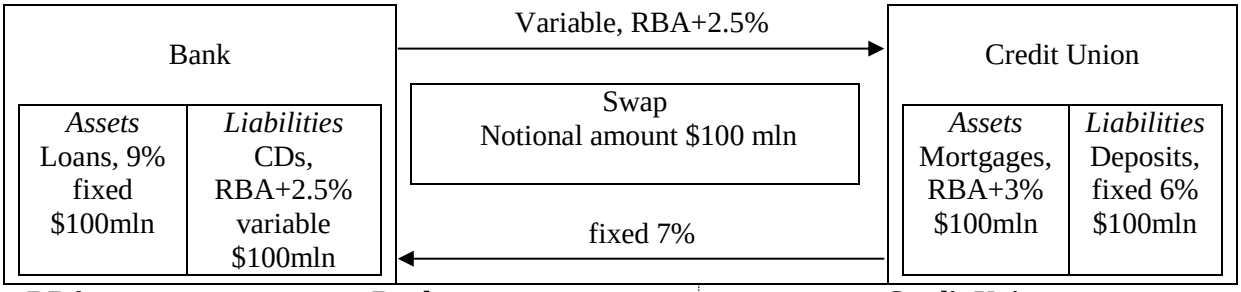
	Bank		**Credit Union**	
RBA rate	*Assets* Loans, 9% fixed $100mln	*Liabilities* CDs, RBA+2.5% variable $100mln	*Assets* Mortgages, RBA+3% $100mln	*Liabilities* Deposits, fixed 6% $100mln
5%	NII=9%*$100-(5%+2.5%)*$100=$1.5mln		NII=(5%+3%)*$100-6%*$100=$2mln	
4.5%	NII=9%*$100-(4.5%+2.5%)*$100=$2mln		NII=(4.5%+3%)*$100-6%*$100=$1.5mln	
3.9%	NII=9%*$100-(3.9%+2.5%)*$100=$2.6mln		NII=(3.9%+3%)*$100-6%*$100=$0.9mln	

Figure 2. Example of calculations in Experiment 2 – Unhedged balance sheet positions.

Experiment 3. Hedging with the plain vanilla swap

The third experiment was considered the pinnacle of the role game as it clearly shows how combining a balance sheet position and a swap instrument creates a hedged balance sheet position. Experiment 3 required exactly the same number of players and roles as in Experiment 2. For consistency purposes, the same interest rates were used as in Experiment 2 and the same swap rate as in Experiment 1.

The instructor had an important role to manage the cash flow movement and to show the workings that emphasised the point of reduced volatility of the position (zero volatility in our experiment). An example of the workings is presented in Figure 3.



RBA rate	Bank	Credit Union
5%	NII=9%*$100-(5%+2.5%)*$100+ (5%+2.5%-7%)*100=$2mln	NII=(5%+3%)*$100-6%*$100+ (7%-(5%+2.5%))*100=$1.5mln
4.5%	NII=9%*$100-(4.5%+2.5%)*$100+ (4.5%+2.5%-7%)*100=$2mln =$2mln	NII=(4.5%+3%)*$100-6%*$100+ (7%-(4.5%+2.5%))*100=$1.5mln
3.9%	NII=9%*$100-(3.9%+2.5%)*$100+ (7%-(3.9%+2.5%))*100=$2mln	NII=(3.9%+3%)*$100-6%*$100+ (7%-(3.9%+2.5%))*100=$1.5mln

Figure 3. Example of calculations in Experiment 3 – Hedging financial institutions' positions with a swap.

4. Did students like it?

The role-play game described above was implemented in a second year undergraduate course, 'Financial Institutions Management.' The course was taught concurrently on two university campuses. A decision was made to make a trial of the game on the Gold Coast campus, while the Nathan campus class was run using the traditional method of teaching. The Gold Coast campus typically has a smaller number of enrolled students, the majority being domestic students. Griffith Business School has a policy of recording lectures (screen and voice) which means that the classes on both campuses (with and without the game) were available to students. The time allocated for the game was one academic hour, as this was the second half of the lecture related to use of derivatives to hedge interest rate risk. Students were advised at the beginning that in the second half of the lecture there will be a role-play game and they would have an option to attend or not. Moreover, they were advised that a recording from the traditional lecture held at the Nathan campus on the same topic would be made available for their use.

The announcement that the traditional lecture was to be replaced by a game was not well received by some students. Roughly, half of the class opted to leave after the first hour and skipped the experiment. Those who remained were asked to register their names. Thirty-eight students signed the class roll.

The experiment generally went well. Students were asked to volunteer for various roles and the available roles were filled quickly. Those students who missed one of the seven most active roles were asked to split into equal groups to become shareholders/members of two institutions. Students appeared to be engaged in the game and actively participated in the experiment. In the role-play itself, opportunities for further fine-tuning were discovered. For example, the game had five interest rate scenarios for each experiment, which somewhat slowed the dynamics of the game. In the future, perhaps a smoother transition between cases would happen if the experiment were to be limited to three scenarios only. Furthermore, a need for a better pre-game brief for the active participants was also noticed.

Students were asked to fill in a simple optional questionnaire about their experience with the role-play game. Six 5-point Likert scale questions were offered to students, together with one open question to share any other observations/comments from the game. The questions are as follows:

1) Have you enjoyed the experience of the 'Swap Role-Play' game?
2) Do you recommend using the 'Swap Role-Play' game again in the future?
3) Would you like similar experiments in other lectures/courses (instead of traditional lectures/tutorials)?
4) Do you think you understand better the nature of the swap instrument as a result of this experiment?
5) Do you think you understand the concept of hedging using swap contracts in the context of financial institutions as a result of this experiment?
6) Would you prefer to have had a traditional type of a lecture today instead of an experiment?

For each question, students had five options to choose from, with each option allocated a score as follows: strongly no (score 1), marginally no (score 2), neutral (score 3), marginally yes (score 4) and strongly yes (score 5). There was an additional space at the bottom of the survey where students were encouraged to share their thoughts of the game, i.e. what went well, what did not, what can be done better? Out of the thirty-eight students who participated in the experiment, twenty-eight students opted to fill in the questionnaire. The results are presented in Table 2 below.

Table 2. Role-play game students' feedback survey results

Answer (score)	Question 1	Question 2	Question 3	Question 4	Question 5	Question 6
Strongly yes (5)	75.00%	64.29%	60.71%	78.57%	46.43%	0.00%
Marginally yes (4)	7.14%	32.14%	28.57%	17.86%	39.29%	0.00%
Neutral (3)	17.86%	3.57%	10.71%	3.57%	10.71%	14.29%
Marginally no (2)	0.00%	0.00%	0.00%	0.00%	3.57%	46.43%
Strongly no (1)	0.00%	0.00%	0.00%	0.00%	0.00%	39.29%
Average score	4.68	4.61	4.50	4.75	4.29	1.75

As is evident from the answers in the survey, practically all students enjoyed the experience of the game and believed there are positive outcomes for their learning. This is well in line with the existing literature (see Table 1 for the comprehensive list of finance experiments and some economics experiments), which overwhelmingly reports a positive experience for those students who were involved in experimental learning. Relatively, more positive results are observed for the enjoyment and understanding of the simple concept. Question 4, which relates to a more complex concept, reports slightly less positive outcomes, which is logical. Students recommended using games/experiments more often in the classes. The average score in Table 2 represents the arithmetic average score for each question in the twenty-eight available questionnaires.

The open comments were in line with the findings of the survey where they expressed satisfaction and enjoyment of the game. Some of the students did report a difficulty with understanding the third experiment, which might have been expected taking into account the higher complexity of the concept. Some suggestions were made by students to reduce a number of interest rate scenarios for each experiment in order to maintain good dynamics within the game.

We were encouraged by the results of the survey, although we recognised that they should be treated with caution due to a potential 'self-selection bias.' The students who stayed in class for the role-play might be more open to experimental types of learning, as opposed to those who might prefer traditional lectures and chose to leave the class before the start of the game.

Overall, the findings of this paper add to the evidence that in-class experiments are enjoyable and fun for the participants; they benefit students and instructors in terms of breaking the routine and they improve the reputation of finance teaching among students. The shortcoming of the experiment was the lack of willingness by some students to play the game with serious intent. These findings are generally in line with the summary of findings made by Brauer and Delemeester (2001).

Was the game useful?

While the use of experiments and games as teaching tools has been shown to be useful in enhancing the classroom experience of students, Fels (1993) and DeYoung (1993) have questioned whether these techniques have been useful in terms of their pedagogical effectiveness.

Recent studies in economics that have attempted to measure the effectiveness of experiments, show encouraging results. Durham, McKinnon and Schulman (2007) analysed the performance of students enrolled in micro- and macroeconomics to find that classroom experiments enhanced the educational experience of students, irrespective of learning styles. They found that students performed better in the exam questions covering the topics explored in the experiments. Furthermore, they found that experiments improved students' attitudes towards studying economics and increased their retention of

knowledge. Using Test of Understanding in College Economics (TUCE) scores to measure the effect of experiments and controlling for student aptitude and other variables, Dickie (2006) showed that experiments aid learning and that the use of grade incentives offsets this benefit. Similarly, Gremmen and Potters (1997) have reported that in-class game exercises have had a positive impact on learning. They indicated that experiments help the student to retain knowledge more easily and that they have a permanent influence on understanding the concepts involved. Testing whether in-class experiments differ from online experiments in enhancing student achievement, Carter and Emerson (2012) do not find a significant difference between the two methods of teaching. Although students viewed in-class games more favourably, their learning outcomes were no different from those of the students exposed to computerized experiments, indicating that the social interaction of a face-to-face presentation is more enjoyable.

The research by Bell (1993) into finance discipline is the only one that has attempted to assess the effectiveness of the in-class experiment. The study found a strong correlation between the performance in the trading game and the performance in the assessment items. However, Bell's study did not assess whether the trading game had been effective in enhancing students' learning outcomes in comparison to traditional methods.

A summary of the studies in economics and finance that estimated and reported the effectiveness of the games/experiments is presented in Table 3 below.

Table 3. Experiments in finance and economics and their effectiveness on students' performance and learning

Publication	Nature of Experiment/Game	Students' Feedback	Effectiveness of Method	Other Findings
Bell (1993)	An asset trading game consisting of three sequences of eight trading rounds where students buy and sell shares of an imaginary financial asset. Students convey their own prices which compels them to apply asset valuation theory and statistics.	Greater class interest and participation.	Strong correlation between student performance in the trading game and performance on tests and written assignments.	To be used only as a supplement to any investment course.
Frank (1997)	A five to ten minute experiment demonstrating the 'tragedy of the commons' dilemma involving five volunteer students, conducted by seven instructors teaching courses in environmental economics or public finance. Multiple-choice test questions on the topic were answered by students participating in the game and by a control group.	Not formally requested, however casual feedback received after the lecture was encouraging.	Correct answers in the test were significantly higher in the experimental groups than in the control groups. What remains unclear is whether taking part in the experiment is more beneficial than just watching it.	The benefits of the experiments can be underestimated if they are not preceded or followed by discussion or interpretation of a problem.
Gremmen and Potters (1997)	A multi-day international economic game explaining topics such as inflation, employment and exchange rates among others. Pre-test and post-test results on the group of students who played the game are compared with the results of students following a traditional lecture style.	Both groups of students perceived the lectures to be slightly more beneficial to their learning than the game.	Both groups scored the same on pre-test results while the students playing the game scored significantly higher than the lecture group on the post-test assessments.	Before and after multiple-choice test results show no systematic or significant correlation between what students believe they learned from the game and what they actually learned.
Dickie (2006)	A controlled experiment on learning microeconomic concepts to test the efficacy of experimental teaching. The pre-test and post-test of two experimental groups (with and without grade incentives), are compared with those of a control group. The difference between post-test and pre-test scores is considered as the measure of achievement or learning.	Students enjoyed participating in the experiments, with 75% of students indicating that experiments were more interesting than lectures.	The use of class experiments was linked to a significant increase in mean student achievement. The grade incentive to reward performance had no impact on learning.	Class experiments provide greater benefit to high achieving and younger students, and those with more college experience.
Durham, McKinnon and Schulman (2007)	Multiple experiments conducted over three years on 1,585 students from 16 class sections in introductory microeconomics and macroeconomics courses. The effect of classroom economics experiments on student learning was tested using the relative performance of the control and the treatment group based on the results of the mid-term and final exams.	The experiments generated enthusiasm among the students and a better class atmosphere. A survey on attitude towards economics showed that students in the control group expressed an improved attitude towards studying economics.	Controlling for factors like learning styles, attitude, instructor, time -of - day and time-on-task, the overall results showed that classroom experiments had a positive effect on student performance. The larger impact was seen in the macroeconomics concepts.	Multimodal or kinaesthetic learners benefit more from experiments than from lectures, while read-writer learners are not significantly affected by experiments. Experiment participants retain more knowledge of the concepts taught than those in the control group do.
Carter and Emerson (2012)	Microeconomics in-class experiments are compared with ones delivered online to determine the difference in student achievement as measured by the course scores and Test of Understanding in College Economics (TUCE) (Saunders 1991).	Students preferred the in-class experiments more, experiencing higher level of interaction with peers.	No significant difference in student achievement between the online group and the in-class group.	The choice of in-class versus online makes no difference to the general evaluation of the course.

As noticed from the literature reviewed above, the evidence of effectiveness of the games on students' learning is thin and equivocal, albeit never negative. Therefore, it was much harder for the authors to predict the outcome of the next question we asked ourselves: whether the experiments are effective, or not, as learning tools. We kept an open mind and were happy to accept any outcomes whatever they happened to be.

We adopted a two-step analysis of the students' performance. Firstly, we looked at the interaction between attendance of the role-play class and students' willingness to attempt the swap question in the final exam. The purpose was to see whether attending the class gave students more confidence to attempt the optional swap question in the exam at the expense of other optional topics. The exam included a range of compulsory multiple-choice questions with a 20 per cent aggregate weight and five multi-step written problems, where students had an option to choose four (20% weight each). One of those elective questions was on swaps. The analysis has found no significant difference in the take-up rate on the swap question between students who attended the class and those who did not. In particular, 57.89 per cent of those who attended the role-play game lecture attempted the swap question, whereas for those who did not attend the class, the take-up rate was 57.6 per cent. It appeared that attendance of the role-play class has not played an important role in deciding to pick the swap question or not. The take-up rate for the swap question was still smaller than with any other four questions from other topics, which confirmed the relevant difficulty of the topic.

Secondly, we empirically tested whether attendance of the role-play game class had contributed to the performance of the ninety-four students who picked the swap question in the exam. For that, we ran a simple Ordinary Least Squares regression:

$$y_i = a + bx_i + d_i + \varepsilon_i$$

where y_i is a proportion of the maximum mark in the swap question, x_i is a control variable represented by a proportion of the maximum mark in the rest of the exam and d_i is the dummy for the role-play game class attendance. The proportion of the maximum mark in the rest of the exam was chosen as a control for the effect of students' general exam preparation effort and individual abilities. The regression results are reported in Table 4 below.

Table 4. Regression results on the effectiveness of the swap role-play game.

Variable	Coefficient	P-value
Intercept	-0.24	0.005
Control variable	1.21	0.000
Attendance dummy	0.15	0.012
R-squared	*0.513*	
Adjusted R-squared	*0.502*	

As expected, the control variable proved to be highly significant showing that students' preparation and abilities played a very important role in their swap question performance. The negative value of the intercept reflects the fact that performance on the swap question was, on average, lower than in the rest of the exam (50.47% versus 58.59%).

A notable result of the experiment was given by the coefficient of the attendance dummy, which showed a highly significant (98.8% level) value of 0.15. This means that, on average, the attendance of the role-play game added 15 per cent to the performance in the swap question. Although the benefit of the game is clear from the outcome of the empirical test, it is important to mention that all students, whether they attended the in-class game or not, had access to the recorded lectures in both formats, i.e. the role-play game lecture and the traditional lecture, which was delivered on the same week at the other campus. Since technology did not allow us to trace which students accessed the recorded classes in their study and exam preparation, we were unable to undertake more detailed analysis. It is unknown whether students who attended the role-play game used the traditional lecture recording to assist their learning. It is also unclear what strategies those students who missed the class implemented in their studies.

5. Conclusion

Experimental learning has been part of the educational landscape for decades. Although it shows some promising outcomes, it has not become a mainstream education strategy. Instead, it is often used as an alternative and complimentary method when traditional methods do not deliver satisfactory results.

In this paper, we have attempted to answer three questions. Firstly, we reviewed the literature to find out whether experimental learning can offer a solution to assist undergraduate students to tackle, more effectively, the relatively difficult concept of swaps and hedging with swaps. During the process, we examined the theory behind the experimental learning to ensure that experimental learning is a valid alternative to traditional teaching methods. We also documented existing games/experiments in finance and discovered that there were no suitable games to assist us. With no answer from the existing literature, we designed a role-play game, which was implemented in a second year undergraduate course. Secondly, the question addressed was whether or not the experiment conducted was enjoyable for the students and whether or not it was a useful tool for engaging more effectively

with the students. The answer was a resounding ‘yes’ for the group that participated in the experiment. However, since not all students took part in the game, it was impossible to get a broader view of this type of activity from the students who responded to the survey. The final question we examined was whether the experiment we conducted was enabling students to become more successful at answering the swap assessment topic or not. Since the existing literature was limited in this field, we approached the question with an open mind and were prepared for any outcomes. The results of the empirical test conducted showed that attendance and participation in the role-play game was indeed beneficial for the students. Students who engaged in the role-play game performed, on average, 15 per cent better than the students who did not, after controlling for their abilities and preparation efforts.

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