Financial Market Trading Simulations: Are They Effective?

**Timothy A. Krause**

Penn State Behrend

**Eric J. Robbins**

Penn State Behrend

Financial Market Trading Simulations: Are They Effective?

**Abstract**

This study examines the effectiveness of financial market trading simulations relative to student learning. While prior literature has revealed how trading simulations positively affect student learning, we introduce additional demographic and survey data that affects student learning and outcomes. The results indicate various factors that may affect student learning, including the differences between online and residential students, differences in years of career experience, business school majors, as well as a self-reported learning variable that indicates that financial trading simulations are indeed effective. The results indicate that financial market trading simulations contribute to student learning.

**Keywords:** Trading simulation, finance pedagogy, experiential learning

**Introduction**

In the pedagogical finance literature, the benefits of experiential learning are well-documented, since students often learn better when they are active participants in the learning process. See, for example, Kolb (1984), Cross (1987), Lengnick-Hall & Sander (1997), Wolmarans (2005), Walters, Greenwood, & Ritchie (2006), Kumar & Lightner (2007), and Fitzpatrick (2015). The application of theoretical concepts to empirical experiences provide valuable learning experiences to students in the environment of a trading simulation. Simulations allow students to learn critical thinking skills by observing how their analyses are translated into profits and losses in (simulated) financial markets. Using financial markets as the backdrop for an experiential learning exercise also teaches students to realize how much there is to learn, even though they are obtaining skills and becoming more aware of events in financial markets. These skills and awareness are often useful when students are interviewing for career positions in finance. Finally, trading simulations provide a relatively “low stakes” environment (i.e., there is no real money at risk) to explore how emotions affect trading decisions.

There is a natural tension in Kolb’s (1984) circular model of experiential learning, whereby neither abstract instruction nor experiential learning is inherently the best singular method for all learning scenarios. Kolb’s logic suggests that a combination of both traditional, lecture-based learning and experiential learning might be a winning combination to maximize student learning. Heath & Heath (2007) study what makes ideas “stick” in our minds. They find six factors that enhance the long-term “stickiness” of a concept and one of them echoes Kolb’s standard of “concreteness.” While assigned readings and classroom lectures provide students with information, “hands-on” projects provide concrete, real-world application to make the learning “stickier.” Students may learn investments and financial markets concepts more effectively with a combination of in-class instruction and a trading simulation. For instance, they may feel the trading impact of earnings releases rather than just reading about them. The simulations can make classroom learning come to life and turn passive learners into active explorers.

This study explores the use of trading simulations in both residential and online learning environments within the context of an Introduction to Investments class. We explore interest levels, knowledge attainment, and overall self-reported confidence in investing. Specifically, this study uses a two-stage trading simulation whereby student learning in the second simulation can be enhanced by learning in the first simulation in the same class. By testing the effectiveness of trading simulations in the context of the class, this study adds value to the existing body of knowledge on the benefits of nesting experiential learning opportunities within traditional, lecture-based finance classes.

**Literature Review**

Moffitt, Stull, and McKinney (2010) find that students generally think that trading simulations contribute to their educational experience. Some researchers (e.g. Arnold & Henry, 2005; Barry, 2004; Mukherrji, 2003) find that experiential learning using spreadsheet models greatly expands analytical opportunities. Alonzi, Lange, & Simkins (2000) study student feedback about a futures trading simulation regarding the price discovery process in futures markets. They find a mean rating of self-assessed learning effectiveness of 4.37 on a 5-point Likert scale. Other researchers (Tessema, 1989; Elan and Sanderson, 1991; Angel, 1994) encourage the use of trading simulations to introduce students to the uncertain movements of financial markets.

McClatchey & Kuhlemeyer (2000) encourage educators to use trading simulations in the classroom, commenting that trading simulations help students make the link between financial market movements and current events. Angel (1994) plays the “Broker’s Game” on the first day of an introductory finance class. Students actively participate in the price discovery process to fill customer orders at the best execution, and this act of purchasing and selling securities in a non-computer-based trading simulation is informative to students. Elan and Sanderson (1991) use a simulation that spans three college semesters. The authors find that this progressive trading simulation structure is a useful experience in understanding portfolio construction.

In contrast, some finance educators avoid the use of simulations based upon a sense that poor performance in the simulation might deter student interest in the field of investments. Dolvin and Pyles (2011) address this concern by using a pairs test survey with pre-simulation and post-simulation responses. They compare student interest with performance and find that student interest levels in investing are not correlated with performance in the trading simulation. This reinforces the fact that levels of interest and knowledge can be increased through both good and bad benchmark-relative performance. Essentially, students learn from both success and failure.

King and Jennings (2004) study whether a trading simulation enhances learning in a traditional lecture-style classroom. They test the increase in learning of personal financial concepts with a lecture-only class as compared to a class that includes a trading simulation. They find that both classes show an increase in learning, but that the class exposed to the trading simulation experiences an even higher increase in learning than did the lecture-only cohort. Clinebell and Clinebell (1995) find that 14% of surveyed faculty at AACSB-accredited business schools (241 respondents) use investment simulations as a part of their curriculum. McClatchey and Kuhlemeyer (2000) also conduct a survey of business schools and find that 38% of all survey participants use StockTrak as their trading simulation vendor. This is the largest percentage of any of the vendors in their survey.

The trading simulation in the present study is also hosted through StockTrak, who reports on their website ([www.stocktrak.com](http://www.stocktrak.com)) that over 1,000 universities are currently operating trading simulations with their software. Trading simulations are a widely used method of instruction in investment education. Hatfield (1993) uses a two-stage trading simulation where only equities are allowed, and then expanded to include futures. The goal is to help students better understand the differences between the two investment types. Following similar logic, our students participate in two simulations during the course of the semester. Some researchers (e.g., Quinton & Smallbone, 2010; Su & Chung, 2015) note that student learning in an experiential assignment is enhanced by including components that encourage reflection. Thus, at the end of our trading simulation, students write a three-page paper reflecting on what they have learned through the trading simulations.

This study is different from prior research in that we incorporate three unique characteristics. First, we include both online and residential learners, which provides a basis for our first research question. Second, we conduct two different simulations in the same class, albeit with some overlapping time periods, with almost equal numbers of male and female students. This allows for shared learning and the ability to compare and contrast mutual fund and ETF trading with stock and option trading. Thus, our second research question examines this issue. Our third research question relates to differences in learning that may occur in conjunction with a lecture-based class environment combined with a trading simulation. In contrast to Moffit et al. (2010), we conduct the simulations within an investments class where students receive both theoretical and practical instruction. This instruction is related to investing, but not directly linked to the trading simulations and the selection of specific investments.

**Data, Methodology, and Results**

The students surveyed in this study participate in two trading simulations. The first simulation lasts twelve weeks and allows students to trade a hypothetical portfolio of $500,000 using both mutual funds and exchange traded funds. The second simulation has the same limitations, but it lasts for five weeks with a hypothetical portfolio of $1,000,000 and it involves trading in individual stocks and options. Students place orders in “real-time” with actual market data (15-minute delayed) across several global exchanges. These simulations allow students the opportunity to apply classroom learning and their own research in a simulated equity trading environment. The pedagogical hope is to transform students from passive receivers of information into active participants. Both simulations share a common set of rules that are described in Appendix A.

Students are able to monitor their investment progress on the StockTrak website as frequently as they choose. They are able to monitor their portfolio balance, percentage gains (or losses), Sharpe ratios, portfolio beta, portfolio alpha, and rank in the challenge relative to the other students in the class. A primary goal of these two trading simulations is to give students the opportunity to apply facts and theories learned in class to real-world investing. Students are encouraged to process their learning throughout the semester through classroom discussion. Both online and residential students are required to discuss the simulation and market events in online discussion forums.

During the first week of class, student survey participants (it is voluntary, although a small number of course bonus points are awarded for participation) are asked a series of ten demographic questions in addition to fifty basic questions testing general investment knowledge. To ensure student anonymity, both the pre-simulation and the post-simulation surveys are administered using Qualtrics survey software that is anonymous and locked behind a university firewall. In the last week of the simulation window, students are given a closing survey to assess self-perception of learning and to assess the change in score on the investment-related questions.

At the end of the semester, and in the interest of anonymity, Professor 1 (co-author) would then relay survey anonymized participation data to Professor 2 (co-author and course instructor) so that bonus points could be awarded for student survey participation.

**Data.**Simulation participants are all students in an Introduction to Investments course, an upper-level investments course that is required for finance majors and minors. This course is also taken by students with general interest in the subject matter and no program-level requirement. Prior to the course, they have taken basic courses in accounting, economics, and finance. Participants are diverse in terms of major, gender, and geographical dispersion because some of the participants are online learners and some are residential students.

Table 1 provides some descriptive statistics for survey participants. The sample is fairly evenly distributed among online and residential students and with respect to gender. As expected, given where this course falls in the recommended academic plan for business students, all but one of the students is a junior or senior. Table 2 breaks down survey learning outcomes (increases in survey scores and final grades) by subgroups. Panel A divides the sample by class standing, indicating a 76% increase in mean survey (57% median score increase, not reported in table) scores for juniors and a comparable 74% mean increase (61% median) for seniors. Panel B demonstrates a considerable disparity in score improvement by gender. On average, female participants scored 120% higher (102% median) on the terminal survey than on the initial survey, while male students improved by 84% (56% median). This finding contrasts with the results of Moffit et al. (2010), who find that male students make greater gains in score improvement. Panel C demonstrates that online student scores improved by 83% on average (64% median), while residential student scores improved by only 66% (50% median).

Table 3 contains further student demographic information, simulation trading data, and survey summary statistics that may explain student survey and course performance. The first 31 variables in the table represent self-reported demographic data regarding various characteristics that might affect students’ abilities and pre- and post-survey knowledge. Also included are variables collected via the trading simulation interface. The last four variables in the table are examined in the next section as dependent variables that reflect measures of student learning. Specific definitions of each variable and the scale used are contained in Appendix B.

One variable of particular interest is Simulation Effectiveness, a self-reported variable about student opinions regarding their learning via the simulation. Moffit et al. (2010) expand on the earlier research of Ascioglu, Kugele, and Kugle (2005) to use matched paired test results of a pre-simulation and post-simulation survey in non-finance classes. They find that 66% of the students in their matched pairs test self-assessed the trading simulation as effective and 86% of respondents reported an increase in interest level in investments. Similarly, 83% of students in our study respond that the simulation is either “effective” or “very effective”, and the mean score is 3.15 out of 4, which supports the effectiveness of the simulation in their learning.

Our study includes six cohorts with a total of sixty-two students in an upper-level investments course at a five-thousand student branch campus of a major state university. The sample of student participants includes individuals with a wide range of prior investment and economics-related coursework, prior investing experience, and both residential and online learners. Online learners are more prone to have prior financial market experience, and some are currently vocational in the financial industry, thus they bring more experience to the course.

In the next section of the study, the relationships among the variables in Table 3 are examined via stepwise regression analysis (the exact procedure is described below). Twelve of the independent variables are found to significantly explain student course performance. Thus, Table 4 provides a correlation matrix for those twelve variables along with the dependent variables of Initial Survey Score, Terminal Survey Score, and Final Course Grade. In the interest of brevity, the other nineteen variables are omitted. Variables that are correlated with Initial Score, Terminal Score, or Final Course Grade at the 0.30 level or higher are highlighted in **bold** typeface. Potentially significant variables that explain student performance include Experience in Investing, Terminal Confidence in Selecting 10 Mutual Funds, and Female participants (negative correlation), among others.

**Methodology and Results.**In similar fashion to Moffitt et al. (2010), our first empirical analysis involves using the initial survey score as the dependent variable in a series of OLS regressions. First, the total number of ACCTG, ECON, and FIN classes is included as the only independent variable. As expected, and as shown in the first data column of Table 5, there is a significant positive relationship between this variable and students’ initial survey scores (coefficient value of 0.892 with a *t-*statistic of 1.766). Model 2 adds a gender dummy variable on the right-hand side (RHS), and it is significantly negative. Moffitt et. al. (2010) find similar gender-specific results in their study. Model three adds a dummy variable for Interest in Investing at the beginning of the semester. As would be expected, it is positively related to initial survey performance. In distinction from prior studies, however, our sample includes a significant portion of adult online students, some of whom possess significant years of experience with investing and in their careers. Their experiences, as compared to relatively inexperienced undergraduate students, may significantly affect initial survey scores. Model 4 includes years of investing experience on the RHS, and it is so significantly positive that it subsumes the prior significant results, although the number of related classes is marginally significant at the 10% level. This result bears directly on our first research question regarding potential differences among residential and online students. Although this variable subsumes the effect of previously significant variables, it does not invalidate them. It just reflects the fact that introducing new, significantly more experienced students into the sample population changes the dynamics of the initial survey scores. The increasing levels of adjusted R2 indicate that the final model most accurately explains variation in Initial Scores.

Moving from the initial survey results to those of the terminal survey (after both simulations have been conducted), Table 6 presents a similar examination of post-simulation minus pre-simulation survey scores as the dependent variable. The OLS equations are conducted in similar fashion to Table 5, where more variables are introduced sequentially on the RHS. There is clearly a negative relation between changes in survey scores and initial scores in all model specifications. As in Moffitt et al. (2010), there is much more room for improvement for students with lower initial scores. But in one of the most important findings in this paper, female students demonstrate a significantly more positive increase in survey performance than males (Models 2 – 5), even when controlling for Initial Score performance. This finding regarding our second research question stands in contrast to the findings of Moffitt et al. (2010), who find that female students “score significantly lower on both the pre-game and post-game assessments” (p. 71). Hopefully, this result is a reflection of increasing interest of females in more quantitative aspects of business (i.e. ACCTG, FIN, and ECON) promoted by business schools nationwide, as well as better pedagogical methods that accommodate the needs of all students. DePaola, Gioia, and Scoppa (2014) find that men tend to be more overconfident in exam outcomes than did the female members of their study. It is possible that female participants in our study were less confident in the initial survey and hence their learning was more robust. As expected, experience in investing remains an important indicator of pre- minus post-simulation survey performance. Model 5 includes a dummy variable for Simulation Effectiveness (a self-reported survey variable regarding student assessment of the effectiveness of the simulation), but it is statistically insignificant, as in Moffitt et al. (2010). Although our sample is similar in size to that of Moffitt et al. (2010), who provide a valuable contribution to the pedagogical finance literature, we collect significantly more demographic data that provides insights to the value of financial trading simulations for student learning. Tables 7 and 8 provide some incremental insights into the effectiveness of such simulations.

Table 7 presents the results of a stepwise regression of the dependent variable (percentage increase in survey score) on 31 independent variables. We run these regressions at the 11% significance levels to capture any variables that are marginally significant at the 10% level in our very small sample. In an effort to identify which independent variables are important in determining new learning, this process initially runs a “full model” with all 31 of the independent variables on the RHS. Then, the variable with the highest p-value of a particular variable (i.e. most statistically *insignificant*) is removed from the regression. A new regression is then calculated where the remaining variables and the next variable with the greatest p-value are also removed. This process is continued until all of the remaining variables are significant at the 11% level. As indicated in Table 7, the most significant factor remaining at the end of this process is Confidence in Personal Investing (Terminal), which is negatively related to survey score improvement, which seems to be counter-intuitive, given that score performance should inspire more confidence. But, this result may reflect the humility of students that recognize the efficiency of modern financial markets, or alternatively, the initial overconfidence of male students as in DePaola, Gioia, and Scoppa (2014). Further, students often comment in self-reflective papers and discussions that the more they learn about the markets, the more they understand that they still have much to learn. Secondly, students’ ability to beat the market using mutual funds is negatively related to score-improvement. As expected, terminal interest in investing is positively related to score improvement, and we also find that the number of ETF trades is negatively related to performance. Both mutual funds and ETFs are traded in the first simulation, which runs for the longest portion of the semester. These two observations may reflect a “lazy” selection process whereby students sometimes forego conducting real research and are just selecting “popular” funds as revealed by an internet search. However, students that express “confidence in selecting 10 mutual funds” score a positive relation in their score improvement performance, and Interest in Investing is still positively related to score improvement. As in earlier results, females show the most improvement in survey scores. Also, students who are not finance, accounting, or economics majors show significantly greater improvement, which may reflect low initial survey scores. Each of these results bear significantly on our third research question.

Further, while Moffitt et al. (2010) examine student survey performance only, our study examines student benchmark-relative investment performance in the context of a specific course in investments. Thus, Table 8 examines Final Course Scores (grades, 0 – 4 with A being 4, A- being 3.67, etc.) relative to a variety of independent variables that may be affected by course content, prior learning, and the trading simulation. The most significant variable in this analysis (highest *t*-statistic) is interest in investing (Terminal), which is an intuitive result since students who were (or became) more interested in the investment process achieved higher grades in the course. Also, the trading simulations used in the course may have been effective tools to stimulate this interest. The second most-important value is the negative effect of the number of ECON courses taken, but this may just reflect the fact that there are only four ECON students enrolled in the respective courses, perhaps representing outliers. It may also reflect the fact that economics is more theoretical in nature than finance, and that particular economic theories do not bear out well in actual investment activity. However, interest in investing, perhaps inspired by the content of this course, is significantly related to final course grades.

Additionally, in another counter-intuitive result, both Confidence in Personal Financial Non-Investment Decisions and Confidence in selecting 12 stocks are negatively related to Final Course Scores. So, while higher performing students have less confidence in their investment decisions, this may just reflect the fact that they recognize the difficulty in making informed investment decisions. Likewise, the number of ETF trades is negatively related to final course score, most likely reflecting student decisions to just invest in ETFs (perhaps randomly, or without much analysis) as opposed to conducting thorough fundamental analysis of stocks. The dummy variable for Residential students is significantly positive, perhaps demonstrating that the “in class” experience conveys more information and learning than the online environment. Bergstrand and Savage (2013) find that undergraduate student evaluations in their sample of 118 sociology courses indicate self-assessed learning levels to be higher for residential students as opposed to online learning. This could be the result of a student’s desire to avoid active involvement in the learning process, which is required for online learners. This result relates to our first research question regarding the benefits of online vs. residential learning, and further study on this topic may provide further insights.

Once again, experience in investing, confidence in selecting mutual funds, and the female gender dummy are all positively related to course performance. Years of Career Experience are negatively related to course performance, which may reflect years away from an academic environment and/or the normally significant work requirements of potentially more mature students with full-time jobs. Accounting majors score significantly lower in Final Course Scores, which is somewhat anomalous given that they score higher on Pre- and Post-Score Surveys. While they may be well aware of general finance-, accounting-, and economics-related questions, they do not do as well on finance-specific related course material. Finally, the Simulation Effectiveness Dummy Variable is positively related to Final Course Scores. In conjunction with the results presented above, one of the most important new results of this paper is the influence of the Simulation Effectiveness Dummy in the OLS regression conducted in Table 8 (*t*-stat of 1.655 and p-value of 0.104). Moffitt et al. (2010) find that this variable is insignificant in their analysis (t-stat of 0.86), but the results here confirm that trading simulations may indeed enhance student learning. While this variable is only marginally statistically significant at the 10% level (p-value 0.104 for this sample size), given that there are only 62 student observations, it is positive and the coefficient value is large in comparison to others. And while this variable does not appear in Table 7 where the dependent variable is post- minus pre-survey score, it may be significant in overall course learning as reflected by students’ final grades. Thus, students seem to feel that the trading simulation provides a significantly positive learning experience, which directly addresses our third research question.

**Conclusion**

The results of this study provide an indication that real-world trading simulations provide significant learning experiences for both residential and online students. In contrast to prior research, female students show significantly more survey score improvement and obtain higher grades. The regression equations in Tables 7 and 8 provide significant incremental information when compared to those of Tables 5 and 6 that replicate the results of Moffitt et al. (2010). While the results of their study are significant, the R-squared results of the present study provide additional substantive evidence that trading simulations positively affect student learning. In addition to examining the relatively intuitive variables that explain course performance, the results of Table 8 provide incremental information showing students feel that trading simulations contribute to their learning experiences, while controlling for a wide variety of other variables. Although the economically significant variables are slightly different depending on which dependent variable is used, the outcomes are quite similar. Overall, the results indicate that while broadly defined confidence in investing declined after using the simulations, self-reported interest in investing and confidence in selecting mutual funds, in particular, both rose.

The results of the study analyze pre- and post-simulation student surveys, indicating several variables that are influential in student learning, including prior coursework, interest in investing, and gender. While all of these variables are positively related to learning, the positive outcome for the gender variable is a significant new finding. The study analyzes an extensive collection of demographic and simulation trading data (31 independent variables), making it possible to identify variables that contribute to student learning. Among the most important of these are student confidence (mixed results), interest in investing (positive influence on learning), gender (positive for females), and years of career experience (positive influence on survey scores, small negative influence on final course grades). And in a new finding, student assessment of simulation effectiveness on final course grades has a marginally significant positive influence.

There are at least two potential limitations to the study that may be addressed by future research. First, as in most studies on this topic, the sample size is relatively small. Future studies may focus on larger universities where the class sizes are much larger. Additionally, the present study is conducted within the confines of an Introduction to Investments class. In order to distinguish the results from learning that may occur from trading simulations as opposed to classroom instruction, future studies may be conducted in other disciplines, such as Economics and/or Accounting, where the demographic data may be similar, but the learning outcomes may be different due to a lack of specific instruction in the field of investments.

**References**

Alonzi, P., Lange, D. R., & Simkins, B. J. (2000). An Innovative Approach in Teaching Futures: A Participatory Futures Trading Simulation. *Financial Practice & Education, 10*(1), 228-238.

Angel, J. J. (1994). The Broker Game: An Enjoyable Way to Introduce Students to Financial Markets (and learn their names). *Financial Practice & Education, 4*(1), 61-65.

Arnold, T., & Henry, S. C. (2005). An Excel Application for Valuing European Options with Monte Carlo Analysis. *Journal of Financial Education, 31*, 86-97.

Ascioglu, A., Kugele, L. P., & Kugle, L. P. (2005). Using Trading Simulations to Teach Market Microstructure Concepts. *Journal of Financial Education, 31*, 69-81.

Barry, M. J. (2004). Using Excel to Solve the Unequal Lives, Unequal Costs of Capital Problem. *Journal of Financial Education, 30*, 32-45.

Bergstrand, K., & Savage, S. V. (2013). The Chalkboard Versus the Avatar: Comparing the Effectiveness of Online and In-class Courses. *Teaching Sociology, 41*(3), 294-306

Clinebell, J. M., & Clinebell, S. K. (1995). Computer utilization in finance courses. *Financial Practice & Education, 5*(1), 132-142.

Cross, K. P. (1987). Teaching for Learning. *AAHE Bulletin, 39*(8), 2-6.

De Paola, M., Gioia, F., & Scoppa, V. (2014). Overconfidence, omens and gender heterogeneity: Results from a field experiment. *Journal of Economic Psychology, 45*, 237-252.

Dolvin, S. D., & Pyles, M. K. (2011). The Influence of Simulation Performance on Student Interest. *Journal of Economics and Economic Education Research, 12*(3), 35-48.

Elan, D., & Sanderson, G. R. (1991). Investment Games: A modular approach. *Journal of Financial Education, 20*, 11-16.

Fitzpatrick, T. M. (2015). Designing a Foreign Direct Investment Assignment Employing KIVA Micro-Lending as an Experiential Learning Platform. *Journal of Higher Education Theory and Practice, 15*(2), 44-55.

Hatfield, G. (1993). A note on classroom security investment games. *Financial Practice & Education, 3*(2), 105-106.

Heath, C., & Heath, D. (2007). *Made to Stick: Why Some Ideas Survive and Others Die*. New York, NY: Random House Publishing Group.

King, D. R., & Jennings, W. W. (2004). The Impact of Augmenting Traditional Instruction with Technology-based Experiential Exercise. *Journal of Financial Education*, *30*, 9–25.

Kolb, D. A. (1984). *Experiential learning: experience as the source of learning and development*. Englewood Cliffs, N.J.: Prentice-Hall.

Kumar, R., & Lightner, R. (2007). Games as an Interactive Classroom Technique: Perceptions of Corporate Trainers, College Instructors and Students. *International Journal of Teaching and Learning in Higher Education, 19*(1), 53-63.

Lengnick-Hall, C. A., & Sanders, M. M. (1997). Designing Effective Learning Systems for Management Education: Student Roles, Requisite Variety, and Practicing What We Teach. *Academy of Management Journal, 40*(6), 1334.

McClatchey, C. A., & Kuhlemeyer, G. A. (2000). Incorporating Stock Market Games into the Classroom: A Survey of Faculty Teaching Investments. *Financial Practice & Education, 10*(2), 208-221.

Moffit, T., Stull, C., & McKinney, H. (2010). Learning Through Equity Trading Simulation. *American Journal of Business Education, 3*(2), 65-73.

Mukherji, S. (2003). A Spreadsheet Project for an Analyst's Report on a Common Stock. *Journal of Financial Education, 29*, 80-97.

Quinton, S., & Smallbone, T. (2010). Feeding forward: using feedback to promote student reflection and learning - a teaching model. *Innovations in Education & Teaching International, 47*(1), 125-135.

Su, Y., & Chung, Y.-h. (2015). Understanding the emotional reactions and exploring the professional development of college students based on reflections. *Teaching in Higher Education, 20*(3), 285-299.

Tessema, A. (1989). A stock market game in teaching investments. *Journal of Financial Education, 18*, 33-37.

Walters, D., Greenwood, A., & Ritchie, R. (2006). Work-Based Learning: Effectiveness in Information Systems Training and Development. *Higher Education Quarterly, 60*(1), 91-107.

Wolmarans, H. P. (2005). Business simulations in financial management courses: Are they valuable to learners? *Meditari Accountancy Research, 13*(1), 121-133.

Table 1 Descriptive Statistics

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Residential | Online | Totals | Summer 17 | Fall 17 |
| Total Students | 26 | 36 | **62** | 24 | 38 |
| Sophomore | 0 | 1 | **1** | 0 | 1 |
| Junior | 22 | 13 | **35** | 8 | 27 |
| Senior | 4 | 22 | **26** | 16 | 10 |
| Female | 9 | 19 | **28** | 12 | 16 |

**Notes:** This table presents descriptive statistics for the students who completed both the pre- and post-simulation surveys.

Table 2 Learning Outcomes by Survey Demographics

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Panel A: Pre- and Post-Simulation by Class Standing | | | | |  |
| Sophomore n = 1 |  |  |  |  |  |
| Variable | Obs | Mean | Std. Dev. | Min. | Max. |
| Initial Score | 1 | 20.00 | - | 20 | 20 |
| Terminal Score | 1 | 42.00 | - | 42 | 42 |
| Score Increase | 1 | 110% | - | 110% | 110% |
| Final Course Grade | 1 | 4.00 | - | 4 | 4 |
|  |  |  |  |  |  |
| Junior n = 35 |  |  |  |  |  |
| Variable | Obs | Mean | Std. Dev. | Min. | Max. |
| Initial Score | 35 | 18.17 | 7.42 | 5 | 35 |
| Terminal Score | 35 | 28.17 | 9.06 | 5 | 45 |
| Score Increase | 35 | 76% | 0.82 | -39% | 275% |
| Final Course Grade | 35 | 3.53 | 0.69 | 2 | 4 |
|  |  |  |  |  |  |
| Senior n = 26 |  |  |  |  |  |
| Variable | Obs | Mean | Std. Dev. | Min. | Max. |
| Initial Score | 26 | 20.73 | 7.76 | 6 | 47 |
| Terminal Score | 26 | 31.92 | 6.99 | 18 | 44 |
| Score Increase | 26 | 74% | 0.90 | -8% | 450% |
| Final Course Grade | 26 | 3.21 | 0.76 | 2 | 4 |
|  |  |  |  |  |  |
| Panel B: Pre- and Post-Simulation by Gender | | | |  |  |
| Male n = 34 |  |  |  |  |  |
| Variable | Obs | Mean | Std. Dev. | Min. | Max. |
| Initial Score | 34 | 20.82 | 8.77 | 5 | 47 |
| Terminal Score | 34 | 28.97 | 8.81 | 5 | 44 |
| Score Increase | 34 | 84% | 1.04 | -39% | 450% |
| Final Course Grade | 34 | 3.50 | 0.68 | 2 | 4 |
|  |  |  |  |  |  |
| Female n = 28 |  |  |  |  |  |
| Variable | Obs | Mean | Std. Dev. | Min. | Max. |
| Initial Score | 28 | 17.39 | 5.29 | 7 | 27 |
| Terminal Score | 28 | 31.18 | 8.02 | 15 | 45 |
| Score Increase | 28 | 120% | 0.80 | 0% | 229% |
| Final Course Grade | 28 | 3.28 | 0.79 | 2 | 4 |

Table 2 Learning Outcomes by Survey Demographics (continued)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Panel C: Pre- and Post-Simulation by Campus | | | |  |  |
| Online n = 36 |  |  |  |  |  |
| Variable | Obs | Mean | Std. Dev. | Min. | Max. |
| Initial Score | 36 | 20.67 | 7.73 | 6 | 47 |
| Terminal Score | 36 | 33.03 | 7.38 | 18 | 45 |
| Score Increase | 36 | 83% | 0.91 | -22% | 450% |
| Final Course Grade | 36 | 3.28 | 0.80 | 2 | 4 |
|  |  |  |  |  |  |
| Residential n = 26 |  |  |  |  |  |
| Variable | Obs | Mean | Std. Dev. | Min. | Max. |
| Initial Score | 26 | 17.35 | 6.97 | 5 | 35 |
| Terminal Score | 26 | 25.73 | 8.15 | 5 | 36 |
| Score Increase | 26 | 66% | 0.74 | -39% | 200% |
| Final Course Grade | 26 | 3.57 | 0.59 | 2 | 4 |

**Notes:** This table presents students’ improvement is survey scores broken down by demographic characteristics.

Table 3 Further Student Demographic and Survey Summary Statistics

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Variable | n | Mean | Std Dev | Min | Max |
| Fall 17 | 62 | 0.61 | 0.49 | 0 | 1 |
| Residential | 62 | 0.42 | 0.50 | 0 | 1 |
| Female | 62 | 0.45 | 0.50 | 0 | 1 |
| Finance Major | 62 | 0.55 | 0.50 | 0 | 1 |
| Acct'g Major | 62 | 0.24 | 0.43 | 0 | 1 |
| Econ Major | 62 | 0.06 | 0.25 | 0 | 1 |
| Other Major | 62 | 0.15 | 0.36 | 0 | 1 |
| Beat the Market MF | 62 | 0.31 | 0.46 | 0 | 1 |
| Beat the Market Stocks | 62 | 0.56 | 0.50 | 0 | 1 |
| Interest in Investing (Initial) | 62 | 3.26 | 0.92 | 1 | 4 |
| Interest in Investing (Terminal) | 62 | 3.11 | 0.96 | 1 | 4 |
| # Acct'g Courses | 62 | 2.16 | 1.07 | 1 | 4 |
| Yrs. Experience Investing | 62 | 1.77 | 0.97 | 1 | 4 |
| Yrs. Career Experience | 62 | 2.08 | 1.31 | 1 | 4 |
| Initial Confidence Pers. Finance | 62 | 2.79 | 0.93 | 1 | 4 |
| Terminal Confidence Pers. Finance | 62 | 3.03 | 0.94 | 1 | 4 |
| Initial Confidence Investing | 62 | 1.71 | 0.89 | 1 | 4 |
| Terminal Confidence Investing | 62 | 2.15 | 0.83 | 1 | 4 |
| Initial Comfort Selecting 12 Stocks | 62 | 1.68 | 0.86 | 1 | 4 |
| Terminal Comfort Selecting 12 Stocks | 62 | 2.44 | 0.86 | 1 | 4 |
| Initial Comfort Selecting 10 Mutual Funds | 62 | 1.53 | 0.84 | 1 | 4 |
| Terminal Comfort Selecting 10 Mutual Funds | 62 | 2.39 | 1.00 | 1 | 4 |
| Effectiveness of Simulation | 62 | 3.15 | 0.83 | 1 | 4 |
| # Econ Courses | 62 | 2.18 | 0.76 | 0 | 4 |
| # Finance Courses | 62 | 1.52 | 0.95 | 0 | 4 |
| # Option Trades | 62 | 1.27 | 5.80 | 0 | 39 |
| Class Standing | 62 | 3.40 | 0.53 | 2 | 4 |
| # Mutual Fund Trades | 62 | 5.10 | 2.80 | 2 | 13 |
| # ETF Fund Trades | 62 | 10.85 | 11.10 | 2 | 67 |
| # Stock Trades | 62 | 26.76 | 13.73 | 15 | 66 |
| Total Trades | 62 | 43.98 | 26.28 | 22 | 149 |
| **Initial Survey Score** | **62** | **19.27** | **7.55** | **5** | **47** |
| **Terminal Survey Score** | **62** | **29.97** | **8.46** | **5** | **45** |
| **Survey Score Increase** | **62** | **100%** | **95%** | **-39%** | **450%** |
| **Final Course Score** | **62** | **3.40** | **0.73** | **2** | **4** |

**Notes:** This table presents further demographic characteristics regarding students who completed both the pre- and post-simulation surveys.

Table 4 Correlation Table of Significant Variables

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Variable | Initial Survey Score | Terminal Survey Score | Final Course Grade | Terminal Interest Investing | # Econ Courses | Terminal Conf. Pers. Finance | Terminal Conf. Selecting 12 Stocks | # ETF Trades | Residential | Experience Investing (Yrs.) | Terminal Conf. Selecting 10 Mut. Funds | Female | Career Experience | Acct'g Major | Simulation Effective |
| Initial Survey Score | **1** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Term. Survey Score | **0.456** | **1** |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Final Course Grade | 0.131 | 0.114 | **1** |  |  |  |  |  |  |  |  |  |  |  |  |
| Term. Int. Investing | **0.376** | **0.489** | **0.347** | **1** |  |  |  |  |  |  |  |  |  |  |  |
| # Econ Courses | -0.106 | -0.104 | -0.159 | -0.006 | **1** |  |  |  |  |  |  |  |  |  |  |
| Term. Conf. Pers. Fin. | 0.186 | 0.200 | -0.218 | 0.087 | -0.100 | **1** |  |  |  |  |  |  |  |  |  |
| Term. Conf. 12 Stocks | **0.415** | 0.252 | -0.054 | **0.475** | -0.196 | **0.327** | **1** |  |  |  |  |  |  |  |  |
| # ETF Trades | 0.238 | 0.038 | 0.002 | 0.154 | -0.227 | -0.020 | 0.245 | **1** |  |  |  |  |  |  |  |
| Residential | -0.219 | **-0.429** | 0.195 | -0.101 | 0.060 | -0.135 | -0.204 | 0.234 | **1** |  |  |  |  |  |  |
| Experience Investing | **0.490** | **0.388** | 0.083 | **0.382** | -0.079 | 0.243 | **0.456** | 0.168 | **-0.448** | **1** |  |  |  |  |  |
| Term. Conf. 10 MF's | 0.286 | 0.248 | 0.078 | **0.347** | -0.114 | **0.388** | **0.564** | 0.241 | -0.167 | **0.365** | **1** |  |  |  |  |
| Female | -0.228 | 0.131 | -0.155 | **-0.312** | 0.217 | 0.003 | **-0.311** | -0.177 | -0.180 | -0.226 | -0.290 | **1** |  |  |  |
| Career Experience | -0.021 | **0.401** | -0.125 | 0.136 | -0.081 | 0.104 | 0.114 | -0.201 | **-0.506** | **0.404** | 0.151 | 0.193 | **1** |  |  |
| Acct'g Major | -0.157 | -0.164 | -0.292 | **-0.344** | 0.167 | 0.021 | **-0.332** | -0.160 | 0.054 | -0.300 | -0.221 | **0.396** | 0.023 | **1** |  |
| Sim. Effective | 0.175 | 0.134 | 0.099 | **0.321** | -0.003 | **0.378** | **0.336** | 0.159 | 0.052 | 0.067 | 0.267 | -0.172 | -0.036 | -0.033 | **1** |

**Notes:** This table presents a correlation matrix of various demographic characteristics, survey scores, and final course grades. Correlations that are greater in absolute value than 0.30 are highlighted in **bold** text.

Table 5 Prior Knowledge – Dependent Variable is Initial Score

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| VARIABLES | (1) | (2) | (3) | (4) |
|  |  |  |  |  |
| # of ACCTG FIN ECON classes | 0.892\* | 1.109\*\* | 1.077\*\* | 0.760 |
|  | (1.766) | (2.227) | (2.213) | (1.643) |
| Gender Dummy (female = 1) |  | -4.230\*\* | -3.534\* | -2.265 |
|  |  | (-2.266) | (-1.902) | (-1.280) |
| Inv. Interest Dummy (Initial) |  |  | 3.558\* | 2.146 |
|  |  |  | (1.957) | (1.230) |
| Experience Investing Dummy |  |  |  | 3.007\*\*\* |
|  |  |  |  | (3.205) |
| Constant | 14.050\*\*\* | 14.690\*\*\* | 12.670\*\*\* | 9.370\*\*\* |
|  | (4.525) | (4.870) | (4.058) | (3.045) |
|  |  |  |  |  |
| Observations | 62 | 62 | 62 | 62 |
| R-squared | 0.049 | 0.126 | 0.180 | 0.305 |
| Adj. R-squared | 0.034 | 0.096 | 0.137 | 0.256 |

**Notes:** This table presents the results of OLS regressions of initial survey scores on various demographic characteristics.  *t*-statistics are in parentheses. \*\*\* p<0.01, \*\* p<0.05, \* p<0.10

Table 6 New Learning – Dependent Variable is Post Minus Pre-Survey Score

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| VARIABLES | (1) | (2) | (3) | (4) | (5) |
|  |  |  |  |  |  |
| Initial Score | -0.488\*\*\* | -0.425\*\*\* | -0.519\*\*\* | -0.617\*\*\* | -0.623\*\*\* |
|  | (-3.792) | (-3.310) | (-4.185) | (-4.570) | (-4.554) |
| Gender Dummy (female = 1) |  | 4.180\*\* | 4.925\*\*\* | 5.274\*\*\* | 5.366\*\*\* |
|  |  | (2.164) | (2.699) | (2.918) | (2.925) |
| Inv. Interest Dummy (Initial) |  |  | 5.645\*\*\* | 5.140\*\*\* | 4.986\*\* |
|  |  |  | (3.058) | (2.792) | (2.635) |
| Experience Investing Dummy |  |  |  | 1.792\* | 1.824\* |
|  |  |  |  | (1.696) | (1.709) |
| Simulation Effectiveness Dummy |  |  |  |  | 0.980 |
|  |  |  |  |  | (0.412) |
| Constant | 20.107\*\*\* | 16.998\*\*\* | 15.473\*\*\* | 14.285\*\*\* | 13.587\*\*\* |
|  | (7.550) | (5.747) | (5.501) | (5.003) | (4.069) |
|  |  |  |  |  |  |
| Observations | 62 | 62 | 62 | 62 | 62 |
| R-squared | 0.193 | 0.253 | 0.356 | 0.387 | 0.389 |
| Adj. R-squared | 0.180 | 0.227 | 0.323 | 0.344 | 0.335 |

**Notes:** This table presents the results of OLS regressions of initial survey scores on various demographic characteristics.  *t*-statistics are in parentheses. \*\*\* p<0.01, \*\* p<0.05, \* p<0.10

Table 7 New Learning – Dependent Variable is Percentage Increase in Survey Score

|  |  |
| --- | --- |
|  | Coeff. |
| VARIABLES | *t-stat* |
|  |  |
| Confidence in Personal Investing (Terminal) | -3.932\*\*\* |
|  | (-3.215) |
| Beat the Market with Mutual Funds | -3.267\*\* |
|  | (-2.106) |
| Confidence Selecting 10 Mutual Funds (Terminal) | 3.034\*\*\* |
|  | (3.070) |
| Interest in Investing (Terminal) | 4.859\*\*\* |
|  | (5.373) |
| # ETF Trades | -0.129\* |
|  | (-1.907) |
| Gender Dummy (female = 1) | 7.665\*\*\* |
|  | (4.623) |
| Initial Survey Score | -0.492\*\*\* |
|  | (-4.916) |
| Major **Not** FIN ACCTG ECON | 14.957\*\*\* |
|  | (4.273) |
| Years of Career Experience | 1.355\*\* |
|  | (2.313) |
| Finance Major | 11.120\*\*\* |
|  | (3.975) |
| Accounting Major | 7.608\*\* |
|  | (2.511) |
| Constant | -7.747\* |
|  | (-1.809) |
|  |  |
| Observations | 62 |
| R-squared | 0.700 |
| Adj. R-squared | 0.634 |

**Notes:** This table presents the results of OLS stepwise regressions (at the 10% and 11% levels) of survey score improvement on various demographic and trading simulation characteristics.  *t*-statistics are in parentheses. \*\*\* p<0.01, \*\* p<0.05, \* p<0.10

Table 8 New Learning – Dependent Variable is Final Course Score (Final Grades)

|  |  |
| --- | --- |
|  | Coeff. |
| VARIABLES | *t-stat* |
|  |  |
| Interest in Investing (Terminal) | 0.293\*\*\* |
|  | (2.949) |
| # ECON courses | -0.327\*\*\* |
|  | (-2.949) |
| Confidence Personal Finance (Non-Investment - Terminal) | -0.280\*\*\* |
|  | (-2.809) |
| Confidence in selecting 12 stocks – Terminal | -0.333\*\* |
|  | (-2.669) |
| # ETF Trades | -0.021\*\* |
|  | (-2.539) |
| Residential Dummy (residential student = 1) | 0.481\*\* |
|  | (2.381) |
| Experience Investing | 0.264\*\* |
|  | (2.321) |
| Confidence in selecting 10 mutual funds – Terminal | 0.202\* |
|  | (2.009) |
| Gender Dummy (female = 1) | 0.358\* |
|  | (1.853) |
| Years Career Experience | -0.134\* |
|  | (-1.803) |
| Accounting Major | -0.362\* |
|  | (-1.764) |
| Simulation Effectiveness Dummy | 0.390 |
|  | (1.655) |
| Constant | 3.815\*\*\* |
|  | (7.650) |
|  |  |
| Observations | 62 |
| R-squared | 0.476 |
| Adj. R-squared | 0.347 |

**Notes:** This table presents the results of OLS stepwise regressions (at the 10% and 11% levels) of final course scores on various demographic and trading simulation characteristics.  *t*-statistics are in parentheses. \*\*\* p<0.01, \*\* p<0.05, \* p<0.10

APPENDIX A – StockTrak Simulation Trading Rules

1. All decisions are made by each student independently. This is not a group effort.

2. All asset prices are provided in real-time, but trade execution is delayed by 15 minutes.

3. Students may enter market orders, limit orders, and stop orders.

4. Short selling is permitted, but margin trading is not.

5. The minimum stock price for buying is $0.25 and the minimum price for shorting is $3.00.

6. Equities charge a $10.00 per trade commission and a 25% position limit is imposed.

7. Options charge a $10.00 per trade commission and a 25% position limit is imposed.

8. Mutual Funds charge a $10.00 per trade commission and a 25% position limit is imposed.

9. ETFs charge a $10.00 per trade commission and a 25% position limit is imposed.

10. Students can purchase any asset that is traded in the United States on AMEX, NYSE, NYSE Arca, OTC, or NASDAQ.

11. Interest earned on cash is limited to 1% per annum.

12. Students are limited to a total of 300 trades per challenge.

13. Orders are filled without consideration of trading volume in the real world.

14. Students must invest at least 95% of the available portfolio value.

15. Students must invest in at least seven different funds (a bare minimum of at least 2 mutual funds and at least 2 ETFs) for the 13-week challenge and at least fifteen different individual stocks for the 5-week challenge.

APPENDIX B – Variable Definitions

|  |  |
| --- | --- |
| Variable | Description |
| Fall 17 | Dummy Variable if the student took the course in Fall 2017 (1) vs. Summer 2017 (0) |
| Residential | Dummy Variable if the student is Residential (1) vs. Online (0) |
| Female | Dummy Variable if the student if Female (1) or Male (0) |
| Finance Major | Dummy Variable if the student is a Finance Major (1) or not (0) |
| Acct'g Major | Dummy Variable if the student is an Accounting Major (1) or not (0) |
| Econ Major | Dummy Variable if the student is an Economics Major (1) or not (0) |
| Other Major | Dummy Variable if the student is none of the above Majors (1) or not (0) |
| Beat the Market MF | Dummy Variable if the student beat the mutual fund simulation benchmark (1) or not (0) |
| Beat the Market Stocks | Dummy Variable if the student beat the stock simulation benchmark (1) or not (0) |
| Interest in Investing (Initial) | Student response for interest in investing, 1 = Not Interested, 4 = very interested |
| Interest in Investing (Terminal) | Student response for interest in investing, 1 = Not Interested, 4 = very interested |
| # Acct'g Courses | Student reported prior Accounting courses, 1 - 3 and 4 or more. |
| Yrs. Experience Investing | Student reported years of experience investing, 1 - 3, 4 or more |
| Yrs. Career Experience | Student reported years of career experience, 1 - 3, 4 or more |
| Initial Confidence Pers. Finance | Student reported initial confidence in personal finance decisions, 1 = not confident, 4 = very confident |
| Terminal Confidence Pers. Finance | Student reported terminal confidence in personal finance decisions, 1 = not confident, 4 = very confident |
| Initial Confidence Investing | Student reported initial confidence in investment decisions, 1 = not confident, 4 = very confident |
| Terminal Confidence Investing | Student reported terminal confidence in investment decisions, 1 = not confident, 4 = very confident |
| Initial Comfort Selecting 12 Stocks | Student reported initial confidence, 1 = not confident, 4 = very confident |
| Terminal Comfort Selecting 12 Stocks | Student reported terminal confidence, 1 = not confident, 4 = very confident |
| Initial Comfort Selecting 10 Mutual Funds | Student reported initial confidence, 1 = not confident, 4 = very confident |
| Terminal Comfort Selecting 10 Mutual Funds | Student reported terminal confidence, 1 = not confident, 4 = very confident |
| Effectiveness of Simulation | Student reported simulation effectiveness, 1 = not effective, 4 = very effective |
| Simulation Effectiveness Dummy | Dummy Variable is 1 if the student answered 3 or 4 to the questions on Simulation Effectiveness (somewhat or very effective). |
| # Econ Courses | Student reported prior Economics courses, 1 - 3 and 4 or more. |
| # Finance Courses | Student reported prior Finance courses, 1 - 3 and 4 or more. |
| # Option Trades | Number of options trades placed in simulation 2. |
| Class Standing | 1 = freshman, 4 = senior |
| # Mutual Fund Trades | Total number of Mutual Fund trades in both simulations. |
| # ETF Fund Trades | Total number of ETF trades in both simulations. |
| # Stock Trades | Number of stock trades placed in simulation 2. |
| Total Trades | Total trades in both simulations |
| **Initial Survey Score** | Initial Survey (Pre-simulation) Score, out of 50 |
| **Terminal Survey Score** | Terminal Survey (Post-simulation) Score, out of 50 |
| **Survey Score Increase** | Percentage increase in survey scores |
| **Final Course Score** | Final course grade score, out of 4 - A = 4, A- = 3.67, B+ = 3.33, B = 3, etc. |