A Web-based Virtual Stock Exchange System for Promoting Learning Efficacy of Financial Management

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ABSTRACT
Because of lacking stock knowledge and information, most investors mainly focus on unconfirmed information provided by media, where experts recommend possible profitable stocks. A web-based virtual stock exchange (VSE) system was designed to simulate the stock exchange, accompanied with tools for financial analyses. It prevents investors from being affected by price fluctuations and nurtures them into becoming rational investors. The VSE system can be easily manipulated through Internet by using PCs or smart phones. With the virtual environment, users can learn skills of stock trading by analyzing financial ratios of individual stocks. A total of 103 students who major in management, and who are taking the course “Financial Management” were recruited. Each was given a certain budget at the beginning of semester. The learning outcome and operating performance were surveyed with questionnaires based on the modified technical acceptance model. The results show that perceived usefulness (4.39±0.53) and behavior intention (4.31±0.50) are significantly higher than the neutral value 3 ($p<0.001$, one-sample $t$-test), indicating that the proposed VSE system is efficient in promoting learning efficiency. Additionally, the users are willing to adopt and recommend it to other users. In conclusion, the proposed VSE system demonstrates great learning efficacy of investment knowledge leading to profit from the stock market.

1. Introduction

Nowadays, people are encouraged to possess knowledge of financial investments in diverse areas such as stock, to earn more profit, instead of depositing their saving in banks with low interest rates. However, most of the investors lack financial knowledge and information about the stock market. They mainly focus on acquiring stock market information from the public media where experts recommend possible profitable stocks as a reference source for investment. Hence, enhancing ability in financial analysis and wise investment in possible profitable stocks is very important for the general public and students. In this study, a virtual stock exchange (VSE) system, which provided the knowledge and function for financial ratio analysis, was designed to simulate stock exchange operations and to elevate students’ learning efficacy of financial management.

1.1 Research background

Generally, paper-based lecturing materials and other electronic media have been mainly used in teaching financial management and accounting in most universities. This fails to either raise students’ motivation and interests or meet their needs in learning. For people living in our modern society being engaged in financial investment is a system where investing in stocks appears to be easy. It is just like gambling, if guided only by mass media or so-called luck, which may result in personal financial disaster if tank stocks or penny stocks are purchased. In order to attract students’ attentions and stimulate their curiosities in studying financial management and related doctrines, we designed a web-based virtual stock exchange (VSE) system by integrating functions, including financial analysis and real-time VSE, to nurture the capability of students to make wise investment. After having been immersed in the VSE system, students will be expected to be capable of analyzing financial ratios of individual candidate stocks before making an investment, which in turn results in making profits from the investment, or at least avoiding risks.

1.2 Aim of the research

Stock prices are strongly affected by either rational or irrational causes. In addition, a company's finances can be referred to as its roots and markets as its fruit. Without sound long-term roots, fruit can't be yielded. How to train students to become a rational investor is one of the objectives of this system. Currently, the web-based software used for the stock exchange are mostly commercial-oriented and only provide financial statements and financial ratio data with little valuable commentary or analytic information to evaluate candidate stocks for the investors. These software systems are not suitable in educating financial
management students. Although several competitions are held each year by a number of investment companies, they are mostly outcome-based and do not provide feedback information to improve investing skills or knowledge for the participants. These systems again are not suitable for financial management education. In this study, a web-based system designed for simulating the operation of the stock exchange market is used for providing students with the skills and background knowledge needed for the stock exchange. All participating students were provided with a free account to make a virtual stock exchange in a real-time manner, which is exactly the same as the real operation because it delivers real-time information released and offered by Taiwan Stock Exchange, GreTai Securities Market-OTC (Over-the-Counter), and related counter stocks.

2. Literature Review

2.1 Investors of Taiwan stock market

Lin (2011) reported that the Taiwan stock market is a shallow-plate market and that investors are mostly individual investors who are generally susceptible to the influence of market news. They often make wrong decisions in investments due to inaccurate or deficient information, leading to severe financial losses. It is clear that either private or public information has a great impact upon individual investors. Fang (2007) argued that the investors’ over-reaction to private or unverified information in Taiwan, complies with investors’ behaviors observed in other countries. Li (2008) also depicted that the more words there were in the good/bad news given about monthly revenue announcements, the more stocks individuals would sell/buy at high or low prices.

From the above investigations, it was found that individual investors mainly rely on the news spread in the market but are lacking the capability of obtaining the valuable information necessary for deeper investigation. Chiang (2010) indicated that the investors in the Taiwanese stock market behave with over-confidence during the bull (striving) market and in the bear (recessing) market, and therefore the phenomenon of the Snake-Bite-Effect is often observed. Kan (2008) also observed that Taiwanese investors always exhibit over-confidence and are prone to be influenced by the ups and downs of daily stock market, which is even more obvious in the time of bull market. This indicates that investors may not be able to make rational decisions in terms of stock bargains. Less effect induced from negative emotions may help investors perform better in stock trading, resulting in more profits.

2.2 E-learning

Web-based learning is becoming prevalent in schools and enterprises around the
world because of its advantages of providing easy access to information and knowledge, supporting a ubiquitous learning environment, and increasing cost-effectiveness for both commercial organizations and educational institutions. A recent investigation in Taiwan showed that more than 90% of public health nurses expressed strong behavior intentions, in web-based learning, to capture new knowledge in order to elevate the quality of care (Chen, Yang, Tang, Huang, and Yu 2008). Online telepathology was reported to be a useful technique in providing continuous education for pathologists to view microscopic images through the Internet (Jará and Barcelo 2008, Farah et al. 2009).

In the past decades, tutoring of a financial management course has focused upon the contents in the textbooks. Most students are, thus, limited only to understand the terms and theories in that context and are not aware of how to apply them in a real situation, such as analyzing price to earn (PE) ratio. The textbook only offers a static interpretation. In contrast, trading on the stock market is dynamic, and may even affect the trading of individual stocks. To increase learning efficiency, students are encouraged to have practical operational experience through stock trading. The VSE system proposed in this study provides the learning environment to accumulate practical stock trading experience.

E-learning is widely used in research in the medical field. Gotthardt et al (2006) indicated that before introducing the new curriculum, teachers were used to teaching a lower level of knowledge. One teacher ever said that before introducing the new teaching method, they tried to tell students what an electron was. Today, they talk about what it does.

Haigh (2004) reported that it is possible to think of the role of information technology in teaching and learning, exclusively in terms of content, e.g. the transmission of technically sophisticated learning resources to individual personal computers or television sets. Salmon (2002) emphasized that, anywhere and at any time, diverse online learners from all over the globe can access online learning and teaching with digital network based technologies.

Xu and Wang (2006.) proffered that virtual learning environments (VLEs) provide computer-based online scenarios, which give online learners the opportunities to learn at the time and location they choose, whilst allowing interaction and encounters with other online learners, in addition to providing access to a wide range of resources. One of the main considerations in developing the VSE e-learning system is to set up a ubiquitous web-based on-board environment available 24 hours a day. The VSE e-learning environment embeds the following properties proposed by Dillenbourg (2000):

1. The information space has to be designed.
2. Educational interactions occur in the environment, turning spaces into places.
3. The information/social space is explicitly represented. The representation varies from text to 3D immersive worlds.
4. Students are not only active, but also serve as actors, who co-construct the virtual spaces. Virtual learning environments are not restricted to distance learning. They also enrich classroom activities.
5. Virtual learning environments integrate heterogeneous technologies and multiple pedagogical approaches.
6. Most virtual environments overlap with physical environments.

In this study, the aforementioned properties were adopted when designing scenarios for the VSE system, in order to construct an efficient learning environment and to facilitate student learning efficacy.

2.3 Situated/Experiential learning

The famous ancient Chinese educator, Confucius, stated that “What I hear, I forget. What I see, I remember. What I do, I know.” This might be the first interpretation of experiential learning (Pica, 2000). E-learning systems with the teacher’s assistance can be employed as an environment for improving a learner’s autonomy, understanding multimedia instructional contents and for gaining problem-solving skills. From the viewpoint of activity-theory, individuals actively construct their knowledge within social realms (Liaw, Huang, Chen, 2006). In other words, learners do not passively accept information by mimicking the wording or conclusions of others. Instead, they need to encourage themselves to internalize and reshape or transform information through active consideration (Brook & Brook, 1993).

With the teacher’s help, learners have more opportunities to develop complex cognitive or meta-cognitive skills, such as breaking down a topic into subtopics, organizing diverse information, and formulating a point of view (Liaw, Huang, Chen, 2006). These meta-cognitive learning activities are effective in developing high-level thinking skills, such as defining problems, judging information, solving problems, and drawing appropriate conclusions (Laney, 1990).

From the aforementioned discussion, it was observed that the learning system combined with the teacher’s in-class lecturing made the experiential learning more complete. Kolb (1984) stated that course learning and knowledge development based on experience should be constructed according to the following propositions:

1. Learning is best conceived as a process, not in terms of outcomes: As addressed by Dewey (1897) “…education must be conceived as a continuing reconstruction of experience; that the process and the goal of education are one and the same thing…”
2. All learning is re-learning: Learning is best facilitated by a process that draws out the student’s beliefs and ideas about a topic so that they can be examined, tested, and integrated with new, more refined ideas.

3. Learning requires the resolution of conflicts between dialectically opposed modes of adaptation to the world: Conflict, differences, and disagreement are what drive the learning process.

4. Learning is a holistic process of adaptation to the world: It is not just the result of cognition but involves the integrated functioning of the total person—thinking, feeling, perceiving, and behaving.

5. Learning results from synergetic transactions between the person and the environment.

6. Learning is the process of creating knowledge.

The operation of the designed VSE system meets the 6 aforementioned proposed requirements. It offers the students a virtual transaction environment to enable them an opportunity to continuously and repeatedly learn and consolidate experiences through the review of personal stock-trading performance (a holistic process of adaptation to the world). Each deal tries to create a new way of thinking, feeling, perceiving, and behaving. Hence, it is a combination of personal learning and a virtual environment.

### 3. System Design and Implementation

#### 3.1 System Architecture of Virtual Stock Exchange System

The system architecture of the VSE system is shown in Figure 1. As illustrated in the figure, users can use their PCs, laptops, tablet computers, or intelligent mobile phones to operate functions provided by the VSE learning system. The operation system of the web server is Linux with PHP web programming language used for designing the service applications for data accessing. Through accessing the web server, users can obtain the information of interest provided by governmental authorities and save it in the database system for later analysis. The dataflow process is shown in Fig. 2.
3.2 System Function and Operation
The functions and operational procedures are described below:

3.2.1 Graphical User Interface of Virtual Stock Exchange System
Figure 3 demonstrates the main screen of the VSE system after login. The VSE system includes 5 functions, i.e. Financial Ratio Analysis (FRA), Candidate Stocks, Investment Performance Inspection, Financial Report of Stock, and Message Input for Instructor Support. Detailed descriptions of the 5 designated functions are as follows:
1. Financial Ratio Analysis: As depicted at the top-left panel of Fig. 3, five constructs, including Capital Structure, Solvency, Viability, Profitability, and Cash Flow, are needed for FRAs. A total of 18 items are calculated to complete the FRA. Figure 4 displays an example for illustrating the definition of financial ratio analysis of the “Capital Structure” construct. The FRA of two semi-conductor stocks, i.e. UMC and TSMC, are displayed for comparison.

2. Candidate Stocks: The user can input either one or two candidate stocks for the financial ratio analysis mentioned above. If only one stock code is input, its financial ratio will be displayed at the right panel after clicking on the “Financial Ratio Analysis” button. However, as shown in Fig. 5, if two stock codes are input, the financial ratios of two stocks will be displayed for easy comparison.

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**Fig. 4. Definition of Financial Ratio Analysis**

1. **Debt Ratio** = \[ \frac{\text{total liabilities}}{\text{total assets}} \]

   Expression of the two major sources of funds in the proportion of debt part, the higher ratio means the higher the risk borne by the creditors, too low means the lack of financial leverage, less favorable to shareholders.

2. **Long-term Capital Ratio** = \[ \frac{\text{shareholder’s equity + long-term debt}}{\text{net value of total fixed assets}} \]

   Expression if a fixed asset investment is too high or not. General speaking if shareholder’s equity / net fixed asset value is more than 100%, it means that fixed assets own funds (easily) is sufficient to cope. Of course, then while adding in the long-term debt, this ratio will be even higher relatively it is lower risk.
3. Investment Performance Inspection: The up to date transaction records for the user will be displayed to show the history of one’s transactions and the profit/loss status of individual stocks after clicking on “View All” button.

4. Financial Report of Stock: By selecting an item from the financial statement items, which include Income Statement, Balance Sheet, Shareholder’s Equity, Cash Flow, and Company Profile, and the stock code, the financial statement of the stock will be displayed at the right panel after clicking on the “Financial Statement Search” button.

5. Message Input for Instructor Support: A hyperlink linked to the instructor’s message board in the Campus Information System will be initiated for students to input questions regarding usage of the system or lecture content.

![Graph showing financial ratios analysis between two stocks.](image)

**Fig. 5.** Comparison of Financial Ratio Analysis between two stocks.

In addition, there are two alternative operations, i.e. Stock Code Search and Open Account, which can be initiated on the right panel to provide users the functions to search for codes of individual stocks and to open accounts for new users, respectively.

### 3.2.4 Stock Transaction

After stock code and quantity of interested stock has been input, a transaction can be initiated by clicking on the “Buy” button displayed on the left panel as shown in Fig. 3. Figure 6 shows relevant information, including stock number, stock price, current dealing trend, and the business information history, of the selected stock.
Fig. 6. (a) Stock number, stock price, current dealing trend, and (b) business information history of the selected stock of a transaction.

After browsing the relevant information, the user is asked to click on the “Confirm” button to confirm the transaction. And then, a transaction report including the purchased stock code, stock name, number of shares, dealt price, and the disposable cash balance in the account will be displayed for future reference (Fig. 7).
In Fig. 7, if the user clicks on the “View All” button situated at the bottom of the screen, a screen showing the history of transaction records of the user will pop up, as demonstrated in Fig. 8.

Transaction records are displayed at the right-hand side, and include individual bargaining prices, sold prices, profits and losses after transaction fees have been deducted, and currently available cash balance and available funds on hand. The transaction fees include tax and handling fees. The last 3 columns represent: the sold stocks, the available stocks, and the buttons for sold stocks and stocks to be sold.

### 3.2.5 Stocks Selling

After clicking on the “Sell” button which appears at the right column of the table
shown in Fig. 8, the user can assign the number of stocks for selling and then confirm the transaction by clicking on the “Confirm Selling Button” displayed in Fig. 9. A screen (Fig. 10) showing the information, including the stock number and dealt price, will pop up for reference.
3.2.6 Financial Statements

As described previously, five different statements, including Income Statement, Balance Sheet, Owner’s Equity, Cash Flow, and Company Profile, are provided after keying in the stock code. Figures 11 and 12 show, respectively, examples of the income statement and balance sheet of TSMC, a semi-conductor manufacturer.
3.2.7 Message Board
As shown in Fig. 13, users can ask questions regarding operation of the VSE system and domain knowledge, by using the message board to communicate with the instructor, if they encounter any troubles.

3.2.8 GUI For Instructors
The VSE system also provides functions for instructors to inspect and manage the
transactions and performances of individual students in a class. As demonstrated in Fig. 14, there are 3 functions, including (1) View Performance of Students, (2) View/Change Passwords of Students, and (3) Sell All Stocks of Students, reserved for instructors. Notice that the 3rd function is designed for the instructor to sell all the stocks which have not been sold after the deadline of designated project. The instructor can choose the class for which to execute such function by simply clicking the button to sell out all the unsold stocks of each student. Figure 15 shows the performance of each participating student.

Figure 14. Login Interface for Instructor

Figure 15. Transaction Records of Students in a Class

4. System Evaluation

Technology acceptance model (TAM) is an information system model used to evaluate why individuals accept and use a new technology (Davis 1989, Park, Roman, Lee, and Chung 2009). It posits that two particular beliefs, i.e., perceived ease of use
and perceived usefulness, are of primary relevance. Perceived ease of use is the degree to which the prospective participant perceives the information system easy to use. Perceived usefulness is defined as the subjective belief that the use of a given information system improves participant working efficiency. Behavior intention is a function of perceived usefulness and perceived ease of use that directly influences actual usage behavior of participants.

Wu, Wang, & Lin (2007) adopted TAM accompanied with compatibility, self-efficacy, technical support, and training effect to evaluate mobile computing acceptance factors in the health care industry. In general PU and PEU have direct affect on BI, while PEU has positive effect on PU. Compatibility is one of the innovation diffusion theories, which is defined as the degree of innovation perceived to be consistent with a user’s existing value, experience, and need (Plouffe, Hulland, & Vandenbosch, 2001). Self-efficacy regards one’s ability and persistence to do a specific task. Technical support and training are believed to be able to facilitate the efficiency and effectiveness of using a specific system.

In this study, all the participating students were requested to fill in a questionnaire based on the modified TAM to evaluate perceived usefulness, perceived ease of use, behavior intention, self-efficacy, technical support, and training effect after having used the VSE system. All questions are graded on a 5-point Likert scale ranging from 1 point (strongly disagree) to 5 points (strongly agree). Cronbach Alpha was used to estimate the reliability of the questionnaire.

4.1 Statistic Analysis
A total of 103 questionnaires were collected and used for statistical analysis. The Cronbach Alpha value reached 0.88, indicating that the questionnaire has good reliability. As indicated in Table 1, the average and standard deviation were calculated for each construct and its related questions. As shown in this table, all the questions in the 6 constructs, including the perceived usefulness, perceived ease of use, behavioral intention, self-efficacy requirements, technical support and training of the effects, are significantly higher than the neutral value (3) at the level of 0.001 with one-sample t-test. In general, the VSE learning system is regarded as a useful system for students to learn the skills and knowledge needed for financial management.

4.3 Path Analysis
Figure 16 illustrates the outcome of the path analyses of the modified TAM, as summarized below:
A. Training effects → Perceived usefulness → Behavioral intention: Users being offered more training will perceive the system useful in promoting their working
efficiency, which in turn will elevate their intention to adopt the system.

B. Training effects \(\rightarrow\) Perceived ease of use \(\rightarrow\) Behavioral intention: Users being offered more training will become more skillful in using the system, which in turn will elevate their intention to adopt the system.

C. Technical support \(\rightarrow\) Perceived usefulness \(\rightarrow\) Behavioral intention: Users with sufficient technical support will deem the system useful for promoting their task efficiency, which in turn will elevate users’ intention to adopt the system.

D. Technical support \(\rightarrow\) Perceived ease of use \(\rightarrow\) Behavioral intention: Users with sufficient technical support will deem the system easy to operate, which in turn will elevate their intention to adopt the system.

Table 1. Statistic Analysis of TAM (N=103)

<table>
<thead>
<tr>
<th>Question</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Perceived Usefulness</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. I agree the virtual stock exchange (VSE) system can improve my learning efficiency</td>
<td>4.39</td>
<td>0.53</td>
</tr>
<tr>
<td>2. I agree the VSE system can provide real-time and accurate information about the stock trading market</td>
<td>4.44</td>
<td>0.62</td>
</tr>
<tr>
<td>3. I agree the VSE system can provide financial ratio analysis in a rational way</td>
<td>4.35</td>
<td>0.71</td>
</tr>
<tr>
<td>4. I agree the VSE system is useful in facilitating the learning of financial management knowledge and stock market trading</td>
<td>4.14</td>
<td>0.74</td>
</tr>
<tr>
<td><strong>Perceived Ease of Use</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. I agree the VSE learning system is easy to operate</td>
<td>4.61</td>
<td>0.63</td>
</tr>
<tr>
<td>6. I agree the interface of VSE learning system is user-friendly</td>
<td>4.31</td>
<td>0.59</td>
</tr>
<tr>
<td>7. I agree it’s easy to learn how to operate the VSE learning system</td>
<td>4.32</td>
<td>0.78</td>
</tr>
<tr>
<td><strong>Behavior Intention</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. I agree the contents of the VSE learning system is lively and practical, which can enhance my intention to adopt the system</td>
<td>4.31</td>
<td>0.50</td>
</tr>
<tr>
<td>9. I agree the instructors can express the contents more clearly and effectively, which increase my intention to use the VSE system</td>
<td>4.30</td>
<td>0.60</td>
</tr>
<tr>
<td>10. I intend to use the VSE learning system as frequently as I need</td>
<td>4.50</td>
<td>0.74</td>
</tr>
<tr>
<td>11. I wish the VSE learning system could be applied in other courses related to financial management</td>
<td>4.40</td>
<td>0.59</td>
</tr>
<tr>
<td>12. After having completed this course, I will still continue to use the VSE learning system for learning financial management.</td>
<td>4.05</td>
<td>0.71</td>
</tr>
<tr>
<td><strong>Self-Efficacy</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13. I agree I can use the VSE learning system without any guidance</td>
<td>4.00</td>
<td>0.83</td>
</tr>
<tr>
<td>14. I agree I can use the VSE learning system with a one-time demonstration</td>
<td>4.50</td>
<td>0.81</td>
</tr>
<tr>
<td>15. I agree I can use the VSE learning system as long as I browse and start from the main webpage</td>
<td>3.97</td>
<td>0.81</td>
</tr>
<tr>
<td>16. Generally, I can skillfully operate other systems related to information technology</td>
<td>3.90</td>
<td>0.88</td>
</tr>
<tr>
<td><strong>Technical Support</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17. I agree that someone fixed the problems immediately if the VSE learning system went wrong</td>
<td>3.58</td>
<td>0.81</td>
</tr>
<tr>
<td>18. I agree that someone helped me solve the problem whenever I encountered problems in operating the VSE learning system</td>
<td>3.54</td>
<td>0.91</td>
</tr>
<tr>
<td>19. I agree that I received a quick response, or maintenance was done by the technical support team or the instructors if I had any suggestions</td>
<td>3.54</td>
<td>0.83</td>
</tr>
<tr>
<td>20. I agree it will increase my willingness to use the VSE system after getting the training</td>
<td>4.27</td>
<td>0.76</td>
</tr>
<tr>
<td>21. I agree I don’t have to spend a lot of effort on learning the system</td>
<td>4.27</td>
<td>0.78</td>
</tr>
<tr>
<td>22. I agree I can understand the advantage of the VSE learning system and that it is helpful in enhancing my operating skills</td>
<td>4.28</td>
<td>0.76</td>
</tr>
</tbody>
</table>

*One-sample t-test with \(P<0.001\)
E. Self-efficacy → Perceived ease of use → Behavioral intention: Users who own basic knowledge and are proficient in using digital equipment will deem the system easier to operate, which in turn will elevate their intention to adopt the system.

F. Self-efficacy → Behavioral intention: Those who own basic knowledge and are proficient in using digital equipment will have stronger intention to use the system.

![Path Analysis of the Modified TAM](image)

5. Discussion and Conclusion

Jensen (1998) noted that when more senses are involved in the learning process, a greater impression is made and the longer the information stays with the learners. An enriched environment creates a thicker cortex within the brain, more dendrite branching, more growth of the spinal nervous system, and larger cell bodies that lead to cells that communicate better. An enriched environment is multi-sensory so that people are able to see, hear, say and do as they learn. Fauth (1990) and Jensen (1998) indicated that people retain 10% of what they read, 20% of what they hear, 30% of what they see, 50% of what they see and hear at the same time, 70% of what they hear, see, and say, and 90% of what they hear, see, say, and do. Jensen [9] also noted that most people learn many things at the same time due to the abilities of their brains to process concurrently vast amounts of information, emotion, and awareness. Confucius, the ancient Chinese educator, introduced a similar concept “What I hear, I forget. What I see, I remember. What I do, I know.” (Pica 2000). It has been found that the majority of people are more likely to really know what they have a chance to do. Einstein stated that he felt an idea first, and then experienced it through visual and kinesthetic images, before he was able to put the idea into words (National Dance...
Association, 1990). Diamond (1988) demonstrated that enriching the learning environment changes the structure and ability of the brain’s cerebral cortex. All the above psychological and educational theory and studies support the idea that interactive learning is a more effective method of training, for practical skills. In conclusion, the proposed VSE system demonstrates great efficacy in learning stock investment knowledge leading students to profit from the stock market.

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