

Elementary Students' Concepts and Strategies in a Digital Stock Investment Game

Euphony F. Y. Yang^{a*}, Zhi-Hong Chen^b & Tak-Wai Chan^a

^aGraduate Institute of Network Learning Technology, National Central University, Taiwan

^bDepartment of Information Communication, Yuan Ze University, Taiwan

*euphony@cl.ncu.edu.tw

Abstract: To improve the design of game-based learning systems for elementary school students in the subject domain of financial management, this study investigates how students use concepts and strategy in a game-based stock investment environment. An interview approach was conducted on 23 fifth-grade elementary school students who used the system to collect their opinions on stock investment functions. The results showed that (1) students were easy to unilaterally interpret the stock descriptions and misunderstand some key investment vocabularies; (2) students' understanding were majorly influenced by significant others and media reports so that their key concepts were shaped. Based on these results, several suggestions for future development of financial management systems were also discussed.

Keywords: Game based learning, financial education, financial management, stock

1. Introduction

Recently, financial education has attracted increasing research attention because it closely links to our current society of knowledge economy in 21st century. Although financial knowledge is significant and has close relationship with students' daily lives, it does not always have positive impacts on students' attitude and behaviors [6]. This may due to two reasons. The first one is related with the complexity of the *content knowledge* itself, which might make students spend much time and effort in understanding the concept knowledge. The second one may be the complexity of *knowledge transfer*. Students can learn key concepts about financial management, but lack experiences of applying what they have learned to real situations.

To overcome the two complexities, some approaches are proposed to support financial education through information technologies [7], especially digital game technology. One example is the use of simulation games to facilitate students' financial literacy and skills [5]. Digital games not only can integrate information representation tools, but also enhance students' learning motivation [4]. When students are willing to invest their time and effort to learn, the complexity of *content knowledge* could be overcome, and students can gain better learning achievement. It should be noted that the learning achievement of students who learn with digital games are better than that of students who do without digital games [2]. Because digital games offer opportunities for students to learn, think, and make decision, which further enhance student learning [8]. Furthermore, digital games can immerse students in a learning context similar with their daily lives so that students' knowledge gained from the learning context can be transferred easier to practical settings. Thus, digital games could reduce the complexity of *knowledge transfer*.

Although digital games have great potential in students' financial learning, few studies emphasize on the investigation of how digital games influence students' learning process. In other words, most of previous studies emphasize on the outcome or learning achievements, rather than their learning process. Thus, there is a need to investigate how students learn during a game-based environment. To this end, this study investigates how students learn and practice what they have learned in a game-based environment. More specifically, the research question of this study is *"How do students learn and practice financial knowledge in a game-based learning environment?"* By doing so, we can obtain a deeper understanding about students' concepts and strategies during learning process, which could contribute to the development of game-based learning for a number of specific subject domains.

2. Method

To address this research question, this study conducts a case study so that participants' usages and feedback can be collected and analyzed in detail.

2.1 Instrument system

An instrument system is "My-Investment" system [1], whose purpose is to help elementary students learn financial literacy in a game-based environment (see Fig 1). More specifically, in My-Investment system, students' goal is to earn money for taking good care of their doggy, My-Pet. To this end, students can learn how to manage their money from a set of digital materials, and then invest their money to stock market. In particular, students' learning and practice in the stock investment is emphasized. Those functions include: basic financial knowledge, stock news board, and the table of stock prices (see Fig 2).

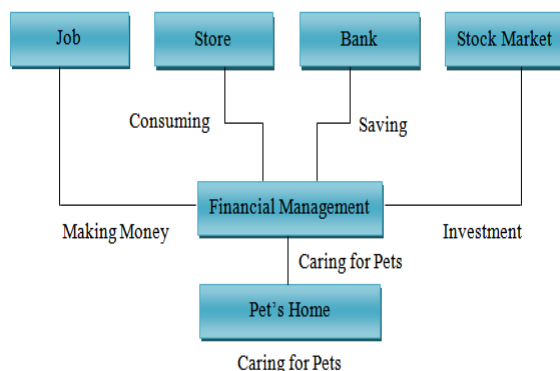


Figure 1. My-Investment system



Figure 2. Subsystem of stock investment

2.2 Participants

Participants were 23 fifth-grade primary students from three classes in north Taiwan. Every student used the system for forty minutes every week and lasted for eight weeks in school. In addition, students could also use this system after school if they were willing to.

2.3 Data collection

Harter and Harter [2] used multiple-choice to investigate whether students improved learning in a stock game. However, the format of multiple-choice might be limited in some aspects. For example, it was hard to find out what students have learned and the difficulties

they encountered during learning process. Thus, this study uses an *interview approach* to collect students' data. Two trained researchers interviewed students one by one. The major question was to investigate what students' concepts were and what strategies they used in this stock game. To help students offer more detailed information about their learning process in the system, they were told to login the system to explain how they play and their reasons in this stock investment game during the interview session.

3. Result

3.1 Students' interpretation of stock information

Stock information was news that students can obtain from My-Investment. Thus, examining students' interpretation of stock information can examine what they have learned through explaining about the concepts of stock investment after reading the stock news board. There were three examples.

Example #1: Hard to understand the business terms.

R: How do you judge the auto stock may help you make money?

S2: Because its evaluation is good.

R: You feel that "sales will reach the break-even point" is good?

S2: It seems not the case.

S2 could not understand the business terms. When he saw the term "break-even point", he was likely to treat the auto stock as a positive description and worth be bought. Through the interviewer's questioning, the student started to doubt his judgment and responded the uncertain answer "It seems not the case". Without the rhetorical questioning process, the auto stock would be treated as a good stock and be the investing choice of S2.

Example #2: Positive phrases plus reverse narrative caused students' misunderstanding.

R: Why do you buy the financial stock?

S14: Because the information says that the financial company earned ten billion dollars last season which was lower than expectation. But all other stocks refer to decline, which is not good.

R: Do you know the meaning "It earned money which was lower than expectation"?

S14: It means exceeding...exceeding...

R: Is the original expectation higher than ten billion or lower?

S14: Lower. Is it lower than the expectation? (Murmur) It seems that...

R: So is the original expectation higher or lower?

S14: The original expectation should be higher.

R: So is this stock good or not?

S14: Not good at all.

Some specific terms with positive meaning in the sentence were easier treated as good situation by students and misleading them. The financial stock was thought as a deserved investment because the term "earnings" and the phrase of "performance is lower than expectation" show in the same sentence. Besides, the other three stocks are all referred to the key word "decline", which was not suitable for buying. In contract, the financial stock had no negative adjective apparently, but referred to the term "earned", which easier connected to a great situation. However, when it combined with the phrase "lower than expectation", it might be different, particularly when the interpreter misunderstood the actual meaning of the sentence. It seemed that S14 thought "lower than expectation" was a good description for the financial stock, so he responded "exceeding", which meant that the

company earned money exceeding ten billion and thus deserved to buy. Not until the researcher asked him the meaning through every signal word or phrase, he was hard to discover his misunderstanding.

Example #3: Interpretation from the consumer position

R: “The auto stock published new products, and its sale performed well”, “the technology of electric stock industry had not upgraded, thus their future did not have prospect”, “3C stock company involved in an Embezzlement Case, so that the investors’ confidence had adversely affected.”, “the transportation cost magnitude of financial stock increased, and the profit performance would be reduced.” Above four stocks, which one will you buy? How do you decide?

S4: I may buy the financial stock or the auto-stock. Although their turnovers are not higher than the others, but their sale performance and cost extent are good, so I won’t consider the other two stocks.

R: What does good information mean?

S4: Their cost rose, so the price becomes lower.

S4 interpreted “the transport cost of financial stock increased” as cost-raising and price-reducing. In fact, as the cost increased, the price could only raise. The student was likely to misunderstand that the decreasing of company profitability was price down, and price down was a good thing. However, both cost increasing and price down are disadvantage for a company.

3.2 Major strategies within stock exchange

When the stock nature and operating mechanism were not clear, students were easy to use intuition to do stocks transaction. Their investment stressed to reduce risk and make money, so the timing of intuitively transaction for students was “buy the stock when it rises, and sell it when it drops”. The method of selecting stock was alike to buy things: “stock price is the priority indicators of purchase”. This might be because the growth of environmental constraints, and stock selection was “according to significant others’ preferences and media reports.” We could clearly understand the intuitive thinking from the following three examples.

Example #1: Buying stock when the price rose and selling it as the price fall

S14: When the stock price decline, I sell it because I don’t want to lose money. The stock price may continue downward.

R: But the price may go up quite substantially in contrast?

S14: I can buy it when the time comes.

Comparing with earning from the stock, most students cared about the deficit more. Students tended to exchange stock according to the price. Price was thought to be the crucial point in exchange stocks. The opportune moment of purchasing stock was price-rising, but otherwise it must be sold. Although stock price often changes (the price goes down this time, and may go up next time or next day), students did not want to take the risk of holding the stock. Worrying about the damage of the stock price would influence students’ behaviors of stock exchanging.

Besides, it seemed that some students considered the stock ups and downs had domino effect. It meant that as stock price went down, it was down all the way. So the stock must sell it as soon as possible; if not, loss was definite. Similarly, as the stock price went up, it must continue boosting. In other words, the stock price was predictable. Thus, students would wait for the boost time to prevent disadvantage. S2 had the same idea. She referred

that “I always make money, because I would direct selling it when losing”. S13 had another opinion with stock price and exchanges. He evaluated the stock price from its ups and downs, because “If stock goes up, it is very expensive, but if it goes down, the selling price should be cheaper.” A cheap stock would go down, and I can’t afford the expensive one. Not buying any stock maybe the best choice”. Hence, for students, not buying the stock as it goes down and only buying when it goes up.

Example #2: Stock price was the prior purchase indicator

Some students treated stock as general merchandise and used cheap price as the first consideration intuitively. There were three investment types which bought the low price stock for different reasons. First, “*cheap priority and saving first*” type of students regarded the stock as general merchandise, so they considered the lower price was better. For example, S1 claimed that “cheapest stock rises and makes money easily”. In short, this type of students equated low price with saving and making money.

The second type was “*cheap priority and quantity win*”. This type of students loved cheap stock which was the same with the first type of students. However, students of “*saving first*” type emphasized on saving money, but students of “*quantity win*” type already had the notion of buying low price and selling high. The main goal of them was to buy many stocks and take advantage of rising prices to make profits. Limited to the amount of money, students only bought low price stocks to ensure buying enough, as S8 said “I would buy stocks according to the money I have. I buy cheaper stocks more, and earn the spread between selling and buying prices. If I don’t have much money and buy the expensive one, I can merely earn one thousand when the next day the share price rises a little.” The notions of two different students above were similar to small profits and quick turnover in business. In other words, buying more cheap stocks earned fewer price differences, but large amount would balance the insufficient margin of profit and obtain the maximum profit overall.

Final one was “*low price priority, but information determine*” type. This type of students also bought stock according to the price, but they tended to evaluate stock situation first. For instant, S4 determined stock by “finding the cheapest one, then read the information. If its information is not good, I may change the better one; if the better one is expensive, I may earn more money from other places. Then I come back to buy the stock later”. Although these students also considered the lower price first, they wouldn’t insist. They will also concern other aspects based on the positive information at the same time. So they were the investors who more wise and considered more aspects.

Example #3: Investment depending on the important person and media report

The stock students decided what to buy were easily affected by surrounding social environment, especially the people they contacted in daily life. The factors which influenced the stock price were various. However, students tended to trust the persons who had credibility, such as TV media, parents and teacher. When students lacked of related background, the preferences and experience of their important person were their priority even the only target. For example, when researcher asked S17 about why stock could make money but most people didn’t buy stock. He responded immediately that “they surely watch TV”. It was clear that he considered TV as the important channel to spread the information about stock deserved to buy or not, and the media usually reported stock investment defeated at the time. So he misunderstood that people had common behaviors were due to receiving the same information.

Some students used the news report in reality life as the base in their stock investment game. S10 thought the financial stock wasn't good, while the 3C stock deserved to be purchased. Because "the financial stock is disadvantage for Taiwan, since it's not allowed by the government. In contrast, the 3C stock is good, because Taiwan sells 3C and is a 3C big country. So the 3C company makes money very soon". Student was very sure to get enough information from the reality, in spite of the game had its' own random stock information as the investment indicator and not correspond to the reality.

Personal experience and people's preference around students would also influence their predilection and misjudged. S1 referred that his father bought the 3C stock. He thought his father would not buy a money-losing stock, so buying 3C stock should be more likely to make money. Thus, he applied this criterion to the financial investment game. On the other hand, for students, in addition to credible parents, teacher was the most influential person. S14 said that "I usually buy financial stock but not others; because my teacher ever showed us the financial stock was a better choice". The stock which teacher recommend may only applicable to certain situation at that time. However, students never considered other options and merely chose financial stock teacher recommend as the only one choice when he wanted to buy stock.

4. Discussion and suggestion

4.1 Scaffolding of multiple representations and embedding financial knowledge

Students were less exposure to the stocks in real life. They were not sensitive to the business terms of the stock information in this game. Besides, they might have different text comprehensive abilities. Thus, the system was necessary to help students learn the stock and financial background knowledge, and foster their sensitivity of complex narrative. Following were three recommendations.

(1) Providing explanations or examples to help students understand the professional background and financial terms. In the present study, the students tended to decide what stocks to buy from one-sided message. But students might not interpret the message correctly. For example, students interpreted "the sales of auto stocks will reach break-even point", "the financial stock earned ten billion dollars last season which is lower than expectation", "the transportation costs magnitude of financial stock increase and the profit will be reduced," as the positive descriptions and deserved to buy. Students were unable to find out the keywords from the textual for the overall market assessment, and were not familiar with the business language. It might due to their language comprehension abilities. If the description of stock situation can provide a small dictionary for students to click and look up business terms, they might improve the shortage of situation understanding.

(2) Constructing students' correct investment concepts through the complementary cooperating between abstract concepts and the concrete operation. In this study, students who lacked of knowledge of stock market analysis and information might be difficult to assess the pros and cons, so they used the stocks potential and available information to determine trading. Thus they had herd behavior: buying stock as the price went up, and selling it as price went down. Although students preferred not to buy stocks by fear of losing money, stop-loss immediately, or not to take risk to gamble the next comeback for avoiding some huge financial loss, the learning system in the financial management game should offer proper investment content and appropriate financial instruction.

(3) Using multiple representations to represent the complex narrative context, and prevent framing effects. Students are easy to mis-interpret different explanations. For example: "this company estimated turnover increased 6% last season in original, and they

earned 10 billion finally which increased five billion than before” and “this company earned 10 billion which lower than expected” have the same meaning, but the former one makes people mistakenly believe as the blue chip stock, while the latter one is a money-losing stock. This is a framing effect. That is, using different manners of representation for the same problem, so that people have different decision-making results [3].

Except for the financial stocks game, there are many things that influence people's judgments and decision through framing effect, such as news reports. Banks encourage investment by using high remuneration advertisement and insurance provides preferential protection. Financial game design not only provides children opportunities to experience what their age can't encounter and learn financial knowledge, but also needs to consider how to support transfer from financial management to the decision-making from different angles. By doing so, as children face various events and information processing in their life, they could foster their multi-thinking habits and make the right decisions and behaviors.

4.2 Using situational anchor to connect the learning content and game environment

The lacking of information would seriously affect the judgment of students' stock selection. From the third examples, the results show that students' life experiences influence their financial behavior. Real-life stock market, the recommendation of the TV media, teachers' experiences and preference are all the information sources in this game. But even in reality, those information sources still can't apply to different situations and timing. Hence, it's crucial to provide sufficient knowledge for students to learn and practice in the game. Beside, how to design particular stock investment financial instruction and scaffolding in a game based learning environment for developing students' awareness, and helping them understand the situation and meaning of various stocks, or financial investment within and outside the website. In addition, it is also important to learn how to overall analyze the stocks, and when to buy and sell stocks, and how to prevent from following the ideas of significant others to make wrong decisions.

Good connection with learning content and game environment depends on the appropriate context anchor. Knowledge created by students from the digital content in the game, where decision are often combined with the interpretation of students' life experiences, and thus turned into resistance or power in their financial management practice. Game environment is good at producing context, while the situation is easy to anchor the problems and create further learning opportunities. Thus, the environment should promote students' in-depth study and reflection, including whether it is a positive guidance that approaches life situations or whether the investment landscape matches the information with their real life, and deliberately produces cognitive conflict.

Students would bring some kinds of pre-existing views and knowledge to the game situations. Without taking the advantage of students' understanding and available information in reality, we cannot control the new concepts and information and subsequently blending with the views of the outside world. Games can provide students with appropriate life context, like a vessel anchor, to connect with learning content seamlessly for a specific topic. Embedded reference information in stock trading page, such as the movie or animation included in the investment consultant's recommendations and their prediction of stock ups and downs in daily life like news broadcast. We may lead the students to engage in the financial game and have better stocks understanding. Based on the foundation, students often exposed to provide more investment knowledge and skills as a stock investment presented manner so that the opportunities for students to internalize knowledge can be increased.

5. Conclusion

This study provided students' operating behaviors of the stock concepts and practice strategies in the financial game through a content analysis of interviewed with elementary students. Students interpreted the descriptive information of stock market might occur some problems, especially one-sided interpretation or misjudge the meaning of certain words. This study also further explored the imagination of financial concepts and stock trading operation, and how those operating concepts influenced their investing practice. For example, in order to reduce risk, they followed other people to purchase the rising stock and sell the falling one, or preferred low price stocks to prevent large losses of stock decline, and treat the stock price as the prior purchase indicators. In addition, students were influenced by the significant others in their daily life, such as purchase experience and preference of a particular stock of parents, teachers, and television media, and select stocks based on these experience in the financial game, resulting in ignoring the game setting on the stock and is inconsistent with the reality and thus suffered losses.

Based on these results, this study provided further suggestions for improvement of the future development of financial management in game content and systems, including the framing effect of the learning content, scaffolding of multiple representations, complementing abstract concepts with concrete operations, and using situational anchor to connect the learning content and game environment. This study is expected to have real help for the future development of digital investment games.

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