

An Evolutionary Evaluation of Design Components of a VLE to Promote Investment among the Risk Averse

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Abstract—In this globalized world developing countries strive for accelerated economic development through more active involvement in the economy. However, some societal characteristics appear to pose barriers to such attempts. In Sri Lankan society for example, risk averseness of the general population acts as a stumbling block to rapid economic growth. Due to the general reluctance to investing, the country's economic growth is below expectations. In order to address one aspect of this malady, using past studies we have developed a learning environment that will promote investment among the Sri Lankan society in the context of stock market trading. This follow up work on a previously designed virtual learning environment (VLE) validates its effectiveness in improving users' attitude to risk taking. We discuss how the system was validated and adjusted accordingly to cater to Sri Lankan society to promote trading in shares. This paper addresses the evolutionary evaluation of the pilot system OFFventure.lk through four phases of evaluation.

Index Terms—virtual learning environment (VLE), goal based learning, ideal learning environment, e-learning

I. INTRODUCTION

Ref. [1] Studies show that Sri Lankan society by its culture is risk averse and its citizens in general are not willing to take financial risks even when they are financially capable. The characteristics identified by this study shows that the society lacks the knowledge and understanding of stock trading and are thus not willing to step into it because of the uncertainty involved. Furthermore, the work presents components of a virtual learning environment addressing all the issues identified which need to be fixed in order to cater to the risk averseness of the society. This is following up work to Weerasinghe, Dilhari and Weerasinghe, 2013 and it incrementally evaluates the components proposed, and discusses the validity of the virtual learning environment developed to promote investment.

The components of the proposed learning environment (which is identified as the Ideal Learning Environment in the mentioned study [1]) in the context of stock trading are based on identified issues, capabilities, the nature of the society and the technological skills of the general

public of Sri Lanka. These components include a network game, a goal management component, a learning component management tool, communicator, levels energy and virtual money, indicators and alerts, practical knowledge and public and private advisory.

Based on the design components developed, we have conducted a pilot study to evaluate and validate the VLE. The main objectives of this study were to identify deviations of the design from societal requirements and how the society perceives the components and also to look for new possible features if exciting.

The section 2 of this paper discusses the design components of the VLE while section 3 elaborates the evaluation methodology including the pilot study on evaluation. Section 4 is dedicated to the discussion of the outcomes of the study.

II. DESIGN COMPONENTS OF THE VLE

Savings accounts and fixed deposits have been popular instruments of investment in Sri Lankan society as they are perceived to be safe compared to other investments such as stock trading and other types of business investments. [1] research shows that the reasons behind the small scale of investment in the share market is due to unawareness and lack of stock trading literacy in the people of the country.

[2], [3] However, e-learning comprises of all forms of electronic learning such as virtual classrooms, streaming video, audio, text and more. It was identified [1] that a virtual learning environment will cater to the information needs of Sri Lankan society in terms of striving for a better future where society strives for taking risks and investing in the stock market.

[4] The proposed design components cater to all three identified learning domains cognitive, affective and psychomotor. They also cater to all the identified requirements at the requirement analysis; namely, facilitating the current scenario based on a sand box mechanism, investment capabilities in general, communication media involvement in Sri Lankan decision making, and also to current Sri Lankan technological capabilities [1]. This design also addresses the e-learning issues identified in Sri Lankan society of isolation, lack of motivation and little guidance. Thus, the proposed design components were developed as a

network game, facilitating a major goal management module which provides guidance to users. A brief description of the design components is given in Table I.

TABLE I. DESIGN COMPONENTS (BASED ON WEERASINGHE ET AL. 2013)

Component	Description
Network Game	The virtual learning environment will operate in a network environment and will take the form of a game.
Goal Management Component	User centered goals will be provided where users are allowed to achieve goals of their choice. This component addresses the issues of guidance and motivation.
Learning Component Management	A study guide to cater to learners in the cognitive learning domain. This provides all the learning material in written form explaining the trading process.
Communicator	This component incorporates news into the system, facilitating the current trading procedures of traders
Levels	This feature provides motivation to users as they will be promoted to higher levels once the goals are achieved.
Energy	This is to facilitate the limitations of Colombo Stock Exchange, which restricts user engagement in trading.
Virtual Money	This provides virtual money to practice trading.
Indicators and Alerts	A feature that allows following a particular company and receiving alerts on its performance.
Practical Knowledge	Buying and selling knowledge given mainly through goals.
Public Advisory	Provided to all users of the system.
Private Advisory	Provided to specific user.

A. More about the Goal Management Component



Figure 1. Different aspects of goal management component to facilitate ideal learning environment by giving proper guidance [1].

The Goal Management component mainly addresses the competition, guidance and isolation from the problem definition. Users are guided under the goal completion scenario and the goals are given by the Actors (mediators) who are pre-defined in the system. Fig. 1 shows how the goal-wise guidance is facilitated in the pilot study. It represents how the goals are managed by the system. All the external and internal parties are defining the goals and the goal management system defines the methodology of presenting each and every goal (which could be a predefined goal or a goal that appears only for an instance).

The actors of goal management are defined with respect to the identified aspects of the goals. The goal management component evolves through 3 stages as given in the evaluation section.

1) Stage 1

In stage 1 the goals were defined as a single static array. The user was given the ability to engage in any type of goals they want. All mediators were displayed but there were no relationships between different types of goals.

2) Stage 2

In stage 2 we introduced a priority system where the goals were generated as per the priority only defined in a dynamic single array. The users were forced to complete the given goal and move forward to the next as the other goals were kept disabled till the user finishes the highest priority goal using the relevant mediator.

3) Stage 3

In stage 3 the goals were defined in a dynamic multiple array. The goals had a predefined priority but no goals were disabled. A user can finish any goal as per his wish. Only 4 goals of mediators were displayed on the screen. When one goal was completed the set of mediators moved up making space for the latter priorities to appear in the list of mediators.

All the components were evaluated in the next step of the process, the evolutionary evaluation, given below.

III. EVOLUTIONARY EVALUATION METHODOLOGY

An evolutionary evaluation was carried out to identify the validity of the concept brought forward from the research. It was evaluated in 4 main phases; namely, (i) analysis of attitudes and emotions, (ii) effectiveness of knowledge transfer analysis, (iii) effectiveness and emotional factor of prototype components and (iv) analysis of the process of the prototype verses current scenario (report reading and other existing simulators in the world).

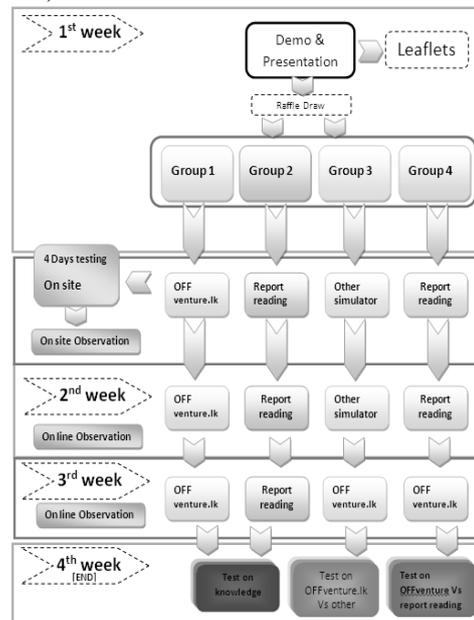


Figure 2. Big picture of evolutionary evaluation

For the whole evaluation 4 groups of participants were selected and were given separate tasks to perform. Group 1 was introduced to the developed prototype OFFventure.lk, group 2 was selected to do report reading

of the daily share reports of the CSE for which learning content was mailed to them, group 3 was introduced to another available stock simulator named MarketWatch for 2 weeks of practicing after which they were introduced to OFFventure.lk. Group 4 was selected to do report reading for 2 weeks and in the following week they were introduced to OFFventure. The big picture of this evolutionary evaluation is given in Fig. 2. Furthermore, we refer to this evaluation as evolutionary evaluation as evaluation grows in several phased and a complex evolved evaluation has been conducted.

	(G1)	(G2)	(G3)	(G4)
1st week				
Learning	X	X	X	X
Emotional Factor	○	X	X	X
2nd week				
Learning	○	○	○	○
Emotional Factor	○	X	X	X
3rd week			OFFventure.lk	
Learning	X	X	X	X
Emotional Factor	○	X	X	X
4th week				
Learning	○	○	X	X
Emotional Factor	X	X	○	○

Figure 3. Questionnaire distribution and their time frames

The evaluation was done using online and onsite observations, questionnaires given to the participants and tests conducted to measure their knowledge. The questionnaires for online and onsite observations as well as which were given to the participants were prepared using a rating scheme with a scale of 1 to 7, where 1 was *least effective* and 7 was *most effective*. The ratings were given by the observer or the participant in the respective cases. The scenarios of evaluation questionnaires used are shown in Fig. 3.

The phases of the evolutionary evaluation are described below in detail.

A. Phase I – Analysis of Attitudes and Emotions

In this phase students of group 1, 2 and 3 were observed and rated in the 1st week. Group 4 was not taken into account at this phase as they were involved in report reading similar to group 2. By observation, ratings were given to groups on identified emotional factors such as excitement, attitude and activeness. The average ratings were calculated and analyzed using Pearson’s Chi-Square tests [5]. The results showed that the emotional factor is more on simulators than report reading. The participants were more enthusiastic when practicing a simulator than when engaged in report reading. Both the simulators, OFFventure and MarketWatch showed similarly higher average ratings than report reading, which can be taken to indicate that active learning and engagement is better facilitated by simulations.

B. Phase II – Analysis of Effectiveness of Knowledge Transfer

In this phase, similar to the phase 1, only groups 1, 2

and 3 were chosen for the evaluation. The 3 groups were given a general market test on the second week to analyze to what extent they had gathered market knowledge. This test was not targeted on CSE specific knowledge. By giving a general market knowledge test, the effectiveness of knowledge transfer was analyzed. From the 3 groups, the average scores for this test showed that the students gathered more market knowledge from the simulators than by report reading. Further, knowledge gathered by OFFventure participants score more on average than MarketWatch participants. Table II shows the average scores of the all three groups.

TABLE II. AVERAGE SCORES OF GROUPS TO ANALYZE THE EFFECTIVENESS OF KNOWLEDGE TRANSFER

Group Number	Avg Score
Group 1	10.75
Group 2	7.75
Group 3	9.5

The above table depicts the consolidated scores of the test conducted. The findings indicate that OFFventure is capable of transferring knowledge most effectively.

C. Phase III – Effectiveness and Emotional factor Analysis of Prototype Components

This phase was carried out using the participants of group 1 through all 4 weeks. It was carried out in 2 ways; online observations on the participants’ performance, and by the rating questionnaire given to the participants in the end of each week. Online observations were carried every week to analyze the performance of participants in each phase of goal management by their state of goal completion. Their performances for each week were then statistically analyzed.

1) Online observation of user behaviour

In the 3 weeks of the evaluation, the goal component was given in stages to the participants. As explained in the prototype designs’ goal management section, the participants practiced one goal management stage each week.

a) Results of Stage 1

When users were exposed to stage 1 of goal management they tended to engage in one particular area only and ignore the other areas. This made a user learn only one part of the stock trading process. Hence stage 2 of goal management evolved.

b) Results of Stage 2

As the users had to complete one task in order to proceed to the next, this stage of goal management created deadlocks for some users who did not like a particular goal or were unable to complete several goals. With the identified issues in stage 2, stage 3 was then introduced for better goal management.

c) Results of stage 3

Users seemed to engage with this goal management stage successfully compared with the other 2 stages as they were able to select their choice of goal.

The 3rd stage of goal management seemed to be more effective as the participants were able to select goals among those appropriate, and these goals were also displayed as per a predefined user priority. The difference in this phase from stage 1 is that the goals were not coming in a static way. Four of the most prioritized goals were enabled so that it gave a user a choice from among those most appropriate. The observation results showed that the participants' performance was much better in the 3rd stage.

2) Emotional factor analysis

This was analyzed using Pearson's Chi-Square Test using the calculated average ratings given by participants on the identified emotional factors motivation, guidance and non-isolation. The results are shown in Fig. 4.

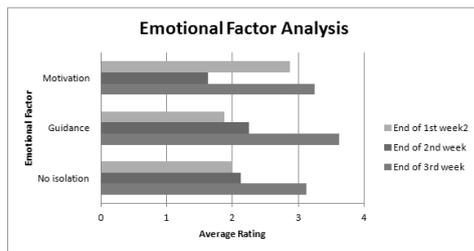


Figure 4. Emotional factors average ratings for the phases of goal management of OFFventure

As the above figure shows all 3 factors measured have a higher average rating in the 3rd week than in the other 2 weeks.

As per the findings in online observations and the ratings by participants we can conclude that the 3rd stage of goal management is effective compared to the other 2 stages

D. Phase IV –Analysis of the Process of OFFventure versus the Current Scenarios of Report Reading and Other Simulators

The Phase IV of evaluation was carried out to measure 3 factors, namely, Effectiveness of Learning Aspect, Effectiveness of OFFventure versus MarketWatch and Effectiveness of OFFventure versus Report Reading. This phase was carried out at the end of the 4th week of the evaluation period.

1) Effectiveness of learning aspect

The Effectiveness of Learning Aspect was analyzed using the participants of Group 1 and Group 2. They were given a test on the Colombo Stock Exchange knowledge to see which method was more effective in transferring the knowledge. This test did not only have theoretical knowledge tested, but also tested the practical side of CSE trading. The participants were not aware of the test until it was administered. This was done to make sure that they would not study for the test. After the test was given, the participants' marks were analyzed by calculating the average marks for the 2 groups separately. The OFFventure group scored a higher average of 10.875 while the report reading group only scored an average of 7.625. As per the results it could be concluded that OFFventure.lk imparts better knowledge on the CSE with overall CSE background rather than report reading.

2) Emotional aspect of marketwatch verses OFFventure

This evaluation was carried out using the students of group 3. They were given questionnaires to rate the emotional factors identified namely, engagement factor, motivational factor and guidance factor. The engagement factor was rated for discussion, competition, debate on background and team play. Except for debate on background other engagement factors came up with higher average ratings in OFFventure and resulted in overall higher rating for OFFventure on the engagement factor. Similarly, motivation factor was analyzed for novelty and variety, competition, interactive guidance and graphical content. After analyzing the average motivational factor it was identified that OFFventure has an average rating for motivation of 4.3 which is over the 2.7 average of MarketWatch. The guidance factor was analyzed for goal management, advisory and hints, resulting in a higher score for OFFventure. In this section it was identified that the emotional aspect is addressed better in OFFventure, which appears to suite Sri Lankans in a better way than MarketWatch.

3) Emotional aspect of report reading verses OFFventure

Emotional aspect for report reading verses OFFventure was analyzed from an e-learning point of view and a CSE point of view using participants of group 4. For E-learning point of view engagement, motivation and guidance factors were analyzed. OFFventure.lk resulted in a higher average for the above factors over report reading. The CSE point of view was analyzed for decision making and timing factors where OFFventure managed to show higher average ratings as it facilitates decision making and waiting for the right time. In this section it was identified that OFFventure caters better to knowledge seekers than report reading in transferring CSE trading knowledge.

IV. DISCUSSION

After conducting the evaluation on the above mentioned 4 phases we have identified that the learning aspect and emotional factor effectiveness of OFFventure is well above both the other approaches used in the evaluation.

Even though some aspects of learning were better in Report Reading, emotional aspects such as motivation, guidance and non-isolation were never at a satisfactory level. Since the learning factor of OFFventure was at a satisfactory level, it was identified that overall OFFventure performance is suitable to motivate Sri Lankans to get engaged in investing in stocks.

When considering the other approach of evaluating OFFventure with an existing simulator (MarketWatch), we have identified some emotional factors having better average ratings on MarketWatch than OFFventure. However since MarketWatch does not focus on the Colombo stock exchange we identified that its Learning aspect from a CSE point of view was not satisfactory. As a result participants only learnt general market concepts by practicing with such simulators. Since in all emotional

factors identified most are at a satisfactory level for OFFventure, and since in the learning aspects we have measured OFFventure is more feasible in the Sri Lankan context to give better knowledge for the Sri Lankan society, we can conclude that OFFventure achieves our original goal of promoting investment among the risk averse.

V. CONCLUSION

This research was focused on a solution that addresses the 'risk averseness' of Sri Lankan society [6]. The Colombo Stock Exchange was named the best stock market of the world in the year ended in December 2010. It is ironic that the majority of the Sri Lankans are not willing to invest in the CSE even with these credentials.

In such a growing economy it is important for the individual and the economy of the country that people invest more in the local stock market. The current percentage of Sri Lankan investors on the stock market is very low. OFFventure is an attempt to address this issue and find an indirect and enjoyable way to make people understand the fact that investing in the stock market will make them wealthier while also helping the country to prosper.

[1] To overcome this problem we have identified that a learning environment needs to be facilitated. As this learning environment should be available to the public at large, we have chosen e-learning as the most practical means. After identifying that Sri Lankan society has a readiness for e-learning, we focused on creating an Ideal Learning Environment to provide a platform for experiential learning of the Colombo Stock Exchange.

In the ideal learning environment we have addressed the most prominent problems of e-learning which are isolation, lack of motivation and absence of guidance. The virtual Investors design was implemented as a conceptual prototype and the feasibility of the concept was evaluated in this paper. As per the evaluation, OFFventure featured as a very feasible solution over the other simulators which do not facilitate data on the Sri Lankan market. It was also found to be more feasible for enabling learning than reading learning content from reports.

To use OFFventure.lk, the main outcome of the Virtual Investor, a user only requires basic computer knowledge and internet connectivity.

REFERENCES

- [1] W. M. K. G. Weerasinghe, K. L. V. Dilhari, and A. R. Weerasinghe, "A design of an experiential learning environment to promote investment among risk averse," in *Proc. 8th*

International Conference on Computer Science & Education, Colombo, 2013, pp. 725-730

- [2] E-learning survey results report, A poll was held to coincide with the 5th anniversary of the first use of the term 'E-learning. [Online]. Available: <http://www.cipd.co.uk/NR/rdonlyres/3A316F9C-6F07-47A9-B427-6FBF8D00A381/0/learnsurveys04.pdf>
- [3] M. Driscoll, "Blended learning: Let's get beyond the hype," in *Elearning*, 1.4. 2002.
- [4] Ed. D. C. Vinson. Learning Domains and Delivery of Instruction. [Online] Available: http://pixel.fhda.edu/id/learning_domain.html
- [5] H. M. Rhoades and J. E. Overall, "A sample size correction for pearson chi-square in 2x2 contingency tables," *Psychological Bulletin*, vol. 91, no. 2. pp. 418-423, 1982.
- [6] Awesome Sri Lanka from Fox News. [Online] Available: <http://www.youtube.com/watch?v=PfmLiHCzj4>



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