Research Article

Visual Risk Measurement (VRM) App

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Abstract: *The mobile technologies have provided new opportunities for innovative learning to the younger generation who are digital natives. Visual Risk Measurement (VRM) App is an innovative mobile learning that incorporate visual representation in teaching the measurement of risk. It illustrates how standard deviation can be employed to measure level of uncertainty (risk) of the returns on investment. In order to facilitate two ways communication, interactive gamification is embedded to provide feedback to the user on their performance. A survey was solicited after the adoption of VRM App by 48 students who enrolled in Business Finance course. The results are inspiring as the VRM App is beneficial to the students in terms of learning outcomes, perceived enjoyment, informativeness, perceived ease of use, perceived usefulness, attitude toward VRM App, behavioral intention toward VRM App and self-efficacy. This App has practical implications as it simplifies complex information through visual representation while the gamification elements embedded in the formative assessments enhances the learning process.*

Keywords: Visualization in teaching and learning; teaching aids in risk measurement; mobile learning.

1. INTRODUCTION

The past five years had witnessed the fast-expanding mobile learning due to the advancement of mobile technologies designed specifically for educational purpose (Hameed et al., 2022). It is anticipated by 2025, 5 billion people will be adopting mobile devices to access the internet in conjunction with the progression of mobile connection to 5G technologies (Sophonhiranrak, 2021). Hence, mobile learning has emerged as a fundamentally beneficial addition to accessing timely and appropriate directions (Al-Bashayreh et al., 2022) and gradually replacing traditional classroom teaching in the educational process by allowing learning to occur irrespective of time and place (Zaidi et al., 2021). This is supported by Sophonhiranrak (2021) who postulated that mobile learning is effective as the learners can access the information all the time and in all places.

Besides, past findings are also in support that mobile learning promotes an environment that allows students to learn and interact (Hamidi & Chavoshi, 2018; Criollo et al., 2021). Papadakis (2021) further added that the learning process with no constraint of fixed location and time with accessible learning materials motivates learners to participate in learning actively. In a nutshell, mobile learning outweighs the traditional classroom by facilitating the quick access of learning materials and information, no restriction on location, and most importantly expediting the two-way communication (Al-Rahmi et al., 2021).

2. METHOD & MATERIAL

This study developed a mobile learning app for learning the risk measurement, namely Visual Risk Measurement (VRM). The app incorporates visualized learning materials and formative assessment via gamification. We carefully design every element and component, with a strong emphasis on the aspects of feedforward and feedback processes and on the interactions between audio visual learnings and the metacognition of the students. We study the effects of different design combinations and based on our findings, the app is enhanced considerably over previous designs in order to cultivate the self-supervised and transfer learning.

When a concept is explained to students verbally, the effect is less because students could not "see" the concept, especially the risk measurement which requires computation using complex statistical formula that is hard to comprehend. This is supported by Opoku et al. (2021) who showed that with all possible sensory combinations, the stimulus detection, localization, and response accuracy as well as to speed responses will be strengthened. As a result, students attending the traditional classroom might be able to compute the risk based on the formula but they were unable to relate and explain how could the formula measure the risk (Liew et al., 2023). Eventually, they remain as students who just merely memorizing the formula in order to achieve a good grade without really understand the concept.

With the visualization, students will better understand and remember what they have learned. Well-selected images can improve comprehension, enrich communication and stimulate emotional response that allows students to recreate the experience in their mind. The past literature had shown that visual representations can convey complex messages and assist the viewer in deeper understanding the concept represented (Shatri & Buza,2017; Arneson & Offerdahl, 2018; Balalaieva, 2020; Sari & Faridi, 2020; Chatima, 2021). Moreover, Raiyn (2016) showed that visual leaning tools increased the students' higher-order thinking (HOT) skills. This is important to ensure that students are able to face challenges both at the university level and in the workplace.

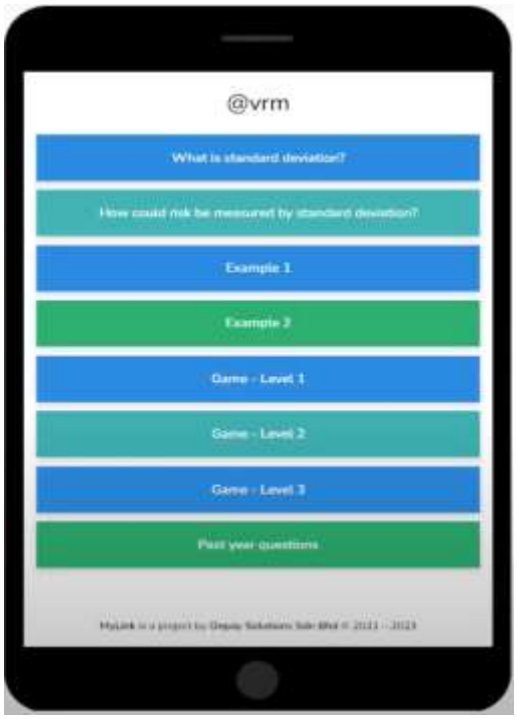

Figure 1. VRM App.

The VRM App consists of consisted of three steps of learning activities:

(1) audio visual learnings on the concept of standard deviation and followed by the learning on how could risk be measured by using standard deviation,

(2) audio visual in solving problems pertaining to the calculation of risk

(3) interactive assessments via gamification, with progressing level of thinking based on the Bloom's taxanomy from Game -Level 1 to Game-Level 3.

The first visual representation demonstrates two groups of students, consisting of three students each. The Group A members weigh 100kg, 60kg and 50kg while the Group B consists of members weighing 69kg, 70kg and 71kg. Both groups record a total weight of 210kg and hence an average weight of 70kg. A question asking "When a student is selected from Group A, how certain are you that his weight is 70kg?". The answer is shown by showing that the three members have weight which are far dispersed from the mean 70kg. Another question asking, "When a student is selected from Group B, how certain are you that his weight is 70kg?". The answer is yes as the three members in the visual representation indicate that their weights are very close to the mean 70kg. This reveals that the risk that a student is selected from Group A is 70kg is higher as there are greater uncertainty that their weights are deviated far from 70kg.

The next visual aids to convey the concept of standard deviation and how it can be used to measure risk. Visual shows the plotting of data of each group and indicate the distance of each data from the mean. As the distance is greater, the value of standard deviation is higher. It explains to the students what the standard deviation is measuring and most importantly, the concept embedded in the formula. Students will understand why the distance between each data and the mean has to be squared and then being square rooted by showing the distance of each student's weight which may be above (+) or below (-) the mean value.

Two examples of problem solving on risk and return measurement are demonstrated. Students can learn with their own path and can re-visit the contents again and again if needed in order to gain better understanding. To monitor the student learning progress and outcomes, assessment via gamification is conducted. The purpose is to motivate students via an engaging learning experience that can keep them focused on the learning task and promote learning that comes with fun (Manzano-León et al., 2021). This is in line with the findings that educational gamification has a potential impact on the academic performance, commitment and motivation of students (Araya et al., 2019; Huang et al., 2020; Sailer & Homner, 2020; Zainuddin et al., 2020; Willig et al., 2021; Fathurohman et al., 2023; Oliveira et al., 2023). To reinforce the motivation of students, the VRM app incorporates the main gamification elements being points, medals, rankings, and narrative which are reported to be necessity (Manzano-León et al., 2021). This is taken into the design of the games in the hope that students who have tasks that they consider fun for them, greater motivation towards the task can be exerted with more desirable study habits.

Prior to registering the course Business Finance, the students had studied standard deviation during secondary school in Mathematics and also the Statistic course in Politeknik Kuching Sarawak. 48 students who enrolled the course in Business Finance was selected to adopt the VRM App in the learning the risk measurement. In order to investigate whether VRM App brings enhancement in comprehending the concept of standard deviation, the students were asked to rate their knowledge about the concept of standard deviation before and after adopting the VRM App.

In order to investigate the effectiveness of VRM App, a survey was solicited after the adoption of VRM App. The questionnaire adapted the instruments developed by Davis et al. (1989), Davis et al. (1992), Compeau et al. (1995), Al-Bashayreh et al. (2022) and Hameed et al. (2022) in testing the effectiveness of VRM App. The aspects evaluated were perceived enjoyment, informativeness, perceived ease of use, perceived usefulness, attitude toward VRM App and behavioral intention toward VRM App.

3. FINDINGS

Descriptive analysis was performed to gain insight into the usefulness of VRM App in teaching and learning the risk measurement.

3.1 Learning outcomes

The results are inspiring as the percentage of students who can understand the concept of standard deviation increases from 45.8% to 97.9%. This low percentage before the application of VRM App ratifies that the students merely memorized the formula without truly understand the concept despite having studied it twice.

Table 1. Number (percentage) of students who understand the concept of standard deviation

	Before adopting the VRM technique	After adopting the VRM technique
Understand	22 (45.8%)	47 (97.9%)
Somewhat understand	7 (14.6%)	1 (2.1%)
Do not understand	14 (39.6%)	0 (0%)

3.2 Perceived enjoyment

Perceived enjoyment was used to evaluate the fun and excitement of using VRM App based on respondent's perception of the entertainment features. The descriptive statistics shown in Table 2 reveals that perceived enjoyment of VRM App is significantly high, with a mean value of 4.73. This indicates that the respondents found VRM App is fun and entertaining and they enjoy the process of using the App. High mean value suggests that most participants rated the entertainment characteristics of VRM App positively.

Table 2. Perceived enjoyment of VRM App

		Mean
1.	VRM App is entertaining to me.	4.79
2.	I think that VRM App is fun to use.	4.73
3.	I feel excited while using VRM App.	4.71
4.	The actual process of using VRM App is pleasant	4.69
	Overall	4.73

3.3 Informativeness

Informativeness measures the respondent's view regarding how informative and whether the contents of VRM App is useful and facilitate the learning process. Table 3 exhibits the results of informativeness of VRM App. The respondents rated the informativeness of the VRM App significantly high, with a mean value of 4.77. This shows that the contents of VRM App is informative, useful and easy to understand. The audio visual representation successfully enhanced the learning process by

displaying clearly the concept while the examples of solution to problem which were shown step-by-step enabled the respondents to answer the questions efficiently.

Table 3. Informativeness of VRM App

		Mean
1	VRM App gives me quick and easy access to large volumes of information	4.79
2	Information obtained from VRM App is useful	4.79
3	VRM App makes acquiring information inexpensively	4.71
4	I can understand the content easily	4.79
	Overall	4.77

3.4 Perceived ease of use

Perceived ease of use evaluates VRM App based on respondents' perception of the App's intrinsic characteristics. The overall mean as high as 4.90 was recorded for the perceived ease of use (Table 4), suggesting that VRM App is easy to use, flexible, and user-friendly. The respondents could easily access and interact with the App by simply selecting the menu in the user interface. We envisaged to simplify the App for students and this goal was achieved as all the respondents indicated that it is easy to use the App.

Table 4. Perceived ease of use of VRM App

		Mean
1	It is easy for me to use VRM App.	5.00
2	I have clear and understandable interaction with VRM App.	5.00
3	VRM App is is flexible to use.	4.79
4	It is easy to get VRM App to do what I want.	4.79
	Overall	4.90

3.5 Perceived usefulness

Perceived usefulness assesses the respondents' perception on the extrinsic characteristics of VRM App, such as the efficiency and the effectiveness of the App in learning risk measurement. As shown in Table 5, the overall mean value of 4.95 reveals that almost all respondents valued the extrinsic characteristics of VRM App as effective in enhancing their learning. It can effectively promote teaching and learning by fostering students' engagement anywhere anytime.

Table 5. Perceived usefulness of VRM App

		Mean
1	VRM App enables me to accomplish learning tasks more quickly.	5.00
2	Using VRM App improves my study performance.	4.79
3	VRM App increases the quality of learning I receive.	5.00
4	VRM App allows instant access to learning modules regardless of my location.	5.00
	Overall	4.95

3.6 Attitude toward VRM App

Attitude toward VRM App intends to evaluate the respondents' general attitude toward the use of the App, including how good is the idea of using m-learning, the pleasant experience it brings, the general attitude and desirableness. The overall mean value of 4.76 as shown in Table 6 indicates the highly positive attitude towards using VRM App for risk measurement learning purposes. The high mean value suggests that most of the respondents see VRM App as a desirable and enjoyable learning

tool, and has emerged as a wise choice for them in learning the topic of risk measurement which is hard to comprehend solely by using audio and text.

Table 6. Attitude toward VRM App

		Mean
1	I think that using VRM App is a good idea.	4.72
2	I think that using VRM App is a pleasant experience.	4.79
3	I have a generally favorable attitude in using VRM App.	4.79
4	In my opinion, it is desirable to use VRM App.	4.72
	Overall	4.76

3.7 Behavioral intention toward VRM App

Behavioral intention toward VRM App measures the respondents' level of intention toward using the App for learning. As shown in Table 7, the overall mean value of 4.90 suggests that the respondents have high intention to employ similar App for learning purposes in the future, acknowledging that the VRM App has successfully inculcated the adoption and use of the technology among the respondents.

Table 7. Behavioral intention toward VRM App

		Mean
1	I prefer VRM App over other learning tools.	4.79
2	I will recommend VRM App to others. .	5.00
3	I plan to use similar App in the future.	4.79
4	Assuming that I have access to similar App, I intend to use it.	5.00
	Overall	4.90

4. DISCUSSION

The findings of this study indicate that the VRM App is an effective tool in learning the risk measurement. The high mean recorded in each domain reassured that the VRM App had exerted great impact to the students. Not only facilitating the learning process by providing useful and easily understood materials, the App was seen as an effective tool to engage and motivate the students via fun and excitement learning process. The VRM App has created a pleasant learning atmosphere for the students and enabled them to enhance their thinking ability and knowledge. The learning activities was well organised so that it is easy to understand by exploring one to another, facilitating the students to solve the questions, promoting the learning motivation and developing the students' competence.

5. CONCLUSION

In the era IR4.0, it has become a must for the educators to employ and integrate the modern technologies in their teaching classroom. The adoption of VRM App and the findings of this paper have implications for educators, administrators, teachers and stakeholders to formulate a holistic policy to introduce a learning environment with the integration of technology which is essential to enhance the quality of educational activities.

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