Mobile-based Visual Decision Support System for Hybrid Learning in Post-COVID-19 Pandemic

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Abstract. The decision-makers which are the stakeholders of educational institutions are much concerned about the whole aspects especially their decisions since the emergence of COVID-19 pandemic. Mobile-based applications has been increasingly used and created since then. Hybrid learning which is the combination of online and distance learning (ODL) with face-to-face (F2F) learning that can be managed by the decision-makers of higher education institutions using mobile-based visual decision support system (VDSS) applications. A ranking method that is multiple attribute decision-making (MADM) can be utilized which can be integrated with core engine of business intelligence and analytics (BI&A) to get insights to analyze data. Art and design of user interface (UI) can support decision-makers' user experience (UX). In conclusion, art and design creativity together with computer and mathematical science methods are useful for the development of applications towards managing ODL, F2F and hybrid learning.

Keywords: Art and Design, Decision Support System (DSS), Multiple Attribute Decision-Making (MADM), Decision-Maker, Hybrid Learning

1 Introduction

Art and design educational researchers have high interests and inspired to look for the strategies via creative pedagogic approaches [1][2]. the learning design has now move into digital learning spaces [3] and cloud-based learning [4]. Realizing its importance, therefore, visual creativity for the students needs to be taken care of. Decision makers admitted that user-experience [5] and usability study [6] plays an important role for the effective and efficient management decision-making. Software development life-cycle (SDLC) is the common method practiced by the apps developers, starting from getting the requirement until testing and delivery. Decision-making and decision support is much the combination of art and science. Decision makers which are human being are commonly make decisions not only based on emotions but also intuitions. Analytical and numerical weights can be evaluated in making decisions since the introduction of management science by Herbert Simon [7].

Malaysia had implemented MCO on 18th March 2020. Nowadays, with the rises of cases around 20,000 daily, the total lockdown were implemented starting 1st June 2021 until middle of August 2021. Mobile-based data applications has been tremendously increasing since due to the closing of educational institutions in the current COVID 19 pandemic scenario, the role of information technology has accelerated. During this quarantine or lockdown period,

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information technology is functioning as a solution for the continuous learning process through creative, learning management systems, and other online platforms especially for work and learning [8][9]. Despite its various advantages, e-learning has a number of drawbacks, including social isolation, a lack of face-to-face contact between instructor and student, and communication issues. The goal is to shorten the learning gap caused by lockdown.

The ADDIE model can be utilized for design and development of digital contents. This is obvious because there are the needs to pay proper attention since online learning are going to be the main means of teaching delivery. Visual creativity using the Hybrid learning which is the combination of online and distance learning (ODL) with face-to-face (F2F) learning are the alternative T&L methodology can be enhanced using mobile-based visual decision support system (VDSS) applications. Online learning incorporates classroom and online instruction to allow students to learn individually, interactively, and collaboratively. The students' information acquisition and success as a result of online learning was found to be comparable to that of face-to-face technique. However, the transition to online learning has prompted numerous concerns about the quality of education. The quality of online education may be a serious issue that requires immediate attention in rural areas.

Several criteria contribute to the ineffectiveness of online learning, including educators' lack of device awareness and skills. During the Covid-19 pandemic, several local governments and higher education institutions in several countries have initiated programme to offer students can get free mobile data internet packages. The internet provided via mobile data aid programme, on the other hand, is perceived as being less impartial and unfair in its distribution to recipients. Some information is necessary, such as the quantity of internet use, the number of classes and meeting lengths, as well as the students' financial capabilities. The purpose of this study is to investigate how much student data is used and how it relates to meeting duration and feature utilization. The study findings help decision-makers support the administration of internet data package assistance programme for students enrolled in Online Learning from Home (OLFH) [8]

2 Literature Reviews

Design industries and creative culture practices can be realized in the cutting-edge business intelligence (BI) applications such as mobile-based visual decision support system (VDSS). According to research by Sharif [10], there exist a relationship between acculturation, creativity, and [10][11]. Surprisingly, Lecturers and students have different ideas about what it means to be creative [11]. Designing these applications is a challenging tasks considering that its requirement could come from the most important stakeholders in an organization; the decision-makers (DM). The usage of data analytics in the form of infographic dashboard has been popularized through the media during the COVID-19 pandemic for the purpose of case reporting and educating citizen on the standard operational procedure (SOP) required. Educational resource management requires efficient resource allocation [12]. Figure 1. shows the trends of social media usage in 5 years ago (before COVID-19 pandemic) that had been soars more than 21 million users in Malaysia either using mobile or laptop to access them.

Creativity in ODL or hybrid learning is very crucial. Students' creativity must be developed, therefore there must be various efforts taken to ensure this is becoming real [10][13][14]. Relation and interaction between instructors, educators, teachers, or lecturers with students are also very important [11][15][16]. Particularly, during hybrid learning, instructions in any forms given must be able to engage students to interact [8][17][18]. Visual creativity is one of the main elements to determine the ease of use in the mobile-based VDSS. One of the elements of multimedia which is video is one of the main attraction in learning especially ODL and hybrid, even F2F if it is capable to be conducted in the near future. During the COVID-19 pandemic, libraries had to adapt the framework of their services to the higher education students' and lectures' need.

The relationship between art theory and design education has much room for improvement since there are opportunities for uniqueness and comparisons in details such as the differences between the art education in rural Kenya [19], Chinese and Western [20], Spain [14] and South Korean [21]. Tools, cultures, and contexts requires specific approaches across the globe. It is important to note that these tools was highly used in Malaysia for many years even before pandemic. Data-driven decision making are required in urgent needs due to the rise of data during post-COVID-19 pandemic. Advancement in technology had changed the mode of communication and delivery of information with clients. Besides websites, information are being shared on social media such as Twitter and Facebook. Students should also trained to fully utilized LinkedIn to ensure their professionalism early on. Next generation workplace can no longer depends on existing companies but rather to start on their own and being able to create and provide job opportunities from the next generations to come. This mindset must be comprehensively encouraged into them; not only in academic, business, but even in sports.

3 Research Methodology

Mobile-based VDSS originated from a decision support system (DSS) which commonly utilize mathematical models rather than abstract emotional decision-making. If there is only one indicator, then it is a considered as a problem with a criterion decision-making. If there is more than one indicators, which are usually the cases, then the multi-criteria or multiple attribute decision-making (MADM) solutions are method required to solve that particular problem. The general formulation of a MADM is as in the following matrix, where *C* referring to criteria or indicator, *A* referring to decision alternatives or choices, while *x* referring to weight which each are associated with the specific criteria and alternatives as shown in (1).

$$\begin{Bmatrix} & C_1 & C_2 & \dots & C_n \\ A_1 & x_{11} & x_{12} & \dots & x_{1m} \\ A_2 & x_{21} & x_{22} & \dots & x_{2m} \\ : & : & : & : & : \\ A_n & x_{n1} & x_{n2} & \dots & x_{nm} \end{Bmatrix} \quad (1)$$

The methods for ranking and pairwise comparison are used in determining criteria weights which are then normalized as in (2).

$$\sum_{i=1}^{n} w_i = 1 \tag{2}$$

Furthermore, the ranking method are summarized as (3).

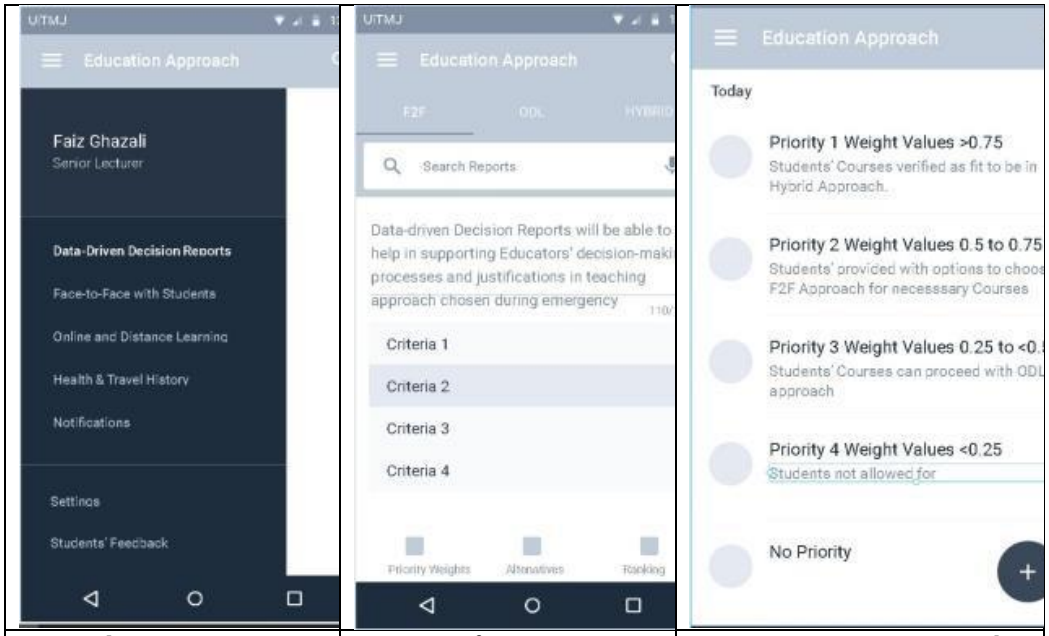
$$w_i = \frac{n - r_i + 1}{\sum_i (n - r_i + 1)} \tag{3}$$

Besides the research methodology based on MADM mathematical models, the development methodology practiced in this research is rapid application development (RAD) which isa fast prototyping method in order to demonstrate the feasibility of the proposed solutions. Traditional software development life-cycle (SDLC) needs to be improved with more attention on the design since the students will be looking on the screen for most of their learning processes. Instructional designers must promote the ADDIE (Analysis, Design, Develop, Implement, Evaluate) model in supporting the delivery of preliminary solutions to the developers which can finally contribute to the well being of the communities as well as the decision-makers. One of the most important role is to consider these techniques is the formulation of the suitable modules for an organizational BI&A including educational institutions such as higher education of learning or university. The decision-makers, from the perspectives of management, requires a tool to measure and record their actions and decision-making processes based on data fed into the system.

The feedback mechanism can be used to iterate the designs proposed. The ADDIE model serves as an enabler to a better designs of digital contents. It is also because the students do have perceptions on learning which can effects their performance. Pedagogical agents and self-regulated learning (SRL) concepts that has taken place can play an important role towards striving the students' mental health issues since the overloading of online T&L. The decision-makers need to determine whether need to decide the most suitable education approach for the time being in accordance to Government's policy. This is including movement control order (MCO) regulations as imposed in Malaysia or more specifically standard operation procedures (SOP) as outlined in the country.

4 Results and Discussions

Knowing the attitudes of the important individuals is extremely valuable for effectively managing the organizational work environment to generate desirable attitudes and decision-making outcomes. Preliminary informal interviews conducted to get decision makers' view. Appointment with the students must be made online throughout each semesters as a mechanism to verify the student existence and truthfulness of engagement in the whole study. Therefore, function to set Appointment reminders can be done especially when there is an urgency for face-to-face (F2F) with students. It can be made in accordance to data-driven decision reports based on criteria and priority weight assessments conducted before determining the best decisions. Figure 3, demonstrate the results of the designed main menu for the user interface (UI) of a mobile-based VDSS named MoViDS 1.0 as shown in Figure 3.



Displaying Main menu	Specifying Criteria	Determining Priority Weights

Figure 3. The proposed User interface (UI) of Mobile-based VDSS (MoViDS) 1.0

The digitization and digital transformation age is radically altering corporate and organizational value chains. The importance of decision-making based on Business Intelligence and Analytics (BI&A) is frequently stressed as a basis for innovation and agility. BI&A utilization adds value to analysis by potentially improving organizational performance. It is in the best interests of enterprises to understand the criteria that influence decision-makers' intents to utilize systems.

The advantages of MoViDS 1.0 is that it is capable of demonstrating the required functionality with the proposed integrated modules specific for the needs of higher education institutional decision-makers during COVID-19 pandemic. The purpose is to support for decision-making processes in ODL, F2F, and Hybrid Learning. The core engine which is the special recipe for this mobile-based VDSS is based on mathematical formulation MADM as detailed in Figure 4.

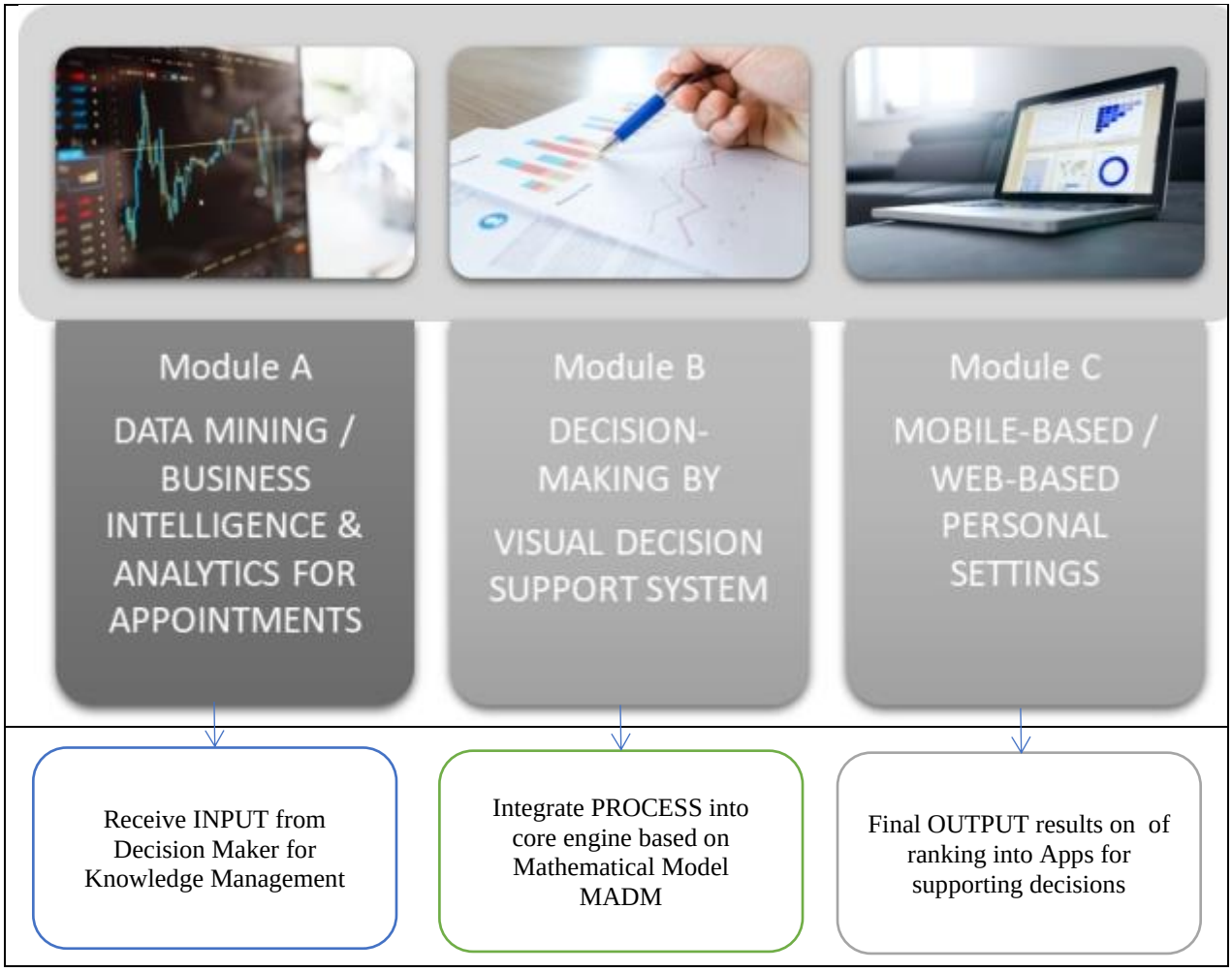


Figure 4. The proposed engine for MoViDS 1.0

As a result, the complete model is a robust integration from several components. In Module A (Figure 4), any inputs key in from decision makers including criteria and priority weights are accepted and this module which has BI&A functionality will filter using pre-processing data of knowledge management. Then in Module B, the processes are integrated into core engine based on MADM mathematical model programmed into the VDSS (Figure 4 so that the data-driven decision reports (Figure 3) can perform its task for processing. Finally, Module C (Figure 4) can automatically arrange the output results into apps for decision makers which can then personalized their preferences (Figure 3).

5 Conclusions

In today's education contexts, users' knowledge and capabilities with technologies are already strong, particularly among decision makers. Furthermore, the interfaces of mobile-based VDSS are becoming more user-friendly. Users' assessments of how a mobile-based VDSS solution fits with decision-makers' work style — the way they want to work – are particularly relevant to be conducted immediately. Data and requirements might shift rapidly, necessitating a high level of adaptability and flexibility in these activities. There is a considerable possibility of inconsistencies between user requirements or demands and the capabilities of the mobile- based VDSS solution. Mobile-based VDSS together with BI&A applications are the potential solutions for education management crisis in post-COVID-19 pandemic. Designs of user interface (UI) for mobile-based VDSS are as following the conceptual modules are useful. Students which are the main customer in higher educational institutions must be managed accordingly in order to avoid educational systems to collapse due to the pandemic and lockdown in many countries in the world. The world needs leaders and they must be trained to undergo hardship and think then visualize creatively from now on.

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