DEVELOPMENT OF NOVEL ECG GAMIFICATION PLATFORM
GAMED-ECG

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Abstract
The electrocardiogram (ECG) is the most commonly used and key diagnostic test in medicine. The 12-lead ECG is used for screening and diagnosis of heart diseases, including many life-threatening conditions. Incorrect ECG interpretation can lead to grave fatal outcome in patient management. Although the integration of computerized ECG interpretation software into modern ECG machines, the sensitivity and specificity of current technology still remain poor, that make need of human medical doctors to perform ECG interpretation accurately. Contemporary data on the diagnostic accuracy of computerized ECG interpretation in determining cardiac rhythm were recently demonstrated to be 88% overall, with 95% correct identification of sinus rhythm, but poor interpretation of non-sinus rhythm at only 53.5%. ECG interpretation is poorly performed among both undergraduate and post-graduate students. Several studies have highlighted insufficiencies in ECG interpretation among medical students and residents from different countries. Polish medical students from 10 medical schools in their clinical years have a good level of competency in interpreting the primary ECG parameters such as heart rate, the origin of heart rhythm, and electrical axis of the heart. However, their ability to recognize ECG signs of life threatening disorders and common heart abnormalities is low. Nigel et al. reported only 52% accuracy in interpreting various ECGs among 52 final-year medical students from New Zealand. According to the review article (Fent et al, 2014), no single teaching strategy is most effective in delivering ECG interpretation skills. Methods described in the literature include tutorials, lectures, teaching rounds and self-directed learning. Web-based packages have risen to prominence in recent years. Currently, there is a lack of data about the best promising method of ECG interpretation teaching.

Clinical educators should look for the new methods to enhance traditional undergraduate medical education. Research team developed a new learning platform that is game based ECG learning platform using principles of gamification to deliver and assess interpretation skills among undergraduate medical students at University Malaysia Sabah (UMS) in 2016–2017. Gamification is stated as ‘the use of game design and mechanic to enhance non-game contexts’. Any application, task, process or context can theoretically be gamified. Gamification’s main goal is to rise the engagement of users by using game-like techniques such as scoreboards and personalized fast feedback (Flatla et al, 2011) making people feel more ownership and purpose when engaging with tasks (Pavlus, 2010). We named our software application as GaMED-ECG. Gamification elements included in GaMED-ECG were (1) voluntary participation; (2) explicit, consistent, software-enforced rules of competition for all participants; (3) immediate feedback (response correct or incorrect, followed by explanation of key concepts); (4) individual participation and (5) participants could increase in rank or level badges and (5) awarding system. The students can play (GaMED) during their free time using mobile apps. The new ECG game apps is strategically designed by researcher collaboration with educationist, information technologists and game specialist in accordance with gamification design theory by Professor Werbach and Dan Hunter six step (“D6”) gamification design framework. ECGs interpretation are verified by two independent physiologists, cardiologists and emergency physicians. For the evaluation of the new ECG learning platform, CIPP evaluation model was used to improve upon the programme itself. CIPP stands for Context, Input, Process, Product.

Keywords: Gamification, ECG, GaMED, gamification platform, CIPP evaluation model.
1 INTRODUCTION

By the year 2020, non-communicable diseases are expected to account for seven out of every ten deaths in the developing regions, compared with less than half today. Deaths from non-communicable diseases, including cardiovascular diseases are expected to climb from 28.1 million a year in 1990 to 49.7 million by 2020, an increase in absolute numbers of 77 per cent. Cardiovascular disease is estimated to be the leading cause of death in the world 2020 [1]. Electrocardiography (ECG) continues to be the most commonly used procedure for the diagnosis of heart diseases. Willem Einthoven (a Dutch physiologist; 1860-1927) made the first ECG recording in 1895. P, Q, R, S, T waves are also first defined by Willem Einthoven in 1895. In 1905, Willem Einthoven recorded ECGs in his laboratory which was located 1.5 km away from the hospital. Willem Einthoven first published his normal and abnormal ECG recordings in 1906. [2]

The ECG is not only the oldest but, in fact, 100 years after its introduction, continues as the most commonly used cardiovascular laboratory procedure. It is noninvasive, simple to record, highly reproducible and can be applied serially. The equipment and the cost of recording are minimal. Furthermore, it is the only practical, noninvasive method of recording the electrical activity of the heart, and, importantly, it is the first laboratory test performed in a patient with chest pain, syncope or pre-syncope, the two major markers of potential cardiovascular catastrophe. Electrocardiography serves as a gold standard for the clinical, noninvasive diagnosis of cardiac arrhythmias [3].

Practicing doctors are expected to have a sufficient knowledge about ECG interpretation to be able to make accurate diagnoses, decide on patient management or further referrals. An adequate knowledge base should include the ability to define, recognize, and understand the basic pathophysiology of certain electrocardiographic abnormalities [4]. Our experience, together with existing research, suggests that most medical students do not feel competent in their interpretation of ECG [5]. Research team developed a new learning platform that is game based ECG learning platform using principles of gamification to deliver and assess interpretation skills among undergraduate medical students at University Malaysia Sabah (UMS). For the evaluation of the new ECG learning platform, CIPP evaluation model was used to improve upon the programme itself. CIPP stands for Context, Input, Process, Product, and these 4 main aspects comprise the CIPP Evaluation Model. The CIPP Evaluation Model was developed by Daniel L. Stufflebeam in 1966, and further updated throughout the years, with the latest update in 2002. [8] The CIPP Evaluation Model is a comprehensive framework for guiding evaluations of programmes, projects, personnel, products, institutions, and systems. The CIPP Evaluation Model may be applied to educational / training programmes, to best determine the merit and worth of the training programme, as well as to determine how to improve upon it. Being an academic model, the CIPP Evaluation Model has at its heart, the institution core values, which should be kept in mind throughout. Faculty of medicine and health sciences, Universiti Malaysia Sabah, was founded with the singular determination to pursue excellence that encompasses all spheres of education including Medicine, to be recognized as a centre of excellence nationally and internationally. To achieve such prestige, medical practitioners graduating from UMS should not only be equipped with the knowledge and skills in advanced technologies in their fields but also be conscious of the ever-changing needs and demands of the communities. Therefore, they must develop skills to acquire ongoing evidence-based medical education that is appropriate for the communities they serve.

2 METHODOLOGY

2.1 Context Evaluation

Context Evaluation, which establishes the goals of the programme. At this stage, the beneficiaries and their needs are also identified, along with potential resources available on hand, and potential problems that will need to be overcome. At this stage, the background of the programme will need to be evaluated, and any social / economic / political / geographical / cultural factors within the immediate environment.

Beneficiaries - medical students of Faculty of medicine and health sciences, Universiti Malaysia Sabah

Needs - to improve the ECG interpretation skills

Resources - Gamefication mobile application App for ECG

Problems - less motivation for ECG learning, difficult to interpret the abnormal rhythms
2.2 Input Evaluation

Encompasses the programme plans/planning. Stakeholders will need to be engaged, and suitable strategies of programme execution identified. Competing or conflicting strategies may also be identified. A budget will need to be allocated and suitably portioned off. To ensure sufficient coverage of the training programme, research may also have to be carried out.

2.3 Process Evaluation

Stage of the CIPP Evaluation Model, the actual actions are evaluated. This can be cyclic, repeated throughout the development stage, or during the implementation/excitation of the training programme. Controls to monitor the progress will have to be in place, as well as a system for feedback from learners and stakeholders, and vice versa.

2.4 Product Evaluation

Stage of the CIPP Evaluation Model measures outcomes. The impact/reach of the training programme, and its effectiveness in fulfilling the objectives. Transportability seeks to determine if the training programme can be transferred, adapted, or used in a different setting. Sustainability is another aspect to be measured, accounting for how durable/long-lasting the benefits were. Adjustments to the training programme may also need to be performed at this stage.

The 4 aspects of the CIPP Evaluation Model respectively ask: What needs to be done (Context)? How should it be done (Input)? Is it being done (Process)? Did it succeed (Product)? The CIPP Evaluation Model provides for both a big picture overview, as well as the component overview, to better evaluate, account for, and improve upon, training programmes.

Table 1. CIPP Evaluation Model.

REFERENCES


