A COMPARATIVE STUDY ON THE EFFECTIVENESS OF ADJUNCT ONLINE LEARNING TOOL BETWEEN CONVENTIONAL AND GAMIFIED E-LEARNING IN ENHANCING ELECTROCARDIOGRAM COMPETENCY AMONG MEDICAL STUDENTS

MAY HONEY OHN

THESIS SUBMITTED FOR FULFILLMENT OF DOCTOR OF PHILOSOPHY

FACULTY OF MEDICINE AND HEALTH SCIENCES

UNIVERSITI MALAYSIA SABAH

2019

UNIVERSITI MALAYSIA SABAH

BORANG PENGESAHAN TESIS

JUDUL: **A COMPARTIVE STUDY ON THE EFFECTIVENESS OF ADJUNCT ONLINE LEARNING TOOL BETWEEN CONVENTIONAL AND GAMIFIFED E-LEARNING IN ENHANCING ELECTROCARDIOGRAM COMPETENCY AMONG MEDICAL STUDENTS**

IJAZAH: **SAINS PERUBATAN (DOKTOR FALSAFAH)**

Saya **MAY HONEY OHN**, sesi **2016-2019**, mengaku membenarkan tesis Sarjana ini disimpan di Perpustakaan Universiti Malaysia Sabah dengan syarat-syarat kegunaan seperti berikut:

1. Tesis ini adalah hak milik Universiti Malaysia Sabah.
2. Perpustakaan Universiti Malaysia Sabah dibenarkan membuat salinan untuk tujuan pengajian sahaja.
3. Perpustakaan dibenarkan membuat salinan tesisi ini sebagai bahan pertukaran antara institusi pengajian tinggi.
4. Sila tandakan (/):

☐	SULIT	(Mengandungi maklumat yang berdarjah keselamatan atau kepengtingan, Malaysia seperti yang termaktub di dalam AKTA RAHSIA 1972)
☐	TERHAD	(Mengandungi maklumat TERHAD yang telah ditentukan oleh organisasi/badan di mana penyelidikan dijalankan)
☑	TIDAK TERHAD	

MAY HONEY OHN
DM 1521001T

Tarikh: 20 MARCH 2019

Disahkan Oleh,

NORAZLYNNE MOHD. JOHAN @ JACKLYNE
Pustakawan
UNIVERSITI MALAYSIA SABAH

(Tanda Tangan Pustakawan)

28/3/2019

Professor Dr Urban John
Arnold D Souza
Pengerusi Jawatan kuasa
Penyeliaan

PROF. DR. JOHN ARNOLD URBAN D'SOUZA
Kedoktoran
Jabatan Sains Bioperubatan & Terapeutiks
Fakulti Perubahan Dan Sains Kesihatan
Universiti Sabah Malaysia

Professor Dr Shahril Bin Yusof
Ahi Jawatankuasa Penyeliaan

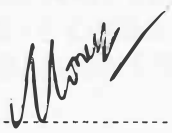
PROF DR ZAINAL ARIFIN MUSTAPHA
Fakulti Perubatan dan Sains Kesihatan
Universiti Malaysia Sabah
No. Pendaftaran MPM: 27180

Professor Dr Zainal Arifin Bin Mustapha
Ahi Jawatankuasa Penyeliaan

Dr Zamhar Iswandono Bin Awang Ismail
Ahi Jawatankuasa Penyeliaan

DECLARATION

I hereby declare that the material in this thesis is my own except for quotations, excerpts, equations, summaries and references, which have been duly acknowledged.



20TH MARCH 2019

MAY HONEY OHN
DM 1521001T

CERTIFICATION

NAME : **MAY HONEY OHN**

MATRIC NO. : **DM 1521001T**

TITLE : **A COMPARATIVE STUDY ON THE EFFECTIVENESS OF ADJUNCT ONLINE LEARNING TOOL BETWEEN CONVENTIONAL AND GAMIFIED E-LEARNING IN ENHANCING ELECTROCARIOGRAM COMPETENCY AMONG MEDICAL STUDENTS**

DEGREE : **DOCTOR OF PHILOSOPHY (MEDICAL SCIENCE)**

TARIKH VIVA : **05/03/2019**

CERTIFIED BY;

Signatures

1. **Chairperson**

Professor Urban John Arnold D Souza

2. **Committee Members**

Professor Dr. Shahril Bin Yusof

Professor Dr. Zainal Arifin Bin Mustapha

Dr. Zamhar Iswandono Bin Awang Ismail

ACKNOWLEDGEMENT

I would like to extend my heartfelt thanks and appreciation to everyone who have helped make this thesis a reality. First and foremost, I must express my very profound gratitude to my father Professor Dr.Khin Maung Ohn @Arif and my mother Dr Khin Sanda Min for providing me with unfailing support and continuous encouragement throughout my years of study and through the process of researching and writing this thesis. I would also like to express my sincere gratitude and deepest appreciation to my supervisors Professor Urban D'Souza, Professor Dr. Shahril Yusof, Professor Dr. Zainal Arifin Bin Mustapha, Dr. Zamhar Iswandono Ismail for their guidance and support towards the completion of this research work. Under their supervision, I was able to undertake my research with a clear vision and an unwavering determination.

I would like to thank Professor Dr. Vincent Pang Ah Fook, educationist, Faculty of education, Universiti Malaysia Sabah and Professor Ayub Sadiq, a medical statistician of University of Brunei Darussalam for guiding me the research design and statistical advice. I would also like to thank the experts who were involved in the validation survey for this research project: Dr Chu Chong Mow (Cardiologist), Professor Dr M.Phanindranath (Cardiologist), Dr.Shaila Kabir (Physician), Dr Nagesh N. Chodankarh (Physician), Dr.Meryl Grace Lansing (Physician), Dr.Fairrul Bin Masnah @ Kadir (Emergency physician), Dr.Faizal Amri bin Hamzah (Emergency physician) and preclinical validation by Professor Dr. Dilip Murthy (Physiologist), Dr. Wan Salman Wan Saudi (Physiologist), Dr Sadia Choudhury Shimmi, Dr.M. Tanveer Hossain Parash. Without their passionate participation and input, the validation survey could not have been successfully conducted.

A word of thanks goes to Mr. Issa Mchucha, Dr Nursakinah Najyah Suhaimi, Dr. Ng Pey Luen and last not the least to all the students from the Faculty of Medicine and Health Sciences at Universiti Malaysia Sabah and International Islamic University Malaysia who had willingly provided their time and energy to participate in this research. I am greatly indebted for without them the research could not have proceeded. To everyone, thank you.

MAY HONEY OHN

20TH MARCH 2019

ABSTRACT

The abstract knowledge of Electrocardiogram (ECG) is tough for medical students to comprehend and requires higher order cognitive skills such as application of knowledge into graphic analysis and evaluation in order to make a correct clinical diagnosis. Several studies have shown that the graduate medical students lack proficiency and confidence in ECG interpretation and in turn, they tend to be dissuaded to learn ECG more. Such negative affect state toward learning has a substantial impact on the learning process, academic performance and success in a particular subject, but has been received relatively little attention in the medical education research. If these affective state cannot be improved, medical students could not only fail to achieve the targeted learning outcome but also it could affect the diagnostic accuracy to correctly interpret ECGs by those graduated medical doctors in the real clinical world. The development of technology has ushered in the use of new teaching and learning strategy such as gamification to enhance learning in medical education. Preclinical and clinical medical training have evolved from the use of traditional approaches in order to infuse the new tools and media into the curriculum that is required to meet the needs of the internet generation. Thus, many medical schools have begun to incorporate technology-enhanced active learning and online blended learning in medical education. However, gamification in the medical field is still new. Therefore, more empirical research is needed to prove the effectiveness of gamified learning in medicine. Furthermore, little is known how game elements impact on motivation, engagement of students and their learning performance. In this study, a quasi-experimental action research was conducted among pre-clinical and clinical year medical students in the Faculty of Medicine and Health Sciences, University Malaysia Sabah between the academic year 2017 and 2018. The study's context was to improve ECG teaching and learning by introducing a new instructional method called online gamified learning. An online gamified learning platform called GaMED ECG@™ was developed by a working team composed of programmers, multimedia designers, guided by a gamification expert, and lead by the researcher as the ECG expert. It was developed using the instructional design ADDIE model. In order to analyze the achievement of the goal of the research, both

quantitative and qualitative research methods were adopted. Independent t-test and Whitney U-test were used to analyze the mean score differences between the two cohort groups among pre-clinical year and clinical year students. The findings suggest that gamified e-learning (GaMED ECG@TM) is as effective as conventional e-learning (Moodle a.k.a. SMART2UMS) to improve ECG knowledge, diagnostic accuracy and interpretation skills among undergraduate medical students. Surprisingly, gamified e-learning enhances the faster interpretation time compared with the conventional e-learning group in both clinical and pre-clinical year students. Interview findings reveal that gamified learning was mostly perceived as enjoyable and interesting learning platform. Structural equation modelling (SEM) was used to examine the causal relationships and test the hypotheses between the observed and latent variables in the proposed research model. In order to test the model of this research, SmartPLS 3.2.7 software was used for the partial least squares analysis of the proposed measurement model and structural model. Findings revealed that learning engagement had the strongest effect on learning achievement followed by learning satisfaction motivation. Therefore, gamified learning environment may be used as a tool to stimulate students' understanding of certain knowledge in ECG interpretation and largely medical education. Winning two Gold medal innovation awards, GaMED ECG@TM showed that it provides interactive self-paced activities structured as gamified e-lessons to enlighten the students with ECG knowledge and skill. Further modification of this gamified learning principle and strategy is recommended to upgrade the platform into a learning management system (LMS) by supporting multiple administrative accounts.

Keywords: gamification, gamified e-learning, Electrocardiogram competency, innovative learning, blended learning.

ABSTRAK

KAJIAN PERBANDINGAN ATAS KEBERKESANAN PEMBELAJARAN TALIAN SAMPINGAN DALAM ANTARA PEMBELAJARAN KONVENSIONAL DAN GAMIFIKASI DALAM MEMPERTINGKATAN KOMPETENSI ELETROKARDIOGRAM ANTARA PELAJAR PERUBATAN

Pengetahuan abstrak Electrokardiogram (EKG) adalah sukar bagi pelajar perubatan untuk memahami. Selain itu, ia memerlukan kemahiran kognitif yang lebih tinggi untuk menerapkan pemahaman yang dicapai dalam analisis grafik dan tafsiran supaya dapat membuat diagnosis klinikal yang betul. Beberapa kajian menunjukkan bahawa pelajar perubatan siswazah tidak mempunyai kecekapan dan keyakinan terhadap interpretasi EKG dan ini telah menyekat semangat untuk belajar pengetahuan EKG dengan selanjutnya. Kesan negatif seperti ini mempunyai kesan yang besar terhadap proses pembelajaran, prestasi akademik dan kejayaan dalam subjek tertentu, tetapi ia hanya mendapat sedikit perhatian dalam penyelidikan pendidikan perubatan. Sekiranya keadaan ini tidak dapat diubahkan, pelajar perubatan bukan sahaja gagal mencapai hasil pembelajaran yang disasarkan tetapi ia juga mengimplikasikan bahawa kelemahan pentafsiran EKG yang tepat oleh mereka yang berkelulusan doktor perubatan di dunia klinikal sebenar. Perkembangan teknologi telah membawa kepada penggunaan strategi pengajaran dan pembelajaran baru seperti gamification untuk meningkatkan pembelajaran dalam pendidikan perubatan. Demi memenuhi keperluan era generasi internet, penggunaan pendekatan alat dan media baru dengan pendekatan traditional dalam kurikulum latihan perubatan pra-klinikal dan klinikal telah berkembang. Oleh itu, banyak sekolah perubatan telah menggabungkan pembelajaran aktif berdasarkan teknologi dan pembelajaran penyelaras dengan talian campuran dalam pendidikan perubatan. Dalam bidang perubatan, gamifikasi masih baru. Oleh itu, lebih banyak kajian empirik diperlukan untuk membuktikan keberkesanan pembelajaran gamifikasi dalam bidang perubatan. Selain itu, pengetahuan bagaimana elemen permainan memberi kesan kepada motivasi, penglibatan pelajar dan prestasi pembelajaran mereka adalah kurang. Dalam kajian ini, penyelidikan berdasarkan kuasi-eksperimen dijalankan dalam kalangan pelajar perubatan pra-klinikal dan klinikal di Fakulti Perubatan dan Sains, Univeristi Malaysia Sabah dalam kalangan pelajar tahun akademik 2017 dan

2018. Matlamat kajian ini adalah untuk meningkatkan kecekapan process pengajaran dan pembelajaran EKG dengan mempekenalkan kaedah pengajaran baru yang dinamakan pembelajaran gamifikasi dalam talian. Platform pembelajaran dalam talian yang dipanggil GaMED ECG @ TM telah dibangunkan oleh pasukan kerja yang terdiri daripada pengaturcara, pereka multimedia, dipandu oleh pakar gamifikasi, dan diketuai oleh penyelidik sebagai pakar ECG. Ia telah dibangunkan dengan menggunakan model ADDIE.Demi menganalisis hasil kajian matlamat penyelidikan, kedua-dua kaedah penyelidikan kuantitatif dan kualitatif telah digunakan. Ujian t bebas dan Whitney U-test digunakan untuk menganalisis perbezaan skor min sebelum dan selepas ujian untuk kedua-dua kumpulan kohort pelajar pra-klinikal dan klinikal. Hasil gajian menunjukkan bahawa gamifikasi e-pembelajaran (GaMED ECG@™) adalah berkesan seperti konvensional e-pembelajaran (Moodle a.k.a. SMART2UMS) untuk mempertingkatan pengetahuan ECG, ketepatan diagnostic dan kemahiran pentaksiran dalam kalangan pelajar perubatan siswazah. Tambahan lagi, gamifikasi e-pembelajaran membantu pelajar pra-klinikal dan klinikal mempercepatakan masa pentaksiran berbanding dengan keadah e-pembelajaran secara konvensional. Hasil gajian menunjukkan GaMED ECG@™ menyeronokkan dan menarik. Pemodelan Persamaan Struktur (SEM) telah digunakan untuk mengkaji hubungan kausal dan menguji hipotesis antara pembolehubah diamati dan laten dalam model penyelidikan yang dicadangkan. Untik menguji model kajian ini, SmartPLS3.7 telah digunakan untuk analisis kudrat paling kurang separa bagi model pengukuran yang dicadangkan dan model struktur. Kajian ini mendapati bahawa penglibatan pembelajaran merupakan kesan terkuat pada pencapaian pembelajaran diikuti dengan motivasi kepuasan belajar

Oleh itu, persekitaran pembelajaran gamifikasi boleh digunakan sebagai alat untuk merangsang pemahaman pelajar tentang pengetahuan tertentu dalam pentafsiran EKG dan terutamanya pendidikan perubatan. Dengan pencapaian memenangi dua anugerah pingat emas inovasi, GaMED ECG@™ dibukitkan merupakan alat pembelajaran interaktif berdasarkan individual pelajar sendiri untuk untuk memberi pencerahan dalam pengetahuan dan kemahiran EKG. Pengubahsuaian lanjut mengenai prinsip dan strategi pembelajaran berdasarkan game adalah disyorkan untuk meningkatkan platform ke dalam sistem pengurusan pembelajaran (learning mangament system) dengan menyokong beberapa akaun pentadbiran.

Kata kunci: gamifikasi, gamifikasi e-pembelajaran, kecekapan Electrokardiogram (EKG), pembelajaran inovatif, pembelajaran peyelaras

TABLE OF CONTENTS

PAGES

LIST OF TABLES

PAGES

LIST OF FIGURES

LIST OF PHOTOS