

THE EFFECT OF COLLABORATIVE MOBILE AUGMENTED REALITY  
APPLICATION ON STUDENT'S LEARNING PERFORMANCE

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THESIS SUBMITTED IN FULFILLMENT OF THE  
REQUIREMENT FOR THE DEGREE DOCTOR OF PHILOSOPHY  
(MULTIMEDIA EDUCATION)

FACULTY OF ART, COMPUTING AND CREATIVE INDUSTRY  
UNIVERSITI PENDIDIKAN SULTAN IDRIS

2017



## ABSTRACT

The objective of this study is to develop and test the effect of a mobile learning application, called Collaborative Mobile Augmented Reality Learning Application (CoMARLA), on student learning achievement and motivation in learning the Information Technology course. The development of CoMARLA is based on a framework guided by Moshman's constructivist learning principles and Keller's motivation principles. This study was based on a quantitative approach using a quasi-experimental method that employed a 2 by 2 factorial research design. The independent variable was the learning method and the dependant variables were students' learning achievement and motivation, with gender as the moderator variable. The sample of the study consisted of 120 social science undergraduates, with a mean age of 19.5 years, who were divided into an experimental and a control group. The experimental group received treatment with the use of CoMARLA on the mobile platform, while the control group received the same treatment with the use of similar application on the desktop platform. The research instruments used were a set of multiple-choice test and Intrinsic Motivation Inventory to measure students' learning achievements and motivation, respectively. A series of tests based on the independence t-test and Analysis of Covariance (ANCOVA) were performed on the data. The findings showed the students' learning achievements and motivation after treatment were significantly higher than they were before treatment. The same findings showed the experimental group's learning achievement and motivation after treatment were significantly higher than those of the control group. In addition, male participants' learning achievement was significantly higher than that of female participants. However, no significant difference in motivation between the two genders was observed. Overall, the findings suggest that such a novel mobile learning application can be used to help improve the learning achievement and motivation of social science undergraduates in learning Information Technology course.





## KESAN PENGGUNAAN APLIKASI ‘*COLLABORATIVE MOBILE AUGMENTED REALITY*’ TERHADAP PENCAPAIAN PEMBELAJARAN PELAJAR

### Abstrak

Objektif kajian ini adalah untuk membina dan menguji kesan penggunaan satu aplikasi pembelajaran yang dinamakan sebagai “Collaborative Mobile Augmented Reality (CoMARLA)” dalam pembelajaran subjek Teknologi Maklumat. Rangka kerja pembangunan CoMARLA adalah berpandukan kepada prinsip-prinsip pembelajaran konstruktivis Moshman dan motivasi Keller. Kajian ini menggunakan pendekatan kuantitatif dengan reka bentuk faktorial 2x2 kuasi-eksperimental ujian pra dan pos. Pembolehubah kajian adalah terdiri daripada pembolehubah bebas iaitu dua mod pembelajaran, pembolehubah bersandar iaitu pencapaian pelajar dan motivasi, dan jantina sebagai pembolehubah moderator. Sampel kajian melibatkan 120 orang pelajar sains sosial dengan purata umur 19.5 tahun yang telah dibahagikan kepada kumpulan eksperimen dan kumpulan kawalan. Kumpulan eksperimen menerima rawatan dengan aplikasi CoMARLA manakala kumpulan kawalan menggunakan kaedah konvensional dalam mempelajari topik Unit Sistem Komputer. Instrumen yang digunakan dalam kajian ini adalah set ujian aneka pilihan dan Inventori Motivasi Intrinsik. Data kajian dianalisis dengan sampel bebas ujian t dan Analisis Kovarians. Dapatan kajian menunjukkan terdapat perbezaan yang signifikan bagi pencapaian dan motivasi bagi pelajar yang mengikuti rawatan dengan aplikasi CoMARLA. Dapatan kajian juga menunjukkan pelajar dalam kumpulan yang menerima rawatan dengan aplikasi CoMARLA adalah signifikan lebih baik berbanding dengan pelajar dalam kumpulan kawalan. Seterusnya, hasil kajian tidak menunjukkan perbezaan yang signifikan bagi aspek motivasi antara kumpulan rawatan dan kumpulan kawalan. Namun begitu, wujud perbezaan yang signifikan bagi aspek motivasi antara jantina bagi kumpulan pelajar yang mengikuti pembelajaran dengan CoMARLA. Implikasi kajian ini dapat dirumuskan bahawa aplikasi CoMARLA berpotensi untuk digunakan secara meluas dalam pembelajaran bidang Teknologi Maklumat.





## CONTENT

	<b>Pages</b>
<b>DECLARATIONS</b>	<b>ii</b>
<b>ACKNOWLEDGEMENT</b>	<b>iii</b>
<b>ABSTRACT</b>	<b>iv</b>
<b>ABSTRAK</b>	<b>v</b>
<b>CONTENT</b>	<b>vi</b>
<b>LIST OF TABLES</b>	<b>xiii</b>
<b>LIST OF FIGURES</b>	<b>xv</b>
<b>LIST OF ABBREVIATIONS</b>	<b>xviii</b>
<b>CHAPTER 1 INTRODUCTION</b>	
1.1 The Background of the Study	1
1.2 Problem Statements	8
1.3 Purpose of Study	10
1.4 Research Objectives	12
1.5 Research Questions	13
1.6 Research Hypotheses	14
1.7 The Significance of the Study	15
1.8 The Scope and Limitations of the Study	16
1.8.1 The Conceptual Framework of the Study	17
1.8.2 The Theoretical Framework of the Study	20



1.9	Operational Definitions	23
1.10	Summary	26
1.11	The Outline of the Dissertation	26

**CHAPTER 2 LITERATURE REVIEW 29**

2.1	Introduction	29
2.2	The Importance of Information and Communications Technology (ICT) in Today’s Economic and Educational Realms	30
2.3	The learning of Information and Communications Technology (ICT) in Malaysian Educational Context	33
2.4	Learning Theories	38
	2.4.1 Behaviourism	38
	2.4.2 Cognitivism	40
	2.4.3 Constructivism	41
	2.4.4 User Acceptance and Use of Technology (UTAUT)	44
2.5	Motivation	46
	2.5.1 The Impact of Motivation on Learning	48
	2.5.2 ARCS Motivation Theory	50
	2.5.3 Self Determination Theory (SDT) Theory	54
	2.5.4 Intrinsic Motivation and Learning	56
	2.5.5 Extrinsic Motivation and Learning	58
	2.5.6 Instructional Strategies to Support Students’ Satisfaction of Autonomy, Competence, and Relatedness	63
	2.5.6.1 Instructional Strategies to Support Students’ Satisfaction of Autonomy	63

2.5.6.2	Instructional Strategies to Support Students' Satisfaction of Relatedness	65
2.5.6.3	Strategies to Support the Students' Satisfaction of Competence	66
2.6	Augmented Reality	67
2.6.1	Definitions and Attributes of Augmented Reality	69
2.6.2	Applications of Augmented Reality	75
2.6.3	Types of Augmented Reality System	77
2.6.3.1	Marker-based Augmented Reality Technology	79
2.6.3.2	Markerless Augmented Reality	80
2.7	Case Studies involving the Use of Mobile Augmented Reality Learning Tools	82
2.7.1	Case Study 1: The Learning of Human Anatomy	82
2.7.2	Case Study 2: The Learning of Mathematics	85
2.7.3	Case Study 3: The Learning of Natural Science	88
2.8	Commentary of the Case Studies	91
2.9	The Educational Benefits of Mobile Augmented Reality	95
2.10	Mapping Mobile Augmented Reality Capabilities with Constructivist Learning Principles	98
2.11	Summary	107
<b>CHAPTER 3</b>	<b>RESEARCH METHODOLOGY</b>	<b>108</b>
3.1	Introduction	108
3.2	Research Methodology	109

3.2.1	Quasi-Experimental Research	111
3.2.2	Internal and External Threats	112
3.3	Sampling	115
3.3.1	Convenience Sampling	115
3.3.2	Stratified Random Sampling	116
3.4	The Research Participants	118
3.5	The Sampling of the Participants	118
3.6	Instructional Tasks and Materials	121
3.7	Research Instruments	122
3.7.1	Research Instrument for Learning Performance	123
3.7.2	Research Instrument for Motivation	124
3.7.3	Research Instrument for User Acceptance	124
3.8	Procedures for Pre-testing, Learning Treatment, and Post-testing	126
3.8.1	Pre-testing	127
3.8.2	Learning Treatment	128
3.8.2.1	Collaborative Protocol in Learning CoMARLA	131
3.8.3	Post-testing	133
3.9	Data Analysis	134
3.9.1	Paired Sample T-test Procedure	134
3.9.2	Analysis of Covariance (ANCOVA) Procedure	135
3.10	Summary	138
<b>CHAPTER 4</b>	<b>THE DEVELOPMENT OF THE COLLABORATIVE MOBILE AUGMENTED LEARNING APPLICATION (CoMARLA)</b>	<b>139</b>

4.1	Introduction	139
4.2	The Background of the Development of Collaborative Mobile Augmented Learning Application (CoMARLA)	140
4.3	Theoretical Considerations in the Development of CoMARLA	142
4.4	The Conceptual Framework of the Development of CoMARLA	148
4.4.1	The Instructional Design of CoMARLA	159
4.5	The Development of Collaborative Mobile Augmented Reality Learning Application (Desktop Computer Version)	160
4.5.1	The Sharing Collaboration Tools of Aurasma on Smart Phones	170
4.6	The Instructional Design of the Computer-assisted Group Based Learning	174
4.7	Learning Activities in Mobile Augmented Reality Learning Application	177

<b>CHAPTER 5</b>	<b>RESEARCH FINDINGS</b>	<b>185</b>
5.1	Introduction	185
5.2	Measurements of Learning Performance and Motivation Before and After Treatment	186
5.3	Measurements Learning Performance and Motivation After Treatment by Learning Method	187
5.4	Measurements Learning Performance and Motivation After Treatment by Gender	189
5.5	Testing of the Assumptions of ANCOVA	191
5.5.1	Testing of Normality	192

5.5.2	Testing of Correlations between Dependent Variables	195
5.5.3	Testing of Homogeneity of Variances	196
5.5.4	Testing of Homogeneity of Covariance	198
5.6	The Testing of the Research Hypotheses	202
5.6.1	The Testing of the First and Second Research Hypotheses	202
5.6.2	The Testing of the Third and Fourth Research Hypotheses	204
5.6.3	The Testing of the Fifth and Sixth Research Hypotheses	205
5.7	User Acceptance of the Mobile Augmented Learning Application	208
5.9	Summary	209

<b>CHAPTER 6</b>	<b>DISCUSSIONS AND CONCLUSION</b>	<b>210</b>
6.1	Introduction	210
6.2	The Impact of Learning Treatments on Undergraduates' Learning performance and Motivation	211
6.3	The Impact of Mobile Augmented Learning Application on Learning Performance of Undergraduates Based on Learning Method and Gender	212
6.4	The Impact of Mobile Augmented Learning Application on Motivation Undergraduates based on Learning Method and Gender	215
6.5	The Undergraduates' User Acceptance of the Mobile Augmented Learning Application	217
6.6	Implications for the Learning and Teaching Practice	220
6.7	Research Contributions	223

6.7.1	Contribution to the Teaching and Learning Practice	224
6.7.2	Contribution to the Application Development Practice	229
6.7.2.1	Design Process Guideline for Collaborative Mobile Augmented Reality Learning Application	229
6.7.2.2	Determining the Level of Learning in a Particular Topic of a Course	230
6.7.2.3	Selecting Appropriate Learning Objects for the Learning of a Particular Learning Topic	231
6.7.2.4	Developing Appropriate Instructional Approach for Learning	232
6.7.2.5	Developing the Appropriate Mobile Learning Environment	234
6.8	Recommendations for Future Research	235
6.9	Conclusion and Discussion	237

**REFERENCES**

**APPENDIX**



## LIST OF TABLES

Table No.		Page
2.6.1.1	Definitions of Augmented Reality (AR)	71
2.6.1.1	continued	72
2.6.1.2	List of Fields and Roles of Augmented Reality Technology	73
2.10.1	The Mapping of Constructivist Learning Principles with the Capabilities of Mobile AR Technology	102
2.10.1	continued	103
2.10.1	continued	104
2.10.1	continued	105
2.10.1	continued	106
3.2.1	The Pretest Posttest Control Group Design of the Study	112
3.5.1	The Number of Participants in the Experimental and Control Groups Based on Gender	121
3.7.3.1	Cronbach's Alpha of the UTAUT Constructs	126
3.8.2.1	The Learning Activities of the Experimental Treatment	130
3.9.1	Statistical Procedures for Testing the Research Hypotheses	137
3.9.1	continued	138
4.4.1.1	The Development Phases of CoMARLA Based on ADDIE Model	159
4.4.1.1	continued	160
5.2.1	Learning Performance and Motivation Before and After Treatment	187



5.3.1	Learning Performance and Motivation After Treatment by Learning Method	188
5.4.1	Learning Performance and Motivation After Treatment by Gender	189
5.5.2.1	Pearson Correlation Matrix for the Dependent and Independent Variables	195
5.5.3.1	Levene's Test for Equality of Variances	198
5.5.4.3	Box's Test of Equality of Covariance	201
5.6.1.1	The Differences Between Learning Performance and Motivation Before and After Learning For All Participants	203
5.6.2.1	Tests of Between-Subjects Effects (Learning Method)	204
5.6.3.1	Tests of Between-Subjects Effects (Motivation)	206
5.6.3.2	Statistical Procedures for Testing the Research Hypotheses	207
5.7.1	The Mean Score of Constructs of User Acceptance of CoMARLA	208

## LIST OF FIGURES

No. Figures		Page
1.8.1	The Conceptual Framework of the Study	19
1.8.2	The Theoretical Framework of the Study	22
2.4.4	Simplified UTAUT Constructs and their Relations (Adapted from Venkatesh et al., 2003)	46
2.6.1.1	The Virtual Reality Continuum	74
2.6.3.1.1	A Visual Marker of an AR Application	79
2.6.3.2.1	A Browser Interface displaying the Markerless AR Contents	81
2.7.1.1	The HuMAR Interface	84
2.7.2.1	Students Performing the Pilot Study with the pARabola Plotting Application	87
2.7.3.1	The Basic Function of the Mobile AR Learning Tool	90
3.3.2.1	The Stratified Random Sampling Procedure	117
3.5.1	Stratified Random Sampling Based on Gender	120
3.8.1	Pre-testing, Treatment, and Post-testing Stages	127
3.8.2.1.1	The Learning Protocol for Collaborative Learning using CoMARLA	132
4.2.1	Three Major Factors to Consider for AR Learning	142
4.3.1	The Exogenous, Endogenous and Dialectical Learning Elements of CoMARLA	147
4.4.1	The Three Architectural Layers of an AR Environment	148

4.4.2	The Conceptual Framework of the Learning Processes Accorded by CoMARLA	153
4.4.3	The Learning Process Performed using CoMARLA	157
4.5.1	The Aurasma's Web Page Depicting Brief Introduction about Sharing Templates and Popular Hashtags	161
4.5.2	Aurasma's Web Portal	162
4.5.3	The Aurasma Studio's Interface for the Development of Contents	163
4.5.4	The Creation of an Augmented Reality Scene Based on the ICT Competency Course	164
4.5.5	Setting up the Trigger	165
4.5.6	Setting up the Overlays	165
4.5.7	The Predefined Overlay Actions	166
4.5.8	Previewing of an Overlay Action Based on a Trigger Image	167
4.5.9	Sharing of and Linking to AR Contents	168
4.5.10	Link to a Designated Material	168
4.5.11	Flagging of Inappropriate Contents	169
4.5.1.1	A Channel Showing the Student Profile	171
4.5.1.2	The Private Auras	172
4.5.1.3	An Array of Collaborative Tools in Aurasma Environment	173
4.6.1	The Logical Flow of the Construction of Multimedia Learning Materials	176
4.7.1	The Interface of Audacity Software for Sound Editing	178
4.7.2	The Process of Removing Vocal from an MP3 song	179
4.7.3	The Predefined Effect of Removing Vocal	179

4.7.4	The Interface of GIMP Software to Edit Images as Trigger Images	180
4.7.5	The 3D Viewing Option in Aurasma	180
4.7.6	The Anchor Points for the Scaling, Rotation, and Translation of an Object	181
4.7.7	The Interface of Movie Maker	182
5.3.1	Learning Performances Based on Learning Method	186
5.3.2	Motivation Based on Learning Method	189
5.4.1	Learning Performances Based on Gender	190
5.4.2	Motivation Based on Gender	191
5.5.1.1	Normal Q-Q Plot of Learning Performance of Participants using CoMARLA on a Mobile Phone	193
5.5.1.2	Normal Q-Q Plot of Learning Performance of Participants using a Similar Application on a Desktop Computer	193
5.5.1.3	Normal Q-Q Plot of Motivation of Participants using CoMARLA on a Mobile Phone	194
5.5.1.4	Normal Q-Q Plot of Motivation of Participants using a Similar Application on a Desktop Computer	194
5.5.3.1	The Boxplot of Learning Performance Based on the Group	197
5.5.3.2	The Boxplot of Motivation Based on the Group	197
5.5.4.1	Scatter Plot of Learning Performances Before and After Learning	199
5.5.4.2	Scatter Plot of Motivation Before and After Learning	200



## LIST OF ABBREVIATIONS

3D	Three Dimensional
ANCOVA	Analysis of Covariance
AR	Augmented Reality
CoMARLA	Collaborative Mobile Augmented Learning Application
ICT	Information and communications technology
MANCOVA	Multiple Analysis of Covariance
MAR	Mobile Augmented Reality
MKO	More Knowledgeable Other
UPSI	Universiti Pendidikan Sultan Idris
UTAUT	User Acceptance and Use of Technology
ZPD	Zone of Proximal Development
GLM	General Linear Model
MSC	Multimedia Super Corridor
MOE	Ministry of Education
MP3	MPEG-1 Audio Layer-3



## LIST OF APPENDIX

### I Final Questionnaire For CoMARLA (Actual Study)

The Consent Form for The Survey Research of CoMARLA

Part A: Students Background Information

Part B: Learning Process of CoMARLA

Part C: Motivation of using CoMARLA-Pre (MSLQ)

Part D: Motivation of using CoMARLA-Post (MSLQ)

Part E: Acceptance of CoMARLA

Suggestions and Comments

Final Questionnaire For Conventional Learning Mode (Actual Study)

The Consent Form for The Survey Research of Conventional III

Learning Modes

Part A: Students Background Information

Part B: Learning Process with Conventional Learning Approach

Part C: Motivation of using Conventional-Pre (MSLQ)

Part D: Motivation of using Conventional-Post (MSLQ)

Part E: User Satisfaction of Conventional Learning Approach

Suggestions and Comments

### II Quiz I and Quiz II



## CHAPTER 1

### INTRODUCTION



#### 1.1 The Background of the Study

At the dawn of the new millennium, the world has been witnessing a myriad of transformations or changes, affecting every sphere of the human's life across the globe. Naturally, these changes have reshaped the educational, political, and social landscapes, exposing humans to new challenges. One thing is for sure, the human's life is now more dependent on Information and Communications Technology (ICT), especially computer technology, which helps nations to move forward with greater



ease and efficiency. Undisputedly, the use of ICT has literally swamped the human's life – in fact, it has become totally indispensable (Thomas & Watters, 2015). For example, design engineers will rely on specialized equipment, notably ICT-based hardware and software, to analyse the mechanical properties and dynamics of components in their designs. Likewise, environmental scientists will use an array of ICT systems to gather and analyse a huge amount of environmental data before making precise predictions or forecasts. More importantly, those involved in teaching, such as lecturers, instructors, and teachers, have become more and more dependent on novel, innovative learning tools and materials (which are invariably based on digital technology) to improve their tasks (Zylka *et al.*, 2015). Given the imperative to stay abreast with this kind of technologies, it is not surprising that many nations have begun putting in every resource available to improve the ICT *Competency* of their populace, as only through such competency can the nations move forward in this challenging time. In some nations, the efforts to educate the masses with an ICT start at the preschool level, such as Greece and China (Liu *et al.*, 2014).

In recognition of the need to educate and equip its general masses with this technology, Malaysia has introduced and implemented a series of initiatives to make Malaysians ICT literates. Among those, the *Multimedia Super Corridor* (MSC) represents the pinnacle of Malaysia's efforts to help produce a vast pool of knowledge workers to spur its economic growth. More importantly, the MSC program was launched to catapult Malaysia to an industrialised nation by 2020, the year that will see Malaysia as a high-income nation. Undisputedly, Malaysia is hard-pressed to achieve this ambitious goal as the number of engineers, scientists, computer experts,



and IT specialists will be extremely huge, thus entailing a concerted effort to produce such a workforce. As it stands now, Malaysia is still short of meeting the required number of ICT professionals as evidenced by the high recruitment of foreign ICT experts, programmers, and analysts, especially from India (Gopinathan & Raman, 2015).

Taking cognizance of such predicament, the Malaysian government, through its Ministry of Education (MOE), has revamped its educational policy by introducing important changes to its primary, secondary, and tertiary educational curricula and academic programs (Hanapi & Nordin, 2014). For example, all primary school pupils will now have to learned the basic of ICT, starting from Year Four to Year Six, totalling three years of learning the subject matter (Barghi *et al.*, 2017). For the



secondary schools, the subject *ICT Literacy* serves an elective subject by which the

secondary school students can learn at the lower secondary level, namely at the Form 2 and Form 3 levels involving 14-year-old and 15-year-old pupils, respectively. In addition, students can also learn *Programming* and *Multimedia Production* subjects at the middle, secondary level, namely at Form 4 and Form 5 consisting of 16-year-old and 17-year-old pupils, respectively (Kassim *et al.*, 2014). At the tertiary level, many Malaysian public universities mandate their “non-technical” and “non-ICT” fresh undergraduates to take of the university compulsory course, notably *ICT Competency* (Arokiasamy *et al.*, 2014). Only when students are equipped with the knowledge and skills in ICT can they learn more efficaciously as today’s learning realm is characterized by the use of digital contents and delivery. Devoid of such ability can render students ineffective or demotivated in their pursuit of academic excellence, be it as the primary or tertiary levels (Hussein & Kabai, 2015).





In carrying out the above reforms, many problems have emerged besetting the smooth transitions from old teaching and learning practices to new ones. Such problems encompass a wide range of technical, logistical, managerial, and financial issues. Such issues have become a focal point in many studies in Malaysia of late. In terms of academic achievement, studies have shown that the secondary school pupils' learning performance in the *ICT Literacy* subject is just average, especially among those from sub-urban and rural communities compared to those living in big cities and affluent neighbourhood (Sua, 2012). Undeniably, the latter represents students who are economically disadvantaged, depriving them the necessary supports to help learn effectively (To, 2016).



Another problem seems to stem from the schools' policy with regard to the prioritization of subjects. Being an elective subject, *ICT Literacy* is deemed less important by many school administrators, which has resulted in less financial and logistical support. As a consequence, the subject matter is being taught in less favourable condition, as typified by poorly maintained computer laboratories and inadequate teaching and learning aids (Thomas & Watters, 2015). Without the necessary redress, the situation has made the teaching and learning process stale, lacking the vitality to make students motivated and engaged in learning the subject matter (Fini *et al.*, 2010). Ultimately, their learning efficacy suffers, with many of the students failing to attain high grades in their assessments. The importance of motivation in learning should never be downplayed as many studies have endow its positive impact on learning efficacy (Yilmaz, 2017). In general, students with high motivation tend to invest in more effort to achieve the learning goals, and they will be





more persistent, and not easily defeated, when face challenging tasks (Bindewald & Atallah, 2017).

Another disturbing trend is that male students tend to outperform their female counterparts in learning the subject matter (Michalak *et al.*, 2017). These finding run parallel with other findings of research focussing on the learning achievements of technical and science-related subjects among secondary school pupils or middle-graders (Markovits & Benenson, 2010). The former's superiority may be attributed to their advanced computing experience, particularly in video games or computer games, thus giving them a comfortable lead (Kinsler, 2013; Tomai *et al.*, 2014). Consequently, boys will also develop a strong inclination to learn any subjects that require extensive use of computers. In all likelihood, male students will also develop strong motivation in learning this subject compared to female students (Hedges & Nowell, 1995).

Currently, in majority of the schools nationwide, the time allocated for the teaching of the subject matter is notoriously paltry. Thus, many teachers are compelled to rush to assure they could complete the school curriculum on time (Alhija, 2016). In such learning scenario, students will be short-changed of quality and meaningful learning experience. Obviously, this is not the fault of teachers, but rather the existing teaching constraints that preclude such learning opportunities (Rodríguez *et al.*, 2016). This type of situation also prevents students to work in the classroom, and they are forced to take home their assignments, but completing such





tasks is quite impossible as many students do not have the right platform to collaborate (Nincarean *et al.*, 2013; Ngang *et al.*, 2014; Stanisavljević-Petrović *et al.*, 2015).

A vast majority of schools in Malaysia is not equipped with the right teaching and learning platform to help students complete their assignments, tasks, or reports. Thus, a new and an affordable learning platform is entailed to provide students the learning space in which learning materials and communication tools can be used for their learning benefits (Ghani *et al.*, 2014). In fact, collaborative learning has become commonplace in many developed nations given its many learning benefits, such as enhanced reasoning, better social interaction, and increased motivation.



Fascination with technology has always been a driving force for people to improve their productivity. Especially in teaching, technology has always been at the forefront in many learning reforms or transformations. Its importance to facilitate and support the teaching and learning process has become more and more critical in today's learning realm as the focus of education nowadays to provide sufficient and meaningful learning opportunities to every student. In this regard, many new learning concepts, such a technology-enhanced learning, computer-mediated learning, web-based learning, e-learning, multimedia learning, and m-learning, among others, have been introduced with some degree of success (Blömeke *et al.*, 2012). In addition, teaching materials and contents take the form of digital multimedia elements (i.e.,





text, graphics, video, audio, and animation) to enrich the learning process (Johnson *et al.*, 2014).

Likewise, interactive and immersive learning environments using innovative technologies, such as virtual reality (VR) and augmented reality (AR), are being used to help students learn complex and abstract learning concepts with ease (Billinghurst *et al.*, 2001; Craig, 2013; Wang *et al.*, 2013). These technologies were once used almost exclusively in the military and research domains, but now they have been made in road in the educational realm. All these accomplishments owe to the continually improving desktop computing technology, engendering effective, and yet, affordable learning solutions to schools and colleges. Studies on the impact of learning applications based on VR and AR have found to be quite efficacious in various disciplines, notably engineering, science, and technology (Cheng & Tsai, 2012; Johnson *et al.*, 2010).

Of late, a variant of AR technology – mobile augmented reality (MAR) technology – is making its presence equally important for training and learning purposes. The appeal of MAR to educators lies in its mobility as learning applications can be accessed using the ubiquitous mobile devices, namely hand phones. Learners can now gain access to learning materials and contents anywhere, anytime on their “palms”. Arguably, the mobility of this technology will transform the way in which learners learn in this new millennium. In developed nations, MAR learning applications are being used in many learning contexts (Chang *et al.*, 2010; Li, 2010;

