MOBILE GAME-BASED LEARNING (mGBL) ENGINEERING MODEL

A thesis submitted to the Dean of Awang Had Salleh Graduate School of Arts and Sciences in full fulfillment of the requirement for the degree of Doctor of Philosophy Universiti Utara Malaysia

by
Syamsul Bahrain Zaibon
2011
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Syamsul Bahrin Zaibon
2011
ABSTRACT

Mobile game-based learning (mGBL) is a game played on any handheld devices such as mobile phones. It is among the most recent growing research areas whereby its main aim is to use game play to enhance motivation in learning, engage in knowledge acquisition, and improve the effectiveness of learning activities through mobile environment. To fully utilize the potential of mGBL, researchers suggest looking at the most important part, which is the development methodology of mGBL. In relation to this, various game development methodologies have been introduced for different types of game genres and platforms. These methodologies propose different numbers of steps and activities; some focusing only on the learning design; some concentrating on the mobile technologies; and others on the complete life cycle. Although many game methodologies have been introduced, studies show that customized phases and steps to develop games for learning in mobile environment are substantially required. Therefore, the study discussed in this thesis addresses this gap by proposing an mGBL Engineering Model based on a number of games and learning theoretical and developmental foundations. In particular, the study identified the key steps of development methodology to be considered in developing mGBL applications which consist of phases, components, steps, and deliverables. In accomplishing this aim, a design science research methodology was adopted, comprising of five phases; (i) awareness of problem, (ii) suggestion, (iii) development, (iv) evaluation, and (v) conclusion. Subsequently, eight mGBL evaluation dimensions were put forward: visibility, complexity, compatibility, flexibility, clarity, effectiveness, manageability, and evolutionary. Model evaluation was conducted in three phases, namely; expert review, prototype development with heuristics evaluation, and experimental study. Generally, the proposed mGBL Engineering Model was well accepted by the experts contacted in this study. The model was also employed by a game company while developing an mGBL prototype. Here, the findings have implied that the model is useful to follow and it provides an easy guideline for fellow developers. In the experimental study phase, four learning or game methodologies; Analysis-Design-Development-Implementation-Evaluation, Input-Process-Output, Game Life Cycle, and mGBL Engineering Model; were studied and compared by 70 respondents. The findings have indicated that the proposed mGBL Engineering Model scored mean above 7.0 (out of 10) of all dimensions compared to the other three models (scored less than 7.0). The ANOVA results show that there are significant differences between all groups in six dimensions except complexity and compatibility. Although complexity and compatibility dimensions are not significantly different, the scores for the mGBL Engineering Model are higher than the other three models. All these results have demonstrated that the proposed mGBL Engineering Model exhibits useful development indicators for mGBL applications and is indeed a theoretical and practical contribution of the study. In addition, the other significant contributions are the eight evaluation dimensions together with the validated instrument. Furthermore, the artefact produced, which is the mGBL prototype is also a functional contribution.
**ABSTRAK**

Permainan pembelajaran mudah alih (mGBL) merupakan permainan yang dimainkan pada peralatan mudah alih seperti telefon mudah alih. Bidang ini antara bidang penyelidikan yang sedang berkembang di mana tujuan utamanya adalah menjadikan corak permainan sebagai jalan untuk meningkatkan motivasi dalam pembelajaran, penglibatan dalam mendapatkan pengetahuan, dan meningkatkan keberkesanan aktiviti pembelajaran melalui persekitaran mudah alih. Untuk mempertingkatkan potensi mGBL, para penyelidik mencadangkan untuk menumpukan aspek yang paling penting iaitu metodologi pembangunan mGBL. Oleh itu, banyak metodologi pembangunan permainan telah diperkenalkan dengan pelbagai jenis permainan dan platform. Metodologi tersebut mencadangkan pelbagai langkah dan aktiviti, antaranya ada yang lebih menekankan reka bentuk pembelajaran, ada pula teknologi mudah alih, dan ada juga kepada kitaran hayat. Walaupun banyak metodologi diperkenalkan, kajian menunjukkan bahawa fasa dan langkah yang boleh disesuaikan dalam pembangunan permainan untuk pembelajaran di persekitaran mudah alih adalah sangat diperlukan.

Oleh itu, kajian yang dibincangkan dalam tesis ini mencadangkan penyelesaian melalui Model Kejuruteraan mGBL yang berpandukan kepada teori dan asas pembangunan permainan dan pembelajaran. Secara khususnya, kajian ini mencari langkah utama dalam metodologi pembangunan mGBL iaitu fasa, komponen, langkah, dan hasilnya. Bagi mencapai tujuan tersebut, metodologi kajian sains reka bentuk digunakan yang mempunyai lima fasa iaitu (i) kenal pasti masalah, (ii) cadangan, (iii) pembangunan, (iv) penilaian, dan (v) kesimpulan. Selain itu, lapan dimensi penilaian mGBL diidentifikasi: keterlihatan, kerumitan, kesesuaian, kelenturan, kejelasan, keberkesanan, pengurusan, dan evolusi. Penilaian model dilakukan dalam tiga cara iaitu: penilaian pakar, pembangunan prototaip dengan pengujian heuristik, dan kajian eksperimen. Umumnya, model yang dicadangkan ini diterima baik oleh pakar-pakar yang terlibat dalam kajian ini. Model ini juga digunakan oleh sebuah syarikat permainan dengan membangunkan prototaip mGBL. Di sini, hasil dapat menunjukkan bahawa model tersebut berguna untuk diikuti dan memberikan garis panduan kepada para pembangun. Dalam fasa kajian eksperimen, empat metodologi permainan atau pembelajaran; Analysis-Design-Development-Implementation-Evaluation, Input-Process-Output, Game Life Cycle dan Model Kejuruteraan mGBL, dikaji dan dibandingkan oleh 70 responden. Hasil dapat menunjukkan bahawa model cadangan mendapat skor min melebihi 7.0 (dari 10) untuk semua dimensi jika dibandingkan dengan tiga model tersebut (skor kurang dari 7.0). Keputusan ANOVA menunjukkan terdapat perbezaan signifikan antara enam dimensi penilaian kecuali kerumitan dan kesesuaian. Walaupun dimensi kerumitan dan kesesuaian tidak berbeza secara signifikan, skor diperolehi model cadangan ini lebih tinggi. Keputusan ini menunjukkan bahawa model cadangan tersebut boleh diaplikasikan dalam pembangunan mGBL yang menjadi sumbangan secara teori dan praktikal dalam kajian ini. Selain itu, sumbangan lain ialah lapan dimensi penilaian melalui instrumen yang telah ditentu sah. Artifak yang dihasilkan, yang merupakan prototaip mGBL juga merupakan satu lagi sumbangan fungsional.
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Alhamdulillah, first and foremost all praise and thanks be to Allah s.w.t for giving me the opportunity to complete this thesis. I would like to express my sincere gratitude to Prof. Dr. Norshuhada Shiratuddin, my supervisor, for her insightful mentoring, advice, and support during this thesis process. Not forgetting the Malaysian government and Universiti Utara Malaysia for sponsoring this study.

I would also like to thank my colleagues and friends at Information Technology and Multimedia programmes, Universiti Utara Malaysia for their encouragement and support throughout this journey.

Special thanks go to Aspati groups, who gracefully agreed to participate as the developer of mGBL following the proposed model.

Finally and most importantly, I deeply thank my loving parents Hj. Zaibon & Hjh. Ainun, parents in law, lovely wife Hidayati, dearly daughter Syafi, and families for all their support and patience in these past several years.
TABLE OF CONTENTS

PERMISSION TO USE ........................................................................................................... ii
DECLARATION ......................................................................................................................... iii
ABSTRACT ............................................................................................................................... iv
ABSTRAK ..................................................................................................................................... v
ACKNOWLEDGEMENT .............................................................................................................. vi
LIST OF FIGURES .................................................................................................................... xiv
LIST OF TABLES ...................................................................................................................... xviii
LIST OF ABBREVIATIONS ......................................................................................................... xx
LIST OF PUBLICATIONS ......................................................................................................... xxi
LIST OF AWARDS AND RECOGNITIONS .............................................................................. xxiii

CHAPTER 1: BACKGROUND OF STUDY ................................................................................. 1
1.1 Introduction ....................................................................................................................... 1
1.2 Research Motivations ....................................................................................................... 1
  1.2.1 Current State of Mobile Phone Subscriptions in Malaysia ........................................ 1
  1.2.2 Government Supports and Initiatives ................................................................. 4
  1.2.3 Advances in Mobile Learning ............................................................................. 5
  1.2.4 Summary of Research Motivations .................................................................... 8
1.3 Preliminary Study .......................................................................................................... 9
  1.3.1 A Survey on Student Preferences for M-learning ........................................... 9
1.4 Problem Statement ....................................................................................................... 14
  1.4.1 Research Gaps .................................................................................................. 17
1.5 Research Objectives ...................................................................................................... 18
1.6 Research Questions ....................................................................................................... 18
1.7 Research Scope and Limitations ................................................................................... 19
1.8 Contributions of the Study ........................................................................................... 19
  1.8.1 mGBL Engineering Model ................................................................................ 19
  1.8.2 A Prototype of mGBL Application ................................................................. 20
CHAPTER 3: METHODOLOGY

3.1 Introduction ......................................................................................................... 106
3.2 Design Research ................................................................................................... 106
3.3 Rationale of Using the Design Research ............................................................... 109
3.4 Phases in Methodology ....................................................................................... 109
3.5 Phase 1: Awareness of Problem ........................................................................... 111
  3.5.1 Literature Review and Content Analysis ....................................................... 111
  3.5.2 Comparative Studies ..................................................................................... 111
  3.5.3 Preliminary Study- a Survey ......................................................................... 113
3.6 Phase 2 & 3: Suggestion and Development ......................................................... 113
  3.6.1 Study on the Flows and Cycles of mGBL Development ............................... 113
  3.6.2 Expert Consultation ..................................................................................... 114
  3.6.3 Combine mGBL Learning Model with the Proposed Model ....................... 115
3.7 Phase 4: Evaluation .............................................................................................. 115
  3.7.1 Pre- Evaluation and Expert Review ............................................................... 118
  3.7.2 Prototype Development and Heuristics Evaluation ....................................... 118
  3.7.3 Pre-Selection Study on the Preferred Models for mGBL Development ....... 119
  3.7.4 Experimental Study ..................................................................................... 119
3.7.5 Instruments Developed for this Study ............................................................ 120
  3.7.5.1 Instrument for Expert Consultation ......................................................... 121
  3.7.5.2 Instrument for Pre-Evaluation Review ..................................................... 121
  3.7.5.3 Instrument for Pre-Selection Study ......................................................... 122
  3.7.5.4 Instrument for Expert Review and Experimental Study ......................... 122
  3.7.5.5 Instrument for Heuristics Evaluation Strategy ......................................... 128
CHAPTER 4: THE PROPOSED MODEL: mGBL ENGINEERING MODEL ............................... 134
4.1 Introduction ........................................................................................................... 134
   4.1.1 The Expert Consultation ................................................................................. 135
4.2 The Proposed mGBL Engineering Model ............................................................. 138
   4.2.1 Pre-Production Phase .................................................................................... 140
   4.2.2 Review and Sign-Off After Pre-Production Phase ...................................... 149
   4.2.3 Production Phase ........................................................................................... 150
   4.2.4 Review After Production Phase ................................................................... 155
   4.2.5 Post-Production Phase ................................................................................... 155
   4.2.6 Flow of Documents and Deliverables .......................................................... 159
4.3 Summary ............................................................................................................... 160

CHAPTER 5: EXPERT REVIEW AND PROTOTYPING OF mGBL ENGINEERING MODEL... 162
5.1 Introduction .......................................................................................................... 162
5.2 Pre-Evaluation Review .......................................................................................... 162
5.3 Expert Review ....................................................................................................... 164
   5.3.1 Methods and Instruments ............................................................................. 164
   5.3.2 Expert Review Findings ................................................................................ 164
5.4 mGBL Prototype Design and Development ........................................................... 166
   5.4.1 Pre-Production Phase .................................................................................... 166
   5.4.2 Review and Sign Off After Pre-Production Phase ........................................ 175
   5.4.3 Production Phase ........................................................................................... 175
   5.4.4 Review After Production Phase ................................................................... 178
   5.4.5 Post-Production Phase ................................................................................... 178
5.5 Screen Shots of 1M’sia mGBL .............................................................................. 180
5.6 Heuristics Evaluation for mGBL ......................................................................... 185
Appendix C: Instrument for Pre-Selection Study ...........................................................243
Appendix D: Instrument for Expert Review and Experimental Study .................................245
Appendix E: Instrument for Heuristics Evaluation (with the findings) ..............................248
Appendix F: List of Experts (Academicians) .....................................................................250
Appendix G: List of Experts (Game Industries) .................................................................251
LIST OF FIGURES

Figure 1.1: Penetration rate of mobile phone subscriptions in Malaysia from 1998 to 2010 (MCMC, 2011) ............................................................................................ 4

Figure 1.2: Research and Theoretical Framework ................................................................................................................................. 24

Figure 1.3: Relationship between design model, development methodology, and engineering model ............................................................................................. 26

Figure 1.4: Thesis structure based on research objectives ................................................................................................................................. 27

Figure 2.1: Experiential learning stages (Kolb, 1984) ................................................................................................................................. 49

Figure 2.2: Learning model of mGBL using the experiential learning theory (Kolb, 1984) ................................................................................................................................. 51

Figure 2.3: mGBL elements mapped with PBL characteristics ................................................................................................................................. 56

Figure 2.4: Appreciative inquiry stages of 4-D model (Cooperrider et al., 2003) ................................................................................................................................. 57

Figure 2.5: AI stages interrelated to mGBL development phases ................................................................................................................................. 59

Figure 2.6: ADDIE model ......................................................................................................................................................................................... 68

Figure 2.7: Dick and Carey Design Model (Dick & Carey, 1996) ................................................................................................................................. 70

Figure 2.8: ARCS model with Gagne’s events of instruction (Keller, 1993) ................................................................................................................................. 71

Figure 2.9: ASSURE model (Heinich & Molenda, 1993) ......................................................................................................................................................................................... 72

Figure 2.10: Morrisonson, Ross and Kemp Model (Morrison, Ross & Kemp, 2004) ................................................................................................................................. 75

Figure 2.11: Phases alignment in Instructional Design model and Game Design ................................................................................................................................. 76

Figure 2.12: Input-Process-Outcome Game Model (Garris et al., 2002) ................................................................................................................................. 78

Figure 2.13: Integrated Experiential Gaming Model (Kiili, 2005) ......................................................................................................................................................................................... 80

Figure 2.14: Integrated Model for Educational Game Design (Paras & Bizzocchi, 2005). ......................................................................................................................................................................................... 81

Figure 2.15: The Fuzzified Instructional Design Development of Game-like Environments (FIDGE) Model (Akilli & Cagiltay, 2006) ......................................................................................................................................................................................... 82

Figure 2.16: Four Dimensional Framework (de Freitas & Oliver, 2006) ................................................................................................................................. 83

Figure 2.17: The Digital Game Involvement Model (Calleja, 2007) ......................................................................................................................................................................................... 87

Figure 2.18: Framework for Designing GBL for Children (Noor Azli et al., 2008) ......................................................................................................................................................................................... 89

Figure 2.19: Proposed components in DGBL Model for History educational games design (Nor Azan et al., 2009) ......................................................................................................................................................................................... 90
Figure 5.3: Menu 1- Humility ................................................................. 170
Figure 5.4: Menu 2- Traditional Costumes ........................................... 171
Figure 5.5: Mix & Match Game of Traditional Costumes ..................... 171
Figure 5.6: Menu 3- Mutual Respect to Others ...................................... 172
Figure 5.7: Menu 4- At School .............................................................. 172
Figure 5.8: Pick & Run Game of School Rules ....................................... 173
Figure 5.9: Menu 5- Acceptance ........................................................... 173
Figure 5.10: Menu 6- Religious Places .................................................. 174
Figure 5.11: Mix & Match Game of Religious Places ......................... 174
Figure 5.12: The aspiration values of 1Malaysia concept ..................... 176
Figure 5.13: Main Character ............................................................... 177
Figure 5.14: Main environment of 1M’sia ............................................. 181
Figure 5.15: Situation and value in 1M’sia ............................................ 182
Figure 5.16: Humility simple quiz ....................................................... 182
Figure 5.17: Traditional costume store ............................................... 183
Figure 5.18: Mix-and-match game ..................................................... 183
Figure 5.19: Correct answer ............................................................... 184
Figure 5.20: School rules game .......................................................... 184
Figure 5.21: Final score ................................................................. 185
Figure 5.22: Visitors playing 1’Msia mGBL ...................................... 187
Figure 5.23: Visitors playing 1’Msia mGBL ...................................... 187
Figure 5.24: Conducting the evaluation ........................................... 187
Figure 5.25: Game usability components ...................................... 189
Figure 5.26: Mobility components ................................................ 189
Figure 5.27: Playability components ................................................. 190
Figure 5.28: Learning content components .................................... 191
Figure 6.1: Comparison of mean scores between four models for eight variables .... 197
Figure 6.2: Scores of Visibility between mGBL and other models .......... 201
Figure 6.3: Scores of Compatibility between mGBL and other models .......... 201
Figure 6.4: Scores of Complexity between mGBL and other models .......... 201
Figure 6.5: Scores of Flexibility between mGBL and other models .........................201
Figure 6.6: Scores of Clarity between mGBL and other models ............................202
Figure 6.7: Scores of Effectiveness between mGBL and other models ...................202
Figure 6.8: Scores of Manageability between mGBL and other models .................202
Figure 6.9: Scores of Evolutionary between mGBL and other models ....................202
Figure 6.10: Maths Mania mGBL ...........................................................................203
Figure 6.11: Hungry Mouse mGBL .......................................................................203
# LIST OF TABLES

Table 1.1: Mobile phone subscriptions in Malaysia (MCMC, 2011) ........................................... 2  
Table 1.2: Example of M-learning Systems .................................................................................. 6  
Table 1.3: Popularity of Game-Based Concepts (based on Sawyer & Smith, 2008) ................ 8  
Table 1.4: Demographic profiles of respondents (ages and races) ........................................ 10  
Table 1.5: Having access to Mobile Phone .............................................................................. 11  
Table 1.6: Play Mobile Games ................................................................................................ 11  
Table 1.7: Purpose for Playing Games (all types of games) .................................................... 12  
Table 1.8: What do you want to learn from game? ................................................................. 12  
Table 1.9: Preferred Device for Learning .................................................................................. 13  
Table 2.1: Characteristics of GBL (Gee, 2005) ........................................................................ 34  
Table 2.2: Elements of engaging in GBL as described by Prensky (2001) ............................. 35  
Table 2.3: Example of mGBL Projects .................................................................................... 37  
Table 2.4: Summary of Learning Theories ............................................................................. 47  
Table 2.5: Learning theories for mGBL characteristics ......................................................... 48  
Table 2.6: Theories of Play (Verenikina, 2003) ....................................................................... 63  
Table 2.7: Comparative Analysis of GBL Design Models ....................................................... 91  
Table 2.8: Examples of Studies Adopting the Reviewed Models ............................................. 93  
Table 2.9: Comparison of steps involve in mobile game development methodologies 102  
Table 2.10: Comparisons of Mobile Game Development Methodologies ............................ 103  
Table 3.1: Design science research guidelines (Hevner et al., 2004) .................................... 108  
Table 3.2: Design evaluation methods and techniques (Hevner et al., 2004) ..................... 116  
Table 3.3: Comparison of evaluation dimensions from 10 studies .................................... 123  
Table 3.4: Construct Descriptions for mGBL Engineering Model ........................................ 124  
Table 3.5: Case Processing Summary .................................................................................... 125  
Table 3.6: Reliability Test ....................................................................................................... 125  
Table 3.7: Factor Analysis and Loadings for Each Item ......................................................... 126  
Table 3.8: Game usability components (Korhonen & Koivisto, 2006) ..................................... 128  
Table 3.9: Mobility components (Korhonen & Koivisto, 2006) ............................................. 129
Table 3.10: Playability components (Korhonen & Koivisto, 2006) ........................................130
Table 3.11: Learning Content (LC) Components ................................................................131
Table 4.1: Activities performed prior to proposing the model ........................................135
Table 4.2: Responses from the experts ........................................................................136
Table 4.3: Activities and phases suggested for mGame development ............................ 137
Table 4.4: Learning theories for mGBL learning content design ....................................... 144
Table 4.5: Multiple Intelligences connect to mGBL learning content ............................ 145
Table 4.6: Gagne’s Nine Events of Instructions associated with mGBL ....................... 146
Table 4.7: PBL characteristics mapped to mGBL ............................................................. 147
Table 5.1: Comments and Suggestions ........................................................................... 163
Table 5.2: Mean scores of the mGBL engineering model ............................................... 164
Table 5.3: 1M’sia mGBL Characteristics ........................................................................... 169
Table 5.4: Demographics profiles ................................................................................... 188
Table 6.1: Demographics profile of respondents ............................................................. 193
Table 6.2: Preferred Rank of the mobile game development methodologies .............. 193
Table 6.3: Preferred Rank of the ID models .................................................................. 194
Table 6.4: Preferred Rank of the GBL models ................................................................. 194
Table 6.5: Experimental and control groups ................................................................. 195
Table 6.6: Means and Standard Deviations for Four Models and Eight Variables ...... 196
Table 6.7: One Way Analyses of Variance for Four Models on Eight Variables ............ 198
Table 6.8: Post Hoc Test- Multiple Comparisons ............................................................ 200
Table 6.9: One Way Analyses of Variance for Four Models on Applicability ............... 204
# LIST OF ABBREVIATIONS

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADDIE</td>
<td>Analysis, Design, Development, Implementation and Evaluation</td>
</tr>
<tr>
<td>AI</td>
<td>Appreciative Inquiry</td>
</tr>
<tr>
<td>ANOVA</td>
<td>Analysis of Variance</td>
</tr>
<tr>
<td>ARCS</td>
<td>Attention, Relevance, Confidence, and Satisfaction</td>
</tr>
<tr>
<td>CBT</td>
<td>Computer Based Training</td>
</tr>
<tr>
<td>CD</td>
<td>Compact Disk</td>
</tr>
<tr>
<td>GBL</td>
<td>Game-Based Learning</td>
</tr>
<tr>
<td>GD</td>
<td>Game Design</td>
</tr>
<tr>
<td>GLC</td>
<td>Game Life Cycle</td>
</tr>
<tr>
<td>GPS</td>
<td>Global Positioning System</td>
</tr>
<tr>
<td>ICT</td>
<td>Information and Communication Technology</td>
</tr>
<tr>
<td>ID</td>
<td>Instructional Design</td>
</tr>
<tr>
<td>IGDA</td>
<td>International Game Developer Association</td>
</tr>
<tr>
<td>IPO</td>
<td>Input-Process-Output</td>
</tr>
<tr>
<td>ITU</td>
<td>International Telecommunication Union</td>
</tr>
<tr>
<td>MCMC</td>
<td>Malaysian Communications and Multimedia Commission</td>
</tr>
<tr>
<td>MMORGP</td>
<td>Multiplayer Online Role-Playing Game</td>
</tr>
<tr>
<td>mGame</td>
<td>Mobile Game</td>
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<tr>
<td>mGBL</td>
<td>Mobile Game-Based Learning</td>
</tr>
<tr>
<td>MMS</td>
<td>Multimedia Messaging Service</td>
</tr>
<tr>
<td>PBL</td>
<td>Problem Based Learning</td>
</tr>
<tr>
<td>PDA</td>
<td>Personal Digital Assistant</td>
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<tr>
<td>SMS</td>
<td>Short Messaging System</td>
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<tr>
<td>UUM</td>
<td>Universiti Utara Malaysia</td>
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<tr>
<td>VCD</td>
<td>Video Compact Disk</td>
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</table>
LIST OF PUBLICATIONS

Journals:

• Norshuhada Shiratuddin & Syamsul Bahrain Zaibon. (2010). Mobile Games Based Learning (mGBL) with Local Content and Appealing Characters, Int. Journal of Mobile Learning and Organization, 4(1), pp. 55-82. USA.


Conference Proceedings:


• Syamsul Bahrain Zaibon & Norshuhada Shiratuddin. (2010). A Comparative Study of Development Methodologies for Mobile Game-Based Learning (mGBL). In Z. Abas et al. (Eds.), Proceedings of Global Learn Asia Pacific 2010. pp. 1853-1861. AACE.

• Syamsul Bahrain Zaibon & Norshuhada Shiratuddin. (2010). Evaluation Constructs of Mobile Game-Based Learning Engineering Model. 5th Social Economic and Information Technology. Universiti Utara Malaysia.


LIST OF AWARDS AND RECOGNITIONS

- Award: **Gold Medal** at the Seoul International Invention Fair 2009 (SIIF2009), Korea.
  - Project Title: *1M'sia Mobile Game*.
  - Project Members: Norshuhada Shiratuddin & Syamsul Bahrain Zaibon.
- Award: **Gold Medal** at the International Exposition of Research and Invention of Institutions of Higher Learning 2009 (PECIPTA2009), Kuala Lumpur.
  - Project Title: *1Malaysia through Local Content*.
  - Project Members: Norshuhada Shiratuddin & Syamsul Bahrain Zaibon.
- Award: **Bronze Medal** at the Malaysian Technology Expo 2009 (MTE2009), Kuala Lumpur.
  - Project Title: *MY Road Traffic Signs mGame*.
  - Project Members: Norshuhada Shiratuddin, Syamsul Bahrain Zaibon & Ayman Srour.

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  - Authors: Norshuhada Shiratuddin & Syamsul Bahrain Zaibon.
CHAPTER 1

Background of Study

1.1 Introduction

This introductory chapter deliberates on the motivation aspects of the study; the advances of mobile learning (m-learning), the statement of the problem; objectives and significances of the study; and lastly, definition of the terms that are used throughout the study.

1.2 Research Motivations

A few aspects have been brought towards the proposed title of this study. Therefore, this section summarizes some aspects which motivate the study to be conducted.

1.2.1 Current State of Mobile Phone Subscriptions in Malaysia

The ownership of mobile phone is exponentially increasing all around the world. The International Telecommunication Union (ITU) Telecommunication/ Information Technology and Communication (ICT) Indicators Report (ITU, 2008) found indication that ICTs, broadband, and mobile phone uptake advance growth and development in Asia Pacific region. This is due to the fact that mobile technology is naturally portable, flexible to anywhere, possible to connect users to variety of information sources and enable communication everywhere (Smith et al., 1999; Naismith et al.,
The contents of the thesis is for internal user only
REFERENCES


218


228


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230


231


232


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235


