

**DEVELOPMENT AND EVALUATION OF AN ENGAGING
WEB-BASED CONTENT SEQUENCING SYSTEM FOR
LEARNING BASIC PROGRAMMING**

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Abstrak

Asas pengaturcaraan Java adalah salah satu bahasa pengaturcaraan yang akan ditawarkan kepada pelajar sebagai mata pelajaran wajib bagi yang mengambil jurusan teknologi maklumat atau sains komputer. Subjek ini memerlukan pelajar mendalami kemahiran dan teknik pengaturcaraan, berbanding teori konsep. Kebiasaannya, pelajar menghadapi masalah untuk menguasai dan memahami kandungan kursus yang menyebabkan prestasi kurang memuaskan atau penarikan diri daripada program pengajian dan juga sistem pendidikan. Secara umumnya, pembelajaran berasaskan web digunakan sebagai alat untuk meningkatkan pembelajaran termasuk kursus-kursus pengaturcaraan. Satu contoh khusus berkaitan pembelajaran berasaskan web; dipanggil sistem kandungan berurutan yang mempunyai potensi yang tinggi untuk menyediakan pembelajaran adaptif untuk bahasa-bahasa pengaturcaraan. Sistem adaptif kandungan berurutan menganalisis pelajar secara individu, dan urutan kandungan pembelajaran berdasarkan keperluan pelajar. Dengan menangani masalah berbeza mengikut pelajar secara individu, ia membantu pelajar untuk terlibat aktif dalam proses pembelajaran. Penglibatan adalah kunci utama dalam pembelajaran. Dalam kajian ini, tahap penglibatan pelajar diukur menggunakan “teori aliran”. Teori ini mencadangkan tiga keadaan kognitif apabila seseorang itu melakukan aktiviti tertentu, iaitu aliran (penglibatan), kebosanan, dan kekhuatiran. Penglibatan berlaku apabila seseorang individu itu mempunyai tahap kemahiran yang sama dengan tahap cabaran yang diberikan. Kekhuatiran dan kebosanan berlaku apabila terdapat ketidakseimbangan antara tahap cabaran dan kemahiran. Konsep-konsep asas teori diwakili melalui reka bentuk antara muka pengguna melalui penyesuaian komponen yang dikenali sebagai “butang aliran”. Penggunaan butang ini disifatkan sebagai teknik Imbangan Kemahiran-Cabaran (SCB) dan ia disesuaikan dalam sistem pembelajaran berasaskan web yang dikenali sebagai “LearnJava”. Ia menggabungkan teknik SCB di mana komponen utamanya adalah rekaan antara muka pengguna dan enjin berjujukan. Berdasarkan teknik ini, tahap pengetahuan pelajar akan dinilai dan dianalisis untuk mengenal pasti tahap semasa kemahiran mereka. Teknik ini akan mengatur kandungan pembelajaran berdasarkan tahap kemahiran semasa pelajar untuk memastikan penglibatan mereka dalam pembelajaran berasaskan web. Satu uji kaji telah dijalankan untuk menilai bagaimana keberkesanan SCB dalam membantu pelajar melibatkan diri dalam pembelajaran berasaskan web. Keputusan menunjukkan teknik SCB meningkatkan penglibatan pelajar dalam pembelajaran berasaskan web.

Kata Kunci: Sistem kandungan berurutan, Pembelajaran berasaskan web, Pembelajaran adaptif, Perbezaan secara individu, Teori Aliran, Penglibatan, Tiada penglibatan, Kemahiran menyeimbangkan cabaran.

Abstract

Java basic programming is one of programming languages that is offered to students as a compulsory course for Information Technology or Computer Science programs. This subject requires students to learn skills and techniques of programming rather than theoretical concepts. Usually, students have problems to capture and understand the content of the course which resulted in low performance or withdrawal from the program and even the education system. In general, web-based learning can be used as a tool to improve learning including programming courses. A specific instance of web-based learning; called content sequencing systems have a high potential to provide adaptive learning for programming languages. Adaptive content sequencing systems analyze individual difference of students and sequence the learning contents based on the students' needs. By addressing students' individual differences, it helps students to be actively engaged in the learning process. An engagement is a key element in learning. In this research, the level of students' engagement is measured using "flow theory". This theory suggested three cognitive conditions when one is doing a particular activity, namely flow (engaged), boredom, and anxiety. Engagement occurs when an individual has an equal level of skill with the given level of challenge. Anxiety and boredom occur when there is unequal level of challenge and skill. The fundamental concepts of the theory are represented in a user interface design by imposing a component known as "flow buttons". The used of the buttons is described as Skill-Challenge Balancing (SCB) technique and it is adapted in a web-based learning system called "LearnJava". It incorporates SCB where its main components are a user interface design and a sequencing engine. Based on this technique, the students' level of knowledge will be evaluated and analyzed to identify their current level of skill. The technique will sequence the learning contents based on the students' current level of skill to keep them engage in the web-based learning. An experimental study was conducted to evaluate how effective SCB in helping students to engage in web-based learning. The results suggested that the SCB technique improved students' engagement in web-based learning.

Keywords : Content sequencing system, Web-based learning, Adaptive learning, Individual difference, Flow theory, Engagement, Disengagement, Skill-challenge balancing.

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Table of Contents

Permission of Use.....	ii
Abstrak.....	iii
Abstract.....	iv
Acknowledgement.....	v
Table of Contents.....	vi
List of Tables.....	ix
List of Figures.....	x
List of Appendices.....	xi
List of Abbreviations.....	xii
CHAPTER ONE : INTRODUCTION	1
1.1 Overview of Chapter 1	1
1.2 Introduction of the Research	1
1.3 Problem Statement	3
1.4 Research Questions	6
1.5 Research Objectives	6
1.6 Scopes of the Research	6
1.7 Significance of the Research	7
1.8 The Research Organization	7
1.9 Summary of Chapter 1	8
CHAPTER TWO : LITERATURE REVIEW	9
2.1 Overview of Chapter 2	9
2.2 Java Basic Programming	9
2.3 Web-based Learning (WBL)	12
2.4 Adaptive Learning	15
2.5 Web-based Content Sequencing (WBCS) Method in Learning Materials	18
2.6 Student Engagement with Flow Theory Concept	22
2.7 Skill-Challenge Balancing (SCB) Technique	24

2.8	Previous Research on Techniques to Achieve the Maximum Level of Student Engagement in Learning	25
2.9	Summary of Chapter 2	27
CHAPTER THREE : METHODOLOGY		28
3.1	Overview of Chapter 3	28
3.2	An Overview to LearnJava: An Adaptive Web-Based Learning (WBL) System ..	28
3.2.1.	Flow Theory to Achieve Students' Engagement in WBCS	29
3.2.2.	Implementation of SCB in LearnJava	32
3.3	Research Framework	33
3.3.1.	Phase I : Literature Review	34
3.3.2.	Phase II : System Analysis and Design	35
3.3.2.1.	Requirements Gathering	35
3.3.2.2.	System Analysis and Development	56
3.3.2.2.1.	The Architecture and Components of LearnJava ...	57
3.3.2.2.2.	LearnJava: User and WBCS Interactions	62
3.3.2.2.3.	The Implantation of SCB in LearnJava	63
3.3.2.2.4.	Transforming the Design into Rules	66
3.3.2.2.5.	LearnJava Development and Deployment	67
3.3.2.2.6.	LearnJava Programming Code	69
3.3.2.3.	Usability Test	70
3.3.2.3.1.	Methods	70
3.3.2.3.2.	Participants	70
3.3.2.3.3.	Instruments	71
3.3.2.3.4.	Procedure	71
3.3.2.3.5.	Result	72
3.3.3.	Phase III : Evaluation	72
3.3.3.1.	Evaluation of Student Engagement	72
3.3.3.1.1.	The Experiment	75
3.3.3.2.	Validation	80
3.4	Summary of Chapter 3	81

CHAPTER FOUR : RESULTS AND FINDING	82
4.1 Overview of Chapter 4	82
4.2 Pre-processing Data	82
4.3 Student Demographic Data	82
4.4 Learning Experience and Engagement	85
4.5 SCB Button Usage	89
4.6 Non-SCB Notes Usage	90
4.7 Summary of Chapter 4	91
CHAPTER FIVE : CONCLUSION AND RECOMMENDATION	92
5.1 Overview of Chapter 5	92
5.2 Review of the Research Objectives	92
5.3 Summary of the Thesis	95
5.4 Implications of the Project	96
5.5 Limitations of the Findings	97
5.6 Recommendation for Future Work	98
REFERENCES	99

List of Tables

Table 3.1	List of Functional Requirements for LearnJava (Sign Up)	36
Table 3.2	List of Functional Requirements for LearnJava (Login)	37
Table 3.3	List of Functional Requirements for LearnJava (Forgot Password)	37
Table 3.4	List of Functional Requirements for LearnJava (Test)	38
Table 3.5	List of Functional Requirements for LearnJava (Notes)	39
Table 3.6	List of Functional Requirements for LearnJava (Result)	39
Table 3.7	List of Functional Requirements for LearnJava (Participants)	39
Table 3.8	List of Functional Requirements for LearnJava (Change Password)	40
Table 3.9	List of Functional Requirements for LearnJava (Logout)	40
Table 3.10	List of Non-Functional Requirements for LearnJava	41
Table 3.11	Use Case Description of LearnJava for Sign Up	43
Table 3.12	Use Case Description of LearnJava for Login	44
Table 3.13	Use Case Description of LearnJava for Forgot Password	45
Table 3.14	Use Case Description of LearnJava for Test	46
Table 3.15	Use Case Description of LearnJava for Notes	48
Table 3.16	Use Case Description of LearnJava for Result	49
Table 3.17	Use Case Description of LearnJava for Participants	50
Table 3.18	Use Case Description of LearnJava for Change Password	51
Table 3.19	Use Case Description of LearnJava for Logout	52
Table 3.20	Tool Used	56
Table 3.21	Progressive Learning Experience Information	77
Table 3.22	Learning Experience Questionnaire Information	78
Table 4.1	Student Demographic Information	83
Table 4.2	The means and mean ranks for SCB-non-SCB	86
Table 4.3	The means for SCB - non-SCB (Progressive Learning Experience by stages)	87
Table 4.4	The means and mean ranks for the learning experience in the three stages	88

List of Figures

Figure 1.1	The organization of the research	8
Figure 3.1	Changes of mental states based on flow theory concept	30
Figure 3.2	The overall research activities	33
Figure 3.3	The keywords of this study	34
Figure 3.4	Requirements for LearnJava system	42
Figure 3.5	Activity Diagram for Login, Sign Up, and Forgot Password	53
Figure 3.6	Activity Diagram for Change Password, Participants, and Logout	54
Figure 3.7	Activity Diagram for Test, Notes, and Result	55
Figure 3.8	The “anxiety” button and “boredom” button	58
Figure 3.9	The process of SCB technique	59
Figure 3.10	The flow of process in LearnJava with SCB	61
Figure 3.11	The architecture of LearnJava	62
Figure 3.12	The learning process using LearnJava	65
Figure 3.13	The rules and algorithm for LearnJava	66
Figure 3.14	Example of screenshot for “anxiety” button	68
Figure 3.15	Example of screenshot for “boredom” button	68
Figure 3.16	Examples of code snippets in LearnJava system	69
Figure 3.17	The procedure for conducting the experiment	74
Figure 3.18	The interface for both LearnJava systems	76
Figure 4.1	Progressive Learning Experience ratings for three stages	89
Figure 4.2	Types of SCB button usage	90
Figure 4.3	The notes usage during non-SCB learning process	91

List of Appendices

Appendix A	Materials for the Usability Evaluation	103
Appendix B	Materials for Experiment	107
Appendix C	Learning Contents in LearnJava	116
Appendix D	LearnJava Algorithm and Rules	136
Appendix E	LearnJava Screenshots	140
Appendix F	Raw Data	145

LIST OF ABBREVIATIONS

BIT (Hons)	Bachelor of Science with Honors (Information Technology)
CTT	Classical Test Theory
GUI	Graphical User Interface
KS	Kolmogorov Smirnov
IRT	Item Response Theory
IT	Information Technology
Msc (IT)	Master of Science (Information Technology)
PAT	Programming Adaptive Testing
PHP	Hypertext Preprocessor
SCB	Skill Challenge Balancing
SOC	School of Computing
SPSS	Statistical Package for Social Science
TBL	Team Based Learning
UUM	Universiti Utara Malaysia
WBCS	Web-based Content Sequencing
WBL	Web-based Learning

CHAPTER ONE

INTRODUCTION

1.1 Overview of Chapter 1

Chapter 1 describes the background of the study which includes problem statement, research questions, research objectives, scope of the research, the significance of the research and a summary of each chapter.

1.2 Introduction of the Research

Research on adaptive web-based learning (WBL) has been conducted since more than a decade ago. Adaptive WBL is a learning technology that enables students to learn independently adapting to their needs. This technology aims to provide an independent learning opportunity for students through modification of activities, methods, tools, and the learning environment. It helps them to involve in a learning process that is more effective than traditional e-learning systems.

In general, students are individually different in terms of their prior knowledge, motivation, personality, and preferences (Roberts, 2010). For that reason, students need a WBL system that acts differently and adapt to their individual differences. This is because WBL can provide students the opportunity to learn in a variety of techniques and styles. This can ensure that learning content can be delivered more effectively to each student. Adaptive learning is a learning technique that uses computers as an important medium in the learning process. It considers and manipulates students learning

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