

UNIVERSITI TEKNOLOGI MARA

**A CONCEPTUAL MODEL OF AN
INTERACTIVE TECHNOLOGY
ENHANCED LEARNING (TEL)
WITH GAMIFICATION AND
MULTIMEDIA FOR LOW
ACHIEVERS IN INTRODUCTORY
PROGRAMMING**

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ABSTRACT

This study investigates how gamification and multimedia design principles can be combined within a technology-enhanced learning (TEL) environment to better support low-achieving students in introductory programming courses. Although both elements have been individually explored in past research, limited work has integrated them into a cohesive, interactive model specifically tailored for low achievers in introductory programming. To address this gap, the study pursued three main objectives: (a) to determine the components and elements of a conceptual model for an interactive TEL with gamification and multimedia for low achievers in introductory programming; (b) to construct the conceptual model; and (c) to validate the conceptual model through expert review, demonstration of the model, and an experimental study evaluating its effects on cognitive skills performance, perceived motivation, and perceived usability. Following the Design Science Research (DSR) approach, the research progressed through the stages of awareness of the problem, suggestion, development, evaluation, and conclusion. A comprehensive literature review, preliminary investigations, and consultations with stakeholders contributed to the construction of a conceptual model named iGaMedPro. The model comprises four main components: general design, multimedia design, gamification design, and assessment design, all grounded in established learning theories and instructional design frameworks. Refinement was achieved through Focus Group Discussions (FGD) and expert evaluations and validations. Prototypes were developed guided by the Successive Approximation Model Version 2 (SAM2), resulting in two versions: (i) EPLA-iGaMedPro, featuring the integrated model, and (ii) EPLA-0, without the model integration. An experimental study involving sixty-two first-year Diploma in Computer Science students identified as low achievers demonstrated that the EPLA-iGaMedPro platform significantly outperformed the control group in terms of cognitive skills development, motivation, and usability. Overall, the validated iGaMedPro model and its implementation in the EPLA-iGaMedPro platform offer practical insights for educators, researchers, and instructional designers aiming to enhance programming education through technology-enhanced, interactive learning environments. The findings affirm the practical benefits of integrating gamification and multimedia elements in TEL settings to improve engagement, learning outcomes, and support for low-achieving programming students.

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TABLE OF CONTENTS

	Page
CONFIRMATION BY PANEL OF EXAMINERS	ii
AUTHOR’S DECLARATION	iii
ABSTRACT	iv
ACKNOWLEDGEMENT	v
TABLE OF CONTENTS	vi
LIST OF TABLES	xii
LIST OF FIGURES	xx
LIST OF ABBREVIATIONS	xxvi
 CHAPTER 1 INTRODUCTION	 1
1.1 Research Background	1
1.2 Motivation for This Work	4
1.2.1 The Conceptual Model of Technology-enhanced Learning, Gamification and Multimedia Learning	4
1.2.2 TEL Tools for Low Achievers in Introductory Programming	6
1.3 Problem Statement	8
1.4 Research Questions	9
1.5 Research Objectives	10
1.6 Hypotheses of the Study	10
1.7 Scope of Study	11
1.8 Significance of the Study	12
1.8.1 The Conceptual Model of an Interactive TEL with Gamification and Multimedia for Low Achievers in Introductory Programming	13
1.8.2 The Prototype of the Interactive TEL with Gamification and Multimedia for Low Achievers in Introductory Programming	13
1.8.3 The Evaluation Instruments	14
1.9 Ethical Committee	14
1.10 Theoretical and Research Framework	14
1.11 Operational Definitions	16

CHAPTER 1

INTRODUCTION

1.1 Research Background

In Malaysia's educational landscape, under Shift 9 of the Malaysian Education Blueprint 2015-2025 for Higher Education, the government has emphasised incorporating blended-learning models where face-to-face classroom instruction can be combined with computer-mediated learning to encourage a globalise online learning for higher education (Ministry of Education, 2015). The waves of Industrial Revolution 4.0 (IR 4.0) have also positively impacted education, leading to Education 5.0. The use of different fusions of technologies such as robotics, Augmented Reality (AR), the Internet of Things (IoT), and many others have shifted the landscape of the traditional classroom into a more blended learning environment (Bhagat et al., 2025). Thus, by embracing Education 5.0, integrating educational technology into the process of teaching and learning should be the focus of MOE as the latest approach to digitise learning in higher education to keep up with Malaysian students in the competitive workforce industry due to the IR 4.0 (Bhagat et al., 2025).

To embrace the Malaysian government's initiative for globalised online learning in higher education and reduce students' attrition, teaching and learning computer programming must also utilise the technologies to increase students' interactivity and interest in this subject. In Computer Science studies, one of the compulsory subjects that the students need to take during their first semester is the algorithm and introductory programming subject (Othman et al., 2019; Mehmood et al., 2020). It is widely known that high failure and dropout rates in introductory programming courses have been issues for many higher academic institutions worldwide (Margulieux et al., 2020; Elegbeleye & Isong, 2025). Previous studies have investigated the issues in teaching and learning introductory programming courses in higher education to further understand the causes of high failure and dropout rates. Among the issues identified is the lack of problem-solving and cognitive skills such as logical thinking (Margulieux et al., 2020; Kim et al., 2025). The lack of cognitive skills will eventually lead to students failing to grasp fundamental programming concepts, as Othman et al. (2019) and Chan et al. (2019) mention.