EXPLORING DIGITAL GAME-BASED LEARNING PRACTICES IN DIFFERENT LEARNING STRATEGIES AND ENVIRONMENTS AMONG TEACHERS

By

ARYANTI BINTI AMRAN

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfilment of the Requirements for the Degree of Master of Science

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DEDICATION

I dedicate this thesis to:
My beloved husband, Along, Kakngah and Adik

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Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Master of Science

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July 2022

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Industrial Revolution 4.0 (IR 4.0) dimensions are seen benefiting not only in the economic sector but also has gained significant attention in the development of education. This has led Malaysia to Education 4.0, in which the new Digital Malaysia policy is designed to prepare the younger generation to meet 21st-century demands. In line with the development and milestone of Education 4.0, Digital Game-based Learning (DGBL) has been recognized as an approach for new learning by playing game. However, this effort is still at an initial stage in the Malaysian context, and the need for research and development of Game-based Learning that suits Malaysian educational settings is crucial. Therefore, this research aims to comprehensively understand DGBL practises in different learning strategies and how DGBL can be an excellent approach in a more formal educational environment. Three main questions have been set in this research to be investigated, and they are: 1) How does teacher utilise DGBL? 2) How does learning takes place in DGBL? 3) What aspects of the game contribute to teachers' implementation of the DGBL?

Based on studies carried out in past research on emerging technology for learning, it was found that DGBL has gained much attention as an approach to learning that needs a deeper study. Theories underpinning this research are experiential learning theories by David Kolb and Zone of Proximal Development (ZPD) by Vygotsky. All these theories were immersed in the model of Game-based Learning introduced by Garris (2002).

This study employs snowball sampling techniques which the number is growing through the recommendation of the participant to others who share the same interest and practises in DGBL in a specific community group or event. Participants have similar criteria - teachers that use DGBL actively in the classroom. The numbers of informants shall depend on teacher's suggestion of the one with the same criteria, starting by the first

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person and evolving until the data saturated. This qualitative research is employing a case study design and the technique of data collection was semi-structured interviews. The data were analyzed using Atlas.ti 9 software to obtain codes, categories and subthemes and subsequently established the main theme to answer each research question. The audit trail methods and colleagues' examinations are used to obtain validity and reliability.

The Research Questions (RQs) were set to represent different focuses in teaching and learning of using game – *Teaching, Learning* and *Technology* (*Game*). RQ1 represents the perspective of teachers which covers for the context of *Teaching*. In this context there are four themes emerged from the RQ1. RQ2 represents the perspective of students which covers of the context of *Learning* where there are six main themes that emerged from the analysis. RQ3 represents the perspective of technology which covers of the context of *Game*. In this context, as many as five themes were formed. All the three contexts (*Teaching, Learning* and *Game*) are connected to each other to promote the best learning strategies, teaching strategies and better learning environment in improving current practises through implementation of new approach of DGBL integration. In the situation like during pandemic, requires students to learn remotely which this method can serve as an alternative method of learning and attracting students to learn in a fun way through DGBL, individually or collaboratively.

It is hoped that this study will guide the teachers, policy maker as well as Ministry of Education in identifying the best practises in implementing DGBL in the curriculum, formally and to understand how DGBL can promote highly skilled students, especially in collaborative, creative and innovative environment in the face of the IR4.0 era.

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Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains

MENEROKA AMALAN PEMBELAJARAN BERASASKAN PERMAINAN DIGITAL DALAM STRATEGI DAN PERSEKITARAN PEMBELAJARAN YANG BERBEZA DALAM KALANGAN GURU

Oleh

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Dimensi Revolusi Industri 4.0 (IR 4.0) dilihat memberi manfaat bukan sahaja dalam sektor ekonomi tetapi juga telah mendapat perhatian yang semakin besar dalam pembangunan pendidikan. Ianya telah membawa Malaysia ke Pendidikan 4.0, di mana dasar Digital Malaysia baru direka untuk mempersiapkan generasi muda bagi memenuhi keperluan abad ke-21. Selaras dengan perkembangan dan pencapaian Pendidikan 4.0, Pembelajaran Berasaskan Permainan Digital (DGBL) merupakan pendekatan pembelajaran yang semakin mendapat perhatian. Walau bagaimanapun, dalam konteks Malaysia usaha ini masih di peringkat awal, dan keperluan untuk penyelidikan dan pembangunan Pembelajaran Berasaskan Permainan yang sesuai dengan persekitaran pendidikan Malaysia adalah penting. Oleh itu, penyelidikan ini bertujuan untuk memahami secara komprehensif amalan DGBL dalam strategi pembelajaran yang berbeza dan memahami bagaimana DGBL dapat menjadi pendekatan yang sangat baik dalam persekitaran pendidikan yang lebih formal. Tiga soalan utama telah ditetapkan dalam penyelidikan ini untuk dikaji, iaitu: 1) Bagaimanakah guru menggunakan DGBL? 2) Bagaimanakah pembelajaran berlaku di DGBL? 3) Apakah aspek permainan yang menyumbang kepada pelaksanaan DGBL dikalangan guru?

Berdasarkan kajian mengenai teknologi untuk pembelajaran yang telah dijalankan dalam penyelidikan, didapati bahawa DGBL telah mendapat banyak perhatian sebagai pendekatan dalam pengajaran dan pembelajaran yang memerlukan kajian yang lebih mendalam. Teori yang menyokong penyelidikan ini adalah teori pembelajaran pengalaman oleh David Kolb dan Zon Pembangunan Proksimal (ZPD) oleh Vygotsky. Semua teori ini digarap dalam model Pembelajaran Berasaskan Permainan yang diperkenalkan oleh Garris (2002).

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Kajian ini menggunakan teknik persampelan bola salji yang jumlahnya semakin meningkat melalui cadangan peserta kepada orang lain yang berkongsi minat dan amalan yang sama dalam pengimplimentasian DGBL di dalam kumpulan atau acara komuniti tertentu. Peserta mempunyai kriteria yang sama - guru yang menggunakan DGBL secara aktif di dalam bilik darjah. Bilangan informan adalah bergantung kepada cadangan guru yang mempunyai kriteria yang sama, bermula daripada orang pertama dan berkembang sehingga data tepu. Penyelidikan kualitatif ini menggunakan reka bentuk kajian kes dan teknik pengumpulan data adalah wawancara separa berstruktur. Data tersebut dianalisis menggunakan perisian Atlas.ti 9 untuk mendapatkan kod, kategori dan subtema dan seterusnya menetapkan tema utama untuk menjawab setiap persoalan kajian. Kaedah jejak audit dan peperiksaan rakan sekerja digunakan untuk mendapatkan kesahihan dan kebolehpercayaan.

Persoalan Kajian (RQ) ditetapkan untuk mewakili fokus yang berbeza dalam pengajaran dan pembelajaran menggunakan permainan - *Pengajaran*, *Pembelajaran* dan *Teknologi* (*Permainan*). RQ1 mewakili perspektif guru yang merangkumi konteks *Pengajaran*. Dalam konteks ini terdapat empat tema yang muncul dari RQ1. RQ2 mewakili perspektif pelajar yang merangkumi konteks *Pembelajaran* di mana terdapat enam tema utama yang muncul daripada analisis. RQ3 mewakili perspektif teknologi yang mewakili konteks *Permainan*. Dalam konteks ini, sebanyak lima tema telah dibentuk. Ketiga-tiga konteks (*Pengajaran*, *Pembelajaran* dan *Permainan*) dihubungkan antara satu sama lain untuk mempromosikan strategi pembelajaran terbaik, strategi pengajaran dan persekitaran pembelajaran yang lebih baik dalam memperbaiki amalan semasa dan pelaksanaan pendekatan baharu melalui pengintegrasian DGBL. Dalam Situasi pandemik yang melanda dunia kini memerlukan pelajar belajar dari jauh kaedah ini berfungsi sebagai kaedah pembelajaran alternatif dan menarik pelajar untuk belajar dengan cara yang menyeronokkan melalui DGBL, sama ada secara individu atau kolaboratif.

Diharapkan kajian ini dapat membimbing guru, pembuat dasar serta Kementerian Pendidikan dalam mengenal pasti amalan terbaik dalam melaksanakan DGBL untuk diserap dalam kurikulum secara formal dan melihat bagaimana DGBL dapat melahirkan pelajar berkemahiran tinggi, terutamanya dalam kemahiran kolaboratif, kreatif dan inovatif dalam menghadapi era IR4.0.

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"Laa haula walaa kuwwata illa billah"

Aryanti binti Amran

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This thesis was submitted to the Senate of the Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the degree of Master of Science. The members of the Supervisory Committee were as follows:

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LIST OF ABBREVIATIONS

IR 4.0	Industrial Revolution 4.0
ICT	Information Communication Technology
DGBL	Digital Game-based Learning
ASEAN	The Association of Southeast Asian Nations
MOE	Ministry of Education
ICPS	The Integrated Curriculum for Primary School
ZPD	Zone of Proximal Development
MCO	Movement Control Order
CGBL	Collaborative Game-based Learning
RQ	Research Question
MIEE	Microsoft Innovative Educator Expert
MOHE	Ministry of Higher Education
ICPS	Integrated Curriculum for Primary School
ICSS	Integrated Curriculum for Secondary School

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CHAPTER 1

INTRODUCTION

1.1 Chapter Overview

This chapter provides a general introduction to the study and the main components of the study. This chapter begins with the background of the study, consisting of the researcher's motivation to conduct this research, which is broken down into four sections. The first section is about the development of Industrial Revolution 4.0 (IR 4.0), in general. The second section continues with the movement of Education 4.0, especially in Malaysian context. The third section is based on the Ministry of Education Blueprint and the Information Communication Technology (ICT) Transformation Plan (Ministry of Education, 2013, 2019), and the aspiration of the Ministry of Education to provide students with the competency of technological skills and the development in ICT, for teaching and learning approach, in the classroom. The fourth section is about the problem statement, explained in three aspects, namely, Practice Gap, Theoretical Gap, and Research Gap. Through the explanation provided in this chapter, the goals and objectives for this study are portrayed. Following this, the significance of the study, the scope, and the limitations of the study are described in detail. This chapter ends with the summary of Chapter 1.

1.2 Research Background

The background of this study will be discussed in several subtopics, which are the narrative descriptions of how the researcher was motivated to choose the title to be studied. Following this, the current developments of IR4.0 were discussed, in context with the Education 4.0 situation in Malaysia, in particular, before the teaching and learning approach in the classroom in Malaysian schools is explained in depth. Finally, the use of Digital Game-based Learning (DGBL) in teaching and learning, specifically in the Malaysian Education System, is explained.

1.2.1 IR 4.0 and Education 4.0 globally

The founder of The World Economic Forum (WEF), in his book 'The Fourth Industrial Revolution', explained that IR 4.0 refers to the rapid development of the digital revolution across cyber, physical and biological space, that includes a spectrum of the broad economic sector and all levels of society (Schwab, 2016). There are 11 pillars underlying technology in IR 4.0, including Big Data Analytics, IoT (Internet of Things), Simulation and Augmented Reality (Figure 1). The developments in artificial intelligence (AI), genetics, robotics, nanotechnology, 3D prints and biotechnology are so rapid, especially as those technologies merge to trigger more intelligent systems. Offices, homes, factories, farms, transportation, and cities are experiencing the impacts of IR 4.0, which promises something great by triggering new patterns in production, consumption and employment. IR 4.0 also invites challenges that require proactive

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adaptation by business organisations, governments, and individuals. In this regard, employment will undoubtedly experience drastic changes, due to the progress of technological change, socioeconomic and the policy of the country. When the whole industry makes adjustments, most areas of employment will experience transformation. In these circumstances, there will be areas of employment that will grow and certainly, the current jobs will require different sets of skills. Globally, a study by the WEF shows that between 2015 to 2020, a total of 7.1 million jobs would be affected, while 2 million new jobs would exist. Net job loss due to changes in the Industrial era of 4.0 was 5.1 million. Employment opportunities in Industries 4.0 highly emphasise technical knowledge, teamwork and communication skills. The industries are expected to face difficulty in obtaining candidates with problem-solving skills, strategic thinking, innovation, creativity and technical knowledge. In this regard, drastic changes are needed in the education system. According to Puncreobutr (2016), the growth of economic paradigms has contributed to the emergence of new educational paradigms.

Education 4.0 is a pedagogical approach that aligns with the IR4.0. It answers to the demands of the IR4.0, in which the convergence of science and technology is utilized in augmenting manual processes for improved effectiveness and efficiency. Education 4.0 recently captured the attention of policymakers, driven by the onset of IR4.0. According to Fisk (2021), a new vision of learning encourages learners to learn the skills and information they need and find the resources necessary to learn them. Learning is based on understanding where and how to comprehend, and performance is tracked through data-driven customization. For example, Dunwill (2021) reported that technology innovations continually change the teaching method and the learning environment. The learning process in Education 4.0 may require the use of virtual learning environments (VLEs) to combine natural and virtual materials a smart blended learning process with adaptive Internet of Things (IoT) using wearables and intelligent sensors, and artificial intelligence (AI) for system automation, (Huba & Kozak, 2016). In the context of Education 4.0, curriculum design, reflects technology-based environments, (Jamaluddin et.al, 2020).

Several frameworks have recently surfaced, describing how Education 4.0 can be applied. For instance, Thailand's higher education commission implements the third framework of its 15-year long-range plans, which focuses on improving its people's quality—the so-called "Thai people 4.0" blueprint (Buasuwan, 2018). Also, Malaysia redesigned its learning and teaching curriculum to meet the unknown demands of the IR4.0. With this, the Ministry of Higher Education (Tapsir, & Puteh, 2018) launched the book "Framing Malaysia Higher Education 4.0: Future-Proof Talents" to develop and enhance individual potential and fulfill the nation's aspirations. Similarly, Singapore launched the Smart Nation initiative, which drives the pervasive adoption of digital and smart technologies (Smart Nation, 2021). These practices form some benchmarks for developing countries to follow, such as the Philippines. Economists have highlighted that anytime new technologies are brought into an economy, there is a considerable lag period for the technology to be fully adapted to a level where they generate demonstrable productivity impacts (Ruscow,2003). In the presentation of national budget 2018, by the former prime Minister Datuk Seri Najib Tun Razak, the Industrial Revolution 4.0 became one of the leading references and focus of the country, due to the rapid development of sophisticated technology.

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Figure 1 : Eleven Advanced Technological Pillars of IR 4.0

The current rapid technological development has gone beyond IR 4.0, with a variety of challenges, creating an incredible science story. The world of the future is the present time, which will soon become irrelevant in the next few years, if we are not ready for the changes, accordingly. These set challenges insist that Malaysia become more innovative to utilise the technologies available in many forms. According to Ahmad (2017), it appears that the number of gadgets used for communication has surpassed the number of human beings, with each human being owning approximately 6.58 electronic gadgets in Malaysia. This associated gadget creates information and innovation. As such, Malaysia must seize opportunities in IR 4.0 as the Government will provide a conducive ecosystem to generate producers, creators, suppliers, and service providers of the industry in the ASEAN and global markets.

1.2.2 Education 4.0 in Malaysia

IR 4.0 dimensions are not only seen from the economic growth standpoint but, they have also gained increasingly great attention in the development of education, which led us to Education 4.0. Aligned with the development of IR 4.0, former Minister of International Trade and Industry Tan Sri Rafidah Aziz said the education system in the country must be in line with the era. She asserted that:

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"When we talk about IR 4.0, we cannot have an educational system still in the 2.0 era, so if it is 4.0, then (education) should be in line with 4.0. Here is our concern now" (Bernama, 2019).

The Fourth Industrial Revolution's emergence created new technology waves, which led the Government to continue to strive in the making of Digital Malaysia policies. This policy was designed to prepare the younger generation to meet 21st-century requirements. This policy changed the overall syllabus for each public school and national secondary school (Ministry of Education, 2013). Using mechanical advancement in teaching and learning can improve the teaching-learning process and create intrigue for learners to take an interest in learning materials. Education 4.0, in a way, complements the wonder of computerised penetration in our everyday life.

In Malaysia, Education 4.0 has been further highlighted to understand the 4th Industrial Revolution, as part of the call to reshape the Malaysian education system. To realise this, educational technology is the primary key to unlocking the Industrial Revolution 4.0, and to do this, the method of utilising innovative headways in teaching and learning must first be changed (Selamat, 2017). Education 4.0, in a way, complements the marvel of advanced integration in our everyday life, where humans and machines are adapted to require dissolving, troubleshooting and finding the unused hypothesis of advancement. Education 4.0 offers knowledge everywhere and the method of teaching and learning is complicated. Within the evolution of technological headways, it is not complex to conceive what Education 4.0 holds for us. The future of Education 4.0 can remarkably change the economic utilisation of information. The Malaysian education system, under the change brought by the Industrial Revolution 4.0 (IR4.0), needs to start implementing an innovative approach to improving the learning process.

The movement of Education 4.0 in the Malaysian education system started with a keynote address by the ex-education minister, YB Dr Maszlee Malik in conjunction with the 4.0 Industry Revolution Education Colloquium on 5th November 2019 at the Putrajaya International Convention Centre. He was looking at the 4.0 industrial revolution and the need to re-evaluate the level where we are, giving priority to the educational system that is responsive to knowledge-based economies, improving the syllabus for programs required in the schools that are mostly left behind and do not meet the needs of IR 4.0. It is crucial to identify an innovative method of delivering academic programmes in a favourable learning strategy, providing digital platforms for teaching and learning, as well as flexible value-based education to provide potential graduates with a value-added future. This proves that talent that is not outdated and not time–consuming. This talent identifies those highly skilled in different disciplines of expertise and are highly valuable. According to YB Dr Maszlee Malik, the incorporation of IR4.0 into the Malaysian education system at the dawn of Industry 4.0 would help learning institutions stay essential and competitive. Learning institutions have since been urged to revamp their education system and take initiatives to embrace teaching and learning in Education 4.0. This statement is supported by (Halili, 2019), in The Online Journal of Distance Education and e-Learning, who stated that one of four components that need to be emphasised is the incorporation of technological advancements in the teaching and learning process.

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Apart from these four components, Education 4.0 also focuses on the aspect of industry collaboration, which acts as an essential mechanism to meet the needs of the industry. Therefore, teaching and learning processes need to be transformed and state-of-the-art technology integrated (Dzulkifli, 2017). The use of technological advancements in Education 4.0 is expected to play a significant role in educational institutions (Blaschke, 2012). The integration of the latest technologies can increase the effectiveness of the teaching and learning process (Vawn, 2018). Hence, Halili (2019) said in the Malaysian Education System, the process of using technological advancements in teaching and learning must be changed.

1.2.3 Teaching and Learning Approach in the Classroom

Technological advancement in the field of education has enabled face-to-face and distance learning to emerge and has fostered greater innovation in teaching methods, both inside and outside the classroom. This includes gaming activity, known in educational contexts as DGBL. But many still see it as a casual thing and just for fun. DGBL promotes the development of skills and abilities through immersive experiences in an educational context (Marklund, 2013). In empowering Education 4.0, one of the fine branches of educational technology is learning through games (Almeida & Simoes, 2019). The use of games is increasingly in demand for other needs, besides entertainment, these days. Other benefits of games also include education requirements, increasing quality and coaching. (Gabbett et al., 2009).

In Malaysia, various learning approaches are being practised. Among the strategies that are gaining attention are through the use of games. It is to help students grasp the learning material more efficiently than using conventional methods. In the use of games as a medium of learning, there are several different jargon and meanings, such as Gamification, serious games, and DGBL.

According to Karagiorgas and Niemann (2017), a serious game is a planned game, other than as entertainment, for its primary purpose yet, which makes it feel more "serious." In the game, the player not only gets enjoyment but also a piece of information or message that is the purpose of the game (Fabricatore, 2007). On the other hand, Gamification is a process of applying techniques and strategies from a game to the nongame context, which aims at making it more interesting, understandable, and creative to solve a problem (Lee & Hammer, 2011). This learning model will include the characteristics of obstacles, happiness, gratitude, and suspension (Darling-Hammond et al., 2020). However, these two approaches do not have specific and explicit contents in the emphasis of subjects or lessons that should be dominated by students.

1.2.4 Digital Game-based Learning (DGBL)

In line with the development and milestone in Education 4.0, DGBL has been found as a tool for learning purposes by playing the game. DGBL aims to provide learning through games or perform a learning approach using the game. According to Nor Azan,

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Azizah and Wong (2009), DGBL is usually used by students who are in primary, secondary and upper secondary schools.

An extensive line of DGBL is an approach to helping the learning process by using a specially planned game. DGBL includes one of the methods of learning that effectively can increase the upgrading of learning using the game (Campos, 2018). DGBL is specially used for students. Using this approach would make it easier for students to have a more effective learning experience. About 80 per cent of them do it through a simulated approach. (Prasetyo, 2016)**.** DGBL describes an approach in teaching, where students explore relevant aspects of the game in the context of a design game. DGBL is a centralised educational study that uses electronic games for educational purposes. The DGBL process leverages the game on the computer or gadget, as a medium, which delivers learning, enhancing understanding and knowledge capabilities, and the evaluation of a discipline of knowledge. These opinions are supported by Connolly and Stansfield (2007), defining digital games for education as follows:

> "computer usage based on game approach aimed at delivering, supporting, and enhancing teaching, learning, assessment, and evaluation."

Prensky (2003), defines DGBL as integrated computer education and gaming content integration. This new approach has made it possible to have a combination of computer and video games with different educational content to achieve good or better results, compared to traditional learning methods. Digital games also involve the aspect of mental development, which requires a deeper level of thought and provides students with a fun learning method, without compromising the importance of learning concepts (Prensky, 2007).

The use of learning through the game has started to be used for education at schools abroad. They have begun to implement this approach because it was evaluated to be more effective to improve students' understanding of the subjects being taught (Spector, 2015). Comparatively, according to Sayed Yusoff, Tan Wee Hoe, and Muhammad Zaffwan, (2013) in the Malaysian education system, the digital game in this education is still new, in terms of implementation, and it has not been formally implemented in the school system in our country.

According to a study by Osman (2012)**,** in Malaysia, computer games have long been perceived as the medium of entertainment, rather than of learning. Moreover, perhaps due to this, it is considered "too good to be true" and even impossible for some people, especially parents and teachers, to accept the educational part of computer gaming. The implementation of educational computer games in the classroom is seen as slightly aberrant since the educational game industry in Malaysia is still new. As reported by Roslina and Azizah (2009, p.296);

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> "an interview with several educational game developers in Malaysia indicated that the field of education is still relatively new in local scenarios; hence, many localised studies are needed in order to generate more knowledge in educational games in the areas of educational games design and development, as well as its effectiveness, among our (Malaysian) students" *(Roslina &Azizah, 2009)*.

The need for research and development in this area is in line with the Malaysian ICT Master Plan (finalised in 2001), which emphasises the integration of ICT in education and training programmes (Lubis et al., 2009). The "long-term vision of the plan, Vision 2020, calls for sustained, productivity-driven growth, possible only with a technologically literate, critically thinking workforce prepared to participate fully in the global economy of the 21st century" (Lubis et al., 2009, p. 1382).

In tandem with the current trend of the computer game phenomenon among teenagers and school students, its integration in the classroom is relevant and significant. In order to implement educational computer games in a classroom, it is essential to look upon the education system, where the classes are. The Malaysian education system is based on the national curriculum, which is customised for public schools, throughout the primary and secondary levels. Teachers must adhere to the subject syllabus, designed by the Ministry of Education. Therefore, every student in public schools is expected to acquire the same knowledge.

Consequently, the education system is strongly dependent on the national curriculum. Thus, any intervention of pedagogical innovation in the classroom, in this case integrating an educational computer game, must consider the necessity to follow the designated prospectus. The educational game, in a way, should be subject-oriented. Randel et al. (1992) supported this idea by asserting that, subject-oriented educational computer games are more likely to show beneficial effects from gaming, as compared to other types of educational computer games (Randel et al. 1992).

In line with the aspiration of the Ministry of Education in MOE Blueprints, using educational technology can develop students' 21st Century skills. The advantages of DGBL will not only be able to fuel the motivation of the students but also to manage cognitive, including decision-making skills in problem-solving. DGBL encourages a genuine collaboration between students and a collaborative learning environment or cooperation environment, where the participants (students) share information and learn from each other (Marc Prensky, 2003; Papastergiou, 2009; Kebritchi et al., 2010; Iacovides et al., 2012).

Campos (2018), showed strong evidence that a digital game can be used as a learning resource. Thus, for more than a decade, academicians have ventured into the potential of using digital games as pedagogical sources. DGBL is featured to be interactive, with engagement power, provision of immediate feedback, ability to develop problem-solving methods and cognitive skills which all can be vital tools for mental development

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and social growth. All this contributes to the development of critical thinking of players or students using the DGBL approach.

1.3 Problem Statement

In Malaysia, IR 4.0 has become a part of the demand for the re-construction of the education system, whereby more emphasis is given to Education 4.0, which future can remarkably change the economic utilisation of information. To this impact, the first step taken is to shift the approach to using creative developments in teaching and learning. Knowledge is significantly obtainable in Education 4.0, where the teaching and learning process has become more flexible. Within the evolution of technological headways, it is not complex to conceive what Education 4.0 holds for us. The Malaysian education system has to continue to integrate an innovative method to strengthen the education process to meet the needs of IR4.0 in education. However, the implementation of the DGBL in the context of schools in Malaysia, in terms of teaching and learning itself, found a gap in the practical, theoretical, and methodological aspects, discussed in detail, in each paragraph below.

1.3.1 Digital Game-based Learning in Schools (Practice gap)

The significance of the integration of computer games as an integral part of the career and life-long learning skills of the students can be seen through the recent trend in the professional industry. Bughin et al. (2018) recommend ensuring that potential employees are highly trained in new technology, while also developing interdisciplinary skills, that enable them to improve critical thinking. In the future, the greatest challenge for people will be to use such a wide variety of knowledge and expertise in looking for new solutions, manipulated by emerging technologies (Islam, 2018). The Paradigm of Education 4.0 empowers students to establish their learning style and speed. According to Bartolomé et al. (2018), personalisation and versatility are two essential characteristics of Education 4.0. Adaptive learning systems play a crucial role in the Education 4.0 model in that sense (Kara & Sevim, 2013). Technology is used in the adaptive learning model to accelerate learning, according to each student's different needs. Besides, Murray and Pérez (2015) found that, adaptive systems have a beneficial effect on other facets of the educational process, such as motivation and interaction with the students. Games are now part of professional training programmes in specialised careers, such as medical, military, and engineering. Besides in education, it was perceived as just entertainment and leisure activities for students to waste time (Prensky 2006). For example, medical doctors can now perform surgical operations using computer game models and improve the use of electronic medical devices; soldiers undergoing combat training will now be equipped with a realistic 3D video game and simulation aircraft pilots who have long utilised computer simulations during their preparation.

These demonstrate that, computer games can be used as a medium for professional skills training. Thus, the integration of computer games in school education can give students an early introduction and familiarity with their professional life, later. The combination of computer games in the education system is a serious effort of developed countries, such as the USA and the United Kingdom, where in some cases, even a specific DGBL

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curriculum was built to accommodate the implementation of computer games in the classroom. This transformation of the education system was recently achieved kudos to extensive research and development efforts by educational researchers, educators, and developers of educational games.

However, this effort is still at an initial point in the Malaysian context, and the need for research and development of Game-based Learning that suits Malaysian educational settings is crucial (Osman, 2012). Besides, there is no representation or guidance to teachers who may be required to understand the learning strategy needed for the teachers or the students in undergoing DGBL activities (Sayed Yusoff et al., 2013).

1.3.2 Theoretical Gap in GBL (Theoretical Gap)

DGBL has been found as a medium for learning purposes by playing the game, in line with the growth and milestone in Education 4.0. DGBL aims to provide learning through games or to use the game to implement a learning approach. According to (Nor Azan, Azizah, & Wong, 2009), DGBL is usually used for a sound world of basic, secondary, and upper education.

A broad line of DGBL is an approach that uses a specially planned game to help the learning process. DGBL includes one of the learning methods, which can effectively increase the use of the game to upgrade learning. DGBL is used in general for the students. Using this method will make it easier for students who used this game as a learning approach to submit topic material (Prasetyo, 2016).

DGBL describes a teaching approach, in which, students explore relevant aspects of the game in a design game context. DGBL is a centralised study of education, using electronic games for educational purposes. There are many theories and models related to DGBL. To take the existing DGBL model (Figure 2), introduced by Garris et al. (2002), it states that DGBL is a cycled process, ranging from Judgement, Behaviour, and System Feedback.

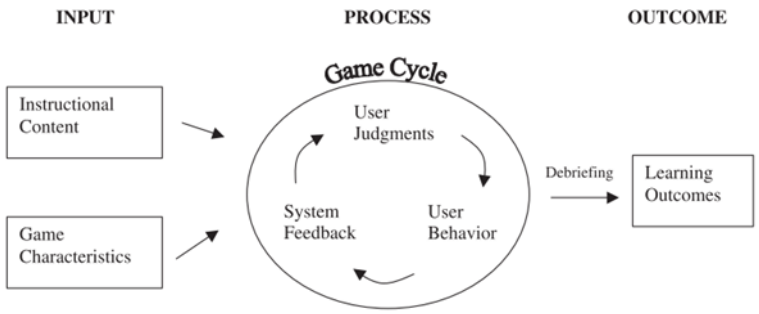

Figure 2 : Game-based Learning Model by Garris (2002)

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However, there are no clear specific theories in this model on how learning takes place in DGBL, and it is much more to an individual context. The model should clearly state how learning occurs and how the learning process runs in the DGBL approach.

1.3.3 Research Gap

Many studies on DGBL have been carried out and there are several studies presented by researchers referring to the education system in Malaysia. According to Nor Azan and Wong (2009, p.269), the strategy for Educational Effectiveness (pedagogical Element) needs integration as a goal from the beginning of the design process. Experts in education and game designers need to work closely together to create an educational computer game that balances learning and play in the game element. Many scholarly reports such as Chen et al. (2020), Hartt et al. (2020), Wardoyo et al. (2020), Wati and Yuniawatika (2020), have supported the positive impact of such games on student learning and on how the implementation of computer-based educational games should be integrated into the classroom. The studies carried out by Rohwati (2012), Farozi (2016), and Prasetyo (2016) demonstrated the approach of game methods in learning to increase students' achievement and interest. Through this approach, various game methods can be planned in learning, according to the appropriate order for students. A few of these methods will be able to help achieve the goals that are compiled in the teaching and learning process. The use of DGBL materials is identified as an alternative to the effective use of teaching materials.

Nevertheless, there is no clear literature review in comparing collaborative learning in DGBL, even in a different learning environment context. Previous studies also mostly use the quantitative method, which is based on questionnaires, surveys, and case studies. However, this method is not only insufficient to be used in an in-depth analysis for understanding the learning technique of students in DGBL, but it also lacks the ability to know how DGBL can be one of the successful learning approaches to a more formal education system. Therefore, it is a need for research to provide an understanding to what extent the practice in DGBL can be applied in the different students' learning strategies, how the different learning strategies play a role in determining the skills obtained from the students, and how the different learning environment influences the DGBL performance.

1.4 Purpose of the study

In general, the study aimed to explore the practices of DGBL in different learning strategies. Besides, it was also to understand how different learning environments influenced the students' performance in DGBL. In addition, this research also aimed to explore the learning process by using DGBL and the way learning tools are placed. This research was expected to provide a thorough understanding of DGBL practises in different learning strategies, as well as to understand how DGBL can be an excellent approach to a more formal education system, which could indirectly provide a better practice for an insight into the most basic method to learning in various types of learning environments.

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1.5 Research Questions

1.5.1 How does the teacher utilise DGBL?

1.5.2 How does learning take place in DGBL?

1.5.3 What aspects of the game contribute to teachers' implementation of DGBL?

1.6 Significance of the Study

This research was an initial attempt to explore the idea of integrating DGBL in the education system in Malaysia. Other efforts by local educators, researchers, and developers of DGBL are necessary if more knowledge is created in education technology, for Digital Gaming-based Education in the country.

DGBL is an approach to problem solving (Sung & Hwang, 2013), as it is expected to improve the capacity of learners and students to think, with significant advantages for students, teachers, and the Ministry of Education. The development of knowledge and skills through learning is the main priority for students and teachers. According to Prambayun (2015), DGBL for learners is also the primary goal from its academic point of view, as students are expected to be more focused on their learning. The educational game encourages the achievement of the goals and the instructional behaviour of students to achieve these goals.

1.6.1 To the Students

The skills learned, directly or indirectly, will enable students to master the subjects taught. The forces that emerge include counting skills, communication skills and decision-making in problem-solving skills. Self-confidence will also be further strengthened to promote achievement and improve basic knowledge. All these skills are critical to the expression of a professional and successful 21st-century student. (All et al., 2014). The teacher is a facilitator responsible for the selection of various teaching and learning methods that have a significant influence on the students. Through the approach of this method, teachers will be more creative in teaching and using multiple techniques in attracting students' attention (All et al., 2014)

1.6.2 To the Teachers

The game-based method of this approach also inspires the school, especially the teachers. Collaborations between the Education Ministry and the school are essential for developing methods of teaching in schools (Abd. Razak, Mohd Johar, Andriani & Yong, 2014). According to Abd. Razak (2014), using creative teaching methods can increase students' achievement, and their excellent performance will build a great reputation for their school. Besides, this study is expected to help schools to create more creative

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educators. The school may organise the necessary training to expose the teachers to the implementation of DGBL as an approach to teaching and learning.

1.6.3 To the Ministry

This study can be used to provide an overview of the best strategy that can be implemented in the education system to introduce DGBL and, hopefully, it can also be referred to as a guide to determine whether this strategy is more suitable for individual or collaborative learning, according to different students groups of academic achievement. The Ministry of Education, Malaysia, can also use this method of research to see the factors that determine the effectiveness of a new approach in the upcoming education system. The Industrial Revolution of 4.0 is a new paradigm shift in the industrial production that combines Internet technology with a future-oriented technology, in the field of intelligent technology. (Lasi, Fettke, Kemper, Feld, & Hoffmann, 2014). As a result, one of the national goals is to ensure that, the young generation of Malaysia is ready for the 4.0 industrial revolution. Hence, the need for new knowledge and skills is critical, for the students to keep pace with the rapid technological advancement.

The key to success in the Industrial Revolution 4.0 is to have a mentality that is open to continual adjustments, due to the unpredictable future. As a result, it is necessary to prepare students who are versatile and brilliant. In order to prepare future-proof graduates, educational programmes must focus on improving students' values, empathy, inventiveness, original thinking, and leadership abilities. Today's students will have the opportunity to shape the global workforce of the future and improve the social order in which they live. Because each country will move at its own pace through digital transformation, the path to the 4.0 IR will be unique. Since innovation has become an inextricable part of human life, Malaysia's educational system must be proactive in responding to the current trends. Collaborative and concerted efforts must be ramped up to extraordinary levels (Schuh et al., 2014). To ensure that, future generations are key players in the global race, the education system must strengthen its embrace of Education 4.0. To accomplish this, students should be given a more efficient learning approach for us to determine how the DGBL method can be applied to various student learning strategies and how they perform in various learning environments.

Another benefit of the current research is that it will provide potential DGBL content developers with a better understanding of the practises and attitudes of those who will eventually decide whether or not, and to what extent, DGBL will be included in our curriculum. Lee and Hammer (2011) recognises the critical role of start-ups and venture projects in meeting the quality and quantity demands of a global DGBL market. The technology and know-how associated with DGBL will not likely reach a level conducive to widespread application, unless a concerted effort is made to overcome a substantial lack of guiding expertise, during the initial development. However, given the level of uncertainty associated with DGBL as a brand-new market, the Federation of American Scientists recognises that, commercial companies would be hesitant to undertake such ventures. As a result, they have called for more research into DGBL, to clear up ambiguity and encourage venture capital investment. It would also help researchers and

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entrepreneurs experiment with DGBL and develop a knowledge base that would make the education field advance by informing strategies and policies.

1.7 Research Scope and Limitation

This study was limited to only national schools familiar with DGBL and actively using DGBL in teaching and learning. The justification for this is that teachers who are familiar with DGBL in the classroom know more about the extent of use and practice in using this method in the classroom. These teachers are also individuals who are witnesses to the progress and development of students through this method. Through this study, the perspective of secondary school teachers and primary school teachers are random. There were some constraints to conduct this study on students, because of the pandemic factor, which made it difficult to get them for interviews. Thus, this study focused only on teachers.

Through this study, DGBL aimed at learning digital games through digital devices, such as smartphones, IOS, and computers. The findings of the study are valid for the participating schools and cannot be applied extensively in all schools throughout the country. The accuracy of the study also depended on the reliability and openness of teachers, expected to be transparent, while conducting the interview process. Other components of communications that were not addressed in the research were not included in the data analysis.

The absence of appropriate acoustic tools and advanced speech analysis software was also seen as the limitation in this study, that could result in non-empirical pieces of evidence. By this means, the intricacies of speech analysis were compensated with the acoustic data, manually transcribed through individuals' perceived judgement, using a qualitative document and oral responses in a series of non-structured interviews, to help the researcher make qualitative field notes. The findings did not represent any institutional practises, and the samples were anonymous. The result of this research was only limited and not to be generalised to any other educational institutions, communities, or individuals to imply their accountability of the study. Each finding is unique to an individual sample and is only used to help answer the academic queries of the research.

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1.8 Definition of Terms

The definitions of key terms used in the research are as follows:

i) Learning Strategies

Before attempting to define and classify learning strategies as used in other studies, the researcher would like, first of all, to provide a rationale for the choice of the term strategy. Although used by many prominent writers (such as Rubin, 1975; O'Malley et al, 1985), the term strategy is not without its controversy. Consensus is not assisted by some writers' and use of conflicting terminology such as learning behaviours (Wesche, 1977; litzer & McGroarty, 1985), tactics (Seliger, 1984) and techniques (Stern, 1992) more or less (but not always exactly) synonymously with the term strategy. Larsen-Freeman and Long (1991, p.199) opted for the term strategy since, as they pointed out, Rubin (1975) used it "in perhaps the earliest study in this area and it enjoys the widest currency today". For this reason, strategy was the term which to be used for the purposes of the present work.

One of the earliest researchers in this field, Rubin (1975, p.43) provided a very broad definition of learning strategies as "the techniques or devices which a learner may use to acquire knowledge". In 1981 (pp.124-126), she identified two kinds of learning strategies, those which contribute directly to learning, and those which contribute indirectly to learning. She divided the direct learning strategies into six types, clarification/verification, monitoring, memorization, guessing/inductive inferencing, deductive reasoning, and practice, and the indirect learning strategies into two types, creating opportunities for practice and production tricks. Under production tricks, Rubin included communication strategies. This is a controversial inclusion since learning strategies and communication strategies are seen by some as two quite separate manifestations of learner behaviour. Brown (1980, p.87), for instance, draws a clear distinction between learning strategies and communication strategies on the grounds that "communication is the output modality and learning is the input modality".

However, in this study, learning strategies referred to the way teaching and learning were being conducted. In other word, it referred to the way the DGBL activities were implemented. Learning can be conducted as an individual strategy or collaborative strategy. Collaborative strategy refers to learning that takes place in situations where emphasis is placed on student-to-student interaction in the learning process, and the instructor's role becomes that of a facilitator (a "guide-on-the-side"). In this study, Cooperative learning strategy referrd to learning that took place, in situations, where students were required to work in small groups, with different abilities. The product of DGBL stated in this research was in reference to the general type of Digital DGBL.

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ii) Learning Environment

Learning environment refers to places or spaces used in the teaching and learning through DGBL. In the context of this study, the researcher referred to the teachers or students themselves, using certain spaces for the purpose of participating in DGBL. The space included those in formal settings, such as classes, computer laboratories, special rooms and so on. In addition, it also referred to space in informal settings, such as outside classrooms, including in the canteen area, under trees or at the student home. This study relied on answers obtained by teachers, to be used to understand which learning setting would affect students' performance more, in the DGBL, and how DGBL could be implemented effectively for the students.

1.9 Chapter Summary

This chapter has covered in detail the introduction of the study containing the emergence of Industrial Revolution 4.0. Part of the developmental effect of 4.0 Industrial Revolution is the introduction of Education 4.0. In Malaysia, Education 4.0 is seen as a new branch in preparing the educational arena, with the current technological developments. For that purpose, upgrading in terms of teaching and learning approach such as DGBL in the classroom should be done. In the statement of problems, the three facts underlying in this study have been described. Through the explanation in this chapter, it will help to set the goals and objectives that need to be achieved, which were to explore the factors that determined the effectiveness of Game-based Learning in different learning strategies, individually and collaboratively, to see how different learning environments influenced the students' performance in Game-based Learning. In this chapter, the significance of this study, the scope and limitations of the study have been discussed. In the next chapter, references on past studies, besides the theories used as a policy or basis in this study will be discussed in-depth. It also discusses the literature review and explains the concept of previous research, theories, and models related to the concern in this case study.

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