CodeToProtect©: C++ Programming Language Video Game for Teaching Higher Education Learners

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Abstract. As more and more media-based and game-based education (Edu-Game) is released each year to meet the increasing demands of this unique form of learning, the Edu-Game is increasingly developing the primary growing market in the education industry. The future of learning is indeed an educational video game, it has been said to suit the learning style of the new generation better than the previous generation. This also suggests that the use of programming subjects has also expanded to Edu-Game as well as Classroom programming education has been reported to not be as effective as it used to be. While several Edu-Game for programming are released today, there is a void that has yet to be occupied, which is a Edu-Game that teaches the language of C++ programming. Furthermore, the concern is the lack of C++ programming language for teaching higher education learners, as C++ has proved to be the most commonly used programming language in Malaysia education, thereby enhancing the overall standard of education programming here in Malaysia.

1. Introduction
A lot of changes have been made to video game technology and the video game industry since it was first introduced back in 1958. Video games have gone up a long way since they were first introduced back in 1958. Video games are now viewed to be one of the most lucrative markets to exist with the technology gaining its popularity among the world's people and industries gradually; its proliferation triggered a chain reaction for the technology to be used in other parts of the industry other than entertainment. Today's video games will do a lot more than they could do 15 years ago since today's video games use modern technologies such as higher computer processing power and three-dimensional graphics capabilities in contrast to when it was first invented.

The use of video games has already been examined by many researchers as early as the 1980s on the value it brings to the player. Ever since education and video games have been merged to improve the
player's learning experience further. Nowadays, all platforms use computer technology, and it has provided an incentive to develop or use an educational game on the market. Educational games have been more successful in educating the player, and in some cases better than traditional education, with the discovery of educational games in the 80s and technological advancement year after year until today. Several different modes of learning for many academic or non-academic subjects have been established through the convergence of both industries.

The nature of educational video games as an alternate learning method, the academic topic is best taught and understood by many students as it not only teaches but also retains a high degree of player concentration at all times. This is why educational video games have proven to be better than traditional learning styles; such capabilities are used to improve the player's learning experience more effectively. The subject has proved among the toughest subjects in many research and statistical studies since the introduction of the programming subject in higher education in Malaysia. [1]. As one of the toughest subjects in education, several individuals have taken the approach of making an educational video game focused on the concept of programming.

1.1. Brief History on Video Game
Since the advent of video games back in 1958, at some point, the vast form of media in the world was far more common than any other source of entertainment in the dominant video game industry worth billions [2]. The video game has influenced generations and is known to have a major effect on many people's lives. Through their major influences, video games have been linked with variety of negative implications. Nevertheless, several forms of studies have been done to show otherwise. The video game is said to have a positive influence on the player's cognitive capacity and motor growth [3]. Recently, the inflow of research into the advantages of video games for players has increasingly expanded video games to other consumers of sectors other than entertainment, such as the military, health care, education, and many more. Video game success in educating a player has provided an incentive for education to take advantage of and make greater use of the learning experience as a whole.

1.2. Edu-Game
The Edu-Game was first addressed in the 1980s when study was carried on cognitive development, learning and motivational effect when a player plays a video game. It can have a positive influence on players' educational experience, interactive education media has been implemented as a mix [4]. Since its release, several more forms of research have been conducted to find the impact the game has on the player. There were as many as 16 learning advantages found while the player was participating in a video game. [1]. Moreover, today's generations are more appealing to digital learning than traditional learning. [5]. This indicates that a transition in education must be made to meet the demands of the new generation. Increasing demand for educational video games has also driven several companies to compete in creating a well-rounded educational video game that can better suit the player's needs.

1.3. Edu-Game Programming
Edu-Game programming s have recently entered the market as more reports have arisen about the advantages of using video games in education. It is proven that in a few research on the use of video games in education, a player's educational experience, motivation and much more can be improved. [1]. In addition, a study conducted by [6] discover educating a student using a game-oriented approach has shown a higher pass rate than the classroom of teaching programming. Latest findings on the benefit that video games can offer to the player are an opportunity that can also be utilized through Edu-Game programming. The complexities of programming can be clarified easily in the video game as it is a type of visualisation software, as it is claimed to be an efficient learning tool, so players can better understand the elements of programming during execution [7]. This statement is further supported by [8] where a number of students who had a visualization software to assist them in learning programming have demonstrated better performance and higher scores compared to learning without visualization tools. Thus, since a video game represents everything in a visual form, the video game is a great medium to be used as an educational tool. Today, more than a hundred educational programming
video games such as CodingGame, CodeCombat, and CodeHunt are available on the market, as shown in table 1.

### Table 1. Existing Video Games

| Details            | CodinGame | CodeCombat | CodeHunt |
|--------------------|-----------|------------|----------|
| Language           | Variety   | Python     | Variety  |
| Audience           | Public    | Public     | Public   |
| Visualization Level| Normal    | High       | Normal   |
| Platform           | Web       | Web        | Computer |
| Level              | Professional | Beginner     | Intermediate |
| Recommended        | Company   | High School | University |
| Subscription       | Free      | Free       | Free     |

2. Methodology

### Table 2. Methodology activities

| Phase          | Activities                                                                 | Outcome/Output                                                                 |
|----------------|---------------------------------------------------------------------------|-------------------------------------------------------------------------------|
| Planning       | Produce a project plan, plan a project timeline, and milestones.          | Overall project plan with an estimated timeline.                               |
| Analysis       | Do research on a video game, gather requirements, carry out questionnaires on university students on programming subjects, and analyze the result. | Result of student’s opinion on programming subject, video game impact, and digital education. |
| Design         | Develop video game storyboard, design storyline, and create a module.     | Video game module that can be used to teach the player.                        |
| Implementation | Develop the mobile game using the Unity engine.                            | Create a video game environment and scenes.                                   |
| Testing        | Test the game functionality on university students.                        | Usability testing result and effectiveness testing result.                    |

3. Results and Discussion

CodeToProtect is an Edu-Game that emphasizes on teaching the player on the theory and use of the C++ programming language. It is designed to assist players practise and process what they learn to improve the player’s understanding of the syntax, functions, variables, and how the C++ programming language works. CodeToProtect would be an alternative way to learn the language of C++ programming that is accessible for use by university students and have a visual illustration of how each line of code works to facilitate a complete understanding of the definition. In addition, the game will also assess the comprehension of the player by bringing the players through a series of tests where the players have to apply what they have grasped to win the game. Lastly, through each test that the player has passed, CodeToProtect will evaluate the player.
For university learners, CodeToProtect can be an important learning method, since it not only teaches programming, but also provides an exciting plot to ensure that players pay attention to playing games. This will end the boredom of players learning such a strict subject as programming at the end of the day. It can also be used by lecturers to determine the level of different coding tests that students have as a game, which also involves topic evaluation. For insufficient C++ programming games, CodeToProtect is an interactive computer game designed for students to help and fill the business void.

3.1. Questionnaires
The questionnaire was carried out to find out about the student’s opinion on the programming subject taught in higher-level education. This is to analyze what is the student’s view entirely is on this particular matter, how effective is the learning method used, how easy it is to learn, and many more.

The first question asked in the questionnaire is the student’s opinion on whether or not they enjoy programming subjects in figure 2. This is to identify the overall student’s interest in the subject itself.

Based on the results shown above, the programming subject itself is not hated among the university’s students, but rather most students enjoy learning to program. This shows student’s level of interest in the subject of programming is high as the majority of respondents voted that they enjoy the subject. This result can be used to support the project as the interest in this particular subject is considered high. Therefore, developing a new alternative tool in teaching programming is still valid as the interest is still high.

The second question in Figure 3 questioned why the respondents considered the programming topic to be difficult to understand. The explanation for this is to discover the true reason why the respondent feels this subject is difficult to understand.
Figure 3. Questionnaire Question 2

Based on the outcome, the question is intended to see why students consider the topic of programming challenges. Three responses were obtained by a majority vote: “I don't understand the basic concept,” “I don’t know how to program” and “I find it difficult to grasp programming in class.” These three responses shed light on the real reason why students consider the subject to be complex. Hence, one of the reasons students find it difficult to learn is the complexity of understanding the term. Including not knowing how to program is yet another indication why it is challenging for students to learn the subject, as programming is the most critical aspect and fundamental understanding in the subject. All in all, it is stressful for students to learn in class, which indicates that class instruction is ineffective. Furthermore, the results of this portion of the questionnaire explain why the project is required to enhance the quality of university student learning in the field of programming.

As shown in Figure 4, The third question asked about the opinion of the respondent on which particular subject they find it most difficult to study and learn. The goal of this question is to build a solid basis on which issues should be highlighted more while the game is at the stage of growth.

Figure 4. Questionnaire Question 3

The questionnaire asked for the opinion of the student on The subject they find most tough to deal with in learning, based on the outcome given in Figure 4; nearly all students voted for the Multidimensional Array topic to be the toughest, followed by an Array and feature. The project module is to be based on this specific part of the questionnaire as CodetoProtect is intended to aid the student in learning programming. Students will find the difficulty level increase primarily in CodetoProtect to help students understand the idea of each topic.

As shown in Figure 5, The fourth question asked is which variable respondent was found to be an efficient medium for programming learning. This segment is intended to explain how the present state of programming for learning is not as successful as it used to be. The outcome of the questionnaire showed how learners depend on learning the subject of programming.
The outcome of the questionnaire showed how on the internet such as YouTube as well as many other students rely on learning the programming subject slowly while only a few rely on classroom learning. This further reinforces the notion that programming for classroom learning is not as valid as it used to be, as many students have voted to venture available platform to learn. This further CodetoProtect as an alternative learning medium that is necessary to assist students in the learning process.

The last question posed, as shown in Figure 6, concerns the respondent's opinion as to whether or not they want to try and learn to programme via an alternative medium, such as a game. As an alternate learning method for the programming topic, these question is to get support from the respondent for the Edu-Game platform.

Based on the above outcome, most students are attracted in learning to program by using video games, which is CodeToProtect. It has been shown that the progress of CodetoProtect is on the right path, as many voices support CodetoProtect. In conclusion, the questionnaires collected information on the student's viewpoint on the subject of programming and presented a solution that indicated a beneficial outcome for the development of the system.

4. Conclusions
In this study, the benefits of using video games in education are not only beneficial to students, but also the education sector as a whole. These benefits can reduce the complexity of students’ programming education, notably for Y-generation students. The purpose of this research is to recognise the benefits of incorporating educational modern media such as video games and to analyse the existing work of C++ Edu-Games focused primarily on university as higher education. For now, one of the many objectives for this great initiative has already been fulfilled. Striving for the other two goals is what is being focused on, one of the objectives is to be released, which is to create an educational C++ video game programming. This specific goal is where the full development process will take place and where the final objective to test the usability and efficacy of the C++ video game programming will be accomplished.
5. References

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