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Gadimath: Gamified Discrete Mathematics

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ABSTRACT

GADIMATH: Gamified Discrete Mathematics is an interactive two-dimensional mobile-based application in discrete mathematics running on the Android platform. This application would serve as a supplementary tool to reinforce the students' learning in discrete mathematics. It would help students to follow specific rules, achieve goals, and solve problems. Upon using the application, students would experience enjoyment, interaction, and motivation while learning takes place. The problems and difficulties that the students encountered towards mastering learning competencies in mathematics are the instructions, school adjustments, and over-extended schedules. With all these problems and difficulties, the proponent develops the GADIMATH's main features, which are the user-friendliness, infotainment, reliability, interactivity, learning reinforcement, portability, and dynamic environment. Also, GADIMATH has seven functions namely, choose avatar, gameplay, backpack, shop, settings, help, and about that are combined to form an accurate and complete product.

A rapid application development model was used in the study because the development of GADIMATH was broken down into small modules and combined to provide a final product. This model was used since the progress and development of the project were measured through the various stages. These stages are the requirements planning, user description, construction, and cutover. The instrument includes 24 measures. However, only twelve measures were considered relevant to product features. Twenty-five respondents were selected to test the application, whereas 10 are teachers and 15 fifteen students. After the data were gathered, the proponent used frequency distribution to determine if the purpose of the game has been achieved. Then the average results were generated and compute the percentile rank and its mean scores.

The development of GADIMATH to school institutions helps students to supplement their knowledge in learning discrete mathematics in the form of gamification. Also, it provides an additional learning tool for teachers who are teaching discrete mathematics. The development of the game help students to develop their mind-setting goals as they answer all the questions for each level of the game while enjoying the whole experience. As GADIMATH follows the scaffolding of activities based on the curriculum given by the Commission on Higher Education (CHED), it greatly helps students to understand the topic because the game itself follows the sequence of the topics given the CHED. The implementation of the features and functionalities of the game makes it useful and usable to school institutions who are offering discrete mathematics and to the students who are currently taking or have finished the said course.

INTRODUCTION

Gamification of education is a developing strategy to boost students' motivation and engagement by consolidating the elements of game design in educational settings (CD, 2017). Elshiekh and Butgerit (2017) proved that gamification is useful in education, as it increases students' determination and commitment to learning. Moreover, it was found out that students enjoyed themselves while learning. This result is further supported by Khalid, Zainuddin, and Nuwairi (2018), proving that gamification can be used as a tool to inspire students and to increase their commitment.

According to Kasurinen and Knutas (2018), university students are more exposed to gadgets and games that most likely motivate them to learn. Also, they suggested that gamification is a practical approach to engage students in learning in the education domain.

1.1 Purpose

GADIMATH is a mobile-based application in discrete mathematics running on the Android platform. This application would serve as a supplementary tool to reinforce the students' learning in discrete mathematics. It would help students to follow specific rules, achieve goals, and solve problems. Upon using the application, students would experience enjoyment, interaction, and motivation while learning takes place.

The application would cover functions, relations and sets, basic logic, proof techniques, basics of counting, and introduction to digital logic and digital systems (CMO 53, S.2006).

1.1.1 Reinforce Student Knowledge about the Fundamentals of Discrete Mathematics

This application would serve as a supplementary tool to help students understand the concept of discrete mathematics. The drill provided in the game, where the students can gain XP, coins, and potions, was designed to improve the engagement and interest of the students. Also, GADIMATH would increase students' understanding of the concepts of the course and, at the same time, are expected to enjoy the learning process while using the application.

1.1.2 Design an Interactive Environment that Promotes Learning

GADIMATH is a supplementary application designed with a dynamic environment. This provision is useful to get the interest of the students in learning discrete mathematics. It provides students with a pool of dynamic activities that would further develop their knowledge and understanding of the course. Also, the use of appropriate music background, volume, typeface, colors, and game plan are included to establish an interactive environment.

1.1.3 Implement Scaffolding in the Different Activities of the Designed Game

Edglosarry (2015) describes scaffolding as a type of instructional techniques used to drive students progressively toward greater understanding and, ultimately, greater self-sufficiency in the learning process. The level of the game increases once the previous level has been completed. Upon completing the level of each dungeon, the students are expected to understand and comprehend the lesson well. This would give students the drive to complete the stage while at the same time, enjoy and have fun.

1.1.4 Provide Additional Learning Tool to Discrete Mathematics Teachers

GADIMATH aims to enhance teaching and improve educational outcomes. According to Johns Hopkins University (2014), implementing a gamified application in teaching helps educators find the balance between achieving their objectives and catering to evolving student needs. Moreover, based on the research of Brull and Finlayson (2016), using gamified applications can help students to learn by doing, which ultimately improves processes and outcomes. GADIMATH would serve as a supplementary tool for discrete mathematics teachers.

PRODUCT DESCRIPTION

The ever continuous development of competitive software is surfacing from time to time. Modern technological marvels of today will be in its state of obsolescence a few months later. Innovations and purpose are always significant criteria for introducing a new product. People consider factors like usefulness and benefits to potential users. The success of these tests would determine how the product would be accepted and be embraced by the users.

GADIMATH is a supplementary tool used to reinforce students' learning about their understanding of discrete mathematics. It would help them develop their mind-setting goals as they answer all the questions for each level of the game while enjoying the whole experience. Figure 1 shows the general features and components of GADIMATH.

2.1.1 Dynamic Environment

The Idea Group Incorporation explains that the game environment is the collaboration of game rules, objectives, and subjects together as a whole to provide an interactive flow of activity (WWW14).

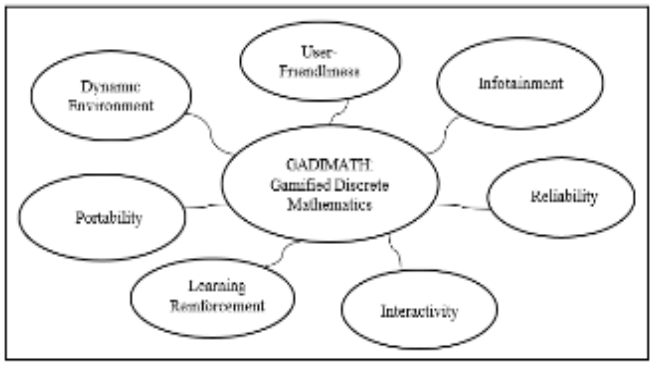

Figure 1. General Features and Components.

GADIMATH provides a dynamic environment that changes over time once a particular level is completed. Also, the dungeon of the game changes its environment when all of the levels have already been completed. This would provide enjoyment to the players and would motivate them to complete the game while learning.

2.1.2 User-Friendliness

User-friendliness is a system that is easy to learn and use (WWW17). GADIMATH is designed to give players the ease of use while playing the game. It would have a compact design where everything needed is placed in one setting, and there is no need to search for it. The game's functionalities are properly arranged in such a way that the players can easily find and click wherever they want.

2.1.3 Infotainment

Instant access to information is essential in such a fast-changing world. Therefore, high-performance apparel, like interaction technologies, is needed (RR2018). GADIMATH is a mobile application that combines information and entertainment to provide an entertaining and fun experience while playing the game. The topics integrated into the application are based on the curriculum of the discrete mathematics course (see Appendix B). Also, the students would be able to engage in the game because they need to answer the questions correctly in

order to proceed. Since the game focuses on discrete mathematics, all the information and knowledge they want regarding the topics are observed since the topics are arranged based on the sequence of the discrete mathematics curriculum.

2.1.4 Reliability

Reliability estimates how much random error might be in the scores around the true score (WWW10). In addition, it is the degree of how consistent the application when it comes to giving its purpose and the manner of displaying its output to the players. GADIMATH provides reliable content because the three jurors thoroughly verified all the questions that have been integrated into the game. They agreed that the questions are suitable for a particular topic. Also, the game underwent a series of a test run to ensure that it would produce an accurate result.

2.1.5 Interactivity

The interaction of the game begins when the players start to use the application and choose their avatar. GADIMATH allows the player to choose what they want to do with the game. As they click or tap any of the buttons within the game, interaction takes place. GADIMATH is a mobile application designed to give a better interaction with the players. The manner of collecting the potions, choosing the desired avatar, maneuver sounds, and music volume, answering the questions, and the selection for the best answer is what makes the game interactive.

2.1.6 Learning Reinforcement

Learning reinforcement allows users to achieve a goal in an uncertain, potentially complex environment (WWW05). GADIMATH aims to reinforce the student's knowledge about the fundamentals of discrete mathematics. This would also strengthen their ability to understand and comprehend the questions assigned to each level of the game. When answering the questions, students need to think well to come up with the correct answer and develop their critical and analytical thinking skills, which helps them comprehend and select the best answer.

2.1.7 Portability

Portability is a feature of the application where users have the convenience to access the system anytime. With this feature, students would be able to use the application in an offline mode, provided, they must install the application on their respective Android devices. GADIMATH can be transferred from one tablet to another, provided that it meets the specification required to run the application.

SYSTEM FEATURES

A product feature is the characteristics of the product that describes its appearance, components, and capabilities (WWW01). In addition, according to eNotes in 2010, the product features are the qualities that would make the product sellable or make it stand out among its competitors. It is longer-lasting or more durable. It is cheaper to operate, and it is better built. It has a particular function that is absent from other competitors, and so forth. In short, this aims to benefit the users as one of its critical traits while ensuring that it maintains the quality and value of the product.

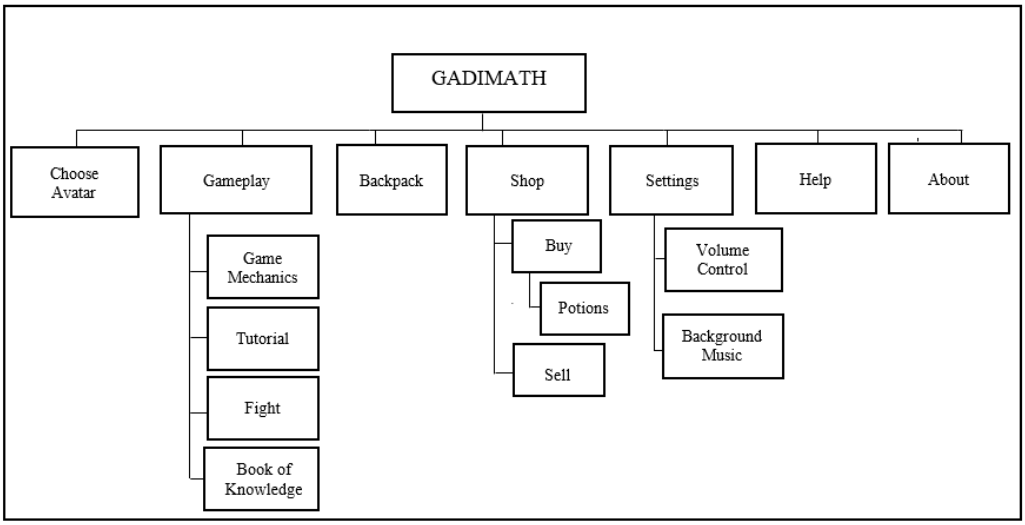

Figure 3. GADIMATH Decomposition Chart.

CONCLUSION

The proponent built the game to reinforce student's knowledge about the fundamentals of discrete mathematics. Also, students would be able to enjoy the game while learning. The game was developed using unity 3D, which is also compatible with a 2D environment. To cope up with the development time constraints, the proponent has provided schedules and timeframes that need to be done to attain the target date of the development. Research focuses on the data gathering that helped the proponent in the conceptualization of the game, programming source codes, and gather data used in the making of the questions that have been integrated into the game. The programming phase focused on the development of the different functionalities of the game, such as Keyboard detection in the gameplay, buying and selling mechanism using GADIMATH shop, data connectivity in the player's avatar, using potions during the gameplay, deadbots performance, and dungeon connectivity. As the proponent chose rapid prototyping as the development methodology, the proponent started developing by designing all the game interfaces and other game elements. The designs made are imported to the unity game engine that is being manipulated with animations and transitions. Also, the connectivity among the interfaces and process the different outputs needed. The proponent used the complexity table, which supervised the difficulty of the game. By the time that the proponent is done, implementing the different functionalities of the GADIMATH, identification of errors, bugs, and problems was performed. The proponent conducted a series of tests to qualify and improved the features of the game.

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