

**College of Computer Studies**

**Gordon College**

**SPECS Space: A COMPETITIVE CHALLENGE  
PLATFORM WITH GAME ELEMENTS USING  
PROGRESSIVE WEB APPLICATION  
FRAMEWORK.**

**A Software Project Presented By:**

Joshua A. Ayrán

Justin Louise R. Ferdes

Enrique Raymond T. Lumbang

John Ulysses N. Paruginog

Kanji Takahashi

**In partial fulfillment of the requirements for the degree of  
Computer Science**

**APRIL 2023**

## **CHAPTER I INTRODUCTION**

### **1.1 Project Context**

The Society of Programming Enthusiasts in Computer Science (SPECS) is a student organization under the College of Computer Studies at Gordon College. As the only organization under the Computer Science course, SPECS aims to promote skills, knowledge, and camaraderie among CS students, while establishing leadership among the SPECS officers and CS students – (SPECS, 2022). To achieve these goals, the researchers GigaTech has proposed to develop the application software “SPECS Space”, a competitive challenge platform with game elements.

By using gamification elements, such as points, badges, and leaderboards, the platform will motivate and recognize member participation, enhancing their engagement and learning. The use of gamification here in educational context has positive effects in student motivation, engagement, and learning outcomes in computer science education. In Ritter, Anderson, Kim, S., and Kim, S. I. (2014) study in “Gamification principles for computer science education”, gamification can increase student motivation and engagement by providing clear goals, feedback, and recognition, as well as creating a sense of challenge and fun. Gamification can also improve learning outcomes by promoting active learning, problem-solving, and retention of knowledge. Here by which the authors conclude that gamification can be an asset for enhancing computer science education.

In the same sense as gamification has effect on computer science student’s education. The same thing can be said to competition and challenges, when integrated

into game-based learning environment. This is explored by Papastergiou (2018) in his research where it is learned thru comprehensive review that competitive challenge platforms that incorporate gamification elements, such as leaderboards and rewards, can be particularly appealing to computer science students who are seeking to improve their skills and demonstrate their proficiency. This in turn will act as motivation for students to participate in SPECS Space.

A dedicated platform software application for student organization members can be highly beneficial for providing a space for them to improve engagement and interaction while also learning and competing. The findings of a study conducted by Nelson, Terui, and Quick (2021) in their research “An analysis of an online learning community for student organizations”. Here the effectiveness of an online learning community was seen to be effective and had positive impact in improving engagement and interactions, with users reporting increased communication, collaboration, and sense of community. The findings support the idea that online communities can help to foster a sense of belonging and motivation, while also competing, leading to increased involvement and success for student organizations.

## **1.2 Project Description**

The application is made for the SPECS members and will be handled by the SPECS officers. SPECS Space is an activity posting board with rankings or leaderboards that will be used to increase the interaction inside the organization. Similar application is

Stack league. According to Business World (2022), StackLeague tournaments are powered by StackTrek’s fully automated talent analytics and assessment platform. As

participants sign up and start solving, they will be tested in eight different areas, which include Simple Expression; Parsing and Regex; Standard Library Usage; Algorithms, Control Structures; Error Handling; Data Structures; and Object-Oriented Programming. The supported programming languages in the competition are JavaScript, Java, Python, C#, and PHP. The StackLeague tournament is free to join in and open to anyone with programming knowledge, whether a student, professional, or in between.

The approval and implementation of the application inside the organization was consulted by the Researchers to the SPECS officers and advisers. This process is necessary to make the application feasible and because the end-user of the application are the members of the said organization. Participation and interactions of the members inside the organization is essential for the betterment of the group. StateUniversity (2023) states that many schools and community organizations sponsor clubs for children and adolescents. These clubs provide opportunities for youth to participate in activities, interact with peers in a supervised setting, and form relationships with adults. Some clubs focus on a specific area, thus allowing members to develop their skills and interests in that area. Other clubs provide an array of activities from which children and adolescents can choose. SPECS Space will be having game elements and feature for the purpose of engagement and interaction of the member. The game elements will also induce the users to participate and use the application. Merriam-Webster dictionary defines that gamification is the process of adding games or game-like elements to something such as a task so as to encourage participation. The basic concept of gamification isn't new, but the word itself is a 21st-century addition to the English lexicon. The word refers to the incorporation of game elements, like point and reward systems, to tasks as incentives for people to participate. In

other words, gamification is about making something potentially tedious into a game. Gamification is effective because it taps into people's natural desires for competition and achievement. Teachers, managers, and others use gamification to increase participation and improve productivity. Gamification is also often an essential feature in apps and websites designed to motivate people to meet personal challenges, like weight-loss goals and learning foreign languages; tracking your progress is more fun if it feels like a game.

The term gamification can be used in two ways. The first way is by adopting the act of playing a video game into everyday use. The engagement levels and entertainment values of video gaming can motivate users to accomplish tasks that are normally viewed as boring, such as learning. Another definition of gamification is the act of using game elements to make non-games more enjoyable (Deterding, S., Dixon, D., Khaled, R., & Nacke, L., 2011).

The rewards system is some of the features of the application that will make the participants more active. The reward system will keep the members motivated to participate more in the organization's event. M. Lynch (2017) states that Gamification modifies the brain's reward and pleasure center and ameliorates learning. It is well established that games, whereby a person wins or receives positive feedback, can activate the brain's pleasure circuits by inducing the release of the neurotransmitter dopamine. Educational games are suggested to have the same influence given their elements of winning challenges or successfully achieving a goal. This pleasure during gamified education results thus in a long-lasting affinity for the academic subject or for solving otherwise complex problems.

Similar feature to the Stack League, the rankings of the users or the leaderboards will result to the competitiveness of the members. Top ranking students at the end of every event will receive recognition from the organization.

### **1.3 Scope and Limitation**

This study will cover the effects of implementing gamification improve the announcing of events and posting activities for CCS students at Gordon College. The respondents will be limited to Students, enrolled in Bachelor of Science in Computer Science, and a member of Society of Programming Enthusiast in Computer Science (SPECS). The academic year 2022-2023 set as a timeline to cover the research's activities and the system's development process.

The results of this research will apply only to the respondents of this study and will not be used to measure the academic success or participation of those who are not part of the population of the study. The respondents should be enrolled this academic year 2022-2023 in the College of Computer Studies at Gordon College - Olongapo City.

This study, however, is subject to several limitations, such as (1) personal issues or problems that the respondents may be experiencing which are not relevant or connected to the study, they may have limited time or resources to dedicate to the study or may be dealing with emotional or psychological distress, which can affect their responses; (2) internet connectivity, inconsistent bandwidth, high jitter, longer latency, and packet loss can negatively affect the user's experience ; (3) some users, especially those with visual or motor impairments or those without access to necessary technology; (4) the

system has a maximum number of users it can accommodate. In other words, there is a maximum capacity that the system can handle, and once that limit is reached, the system will not be able to accommodate any more users.

## **1.4 Objective**

The general objective is to produce a web-based application of Gamified Challenge Platform System for the Society of Programming Enthusiasts in Computer Science (SPECS) in Gordon College Olongapo City that aims to help the SPECS Organization to post and bring the students more active and unite while also learning in the process of competing. The Gamified Challenge Platform Application Software will provide primary features such as uploading of tasks and tracking of work submissions. However, the Gamified Challenge Platform System will provide unique features such as gamification and collaborative work to help the members of SPECS to compete, unify and bond together.

Specifically, it aims to:

1. Design the Gamified Challenge Platform System with the following

features:

- Mobile web-app version for easy access
- Posting Board System

- Leaderboards
- Gamification (Character progression, leveling up, Gaining Experience,

Achievements)

- Collaborative activities (Uploading Group Tasks, Events or Activities)
- Data Security
- Reward System
- Assessment (Checking of Group Leader to the finished activities)
- Student Login
- Notifications

2. Create the Gamified Challenge Platform System within ten months timeframe.

3. Test and improve Gamified Challenge Platform System by using a testing plan.

4. Assess the implementation of the Gamified Challenge Platform System by adopting the ISO 25010 software quality model and Technology Acceptance Model.

5. Deploy the Gamified Challenge Platform System to GC SPECS for use of Student.



## **CHAPTER II**

### **FRAMEWORK OF THE STUDY**

This chapter presents the review of related literature and studies underlying the framework of the study. It includes the conceptual model of the study and the definition of terms.

### **REVIEW OF RELATED LITERATURE AND STUDIES**

#### **Gamification**

Gamification is a process of using game elements, design, and mechanics in nongame contexts to engage and motivate users to achieve their goals (Deterding, Dixon, Khaled, & Nacke, 2011). Game-like elements can include points, badges, leaderboards, challenges, and narratives that are used to enhance users' enjoyment, motivation, and participation in non-game contexts (Seaborn & Fels, 2015). The primary goal of gamification is to make tasks or systems more enjoyable, engaging, and interactive by providing users with a sense of progress, achievement, and feedback (Kapp, 2012).

As stated by Avila-Pes'antez et al. (2017), Games were created as rule-based systems that attracted players, with the primary purpose of entertainment. But with the successful growth of digital games, new designs are emerging with a developmental approach that supports education. In this perspective, there are Serious Games that focus on solving challenges created with quantifiable results, which are designed in various ways, with the purpose of supporting education, concerning the learning and instruction axes. With technological advancement, the massive increase of mobile devices and game consoles at homes, schoolchildren spend more time on game-related activities, which is a

necessity for new forms of education and training to be supported by the metaphor of games, or gamification of learning in different context. As to Dr Zachary FitzWalter, (2021), Gamification is the use of game-design features and gaming principles in situations that are not game-related. It can also be described as a collection of methods and procedures for resolving issues by utilizing or putting to use game mechanics. For thousands of years, games and game-like components have been used to educate, entertain, and engage people. Points, badges, and leaderboards are a few of the traditional game components. Additionally, to Landers (2014), The theory of gamified learning supplies a theoretical framework to test the effect of gamification measures on learner behaviors and attitudes, as well as the impact of these behavioral and attitudinal changes on learning. Random assignment to leaderboards sustained a causal effect. Students with leaderboards interacted with their project 29.61 times, on average than those in a control condition. In addition to that, using the game element of Leaderboards can be used to improve course performance under certain circumstances. Gaming is remarkably popular. Many people play video games, and it does not include non-digital games like card games, board games, or children's games like tag or hide-and-seek. University of Waterloo (2021) states that, Gamification is the implementation of game aspects such as leaderboards, badges, point systems, and other game-related elements into "conventional" learning activities to boost motivation and engagement.

### **Effects of Gamification**

As discussed by to Elshiekh and Butgerit (2017), Gamification is the application of game elements in non-gaming contexts. It is employed in a variety of disciplines, including

business, health, and education. The difficulty of learning a programming language has long been present, and scholars are working to overcome it. Most instructors agree that teaching programming has a difficulty, and many pupils are unable to understand programming logic. So, there must be a way to motivate them. Students must be motivated to learn and exchange ideas. Gamification is a tool that is used to inspire and engage students.

In addition to that, Langendahl et al., (2017) states that gamification can be used in educational practices to inspire and engage students in learning activities involving interdisciplinary collaboration on concerns of sustainable development. More specifically, gaming characteristics other than points, levels, and leaderboards (such as obstacles, story, various pathways, and a sense of progress) can be used in teaching sessions to increase student involvement. Such gaming aspects might be employed in educational activities (for example, seminars and cases) to engage students in multidisciplinary collaboration. Gamification can encourage students to participate in the classroom, provide teachers with better tools to lead and reward students, and encourage students to commit their whole selves to the quest for knowledge. It may show them how education can be a joyous experience, and the blurring of informal and formal learning bound can inspire students to learn in life wide, lifelong, and life deep ways. (Lee & Hammer, 2011)

As pointed out by Blankman (2022), Gamification in education means that educators apply game design elements to an educational setting. The goal is usually to make learning more fascinating. There is in fact a range of elements that games might have, with different players being attracted to different elements. Researcher Dr. Nick Yee proposed one way to model the elements of what motivates gamers: Action (e.g., objectives), Social

(e.g., competition), Mastery (e.g., scoring), Achievement (e.g., awards), Immersion (e.g., roleplaying), Creativity (e.g., customization). In the findings of the study of Kaya & Ercag, (2023) Gamification boosts student participation, interest, and motivation in learning settings and contributes to the collaborative learning process, particularly in distant learning. (Brewer et al., n.d.) conducted research to evaluate the impact of gamification on children. To address the issue of children's lack of motivation, the score and prize systems were included in the experimental tasks. The results show that using gamified systems boosted work completion rate from 73% to 97%. As a result, gamification aided in increasing children's drive to complete tasks. As noted by Quian and Clark (2017), Game-based learning refers to an environment where gaming activities contain problemsolving scenarios and challenges that give players/learners a sense of accomplishment as well as game content and game play that facilitate the acquisition of knowledge and skills.

A gamification platform was established by Berkling and Thomas (2013) and used to instruct the students. They were introduced to a web-based learning platform that included game dynamics, such as status, achievements, and competitiveness, as well as game features, such as points, levels, progress, and leaderboards. To scale the success of the new teaching strategy, they conducted a survey. The result showed that they did not find it useful and generally not interested in such a gamified setting. Additional research was conducted. Avila-Pes'antez et al. (2017) Between 2008 and 2016, 11 studies in the context of higher education examined the serious game design approaches (one model, three frameworks, and seven techniques) that were suggested. Brief summaries of the covered design methods were given, followed by stage-by-stage comparisons. The categorization of 31 different game design stages into four phases (analysis, design,

development, and evaluation), with the features/issues/aspects discovered for each step, is the study's most important finding. Although they are not fully addressed, some design phase components are relevant to the design principles discussed in our study. Moreover, "Avila-Pes" Antez et al. do not cover game motivators.

As discussed by Buljan (2021), Gamification psychology is a field that studies the behavior of users in gamified systems. In other words, it focuses on how to understand and influence people's behaviors through gaming methods. Studies have shown that the brain works in harmony with gamification and that it triggers the release of dopamine, which gives players a raised feeling of motivation and enjoyment. In the study of Buljan (2021) there are five things that show how exactly do they work together (1) Gamification Creates

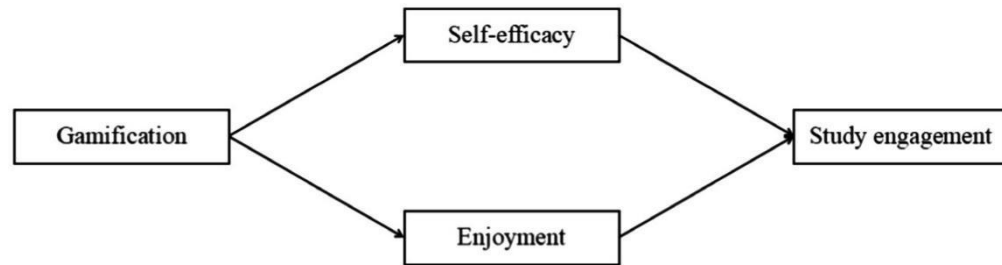
Emotional Connections Between Individuals. An effective tool for learning is emotion. They aid in more efficient knowledge encoding and retrieval, which greatly increases the effectiveness of learning. Students and the information become emotionally connected thanks to gamification. It has a significant impact on people's attention, which increases their openness to learning. (2) The Hippocampus Regulates Memory. The area of the brain that regulates how much information we remember, or recall is called the hippocampus. Therefore, it should come as no surprise that gamification aids in improving learning retention among pupils. The hippocampus memory is stimulated by gamification, which aids in the retention of new knowledge in long-term memory. (3) The brain processes stories more easily than facts. Stories are processed by the brain more quickly than lists of facts. (4) Playing video games enhances endorphin release. Natural painkillers known as endorphins also enhance focus, calmness, and relaxation. Gamification techniques increase endorphin release, which helps to create a setting that is perfect for concentrated learning.

(5) **Playing Video Games Maintains Brain Health** Playing video games enables neuroplasticity, the brain's capacity to adapt to various stimuli and create new connections. Stronger brain connections, improved memory and concentration, improved creativity and problem-solving abilities, and a reduction in age-related cognitive decline are all benefits of this type of training.

### **Game Design Principle**

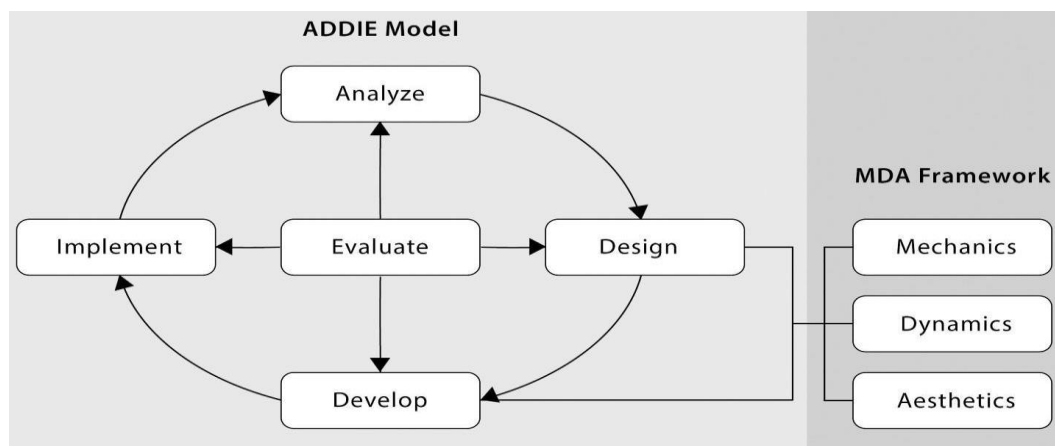
According to the author Laine & Lindberg (2020), To create a sense of challenge and the capability of connecting important aspects to describe the interpretation of challenge-based game design, game design concepts should be used. Self-efficacy will make students have strong self-confidence, always have confidence in completing tasks, and are willing to make efforts to complete them successfully. Self-efficacy will make students have strong self-confidence, always have confidence in completing tasks, and are willing to make efforts to complete them successfully. Similarly, students with low self-efficacy will immerse themselves in the loss of motivation after facing setbacks and difficulties. The result is that they face failure, and their self-confidence is further reduced. In addition, there is a significant correlation between self-efficacy and learning factors such as academic performance and ability improvement. The strength of self-efficacy will affect students' academic performance. Students who improve their self-efficacy will be more likely to obtain better professional results and could self-regulate. Moreover, the strength of self-efficacy affects the level of effort students make to determine behavior. People with high self-efficacy make a tremendous effort to make their own decisions. University students with high self-efficacy have correspondingly higher expectations for learning, and

they believe that through their unremitting efforts, they will be able to achieve learning goals that are consistent with their ability levels (Chen & Liang, 2022).



**Figure 1.** The theoretical model in this study.

This study is G-Class as a gamified e-learning material was developed and implemented in a methodical manner utilizing the ADDIE model of instructional design and the MDA framework of game design. The results of the survey received a positive acceptance from the participants. With the self-report measurement of the participants' motivation, the e-learning material, to some extent, improved their engagement or motivation toward the activity (Aries, 2020). Figure 1 shows the ADDIE model with the incorporation of the MDA framework.



**Figure 2.** ADDIE model with the integration of the MDA framework. ADDIE: Analysis–Design–Development–Implementation–Evaluation; MDA: Mechanics–Dynamics–Aesthetics.

Figure 2 show the Analyze, Design, Develop, Implement, and Evaluate or the abbreviation "ADDIE." It is a model of instructional design that has endured use and the test of time. It is merely a "device" to aid in our course design thinking. (University of Washington Bothell, 2020)

As noted by Hunicke et al., (2004) The difference between games and other entertainment products (such as books, music, movies, and plays) is that their consumption is relatively unpredictable. The string of events that occur during gameplay and the outcome of those events are unknown at the time the product is finished. The MDA framework formalizes the consumption of games by breaking them into their distinct components:



and establishing their design counterparts:



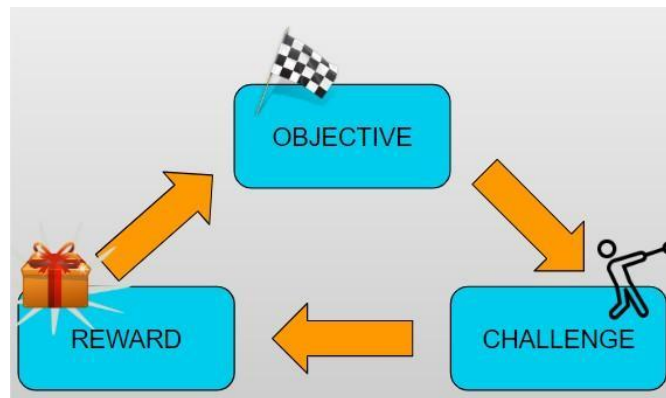
- Mechanics describes the components of the game, at the level of data representation and algorithms.
- Dynamics describes the run-time behavior of the mechanics acting on player inputs and each other's outputs over time.
- Aesthetics describes the desirable emotional responses evoked in the player when she interacts with the game system.



## Gamified Rewards System for Motivation

The player's motivation is crucial since it will determine whether they begin playing your game and continue to do so for an extended period of time. The practice of inspiring someone to perform and continuing performing certain acts is known as motivating them. A successful videogame motivation system will satisfy the player's needs and encourage them to engage in the game and keep playing it.

This is often defined as your core gameplay loop or the OCR of your game. (1) Objective: Give a clear and identified goal to the player. (2) Challenge: Create a fun and identifying goal to the player. (3) Reward: Give rewards to reinforce and reengage the player (Daniel 2019)



**Figure 3.** OCR of Games

One of the stated game elements of the application is the rewards which will be granted to the students that will correctly answer the questions. Further recognition will be given to the top students in the leaderboards. Learning Theories (2022) states that the phrase game reward systems describe the structure of rewards and incentives in a game that inspire intrinsic motivation in the player while also offering extrinsic rewards. Game reward systems can be modeled in non-game environments, including personal and

business environments, to provide positive motivation for individuals to change their behavior.

Rewards system differs in different games; in the case of the application, points and experience are given to the players. Similarly, (Wang, H., & Sun, C. T., 2012) Examples of videogame rewards include virtual items received after completing World of Warcraft (Blizzard, 2004) quests, added points and visual effect after clearing block lines in Tetris, and finding treasure items in secret hiding places in the Super Mario Bros series (Nintendo). Reward systems can be viewed as player motivators or as compromises for easing disappointment. In modern video games, reward systems also provide social meaning within and outside of games (Reeves & Read, 2009; Salen & Zimmerman, 2004). To our knowledge, there is plenty of information and multiple theories in the psychology literature on optimal experiences, intrinsically motivating environments, sense of accomplishment, satisfaction, choice, and other concepts that reward system designers can take advantage of. Reward mechanisms provide sense of fun by fostering intrinsically rewarding experiences and are equally or more important than the extrinsic rewards that are distributed.

D. Garaialde(2021) states that rewards such as points, levels, badges, quests, and leaderboards are usually paired with other types of visual feedback in order to motivate repeated engagement(Tondello and Nacke, 2018). These techniques have been shown to be successful in motivating users to open an app more frequently, spend longer amounts of time using an app, or in increasing levels of participation (Johnson, Deterding, Kuhn,

Staneva, Stoyanov, Hides, 2016, Lewis, Swartz, Lyons, 2016, Looyestyn, Kernot, Boshoff, Ryan, Edney, Maher, 2017, Seaborn, Fels, 2015). Gamification techniques are

particularly popular in contexts where rewards are delayed, such as education (Barata et al., 2013) and exercise (Koivisto and Hamari, 2014), and attempt to provide rewards in the short term to motivate users to stay engaged with the application.

### **SPECS Space as Organizational Interaction**

The application advocates the interaction between each SPECS member and

officers which are all students in the school. Members can learn from participating in the applications activity posting feature. As a study by the SSVM World School (2022) states that, students learn from each other. Whether they are working on one project or separately, everyone is able to learn from each other during club activities. They are not only receiving insights from their teachers or club advisers but also from their classmates and peers. They gain new perspectives and learn the importance of respecting another person's viewpoint. School clubs create small communities. They attract people who share the same interests such as in music, arts, or sports. Club activities help students develop sense of unity and teamwork, learning how to work with others in reaching the same goals.

Huang and Hao (2019) conducted a study to examine the relationship between organizational identification, knowledge sharing, and innovative behavior in student organizations. The researchers collected data from 315 undergraduate students from various student organizations in a Chinese university using a self-administered questionnaire. The results of the study showed that organizational identification was positively related to both knowledge sharing and innovative behavior among students in student organizations. Specifically, students who identified strongly with their

organizations were more likely to share knowledge with other members and engage in innovative behavior that could benefit the organization. Moreover, the study found that the relationship between organizational identification and innovative behavior was mediated by knowledge sharing. In other words, students who identified strongly with their organizations were more likely to share knowledge with other members, which, in turn, increased their innovative behavior.

This is expanded further in a study by Guerin and Russell (2019). This study examines the impact of group membership on leadership development among university students involved in student organizations. The researchers find that students who are actively engaged in their organizations and feel a sense of belonging to their group are more likely to develop leadership skills and experience personal growth. The researchers also found that the impact of group membership on leadership development was mediated by students' sense of belonging to their organization. In other words, students who felt a stronger sense of belonging were more likely to develop leadership skills and experience personal growth because of their group membership. Overall, these findings suggest that group membership can have a positive impact on leadership development and personal growth among university students. By fostering a sense of belonging and providing opportunities for engagement, student organizations can help students develop valuable skills and competencies that will benefit them both personally and professionally.

## **Challenge Platform & Competition**

A challenge platform is an online platform that provides opportunities for users to participate in competitive challenges related to various fields, such as coding, data analysis, and business strategy. These challenges are designed to assess and enhance the participants' skills and knowledge while promoting engagement and motivation through competition (Chen, J. H., & Chen, Y. L., 2021).

Online programming contests have become increasingly popular as a tool for enhancing computer science education and preparing students for careers in the technology industry. Li et al. (2016) investigated the impact of an online programming contest on student learning outcomes in a study involving 81 undergraduate students from a Chinese university. The authors collected data on the students' contest performance, programming skills, and self-reported learning outcomes before and after the contest.

The study found that participation in the online programming contest had a positive impact on students' learning outcomes. Students who participated in the contest showed a significant improvement in their ability to solve programming problems, as measured by the number of problems they solved correctly and the time they took to solve them. Furthermore, the contest improved students' coding skills, as evidenced by their ability to write clean, efficient code that followed best practices. Students who participated in the contest also reported increased motivation and engagement in learning, as well as improved confidence in their ability to solve programming problems and write clean code.

The results of this study suggest that online programming contests can be an effective way to improve students' problem-solving and coding skills, as well as increase their motivation and engagement in learning. The study highlights the potential of online

challenge platforms as a tool for enhancing computer science education and preparing students for careers in the technology industry. The findings of this study can be used by educators to design and implement effective online programming contests as part of their computer science curricula.

The study conducted by Hsu et al. (2017) investigated the impact of a coding competition on students' motivation and engagement with programming tasks. The researchers recruited 34 undergraduate students from a computer science course at a university in Taiwan and divided them into two groups: one group participated in a coding competition, while the other did not. Before and after the competition, the researchers measured students' motivation and engagement using a survey and a coding task. The survey measured students' intrinsic motivation, perceived competence, and perceived autonomy, while the coding task assessed their engagement with programming tasks.

The study found that the students who participated in the coding competition had higher levels of intrinsic motivation, perceived competence, and perceived autonomy compared to the control group. Moreover, the participants showed higher engagement with the programming task after the competition than before. This study suggests that coding competitions can be an effective way to motivate and engage students in programming tasks. The competitive nature of the platform may provide a sense of challenge and excitement that can drive students to put more effort into their work. Additionally, the sense of community created by the competition may foster a more positive learning environment, which can further increase student motivation and engagement. The researchers also found that the competition helped to create a sense of community among the participants, which in turn contributed to their motivation and engagement. Participants reported feeling a

sense of camaraderie with their fellow competitors and expressed a desire to continue participating in similar competitions in the future.

Additionally, another research explores the effects of a competitive coding platform, for example Codeforces, on undergraduate students' academic performance, coding ability, and engagement in the course in the paper "Exploring the Impact of a Competitive Coding Platform on Student Performance," Zhu et al. (2021). The study involved 160 students enrolled in an algorithm design and analysis course at a Chinese university. The findings imply that platforms that encourage students to compete in their coding skills, such as Codeforces, can be an effective means of strengthening computer science instruction and raising students' coding proficiency, engagement, and academic success. The study's conclusions have significant ramifications for academicians and organizations working to enhance computer science instruction and get students ready for the quickly developing technology sector.

### **Gamification and Competitiveness in Learning in Philippines**

A study that explores the effects of gamification and competitive learning in the Philippines by Paulo P. Salazar and Christian Baluran (2019) in their research paper "Gamification and Competitive Learning in Filipino Higher Education,". Here they were able to discover that it boosts student motivation and engagements. The gamification and competitive learning in were applied to higher education in the Philippines with the aim of determining how well these strategies perform in terms of boosting student motivation, engagement, and academic success. Here they conducted surveys in which they also held focus group talks as part of its mixed-methods technique. It included 214 undergraduate

students from a university in the Philippines, while the focus group discussion had 10 students who participated in a gamified and competitive learning exercise. Here through the study of the results, they were able to determine that that gamification and competitive learning can improve student engagement, motivation, and academic performance. The results showed that majority of the students felt that the methods employed were useful in improving their learning time and academic performance. The focus group discussion showed that competitive learning and gamification encouraged students to work harder in their academic endeavors by fostering a sense of camaraderie and healthy competitiveness. The focus group discussion highlighted that competitive learning and gamification encouraged students to work together and engage in healthy competition, which encouraged them to excel in their academic pursuits.

The study also identified several factors that contribute to the effectiveness of gamification and competitive learning, such as the relevance of the gamified activities to the course content, the availability of rewards and incentives, and the use of a leaderboard to track student progress and performance.

Another study in the Philippines regarding improving education by gamification is by Kyle Patrick C. Barrios (2018). In the research paper titled "Enhancing Education in the Philippines through E-Learning and Gamification", while not explicitly saying the positive effects is definite. It suggests that through E-learning and gamification, problems that traditional teaching have such as lack of student interest, low retention rates, and limited access to educational resources can be addressed. While also exploring the other potential benefits including increasing student satisfaction, promoting a sense of achievement, and encouraging healthy competition among students. It also notes the importance of



incorporating game elements that are relevant to the course content and align with learning objectives.

According to Placino (2011) Since the arrival of home video game technology in the Philippines in the 1970s and 1980s, digital games have been an integral element of Philippine culture. Those who used Atari's home video gaming consoles still have warm memories of them. The commercial success of "Pong" paved the way for a plethora of subsequent home video games. The introduction of "Pong" symbolizes how digital games have changed Filipino perceptions. Filipinos continue to play digital games using different platforms such as Family Computer, Brick Game, Game Boy, Tamagotchi, PlayStation,

Xbox, Wii, Personal Computers, and even cellphones. Online Gaming is also a big part of Filipino culture. In a press release by Xinhaunet, the estimated number of online gamers in the Philippines in 2008 is 6.3 million. Another recent phenomenon is the proliferation of social gaming on social networking sites such as Facebook. Reuters reports that Zynga, a social game developer (Farmville, Mafia Wars, etc.) is valued at between \$3 billion to over \$5 billion. These are largely popular and recurrent in the Filipino digital culture.

While many businesses are now adopting game mechanics to considerable effect, experts agree that students could also benefit from the gamification of education. Online social learning platform Brainly has been using game elements to help students since 2009.

Initially launched for Polish schoolchildren as "Zadane.pl", Brainly has grown to over a dozen websites, with 26 million users across more than 35 countries. One of those countries is the Philippines, as Brainly's recent expansion into Asia has given rise to our very own Brainly.ph. Created for Filipino elementary and high school students, the website

aims to provide homework assistance on subjects ranging from Science and Mathematics to Philippine History. (LOGARTA, 2015)

This research project, titled "Online Quest Game as A Tool for Enhancing Learning In Research," set out to find out how well an online quest game could be used to improve learning in research classes for students. It can be inferred from the quantitative results that online quest game-based learning can improve students' cognitive learning. The findings indicated that including game aspects in online classes can raise the degree of courses' student appeal, achieving the goal of raising learning. Even though it only included a small sample and a short period of time, the study is aware of its limitations. To ascertain whether the outcomes change over time and the causes if they do, future researchers will need to perform more studies that take place over a longer period of time and undertake the intervention on larger samples. Future studies may examine additional platforms for online gaming and use them in different subject areas. (Jabonero, 2022).

### **Hypertext Preprocessor (PHP)**

PHP (Hypertext Preprocessor) is a server-side scripting language that is widely used for web development. It is an open-source language that can be embedded into HTML code to create dynamic web pages. PHP is often used to interact with databases, process forms, and handle user input on web pages.

In the study by Andrew Binstock(2009), he discusses the benefits of using PHP in ""Why Use PHP?". Here he outlines in the study that PHP has a number of significant benefits, including as simplicity, adaptability, and compatibility with a variety of databases and web servers. In comparison to other programming languages, PHP has a relatively low

learning curve, which makes it a desirable option for developers who are new to web development. It also emphasizes the fact that PHP has a sizable and vibrant developer community that has contributed to its advancement and produced a wide range of libraries, frameworks, and tools that make it simpler to use.

### **Cascading Style Sheets (CSS)**

CSS (Cascading Style Sheets) is a style sheet language used for describing the look and formatting of a document written in a markup language. In web development, CSS is used to style HTML documents, controlling the layout, fonts, colors, and other visual elements of a web page.

In Yoon, Y., & Kim, J. (2018). The Effect of CSS Quality on Web Accessibility. They discovered that CSS code quality has a significant effect on the accessibility of web pages. Specifically, the authors found that high-quality CSS code, characterized by good readability, consistency, and maintainability, is associated with better web accessibility. Additionally the study also revealed that using CSS for web development has several benefits, such as improving the separation of content and presentation, facilitating the maintenance of web pages, and enhancing the user experience.

### **Javascript**

JavaScript is a high-level, object-oriented programming language used primarily for creating dynamic and interactive web pages. It is a scripting language that can be embedded into HTML and executed by web browsers to perform a variety of tasks, such

as validating user input, changing the content of web pages on-the-fly, and creating animations and interactive visual effects.

The ability of JavaScript to interact with a web page's Document Object Model (DOM), which enables real-time manipulation of the content and structure of online pages, is one of its key characteristics. Through the usage of tools like Node.js, JavaScript is also used to develop sophisticated user interfaces, client-side validation, and server-side programming.

### **Node.js**

Node.js is a server-side runtime environment for executing JavaScript code. It is built on the V8 JavaScript engine, which is also used by the Google Chrome web browser. One of the key features of Node.js is its event-driven, non-blocking I/O model, which allows for efficient handling of a large number of simultaneous connections without the need for multi-threading. Node.js also has a rich library of modules and packages, which can be easily installed and used in applications.

Node.js can be used to build a variety of applications, including web servers, real-time communication applications, streaming services, and more. It has become a popular choice for developing scalable and efficient server-side applications due to its flexibility, performance, and ease of use. Jadhav, G., & Gonsalves, F. (2019)

### **React Framework**

React JS is a popular JavaScript library that has gained immense popularity among developers due to its powerful features and ease of use. A study that has explored

the use of React JS and its positive effects on web development is by Avik Ganguly and Dibakar Dey (2020). "The Impact of Using React JS on Web Development Productivity" is a research paper published in the International Journal of Computer Science and Information Technology Research in 2020. The study aimed to explore the impact of using React JS on web development productivity, with a focus on the time and cost savings achieved by organizations that adopt this framework. With their study they were able to discover that can lead to cost savings for organizations that adopt this framework. And the study suggests that for web developers, React JS is a potent framework that may dramatically increase productivity and cut down on development time. Additionally, this framework is a very appealing choice for companies trying to streamline their web development processes due to the cost savings realized by corporations that use it.

### **Progressive Web Application**

Oktavia (2020) developed a web-based learning media using progressive web application (PWA) technology for vocational high school students. The study aimed to create a platform that could improve students' learning outcomes and provide an interactive and engaging learning experience. The researcher utilized the PWA framework, which enabled the web-based application to function offline, with a fast-loading speed and seamless user experience. The study involved 60 students from a vocational high school in Indonesia, and the results showed that the use of PWA technology in developing the web-based learning media was effective in enhancing students' learning outcomes. The PWA framework provided a seamless experience for the students, which led to higher engagement levels and better retention of knowledge. This study highlights the potential

of PWA technology in developing web-based educational tools that are interactive, engaging, and effective. It suggests that PWA frameworks can be used to create learning platforms that offer a better user experience and can contribute to improved learning outcomes.

Fagerholm et al. (2017) conducted a study to investigate the impact of coding contests on students' coding skills and performance. The study involved 102 undergraduate computer science students who were randomly assigned to either a control group or a group that participated in a coding contest. Before and after the coding contest, the participants completed a coding task that involved implementing a simple web application. The researchers assessed the participants' coding performance based on their completion time, accuracy, and code quality. The results of the study showed that the participants who participated in the coding contest performed better on the subsequent coding task than those who did not. Specifically, the participants who participated in the contest completed the task faster, had fewer errors, and wrote better quality code compared to those who did not participate. The researchers suggested that the competitive nature of the coding contest may have motivated the participants to put in more effort and practice more than they would have otherwise. Moreover, the contest may have provided a more realistic and challenging task than the traditional programming assignments, which may have led to more effective learning. The study by Fagerholm et al. (2017) suggests that coding contests can be an effective way to improve students' coding skills and performance. The competitive nature of the platform may provide a sense of challenge and excitement that can drive students to put more effort into their work. Moreover, the contest may provide a more realistic and challenging task than traditional programming assignments, which can lead to more

effective learning. It's worth noting that the study focused on undergraduate computer science students and the results may not be generalizable to other populations or educational settings. Nevertheless, the study provides valuable insights into the potential benefits of coding contests for improving students' coding skills and performance.

The study by Leng and Li (2019) provides an in-depth analysis of the benefits of Progressive Web Application (PWA) framework, with a particular focus on the React based PWA framework. PWAs are web applications that can be accessed through a web browser but have the functionality of a native app, offering features such as push notifications, offline functionality, and smooth user experience. The study examines the advantages of using PWA frameworks, including improved performance, faster loading times, and ease of installation, which can help improve user experience and retention. The authors also highlight the importance of using a PWA framework for ensuring cross-device compatibility and accessibility, which can be particularly beneficial for users who access web applications on multiple devices. The study also discusses the implementation of the React-based PWA framework and how it can help developers create high-quality web applications. The authors emphasize the importance of using modular components and code reuse, which can help streamline the development process and reduce the likelihood of errors or bugs. The React-based PWA framework also allows for the use of JavaScript libraries and tools, such as Redux and Webpack, which can further improve the development process and enhance the overall user experience.

The study by Lai and Lee (2019) aimed to investigate the benefits of using PWA framework in mobile application development. The authors conducted an empirical study to evaluate the performance and usability of PWAs compared to traditional mobile web

applications and native mobile applications. The results of the study indicated that PWAs had significantly better performance and usability compared to traditional mobile web applications. PWAs also had comparable performance and usability to native mobile applications, particularly in terms of loading times and user engagement. The study also identified some of the key benefits of using PWA frameworks, including the ability to work offline, improved user experience, and cross-platform compatibility. The authors suggest that these benefits can help to improve user retention and engagement, as well as increase the reach of mobile applications across multiple platforms.

### **System and Software Quality Requirements and Evaluation (SQuaRE) Model**

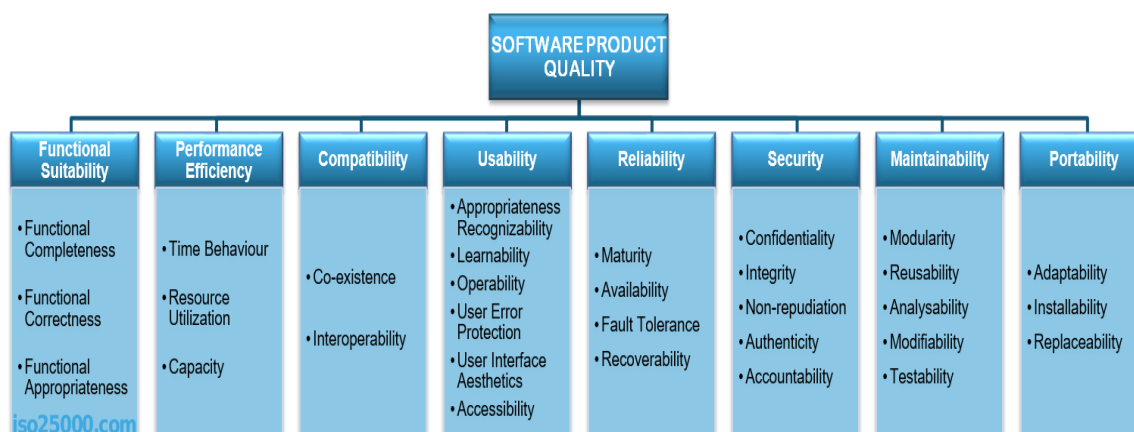
The System and Software Quality Requirements and Evaluation (SQuaRE) Model is a comprehensive set of international standards developed by the International Organization for Standardization (ISO) that provides guidelines for the evaluation of software quality characteristics and metrics (Nasr & Tawileh, 2018). The model covers a wide range of quality characteristics, such as functionality, reliability, usability, efficiency, maintainability, and portability, and includes several standards that focus on different aspects of software quality (Bakar & Hussin, 2016).

One of the key benefits of the SQuaRE model is its flexibility and adaptability to a wide range of software development processes, making it a useful tool for software developers, testers, and quality assurance professionals (Nasr & Tawileh, 2018). The SQuaRE model provides a framework for measuring and evaluating software quality, which can help



improve the quality of software products and increase customer satisfaction (Bakar & Hussin, 2016).

The product quality model defined in ISO/IEC 25010 comprises the eight quality characteristics shown in Figure 4:



**Figure 4.** ISO/IEC 25010 product quality model

A study published in the International Journal of Advanced Computer Science and Applications concluded that using ISO/IEC 25000 can improve the overall quality of software products and increase customer satisfaction. The study found that using ISO/IEC 25000 can help software development teams prioritize quality characteristics, leading to the development of software products that better meet the needs of end-users.

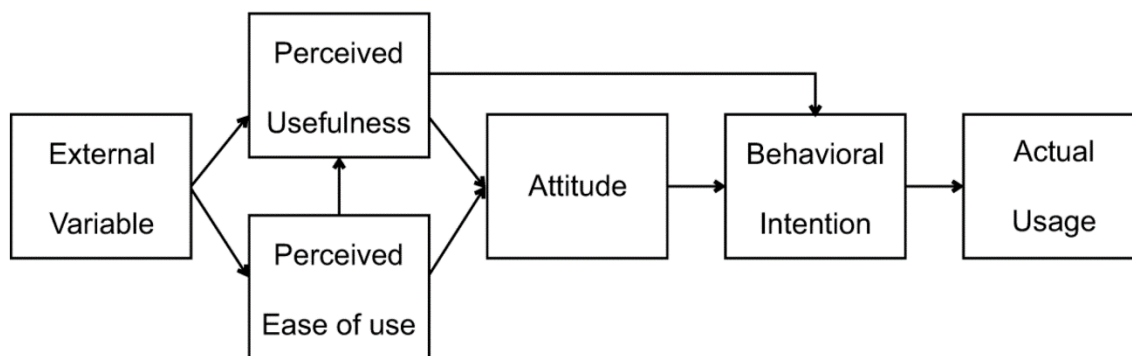
### Technology Acceptance Model

The Technology Acceptance Model (TAM) is a popular theoretical framework for understanding user acceptance and adoption of new technologies. TAM helps identify the factors that influence users' attitudes and intentions toward using a new technology, which

can help organizations and developers design more user-friendly and effective systems (Davis, 1989).

TAM is useful for several reasons. First, it emphasizes the importance of perceived usefulness and ease of use in determining user acceptance of technology. Second, it is relatively easy to apply and can be used in a wide range of settings, including healthcare, education, and business (Venkatesh & Davis, 2000). Finally, TAM has been shown to have high predictive power in numerous studies and has been used to explain user behavior across a variety of technologies (Venkatesh et al., 2003).

By using TAM, organizations and developers can gain a better understanding of users' attitudes and intentions toward a new technology and design systems that are more likely to be accepted and adopted by users.



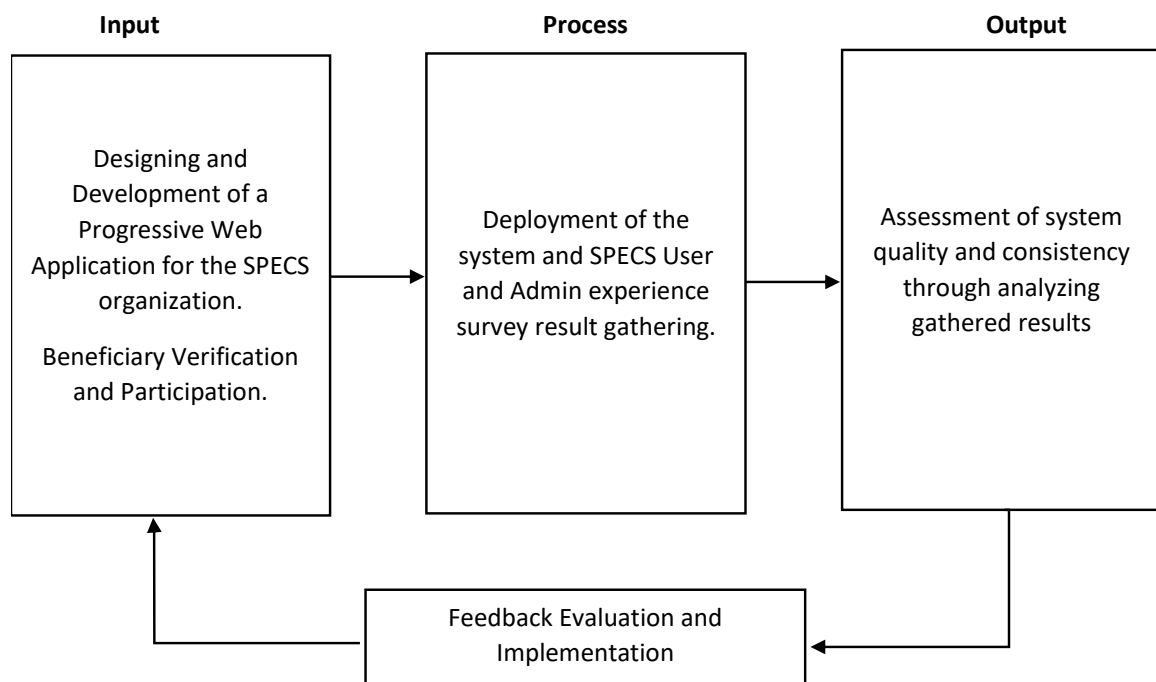
**Figure 5.** The Technology Acceptance Model

As depicted in Figure 5 of the TAM, Perceived usefulness refers to the extent to which users believe that a technology will enhance their performance or make tasks easier to accomplish. Perceived ease of use, on the other hand, refers to the extent to which users believe that using a technology will be easy and require minimal effort (Davis, 1989). Both

of these constructs are believed to directly influence user attitudes and intentions toward using a technology. By considering these various constructs, the TAM can provide a comprehensive understanding of the factors that influence user acceptance and usage of new technologies. This understanding can help organizations and developers design more user-friendly and effective systems.

### Conceptual Model of Study

On the basis of the foregoing concepts, theories, and findings of related literature, studies presented and insights taken from them. Figure 6 shows the conceptual framework for the study.



**Figure 6.** Paradigm of the Proposed Study

## Definition of Terms

**ADDIE Model.** In game design the Mechanics-Dynamics-Aesthetics framework is a tool used to analyze games. It formalizes the consumption of games by breaking them down into three components: Mechanics, Dynamics and Aesthetics.

**Challenge Platform.** It refers to an online platform that provides a space for individuals or teams to participate in various types of challenges. These challenges can take many forms, such as coding challenges, design challenges, or innovation challenges, and are typically offered by companies or organizations as a way to engage with a broader audience, crowdsource solutions, or identify potential talent.

**Code.** It refers to the written instructions that a programmer creates using a programming language to direct a computer to perform a specific task or function.

**Games.** Games or Video Games refers to an electronic game in which it involves interaction where players control images on a video screen activity engaged in for diversion or amusement

**Game Elements.** It refers to elements that games uses in their system for players such as points, rewards, quests, badges, and leaderboards.

**Gamification.** It referts to the process of adding games or gamelike elements to so as to encourage participation

**Programmer.** It refers a person who writes computer code to create software, applications, websites, and other digital products.

**Progressive Web App (PWA).** It refers to a web application that looks and behaves as if it is a mobile app. PWAs are built to take advantage of native mobile device features, without requiring the end user to visit an app store, make a purchase and download software locally.

**Reward System.** It refers to the structure of rewards and incentives in a game that inspire intrinsic motivation in the player while also offering extrinsic rewards

**Student.** It refers to person who is enrolled in a school, actively engaged in learning or obtaining a degree or diploma.

**The Society of Programming Enthusiasts in Computer Science (SPECS).** is a student organization under the College of Computer Studies at Gordon College. It is the only organization under the Computer Science course.

**Web Application.** It refers to a computer software program that executes a specific function through a web browser. These types of applications are commonly found on various websites and are sometimes referred to as "web apps." An instance of a straightforward web app is a contact form that can be found on a website.

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