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Development of Augmented Reality Programming Language using Agile Scrum Methodology

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ABSTRACT

The agile scrum methodology for augmented reality development increases project team efficiency. Private campus are frequently confronted with the dilemma of new students with various backgrounds that come not only from vocational high schools but also from high schools. First year students in the informatics study programme come not only from vocational informatics high schools, but also from high schools that specialize in social studies and languages. This is a difficult task in terms of imparting a comprehension of the fundamentals of programming. This study develops augmented reality in order to teach HTML and Javascript. By combining basic principles with gaming, the proposed augmented reality (AR) makes programming interesting. Players must comprehend their programming logic in order to be immersed in a virtual environment by answering coding bug questions. During usability testing, the System Usability Scale (SUS) assesses user happiness and AR knowledge. Participants from various programming backgrounds were tested on their knowledge of programming languages. According to usability research, 59% of people found AR programming languages useful for learning and understanding basic programming languages. AR and Agile Scrum make programming more enjoyable. This study demonstrates how augmented reality can be used to teach programming languages. These findings imply that Agile Scrum and AR methods can improve learning and programming foundations. More research and development could lead to more complete and complicated AR learning environments for programming instruction.

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1. INTRODUCTION

In our modern day, Augmented Reality technology has become a specialized demand in numerous circles, and the usage of technology has evolved in all sectors of life that are essential. Augmented Reality is now used in a range of fields, including education [1], including the production of English learning resources for primary school pupils. Wedding planners are using augmented reality to provide clients with virtual wedding information [2]. By integrating 3D catalogs in Augmented Reality, product miniatures may be utilized to analyze product samples, stimulate customer interest, save money, and display natural-looking items [3]. Augmented reality may help tourism [4]. Based tracking marking systems may be utilized to calculate the distance between two markers in order to eliminate mistakes in marker character display [5]. Augmented Reality (AR) is a relatively new technology that offers new ways to educate. Because of the growing popularity of mobile devices worldwide, the use of AR on mobile devices such as smartphones and tablets has become a major phenomenon. In order to

promote student creativity and learning efficacy, several learning environments have attempted to mix content and technology, offer appropriate learning material, and enable collaborative, interactive, and communicative learning activities. There are two sorts of augmented reality: marker-less with no other objects and markers with other items.

The game has progressed. The use of this technology in the field of psychology, by lowering somatosensory thresholds in autistic children, has the potential to significantly increase an infant's earnings [6]. Games are effective teaching and learning aids, particularly in the era of Education 4.0 [7]. In the Introduction to Psychology course at college, a mini-game is used to teach students how to learn actively in order to improve their professional skills [8]. Game-based learning may help students explore their creativity and learning skills [9]. The ability to learn may be significantly increased by using a game that employs adaptive algorithms [10]. . Learning about logic gates in the form of an educational game may provide a high level of understanding [11]. The game's theory instructs the player to gain from choice sacrifice and encourages the player's opponent to do the same [12]. The epidemiological game was created in order to integrate the theory of game-based disease prediction into several epidemiological models [13]. Despite having several benefits, the reduction in instructional time when using gamification is a significant factor [14]. Gamification rules and tactics are used to motivate individuals to attain goals and objectives. Serious games may be created using gamification techniques, the most common of which is for math education [15]. Serious games that are successful include the following characteristics: the presence of a host guide, engaging learning by doing, immersive and meaningful experiences, mimicked real-world surroundings, and autonomy in game choices [16]. They have the following characteristics: the presence of a host guide, engaging learning by doing, immersive and meaningful experiences, simulation of real-world environments, and autonomy in game decisions.

The agile paradigm is defined by short-term software development models that need rapid adaptation and modification output in any form [17] . To make programs more engaging, an agile technique may be employed to adapt and construct them [18]. Agile approaches increase the efficacy of software development by relying on repeated labor and improvement cycles [19]. Agile scrum offers strong quality control and is appropriate for use in rapidly expanding sectors [20], the ability to measure progress fast, guidance throughout system development, historical documentation, and everyone involved in the project has a close connection [21]. Scrum's adoption in global projects has sparked interest in learning and using it. Scrum adoption is hampered by a variety of contextual concerns, especially when globally dispersed teams face communication, coordination, and collaboration challenges. To support software development, Scrum methodology must be widened and changed [22]. Students and students have not widely used agile software development using Scrum due to limited experience in software development [23], whereas team maturity greatly influences the success of Scrum implementation (full allocation, low turnover rate, skills and expertise, and self-management) [24]. Furthermore, using and integrating the Scrum approach requires a high degree of adaptability among teams with varied scientific backgrounds [25]. . Learning and mastery of the Scrum process, on the other hand, may be misled by creating serious virtual reality-based games and meeting the learning goals. The use of virtual reality in education is very promising [26].

The use of augmented reality and virtual reality technologies in computer programming education is still in its early phases, especially with regard to mobile devices and immersive VR [27]. Learning a programming language requires an understanding of the logical flow of instructions as well as syntax [28]. The advantages of Augmented Reality Technology may be seen in the cheap costs associated with learning approaches, and users can freely practice their cognitive talents in AR. This research yielded Code Augmented Reality, a puzzle based on Augmented Reality in which the player must match the missing code in a line of syntax. This will improve the user's understanding of basic programming language.

2. METHOD

Scrum is founded on empirical evidence and lean thinking. Empiricism believes that knowledge is gained by experience and decision-making based on what is seen. Lean thinking eliminates waste and focuses on what is most important. Scrum employs an iterative and incremental approach to improving predictability and risk management. Scrum incorporates groups of individuals that together possess all of the skills and experience necessary to complete the task and share or gain new abilities as needed [30]. Figure 1 shows Scrum.

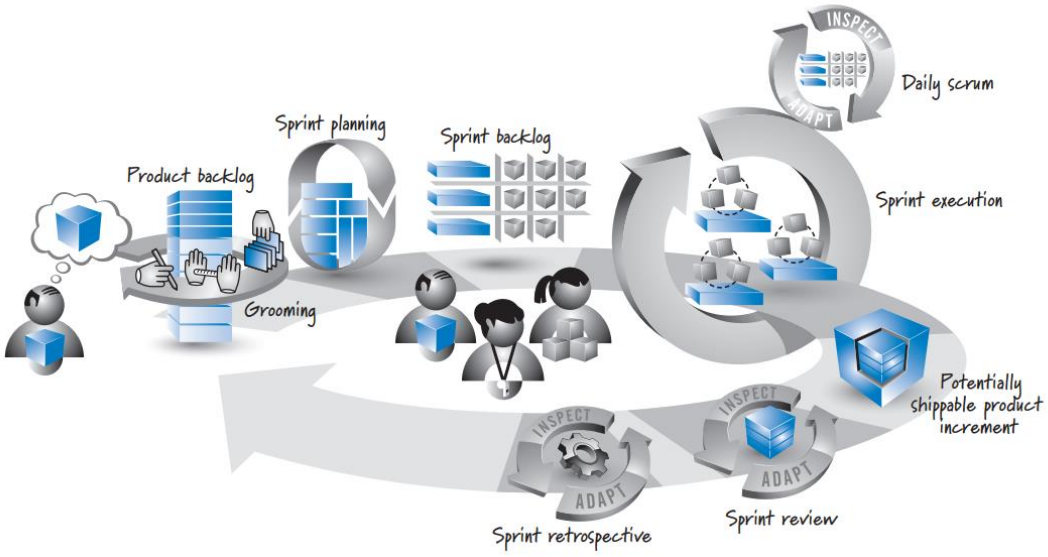

Figure 1. Scrum Framework [30]

Creating an augmented reality (AR) application involves several stages, regardless of the programming language. Figure 2 below are the stages of the AR development process for basic programming language.

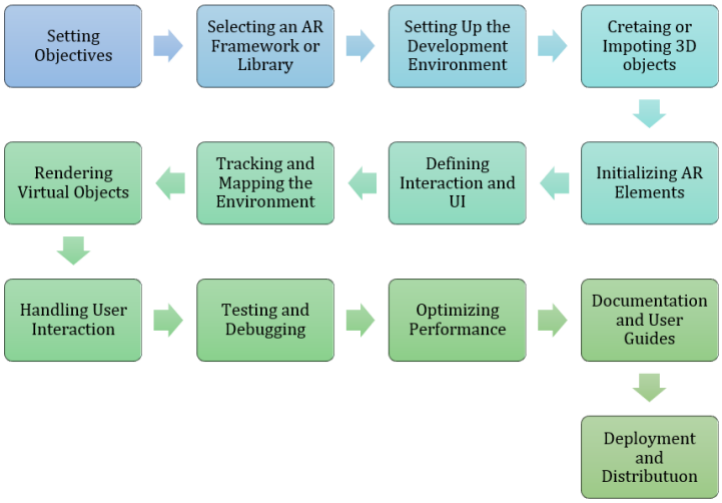

Figure 2. AR Method Stages

Using the preceding figure as a guide, the following are the stages of the AR technique that is currently in development for learning fundamental programming languages:

a. The establishment of goals. Establish the purpose of the augmented reality project, which in this instance is to develop AR for the purpose of learning fundamental programming languages.
b. Pick a programming library or framework that is compatible with augmented reality. Examples of such technologies are AR.js for JavaScript, ARCore/ARKit, and OpenCV.
c. Setting up the environment for software development. Install the necessary tools, libraries, and software development kits (SDKs) for augmented reality development.
d. Import or Create Your Own 3D Models. Construct or acquire 3D models or assets based on code written in a fundamental programming language.
e. Begin the initialization of the AR elements. Programming languages can be used to manage augmented reality settings. This covers the configuration of cameras and sensors as well as the initiation of augmented reality patterns or markers.
f. An explanation of the terms "interaction" and "user interface" Implement the essential user interface elements for the augmented reality experience, such as gestures, touch events, or voice commands. Also implement any other necessary interactions.

g. Keeping tabs on and mapping the surrounding environment. Utilizes augmented reality techniques such as simultaneous localization and mapping (SLAM) to monitor the location of the user and create a map of the surrounding area in real time.
h. The process of rendering the virtual objects. Create some code that will show the virtual items. The camera feed displays a list of code in a fundamental programming language, which ensures that the objects are in the correct position relative to the real world.
i. Managing the Interactions with the Users. Basic programming language code is used in application programming to respond to user interactions with virtual objects. This could be accomplished through the use of gestures, touch input, or voice commands.
j. Testing and finding bugs in the program. Test augmented reality apps thoroughly across a variety of devices and settings.
k. Improving the Overall Performance. Code and assets need to be optimized so that performance is consistent across all devices, taking into consideration limits such as the amount of processing power and memory available.
l. Instructions for users and documentation. Develop documentation and user guides to assist others in comprehending how to utilize augmented reality (AR) applications and interact with them.
m. Deployment and Distribution, and Related Matters Prepare the augmented reality application for release. Depending on the platform that you want to distribute it on, this may require uploading it to app stores or distributing it through other ways.

3. RESULT AND DISCUSSION

We make use of a variety of technologies that facilitate smoother communication within the team in order to facilitate the implementation of Agile Scrum work techniques, particularly in relation to the management of tasks for each member of the team. Because of the way the tools are organized, every single person of the group is able to make use of them due to the fact that they are linked. The Product Backlog is a prioritized list of the required features and other capabilities that must be present in order to make a marketable product. This list is used to prioritize the development of the product [31]. We provide documentation as well as illustrations for the application's explanation. A fundamental programming language that underpins the Agile Scrum technique for the production of augmented reality games. The creation of augmented reality games is divided into a number of product backlogs, as illustrated in Figure 3. These product backlogs include AR Javascript Basic, AR HTML Basic, Main Menu, About Menu, Quit Menu, Option Menu, Gameplay Menu, and Sound Button Menu.

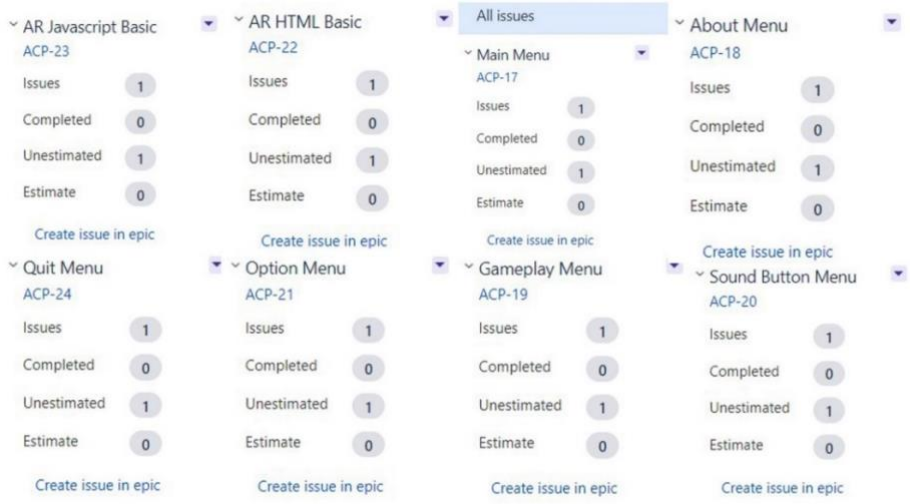

Figure 3. Product Backlog

User Stories are a user-friendly format that may be used to communicate the expected business value for a variety of different sorts of product backlog items, particularly features. This structure can be found in Table 1. User stories are constructed in a manner that makes it possible for individuals from both business and technical backgrounds to comprehend the information that is included within them. They are easy to understand in terms of their structure, and the pauses that they create in the flow of the conversation are quite helpful. In addition to this, it is simple to grow them on an incremental basis,

and they are able to be written at a variety of various levels of granularity [31]. It is helpful to construct products backlog items based on user requirements that have been simplified and summarized in order for the development team to be able to work on products based on tasks throughout each sprint.

Table 1. List of User Story

User Story
As a player, I want to see a marker-based augmented reality display for basic HTML coding so that I can learn HTML through an interactive experience.
As a player, I want to see a marker-based augmented reality display for basic Javascript coding so that I can learn Javascript through an interactive experience.
As a player, I want to be able to navigate to the Main Menu so that I can begin playing the game and access other menus.
As a player, I want to be able to access the About Menu so that I can learn more about the game.
As a player, I want to be able to activate and deactivate sound through the Sound Button Menu so that I can play the game with or without sound.
As a player, I want to be able to exit the game through the Quit Menu.
As a player, I want to be able to access the Gameplay Menu so that I can play Basic HTML or Javascript games.
As a player, I want to be able to access the Options Menu so that I can customize the game settings.

The Scrum roles for the development of augmented reality basic programming language games include Ade Bastian as game producer, Sarmidi as quality assurance, Dadan Zaliluddin as game designer, M. Bagasnanda F. as programmer and Riki Andriana as game artist. Figure 4 depicts the initial activities of the Daily Meeting.

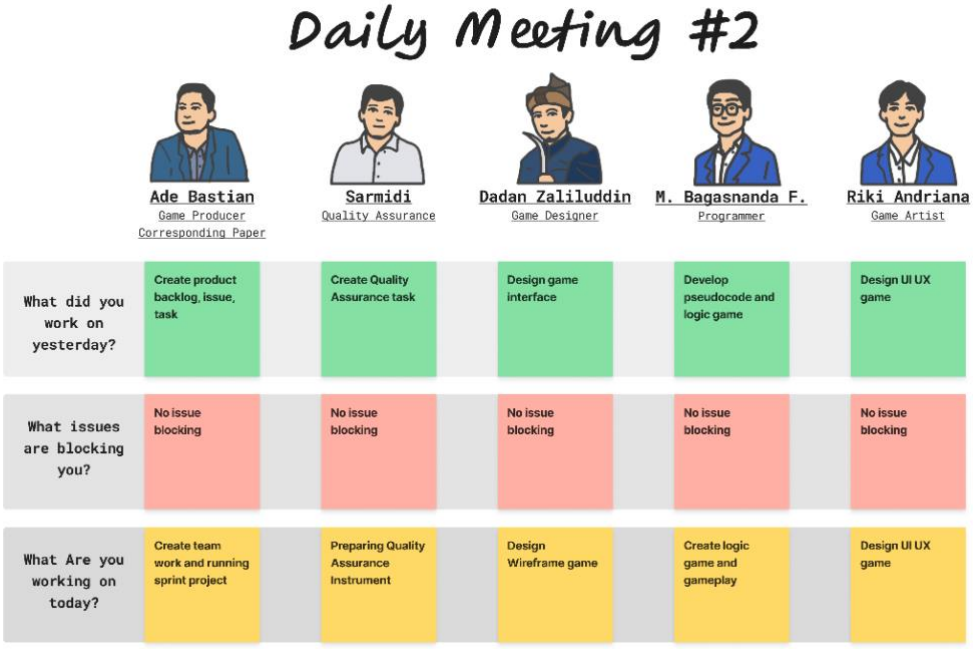

Figure 4. Daily Meeting

Sprints refer to work completed in iterations or cycles lasting up to one calendar month. Each sprint's effort must result in something of meaningful value for clients or users. Sprints are timed such that they always have a definite start and finish date, and they should always have the same length. The last sprint was quickly completed by further sprints to come. We generally do not accept any modifications to the sprint's destination, scope, or people; but, occasionally a business requirement makes compliance with these guidelines difficult [31]. Figure 5 depicts sprint running on the'menu' job. When the sprint begins in the JIRA application, the task and sub-task accomplishment objectives are computed as the processing time till 'done' or still in progress.

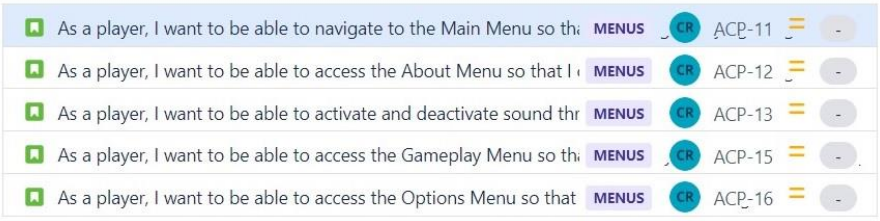

Figure 5. Daily Meeting

A product roadmap explains the incremental nature of how the product will be produced and delivered over time, as well as the key elements driving each particular release [31]. Figure 6 depicts the development plan for augmented reality basic programming language games. The three-month period from January to March and April to June in which the average goal task and sub-task were completed.

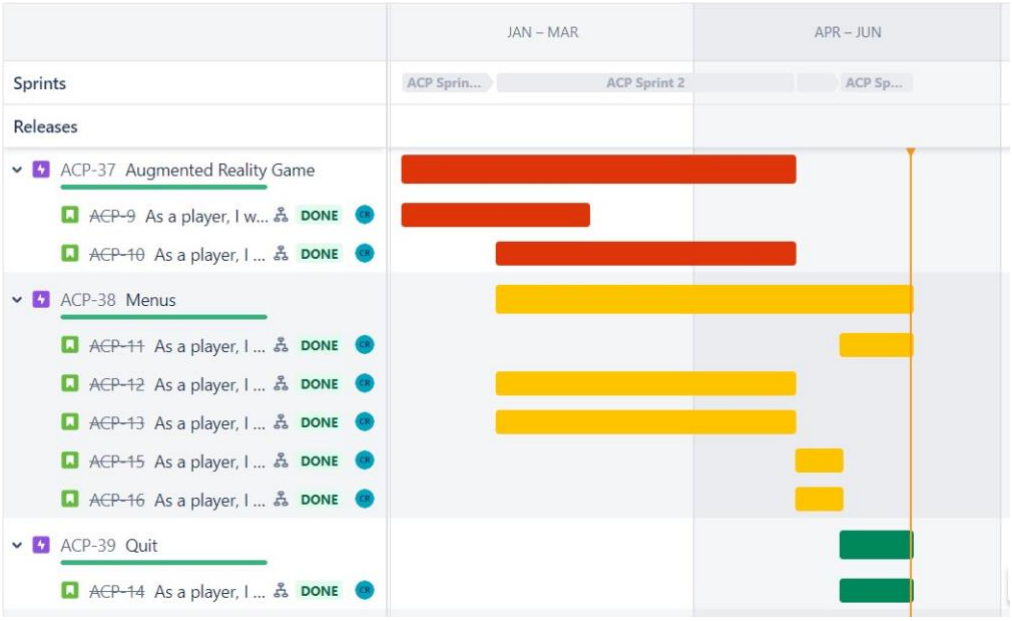

Figure 6. Roadmap

The sprint retrospective is the second examination and adaption activity at the conclusion of the sprint. This activity is usually performed after the sprint review and before to the next sprint sprint planning. Whereas sprint reviews are used to verify and adjust the product, retrospective sprints are used to check and adapt the process. During retrospective sprints, the development team, ScrumMaster, and product owner met to explore what Scrum and associated technical methods can and cannot achieve. The team is fantastic, and the emphasis is on the continual process development required to facilitate excellent Scrum. The Scrum team should have identified and committed to a number of tangible process improvement tasks for the upcoming sprint by the conclusion of the sprint retrospective [31]. Figure 7 depicts a spin retrospective in the creation of this game, displaying numerous records of work successes that are, on average, fairly strong, as well as some feedback for the next stage, such as design improvisation, bug attention in the next sprint, and tweaks for UI UX to make it more solid.

Figure 7. Sprint Retrospective

Figure 8 is a simple HTML augmented reality display. The HTML code line is interactively displayed, and questions are asked to check for errors or shortcomings in the coding line. To answer questions in the game, players may use the supplied button.

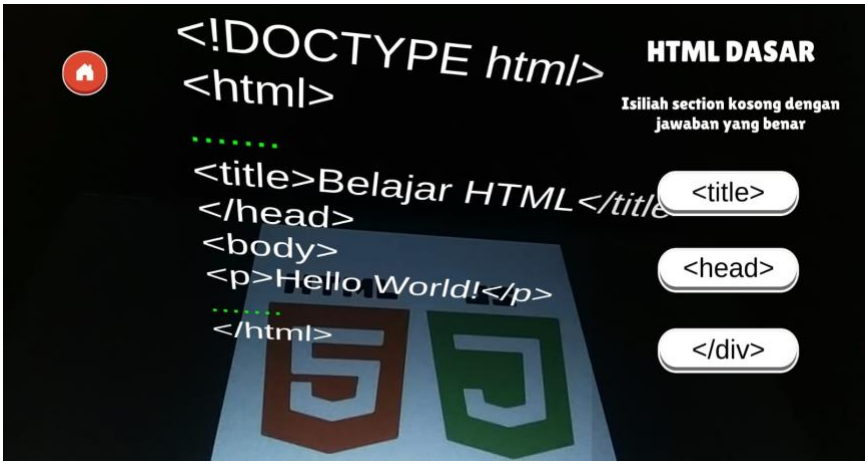

Figure 8. AR Basic Programming Language

The purpose of doing AR evaluation is to check and see if the goals that were established have been met. Steps involved in evaluating AR include functionality testing, fitness for purpose testing, hardware performance testing, security and privacy testing, visual quality testing, user interaction testing, user experience testing, network performance testing, data analysis testing, and update testing. In this particular instance, testing with SUS is connected to several parts of the user experience. The System Usability Scale (SUS) is a popular scale for assessing the usability of various software and hardware solutions [35]. The SUS technique was chosen to measure usability in this research since the resultant usability test was valid and reliable even with a small sample size [36]. Table 2 shows the results of evaluating the usability of the augmented reality game basic programming language on questionnaire respondents (game players).

Table 2. SUS Test Results

No	Question	Answer		
		Strongly Agree	Agree	Don't Agree
1	Is learning programming languages in class currently effective?	-	59,1%	40,9%
2	In your opinion, can the Informatics lecturer when explaining material about a particular programming language be immediately understood?	18,2%	45,5%	36,4%

No	Question	Answer		
		Strongly Agree	Agree	Don't Agree
3	In your opinion, is it necessary to have hands-on practice in class?	59,1%	36,4	4,5%
4	For those of you who have tried the Code Augmented Reality Puzzle game, is this game really suitable for learning basic programming languages?	31,8%	68,2%	Update
5	Can This Game Be Understood Easily?	37,5%	56,3%	6,3%

4. CONCLUSION

After carrying out the process of building augmented reality games in simple programming languages and performing tests utilizing SUS on the players, it is possible to get to the conclusion that augmented reality educational may be an appealing option for students when it comes to the process of learning. Because it provides a pleasant and straightforward visual knowledge of fundamental coding concepts, augmented reality learning may make it simpler for students to grasp the fundamental programming language that is being taught. This is because games like Code Augmented Reality Puzzle give students with a visual understanding of fundamental coding concepts. Because they allow students to participate in engaging activities, augmented reality basic programming language learning may also help students become more active and engaged in the process of learning how to code. This is because the present students with opportunities to do so. Evaluation of AR is a process that occurs continuously. Enhance the augmented reality experiences throughout time. Determine which aspects of augmented reality have room for improvement and then make any necessary adjustments or adjustments to optimize the user experience. Evaluation of user experience using SUS resulted in the conclusion that 59% of users consider the AR programming language useful for learning and understanding basic programming languages.

The use of the user player's point of view in the production of augmented reality basic programming language games has shown to be both successful and efficient in generating game goods within the desired timeframe. Additionally, the design of these games using the Agile Scrum technique has proven to be valuable since it leverages the user player's point of view. Scrum Masters are still quite uncommon, particularly in the field of education, thus it is anticipated that future study will be able to incorporate these professionals. The team will be able to use the Agile Scrum process in a manner that is more effective and accurate if they have a Scrum Master on board.

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