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Flora and Fauna in Minecraft: Bedrock Edition

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Abstract:- Minecraft is a popular sandbox video game that was first released in 2011 by Mojang Studios. It allows players to build and explore virtual worlds made out of blocks, and offers a variety of gameplay options, including survival mode, creative mode, and adventure mode. The game has a simple, blocky graphics style and a focus on exploration, mining, and crafting. In Minecraft, players can gather resources, create structures, and defend against monsters, while also having the freedom to explore and create their own virtual worlds. The game has a massive player base and has become a cultural phenomenon, with an active online community and a wide range of mods and custom content available. The game is available on various platforms such as PC, Xbox, PlayStation, Nintendo Switch and mobile (Gilbert, 2017).

I. INTRODUCTION

Garskof (2014), pointed out that one of the main advantages that Minecraft has over other modern video games is that it blends entertainment, creativity, social media skills, communication, and engineering in an easy-to-use and understand package. For instance, the use of visual blocks within the game is a great way for students to develop spatial skills.

Correspondingly, (Hollet & Ehret, 2014) described that playing Minecraft reshapes the “social, relational space” in which adolescents use it and helps them understand this space of gameplay “as populated with agentive, affecting, and affected bodies-both human and nonhuman”. That is, students are able to foster agency through this video game.

Videogames are increasingly being used in educational settings thus, becoming more and more popular. Games nowadays have overtaken literature to become one of the most popular types of entertainment due to how appealing, fascinating, and intriguing they are. Additionally, research on the nature of enjoyment and motivation in video games shows a variety of elements, such as quick feedback cycles, high levels of engagement, or embodiment, that can have a significant impact on educational settings. As games allow children to immerse themselves in virtual worlds and, at times, connect to individuals from across the world, it can be a great way for them to learn about different perspectives and development of early learning skills. Schools now employ game-based learning more frequently to aid pupils in comprehending and considering difficult subjects. Minecraft is one of the ultimate educational tools, that is great for learning, mostly used in the classroom to teach language, history, and math, it also teaches a wide range of concepts, like logic, problem-solving, goal setting, science, economics, and literacy.

The use of video games in education has been a topic of interest for several years now, and Minecraft has been at the forefront of this movement. Studies have shown that the use of Minecraft in the classroom can lead to increased engagement and motivation in students, as well as improved problem-solving and critical thinking skills. In the study of (Kapp, 2018), students who used Minecraft in their science classes showed increased engagement and motivation, as well as improved problem-solving and critical thinking skills. According to (Farber, 2015), digital gaming has become highly accessible to students from an early age; therefore, this gives teachers an opportunity to use such digital games in the classroom as part of fourth-generation teaching aids or learning tools (i.e. connected, interactive and ubiquitous ICTs) which aim to make abstract, theoretical concepts more concrete to students while they interact with the learning content (Ankiewicz, Batchelo & De Been, 2015).

Teachers can use it as a teaching tool in their classrooms, incorporating it into lesson plans and assignments. This system can also be used to assess student understanding and progress. Teachers can also provide feedback and suggestions to improve the system and collaborate with other teachers and educators to design new and exciting educational activities. The students can benefit greatly from the educational opportunities it provides. The system allows students to learn about different types of plants and animals, their habitats, and how they interact with each other. They can also use the system to practice problem-solving and critical thinking skills as they explore and interact with the various elements in the game. Interested individuals can use the system for entertainment and personal learning and contribute to the development and improvement of the system by providing feedback and suggestions. They can also join the community of players, educators and developers and participate in discussion forums, share their experiences and collaborate with others to enhance the system. Correspondingly, according to (Alkharusi, Al-Harty, Al-Fahdi, 2019) using Minecraft as a tool for teaching geography improved students' spatial thinking skills and their understanding of geographical concepts.

The field of biological science is constantly evolving and advancing, with new discoveries and technologies being developed all the time. In the current academic setting, there is a strong emphasis on interdisciplinary approaches and the integration of technology in research and education. One of

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the key advantages of bioinformatics is its ability to handle the large amounts of data generated by modern biological research. The importance of bioinformatics in understanding genetics has led to significant advancements in the fields of medicine and agriculture. For example, bioinformatics has played a crucial role in identifying genetic variations associated with diseases, which has led to the development of new diagnostic and therapeutic approaches. In agriculture, bioinformatics has been used to improve crop yields and develop more resilient crop varieties (Siyal, 2020).

Another trend in the current academic setting is the emphasis on fieldwork and hands-on learning. According to (Imm, 2021), the importance of fieldwork in biology education, as it allows students to apply their knowledge in real-world settings and gain a deeper understanding of the subject. Moreover, virtual reality and augmented reality technology are also increasingly being used in the classroom to provide students with immersive, interactive learning experiences.

Moreover, the current academic setting in biological science and related fields is marked by a strong emphasis on interdisciplinary approaches, the integration of technology and hands-on learning, and a growing focus on sustainability and the environment.

II. METHODOLOGY

Flora and Fauna in Minecraft: Bedrock Edition was successfully developed using JavaScript Object Notation (JSON) and Visual Studio Code as a programming tool. The use of various tools and technologies, along with the inclusion of interactive features such as trivia, quizzes, a minimap, NPC teacher, gallery and big screen, allows for an engaging and interactive learning experience for users. The developers collectively visualized each essential component and collaborate to make sure that all of the visualizations would become into reality. One method of gathering and identifying the issues faced by the stakeholder was through the conduct of interviews. The project design procedures are presented using diagram illustrations below:

Fishbone Diagram. A fishbone diagram is a visualization tool for classifying a problem's possible origins. This technique was employed to determine the underlying source of the issue. It combines brainstorming exercises with the team and a presentation of the results in a mind map-like template. The developers used this diagram below to show the main problem as the causes and effects of this system. The result were distinguished along with four main factors specifically the human, system, environment, used method. (See figure 1).

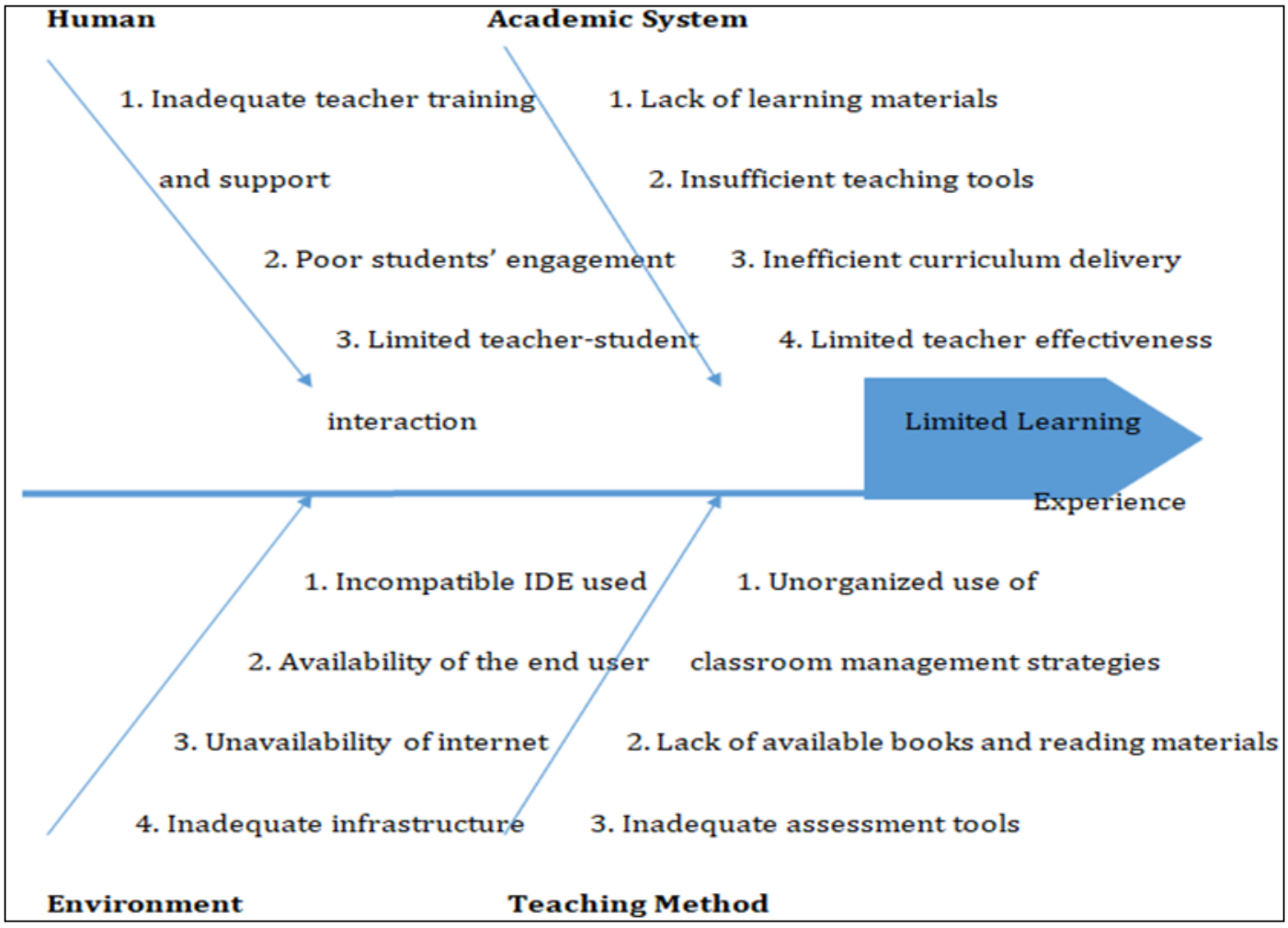

Fig 1 Fishbone Diagram

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➢ *Flora and Fauna in Minecraft: Bedrock Edition Encountered Problems that came from these Several Causes:*

- *Human.*

In the context of the problem "Limited Learning Experience," human factors play a significant role. These factors include insufficient training for teachers or students, poor student engagement, and limited teacher-student interaction. Insufficient training can hinder teachers' ability to effectively deliver the curriculum and engage students, leading to a lack of confidence and motivation. Poor student engagement can result from various factors, such as disinterest, difficulty with the material, or ineffective classroom management. Limited teacher-student interaction makes it challenging for teachers to understand students' needs, interests, and learning styles, making it difficult to tailor teaching methods and leading to reduced engagement and poor learning outcomes.

- *Academic System.*

The academic system factors in the context of the problem "Limited Learning Experience" include the lack of learning materials, insufficient teaching tools, inefficient curriculum delivery, and limited teacher effectiveness. The lack of learning materials can hinder student engagement and academic performance. Insufficient teaching tools can result in ineffective curriculum delivery and low student engagement. Inefficient curriculum delivery, caused by a lack of resources or support, can lead to a lack of student engagement and low academic performance. Limited teacher effectiveness, stemming from inadequate skills or knowledge, can also contribute to low academic performance and a lack of student engagement.

- *Environment.*

In the context of the problem "Limited Learning Experience," the environment factors that may contribute to the issue include incompatible IDE used, availability of the end user, unavailability of the internet, and inadequate infrastructure. The use of an incompatible Integrated Development Environment (IDE) can result in inefficiency in curriculum delivery and a lack of student engagement. The availability of the end user, referring to the accessibility and presence of students for the learning process, can impact student engagement and academic performance. The unavailability of the internet can hinder access to online resources and tools, leading to limited student engagement and academic performance. Additionally, inadequate infrastructure, such as poor facilities and limited resources, can contribute to ineffective curriculum delivery and a lack of student engagement.

- *Teaching Method.*

The challenges in the learning environment encompass the unorganized use of classroom management strategies, the lack of available books and reading materials, and inadequate assessment tools. When classroom management strategies are disorganized, teachers face difficulties in establishing a positive and productive learning environment, hindering the implementation of active learning and student-centered teaching methods. Insufficient access to books and reading materials poses challenges for teachers in implementing reading-focused teaching approaches and engaging students to enhance their reading skills. Furthermore, the absence of appropriate assessment tools hampers teachers' ability to evaluate student learning, make necessary teaching adjustments, and provide valuable feedback to improve performance. This limitation also affects the utilization of formative assessment, a vital aspect of the teaching and learning process.

- *Data Flow Diagram.*

A data flow diagram (DFD) shows the inputs and outputs of a system's processing of data. In the case of Flora and Fauna in Minecraft: Bedrock Edition, the DFD shows how the data flows between the different components of the system, including the user, the NPC teacher, and the sound files. The user interacts with the system by clicking on the NPC teacher, which triggers the system to find the scene tag for the dialogue. The scene tag contains the script for the conversation between the player and the NPC teacher. The system then locates the sound definition of the dialogue, which contains information about the sound file that is to be played, such as the file path and the type of audio file. Once the sound definition is located by the system, it then finds the sound file that is found in the file path within the sound definition. The sound file is then played, allowing the NPC teacher to appear to speak the contents of the dialogue. The user then continues to interact with the NPC teacher, and the system repeats the process for each new dialogue. The developers used this diagram below to show and elaborate the process of the system. (See Figure 2)

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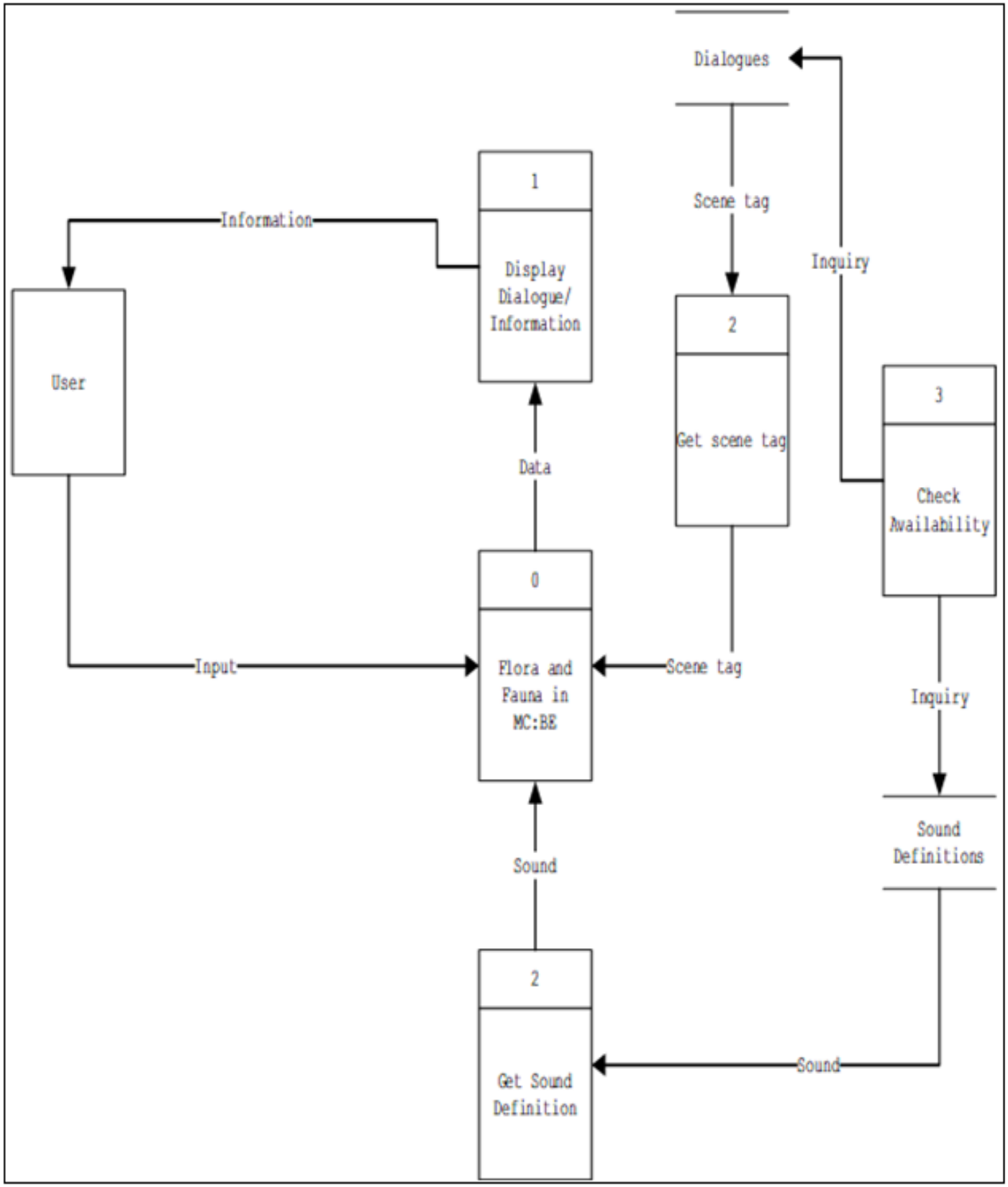

Fig 2 Data Flow Diagram

- *UML use Case Diagram.*

Below is the UML use case diagram of the system, "FLORA AND FAUNA IN MINECRAFT: BEDROCK EDITION" where: the actor is the user, the rectangle represents the system, the oval shape represents the use cases, and arrows as the relationships. The interaction process has been displayed within the diagram. To further understand the process, see figure 3.

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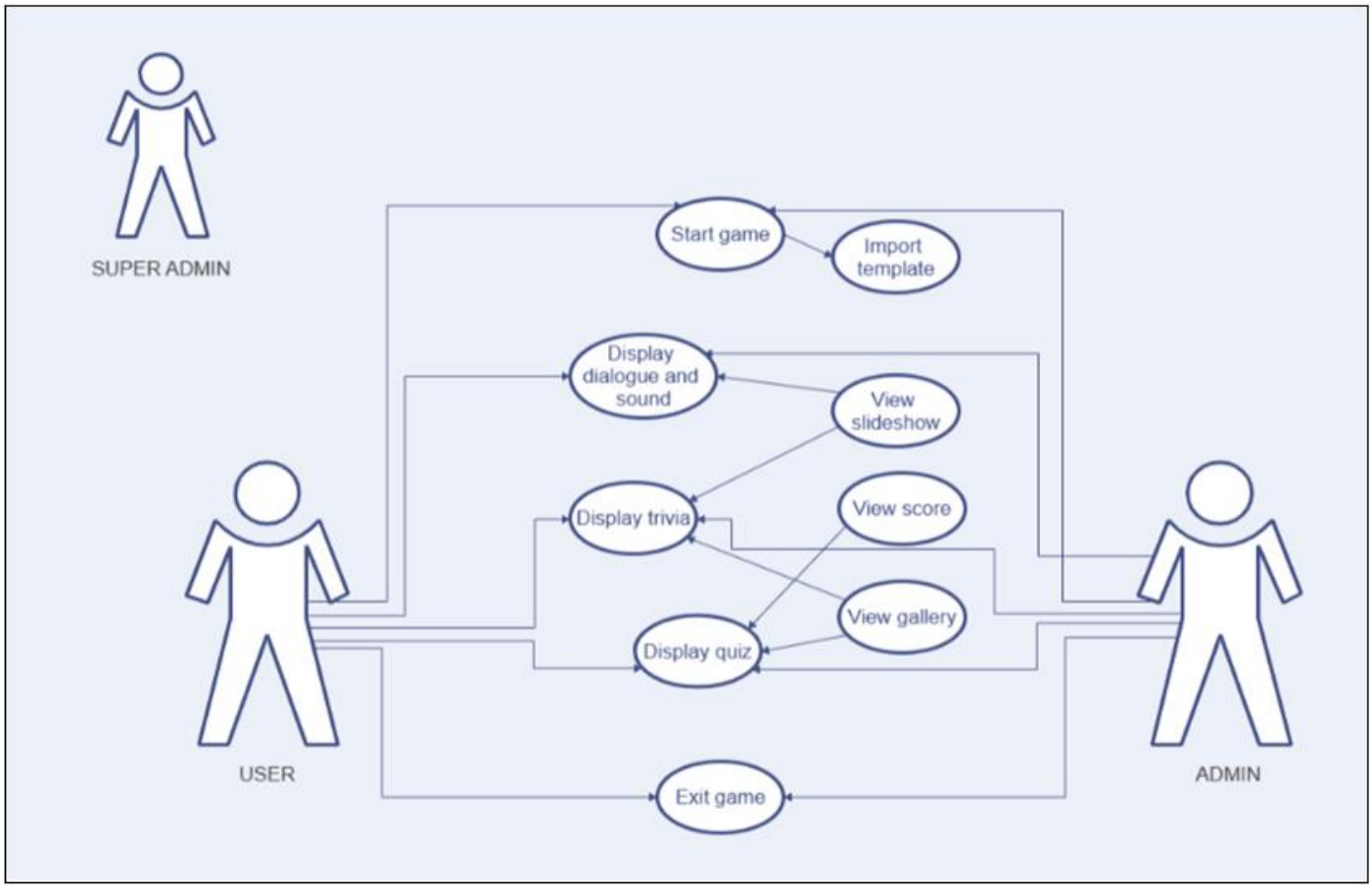

Fig 3 UML use Case Diagram

The UML use case diagram of the system, "FLORA AND FAUNA IN MINECRAFT: BEDROCK EDITION" consist of the following elements:

A stick figure represents the user, who interacts with the system to access the various functionalities. The rectangle represents the system, which provides the functionalities to the user. Oval shapes represent the use cases, which are the different functionalities that the system provides to the user. Arrows represent the relationships between the user, the system, and the use cases. The use cases in Minecraft: Bedrock Edition (flora and fauna) include: locating the players' position with the Minimap which allows the user to locate their position in the game world using a minimap. The user can use the minimap to navigate and orient themselves in the game world. Talking to the NPC teacher where it allows the user to talk to a non-player character (NPC) teacher, who can provide additional information and guidance about the plants and animals found in the game. The user can ask questions and receive answers from the NPC teacher. The arrows in the diagram shows the relationships between the user, the system, and the use cases. An arrow pointing from the user to the "Display Trivia" use case would show that the user can access this functionality by interacting with the system. An arrow pointing from the "View Slideshow" use case to the " Display Trivia " use case would show that the user can view the trivia after observing and studying the plants and animals.

- *Software.*

In developing the said system, Windows 10 and 11 operating systems were used, and JSON to make this software project possible. JSON (JavaScript Object Notation) which is a lightweight, text-based, language-independent data interchange format. It was derived from the JavaScript/ECMAScript programming language, but is programming independent.

The software tools were used in the development process, such as Bridge.V2, an add-on editor that speeds up the development process. BlockBench, used for modeling, texturing, and animations for the different species in the project. Visual Studio Code, a source-code editor. VoiceMaker.in, an online text-to-speech converter website that utilizes AI to generate human-like speech. Wondershare UniConverter 14, which is used for converting sound files generated in VoiceMaker to OGG files, which Minecraft supports. Image Map 4, a simple Windows application that converts images to Minecraft maps using the latest colors and supports both Java Edition and Bedrock Edition. The high-performance machine is necessary to reduce the time required to finish the project and to handle the multiple software that are used in the development process. It ensures that the project is developed efficiently and effectively while maintaining the highest quality standards.

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III. SOFTWARE DEVELOPMENT MODEL AND PROCEDURES

The developers used the Rapid application development (RAD) in developing the game because this model is generally easier to execute in all phases and it is applicable for the development of the game.

➢ *Rapid Application Development (RAD).*

One of the key features of RAD is the use of pre-built components, such as libraries and frameworks, which can greatly reduce the time and effort required for development. This allows developers to focus on the unique features of the application, rather than on building every component from scratch. Another important aspect of RAD is prototyping, which allows developers to quickly create working models of the software, enabling users and stakeholders to provide feedback early in the development process. This feedback can then be used to iteratively improve the software, resulting in a more refined and user-friendly product.

The development of the software system project was done by considering every suggestion given by the thesis adviser after reviewing the development and progress, as well as the recommendations and suggestions provided by the panelists during each defense, in order to improve the system.

➢ *Procedures*

The activities undertaken to see the progress occurred in all phases of the activity are presented below:

➢ *Analysis*.

The process was done through considering and planning of potential project and concept that would be developed. The developers started by coming up with concepts and creating ideas for issues that students and teachers encountered. Discussing and sharing of various ideas on how the project will be constructed and deciding which programming languages would be best to use for the development of the game.

The objective concept and output were produced by creating a plot and storyline, prototype design, and flow chart and algorithm as the basis for how the game would be successfully developed. Providing the game an additional new feature design and sound effects was done with the goal of encouraging players and making the game more attractive and better scenes. In order to create a more appealing scenario, the buttons, textures, images, visuals, and text formatting were also designed.

Additionally, the stakeholders, mainly students, teachers and interested individuals, provided valuable feedback on the issues they encountered in learning about flora and fauna. This feedback helped the developers to understand the specific needs and challenges of their target audience, and tailor the project to address these issues. The panelists, composed of experts in the field of development and education, provided valuable insights on the potential of the project and its feasibility. They also gave suggestions on how to improve the project and make it more effective in achieving its goals. The author, being the developer as well, also provided inputs on the project's concept and design, and played a crucial role in the development process. The author's expertise and experience in game development helped ensure that the project was developed according to the highest standards and met the requirements of the stakeholders and panelists.

➢ *Prototype Cycle.*

It is a methodology of incremental software development that emphasize quick development cycle. Rapid application development (RAD) is a more advanced variant of waterfall development, and it accomplishes RAD by employing a component-based construction method.

This model was used by the developers because of its adaptability and flexibility to any changes.

➢ *1st Iteration:*

- *Develop.*

This was the first iteration of the developers in developing the software project. This iteration started right after the title defense. Designing, coding, texturing, and prototyping are some of the functions of the software project using JavaScript, Blockbench, image map 4, etc. were successfully done.

- *Demonstrate*

The developers came up with the educational game with the adviser's assistance and suggested ideas entitled “Flora and Fauna in Minecraft: Bedrock Edition”. They discussed also on what would be the objectives, purpose and description, significance, scope and limitation of their software project. In these processes, of Rapid Application Development, the software project was found to contain errors and function to be improve as recommended by the respondents as well as the thesis adviser. The respondents’ additional suggestions and recommendations helped in the development of effective and reliable process and use of the system. Observation during the demonstration was carefully perceived especially the sounds, image, slideshow, and controls which sometimes lag in the flow of the game execution.

- *Refine.*

The developers planned and analyzed on what would be the target of the game and the software to be used. The developers choose the Bedrock Edition of Minecraft in developing the game. They also choose to use blockbench, paint.net, wondershare converter, image map and other editing tools for the shape, texture, world, images, for the models and the flow of the game. In this process, it was also found that there is a need for enhancement in the design and function of the said project. It is the process by means of evaluating another plan, making additional codes and sounds.

➢ *2nd Iteration:*

- *Develop.*

The developers went back to the drawing board and began to re-develop the software project, taking into account the feedback and suggestions received from the demonstration phase. Mainly focused on addressing the errors and functional issues identified during the first iteration. This iteration involved redesigning, recoding, and retexturing certain aspects of the game, using updated tools and technologies.

- *Demonstrate.*

The developers presented the updated version of the game to the thesis adviser and a group of respondents for further evaluation. The game was tested for usability, functionality, and overall effectiveness. The developers received feedback on the improvements made and any further areas that need to be addressed.

- *Refine.*

Based on the feedback received during the re-demonstration phase, the developers made further adjustments to the game, fine-tuning the design, functionality, and performance. Worked on implementing new features and functionalities, such as multiplayer support, additional levels and challenges, and improved NPC interactions. This process of refining the game was done iteratively until the game met the desired level of quality and user experience.

➢ *3rd Iteration:*

- *Develop.*

In this iteration, the developers polished the game by incorporating the feedback received during the previous iteration. They focused on improving the overall user experience, fixing any remaining bugs and glitches, and optimizing the performance of the game. They also added final touches to the game's graphics and sound effects to enhance the immersion for the users.

- *Demonstrate.*

The game was thoroughly tested for usability, functionality, and overall quality by a group of beta testers and the thesis advisor. The developers received feedback on the final version of the game and made any necessary adjustments to ensure that the game met the desired level of quality and user experience. The game was also demonstrated to a larger group of users, including potential customers and investors, to gauge their interest and feedback.

- *Refine.*

The updates and patches were optimized to fix any issues that may arise after the release of the game. They also monitored and collected feedback from the users to improve the game further in the future.

➢ *Testing.*

The testing phase of the software development process is crucial in ensuring that the project functions as intended and meets the needs of the users. The developers carefully evaluate the system's performance and functionality to ensure that it is reliable and effective when used by the actual users. To determine the success of the project, the developers selected a group of pilot stakeholders, who closely resemble the actual users of the software. These pilot stakeholders are chosen based on their relevant background, familiarity with the subject matter, and willingness to participate in the testing process. The developers then ran the software through a series of tests, examining its performance, functionality, and usability. They looked for any bugs or glitches that needed to be fixed and evaluated the system's overall effectiveness and reliability. These tests were conducted to ensure that the software meets the requirements of the users and performs as expected. The developers also examined the software's output, comparing it to the expected results and the requirements specified by the users. This was done to ensure that the software's output matched the expected results and met the needs of the users.

➢ *Implementation.*

The implementation phase is the final step of the rapid application development (RAD) model, where the developers put their software project to the test. This phase involves submitting the designed system for completion and making it ready for use by the selected pilot stakeholders. The pilot stakeholders are typically a small group of users who have been chosen to test the effectiveness and relevance of the project. During this phase, the developers conduct extensive testing to ensure that the software is functioning as intended and meets the requirements of the users. They also evaluate the system's performance, looking for any bugs or glitches that need to be fixed. This is done to ensure that the software is reliable and effective when it is used by the actual users. The feedback and suggestions of the pilot stakeholders are crucial in this phase, as they provide valuable insights into the effectiveness and relevance of the software. The developers take these suggestions into consideration and make any necessary adjustments to the software to improve its usability and functionality. This process helps to ensure that the software is useful to the clients and meets their needs.

➢ *Software Cost Estimation*

The COCOMO model is based on the principle that software development is a complex process that requires considerable effort and resources. It takes into account various factors such as project size, complexity, and the development team's experience to estimate the effort and cost required to complete a project successfully. Additionally, the model considers the type of software being developed, including factors such as the platform, the programming language, and the development environment (Pedamkar, 2018). The Constructive Cost Model (COCOMO) is a widely used software cost estimation model that was first developed by Dr. Barry W. Boehm. One of the key features of the COCOMO model is its ability to estimate costs based on the size of the project, measured in

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lines of code. This allows the model to take into account the complexity and scale of the project, which can have a significant impact on the cost and effort required. Additionally, the model also considers various other attributes or metrics that apply to estimates, such as product attributes, personnel attributes, hardware attributes, and general project attributes.

According to Wakakorn (2020), COCOMO is a procedural model that estimates the cost and schedule of a software project based on its size and characteristics. The model uses a set of algorithms and coefficients to estimate the cost and effort required for a project, and it can be tailored to different types of software development environments and methodologies. One of the key features of the COCOMO model is its ability to estimate costs based on the size of the project, measured in lines of code. This allows the model to take into account the complexity and scale of the project, which can have a significant impact on the cost and effort required. Additionally, the model also considers various other attributes or metrics that apply to estimates, such as product attributes, personnel attributes, hardware attributes, and general project attributes.

The total LOC of the software development project is then generated by computing the Line of Codes for each programming language. The final computation will be concluded using Step 1: Converting LOC to KLOC, Step 2: Calculating effort applied in person-months, Step 3: Calculating development time in months, Step 4: Calculating the number of recommended people, Step 5: Calculating the basic cost, and Step 6: Calculating the total cost.

The total cost of Software Cost Estimation using Constructive Cost Model is 34,000 with 8.5 development time in months.

IV. RESULTS AND DISCUSSIONS

The design of the Minecraft: Bedrock Edition (flora and fauna) project is a well-thought-out and comprehensive approach to incorporating education into the popular sandbox game. The use of various tools and technologies, such as JavaScript Object Notation (JSON), BlockBench, VoiceMaker, and Image Map, allowed the development team to create a highly interactive and engaging learning experience for players.

One of the key features of the design is the inclusion of trivia with images and audio, which provides players with a way to learn about the different flora and fauna in an interactive and engaging manner. The images and audio provide players with a clear and detailed understanding of the different species they encounter in the game. Additionally, the use of quizzes that contain random questions on both animals and plants allows players to test and evaluate their understanding of the topics.

Another important aspect of the design is the inclusion of a minimap, which allows players to locate the exact position of the player in the game. This feature is particularly useful when players are exploring the virtual world and trying to find specific species. The addition of an NPC teacher as a guide throughout the game is also a great feature, providing players with a helpful and knowledgeable companion to assist them in their learning journey.

The use of a gallery and big screen that contains images and audio is also a great design choice. It allows players to review and study the different species they have encountered in the game, and the audio provides additional information and context. This feature is particularly useful for players who want to take a more in-depth look at the different species they have encountered in the game.

- *Evaluation Result*

In this chapter, the discussion of the software project output is presented.

Table 1 Numeric Rating and Interpretation

Scale	Descriptive Rating	Qualitative Description
5	Outstanding	The requirement of the system was accomplished.
4	Very Satisfactory	The performance is effective to the client.
3	Satisfactory	The performance meets requirements.
2	Fair	The performance needs some functionality.
1	Poor	The performance of the system fails to meet the requirements.

The testing of the system was conducted at Cabitan Elementary School and in DEBESMSCAT Science Teachers. The developers documented the evaluation accurately.

Table 2 shows the result for the evaluation of the graphic design of the system. About the used designs in the system were accurate and extraordinary, respondents rated outstanding. With regard to the attractiveness and effects of the graphics and image representation in the system, respondents rated outstanding. In terms of used design in dialogue, buttons, modules, etc. in the system, respondents rated outstanding. Overall, the respondents rated 4.7 or outstanding for the graphic design of the system.

Table 3 shows the calculation result for the sound design of the system. On the used sounds in the system, with regards to the quality and immersivity, respondents rated outstanding. About the accuracy of the sounds style used, respondents rated very satisfactory. Overall, the respondents rated 4.5 for the sound design of the system.

Table 2 Evaluation Summary Result of Graphic Design

Graphic Design	Weighted mean	Interpretation
1. The used system design was accurate and extraordinary.	4.5	Outstanding
2. The attractiveness and effects of the graphics and picture representation.	4.7	Outstanding
3. The used design in dialogues, buttons, modules, etc.	4.5	Outstanding
Average:	4.7	Outstanding

Table 3 Evaluation Summary Result of Sound Design

Sound Design	Weighted mean	Interpretation
1. The sounds that are used in the system are immersive.	4.8	Outstanding
2. The accuracy of the sounds is met (e.g., correct animal sounds).	4.1	Very Satisfactory
Average:	4.5	Outstanding

Table 4 shows the result for the security of the system. On the safety of the data build in the system, respondents rated it outstanding. About the appropriateness of the security style used, respondents rated outstanding. Overall, the respondents rated 4.7 or outstanding` for the security of the system.

Table 5 shows the result for the accuracy of the system. On the correctness of data input and output build in the system, respondents rated it very satisfactory. In the preciseness of data in the system, still it is rated very satisfactory. Overall, the respondents rated 4.3 or very satisfactory for the accuracy of the system.

Table 4 Evaluation Summary Result of Security

Security	Weighted mean	Interpretation
1. The safeties of data built in the system.	4.8	Outstanding
2. The appropriateness of security style used.	4.6	Outstanding
Average:	4.7	Outstanding

Table 5 Evaluation Summary Result of Accuracy

Accuracy	Weighted mean	Interpretation
1. The correctness of data input and output built in the system.	4.2	Very Satisfactory
2. The preciseness of data in the system.	4.4	Very Satisfactory
Average:	4.3	Very Satisfactory

The table below (see table 6) was the usability of the system. On the user-friendliness of the system, respondents rated it outstanding. In terms of performance of the system, respondents rated outstanding. Concerning about the flexibility of the software-based learning material, respondents rated it outstanding. Overall, the respondents rated outstanding for the usability of the system.

Table 6 Evaluation Summary Result of Usability

Usability	Weighted mean	Interpretation
1. The user-friendliness of Flora and Fauna in Minecraft.	4.8	Outstanding
2. The system's performance is optimal and can run on lower end devices.	4.7	Outstanding
3. The flexibility of the software-based learning material.	4.8	Outstanding
Total Average:	4.8	Outstanding

V. CONCLUSION AND RECOMMENDATIONS

- *Conclusion*

In conclusion, the developed software project in Minecraft's Bedrock Edition was successful in providing an engaging and flexible platform for game-based learning. The project's compatibility with any device and easy customization through the use of JSON programming language and Visual Studio Code allowed for a seamless and effective development process. The overwhelmingly positive feedback received from the respondents further highlights the potential of this system as an efficient and effective tool in education. By making learning more engaging and fun through game-based learning. This system may have the ability to revolutionize the way educators approach teaching and students approach learning. Overall, the success of the project demonstrates the potential of technology to transform the educational landscape and improve learning outcomes.

Based on the respondents' feedback, it can be inferred that the system was able to engage them in a fun and interactive way, while also providing them with valuable knowledge and insights. This suggests that the system was able to achieve its goal of integrating education and entertainment seamlessly. The outstanding feedback on the system's images and sounds also suggests that the system was well-designed and appealing to the respondents. This positive response may have contributed to their enjoyment

of the game and their ability to learn from it. Overall, the feedback from the respondents indicates that the system was successful in providing an effective and enjoyable learning experience, which may have the potential to be widely adopted in educational settings.

➢ *Recommendations*

The following recommendations were drawn through checking and evaluating the result and output software and from the suggestion of the respondents of the project and the recommendation given by the panelist.

- *Include more plants and animals in the game that can be found in the local set-up.*
- *Include buttons or menus within the in-game menu that the user may venture in th*e zoo such as:

✓ *Map*: A map button could be included to allow users to navigate the zoo and find their way to specific exhibits or attractions.
✓ *Quiz*: A quiz button could be included that allows users to test their knowledge of the animals or exhibits within the game. The quiz could be customized based on the user's age or skill level, and could include multiple choice or open-ended questions.
✓ *Photo Gallery:* A photo gallery button could allow users to view and share photos of animals and exhibits within the game, as well as user-generated content such as fan art or memes.
✓ *Animal Sounds*: An animal sounds button could allow users to listen to and learn about the sounds that different animals make. This could include recordings of animal vocalizations or interactive games that test users' ability to identify different animal sounds.

- *Add level of difficulty in the game, if possible (from the novice to expert).*
- *Group each question of quizzes for plants and animals according to its complexity.*
- *It is highly recommended to use this software in the delivery of the topic related to Flora and Fauna.*
- *It should be noted that putting high-resolution images like those on the gallery of the virtual zoo causes significant impact to the performance as well as drastically increasing the file size due to the bedrock engine using the in-game blocks as the color palette for that image rather than the RGBA (Red, Green, Blue, Alpha) channels. Future developers should prioritize minimizing the use of high-resolution images in the software. Instead, it is recommended using 3D animated models of the plant or animal they are referring to and provide detailed descriptions about it on the NPC Teacher upon detecting it to ensure the best possible knowledge about the subject. This method will be more interactive and immersive than the performance-hungry, high-resolution 2D images.*

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