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volume 1

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PREFACE

Welcome to the inaugural volume of the **Progress in Computing and Mathematics Journal (PCMJ)**, a publication proudly presented by the College of Computing, Informatics, and Mathematics at UiTM Cawangan Melaka.

This journal represents a significant step in our commitment to fostering a vibrant research culture, initially providing a crucial platform for our undergraduate students to showcase their intellectual curiosity, dedication to scholarly pursuit, and potential to contribute to the broader academic discourse in the fields of computing and mathematics. However, we envision PCMJ evolving into a beacon for researchers both nationally and internationally. We aspire to cultivate a space where groundbreaking research and innovative ideas converge, fostering collaboration and intellectual exchange among established scholars and emerging talents alike.

The manuscripts featured in this first volume, predominantly authored by our undergraduate students, are a testament to the hard work and dedication of these budding researchers, as well as the guidance and support provided by their faculty mentors. They cover a diverse range of topics, reflecting the breadth and depth of research interests within our college, and set the stage for the high-quality scholarship we aim to attract in future volumes.

As editors, we are honored to have played a role in bringing this journal to fruition. We extend our sincere gratitude to all the authors, reviewers, and members of the editorial board for their invaluable contributions. We also acknowledge the unwavering support of the college administration in making this initiative possible.

We hope that PCMJ will inspire future generations of students and researchers to embrace research and innovation, to push the boundaries of knowledge, and to make their mark on the world of computing and mathematics.

Editors
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College of Computing, Informatics, and Mathematics
UiTM Cawangan Melaka

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ARTQUEST: A VIRTUAL REALITY ESCAPE ROOM FOR LEARNING ART HISTORY LESSONS

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Article Info	Abstract
	The ArtQuest project bravely tackles the challenges associated with teaching art history, particularly in the context of Malaysia's "Pendidikan Seni Visual." Recognizing the prevalent issue of students finding art history dull due to uninspiring teaching methods, ArtQuest steps in as a game-changer. By harnessing the power of Virtual Reality (VR) technology, ArtQuest aims to inject excitement into the learning experience. The core objective revolves around making art history not only enjoyable but also enhancing students' ability to remember, understand deeply, and stay motivated. Executing a meticulous plan known as the ADDIE methodology, ADDIE is a step-by-step method ArtQuest used to create an engaging VR escape room, ensuring effective and enjoyable art history learning. ArtQuest brings forth a VR escape room that not only received a high satisfaction rate of 83.6% but also successfully blends fun with education. Looking forward, ArtQuest harbors aspirations to elevate its impact further. The plan involves collaboration with teachers to infuse additional captivating information into the VR experience, introducing more quizzes in each room to encourage users to test their knowledge about art history. This strategic move not only facilitates learning but also allows users to delve deeper into various art movements. ArtQuest also envisions supporting more languages, moving beyond Malay, to ensure inclusivity for a broader student base. Recognizing the dynamism of technology, ongoing updates to the VR technology remain a priority, as adding new features can enhance the overall learning experience. In essence, ArtQuest stands as a testament to successful innovation in education, and with future plans for enriching content, language support, and technological advancements, it aims to be an even more valuable and enjoyable educational tool for students preparing for the SPM exam in Malaysia.

INTRODUCTION

The project focuses on enhancing the teaching of Pendidikan Seni Visual (PSV), an elective subject in the Sijil Pelajaran Malaysia (SPM) examination, by addressing issues identified in the current teaching methods. The Visual Arts Education curriculum aims to deepen students' understanding of art, but traditional teaching methods relying on static textbooks have been found to be uninteresting and less engaging (Jenal & Ramli, 2020)

To overcome these challenges, the project proposes the use of Virtual Reality (VR) technology to create an interactive and enjoyable learning experience for students of art history. The VR application incorporates a unique escape room concept, adding a challenging and problem-solving element to make the learning process dynamic and immersive (Alhadeff, 2017).

The identified problems include a lack of enjoyment in learning art history due to the abstract nature of visual arts and uninteresting teaching methods (Norsalawati binti Wahid, 2021). Additionally, the current learning methods lack interactivity, with students primarily relying on static images in textbooks and presentation tools (Cecotti et al., 2024).

The project's objectives include designing non-immersive art history lessons, developing a virtual reality application for learning art history, and evaluating the enjoyment of the VR application. The target audience is SPM students taking PSV and those interested in art history, with the application covering seven levels based on the seven art movements in the 'Pendidikan Seni Visual' textbook for Form 5, Chapter 2.1.

The project's significance lies in making learning more exciting and enjoyable for students through VR technology, allowing them to explore art history in a virtual world and engage in interactive activities (Hui et al., 2022). For teachers, the project provides an opportunity to explore innovative teaching methods and enhance classroom engagement. Workshops and discussions are envisioned to help teachers effectively integrate VR into their lessons (Hui et al., 2022).

LITERATURE REVIEW

The art history lessons in this project delve into the intricate development of painting in the 20th century, shaped by political upheavals like the Russian Revolution and World War I. The emergence of art movements such as Fauvism, Expressionism, Cubism, Surrealism,

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Abstract Expressionism, Pop Art, and Op Art reflected artists' emotional responses to the turbulent times (Ibrahim et al., 2020). Traditional teaching methods using static textbooks have limitations, prompting the exploration of innovative approaches to enhance the learning experience (Jenal & Ramli, 2020).

Methods of Learning Art History Lessons

To make art history lessons more engaging, the project explores various learning methods such as virtual reality (VR), augmented reality (AR), and game-based learning (GBL). VR creates simulated experiences, offering immersive 3D visualization that proves beneficial for educational purposes (Javaid & Haleem, 2020).AR blends virtual elements with the real world, enhancing real-world objects, and has been effectively utilized in education for improved learning outcomes (Garzón, 2021). GBL involves using games to achieve defined learning outcomes and has proven effective, particularly in capturing the interest of students (Chen & Tu, 2021).

Comparison on method for learning art history lessons

The comparison of these methods indicates that VR, with its high level of immersion, is the most suitable for this project. VR provides an immersive, experiential, and personalized approach to learning art history, enhancing engagement and visualization of complex concepts (Plass et al., 2010).

Role of Escape Room Genre

Escape rooms are introduced to the project to add a challenge, enhance problem-solving, and make the learning experience more dynamic and immersive for students (Oliveira et al., 2023).Escape rooms trigger strong feelings in players but balance the negative elements with satisfying progress and achievement, making the learning process more enjoyable (Escape Rooms and the Psychology behind Them, 2021).

Review of Methodologies

In terms of methodologies, the project evaluates ADDIE, Agile, and Waterfall methodologies. ADDIE's systematic instructional design model with phases like Analysis, Design, Development, Implementation, and Evaluation is well-suited for developing VR learning experiences (Dylan Juliano Santoso et al., 2021). Agile's iterative and adaptive planning approach is effective for software development projects (Al-Saqqa et al., 2020), while

Waterfall's linear model is suitable for projects with well-defined requirements (Fajar Pratama & Husniah, 2018). Ultimately, ADDIE is chosen for its comprehensive and structured framework that aligns with the project's goal of creating an immersive and effective VR learning experience.

METHODOLOGY

The instructional design for the Art Quest: A Virtual Reality Escape Room for learning Art History lessons follows the ADDIE methodology, a five-phase model encompassing Analysis, Design, Development, Implementation, and Evaluation (Cahyadi, 2019). The Analysis Phase involves understanding learning objectives, target audience, and content requirements, ensuring alignment with educational goals (Drljača et al., 2017). A comprehensive review of art history literature forms the basis, clarifying project scope, objectives, and methodologies. The Design Phase utilizes information from the analysis to create a flowchart and storyboard for the virtual escape room, depicting the user journey through scenes and interactions. This phase ensures alignment with instructional design theories and models.
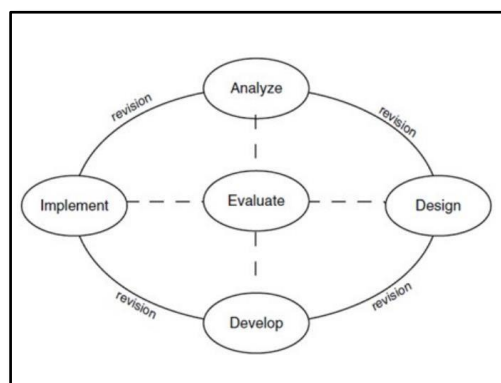
Figure 1: ADDIE Methodology (Source: Cahyadi, 2019)

Analysis Phase

In the analysis phase, the primary focus is on comprehending the learning objectives and project requirements. This includes gathering information about the target audience and the intended outcomes of the VR learning experience. Additionally, a comprehensive examination of Art History content and materials is undertaken to identify key concepts, themes, and challenges that will be integrated into the virtual escape room. This phase establishes the groundwork for subsequent design and development stages, ensuring that the VR learning

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experience is customized to meet educational objectives and effectively engage participants in the realm of Art History. Information about students, tasks, content delivery, and project goals is collected, allowing the instructional designer to organize and create content that is not only effective but also aligned with the project's objectives, ensuring the design of instructional materials that cater to learners' needs (Drljača et al., 2017).

Design Phase

During this phase, instructional designers begin to create the project. The information gathered from the analysis phase, in conjunction with the theories and models of instructional design, is utilized to explain how individuals will acquire the learning (Drljača et al., 2017). In the design stage, it is necessary to sketch a flowchart and storyboard in these instances.

Development Phase

The next phase in the ADDIE methodology is the development phase. During this stage, the course's final structure and content are created based on the elements and parameters defined in the previous two phases. This means that all the necessary information and materials are organized and put together according to the plan developed earlier (Drljača et al., 2017). In this phase, Unity, a game engine, was used to develop the project. Blender and 3ds Max a software, was used to create 3D characters for the game. Furthermore, Ibis Paint X was utilized to draw the 2D elements needed for the game's mechanics. Figure 3.4 shows the development phase of this project.

Implementation Phase

The implementation phase is the initial trial of the entire course, and it is suggested to split it into two parts: a test implementation phase and a final implementation phase (Drljača et al., 2017). During the implementation phase in the ADDIE model, the instructional design plan is put into practice. It involves developing and delivering the learning materials, like courses or training sessions, to the target audience. The main goal is to ensure that the instructional strategies and materials are effectively used. Feedback from learners is collected to evaluate the effectiveness of the instruction and make any necessary improvements. This phase focuses on actively implementing the planned instructional activities.

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Evaluation Phase

Evaluation is the final step of the ADDIE instructional design model to assess the value of developing instructional materials in learning (Cahyadi, 2019). It involves assigning scores to the learning materials to determine their effectiveness. This phase helps identify areas for improvement and guides future revisions. Feedback from learners is collected through questionnaires, and tests. As per the findings in the study by (Fu et al., 2009), the assessment of enjoyment and interactivity can be conducted using the EGameFlow Scale.

DESIGN AND DEVELOPMENT

Art Quest is a non-immersive virtual reality (VR) experience that uses great graphics for a fun and interactive time, meeting the main goal of bringing joy to users. To fully enjoy this VR experience, people who want to take part need to know some requirements. Creating it involved thinking and planning carefully, using the right technology tools to make it work well. Important things like what software and hardware to use, suggested interfaces, the story, how the project flows, and how people interact with it were all considered to fit the system it's meant for. The process started with planning and went on until it was ready to use.

Initiation Phase

The start phase is one of the most important phases of any project since it is the first step in determining and comprehending the major components and elements of the design and development process. Specifying the hardware and software requirements helps developers select the appropriate tools for the job at hand. Inaccurately identifying these tools might result in unforeseen challenges that affect the project's completion date and schedule. Essentially, developers must give priority to the start phase since it is a crucial part of the design and development process. Developers can secure the success of the project, obtain a full grasp of the work, and make educated decisions on tools and resources by doing a thorough analysis of all project parts.

Hardware Requirement

Creating a VR using the right equipment is an intelligent choice because it makes things faster and easier. However, the developer chose the specific hardware details needed to finish creating Art Quest in the current project. Table 4.1 has information on the hardware and how

it's used. Any hardware that doesn't meet the table's minimum requirements isn't considered suitable or proper for similar projects.

Table 1: Minimum Requirements for Art Quest

NO	Features	Requirements
1	Device	Personal Computer or Laptop
2	Processor	Intel Core i3
3	Graphic Card	NVIDIA GeForce GTX 1050
4	RAM	8 GB
5	Storage	5 GB

Software Requirement

Regarding software, it's essential for users engaging in these VR experiences on desktops to use the Windows version, specifically a minimum of Windows 10 64-bit. This choice is significant because Windows 10 is the standard operating system for PCs, including developing graphics drivers. Utilizing optimal graphics drivers is necessary for seamless performance. Software requirements involve the developer's decisions on the software to be employed in the game project's development. This project utilized software such as Unity, 3DS Max, ibis Paint X, Blender, and Canva for design and development.

Project Design

The project design covers the entire VR experience and shows how it evolves from beginning to end. This happens at the pre-production stage. The project design acts as a guide for the VR, with a flowchart and a high-fidelity storyboard outlining the entire process. By providing this knowledge, readers may rapidly realize the VR's structure, dynamics, and visual characteristics, creating the framework for its effective creation and implementation.

Overall Project Process

This project began by exploring historical art and aiming to integrate it into Virtual Reality (VR). Information was gathered from books and by checking the 'Pendidikan Seni Visual' textbook for Form 5. The art quest development had different steps like planning the story, making 3D things, and using computer programs like Unity, 3DS Max, Blender, ibis Paint X, and Canva. Unity was important for making things visible and interactive. It shaped how the project looks and works. 3DS Max and Blender helped create 3D models, making the game interesting. ibis Paint X, a digital painting tool, was used for drawing and designing the

project's look. Canva, known for being easy to use, helped design buttons and images. Before making the actual project, there was a plan. A guide with a flowchart and a detailed storyboard was created. This guide showed how the VR experience would go from the beginning to the end, helping understand how the project should look and work.
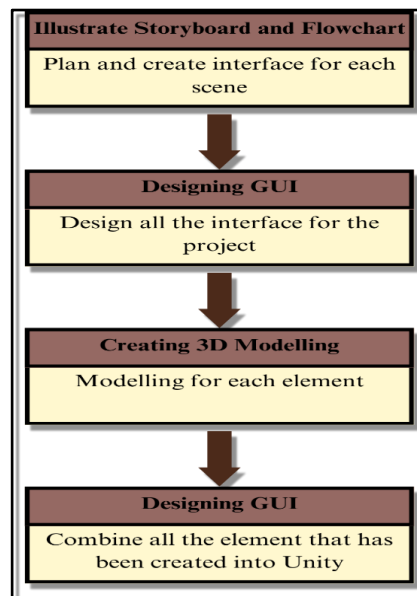

Figure 2: Overall process of VR development

Development

In the development process, the project focused on creating a virtual reality (VR) experience from the beginning. The goal was to ensure that the interaction, interface, and visuals were captivating and in line with the project's objectives. This process required ongoing improvements to deliver a high-quality, immersive, and enjoyable learning experience for users within the virtual reality environment.

RESULT AND DISCUSSION

This section of the thesis focuses on assessing the enjoyment level of participants during the VR testing phase. The participant was from Sekolah Menengah Kebangsaan Taman Daya 2 in Johor Bahru. The student is in Form 5 and is studying Visual Arts. Gathering user feedback is important for evaluating whether the project meets its gaming objectives. The evaluation of Art Quest utilized the EGameFlow questionnaire, a recognized and validated tool for measuring

enjoyment in VR. By employing this questionnaire, the developer gained valuable insights into the strengths and weaknesses of the game's design concerning user enjoyment. EGameFlow assesses enjoyment based on eight factors: concentration, goal clarity, feedback, challenge, autonomy, immersion, social interaction, and knowledge improvement. However, for the Art Quest evaluation, the social interaction factor was excluded, as the project does not involve online interaction. Additionally, the developer selectively used questions from each factor that were most relevant to the game.

Table 2: Total mean value and percentage

Factor	Total Mean
Concentration	4.50
Goal Clarity	4.51
Feedback	4.42
Challenge	2.57
Autonomy	4.47
Immersion	4.42
Knowledge Improvement	4.38
Total Average Mean	4.18
% Of overall total mean	83.6%

The average mean for all factors combined is 4.18, according to the table. The overall satisfaction rate for ArtQuest is 83.6%, which is a high number when expressed in percentages.

The most effective factor in addressing the lack of enjoyment in learning history of art using VR non-immersive is likely "Immersion." The high mean of 4.42 in immersion suggests that students feel deeply engaged and connected with the subject matter.

The second factor that solved the lack of interactivity in traditional teaching methods using VR non-immersive technology was "Feedback." With an average score of 4.42, it shows that the feedback aspect worked really well. VR provided immediate and interactive feedback, creating a more interesting way to learn. By using VR technology to enhance feedback mechanisms.
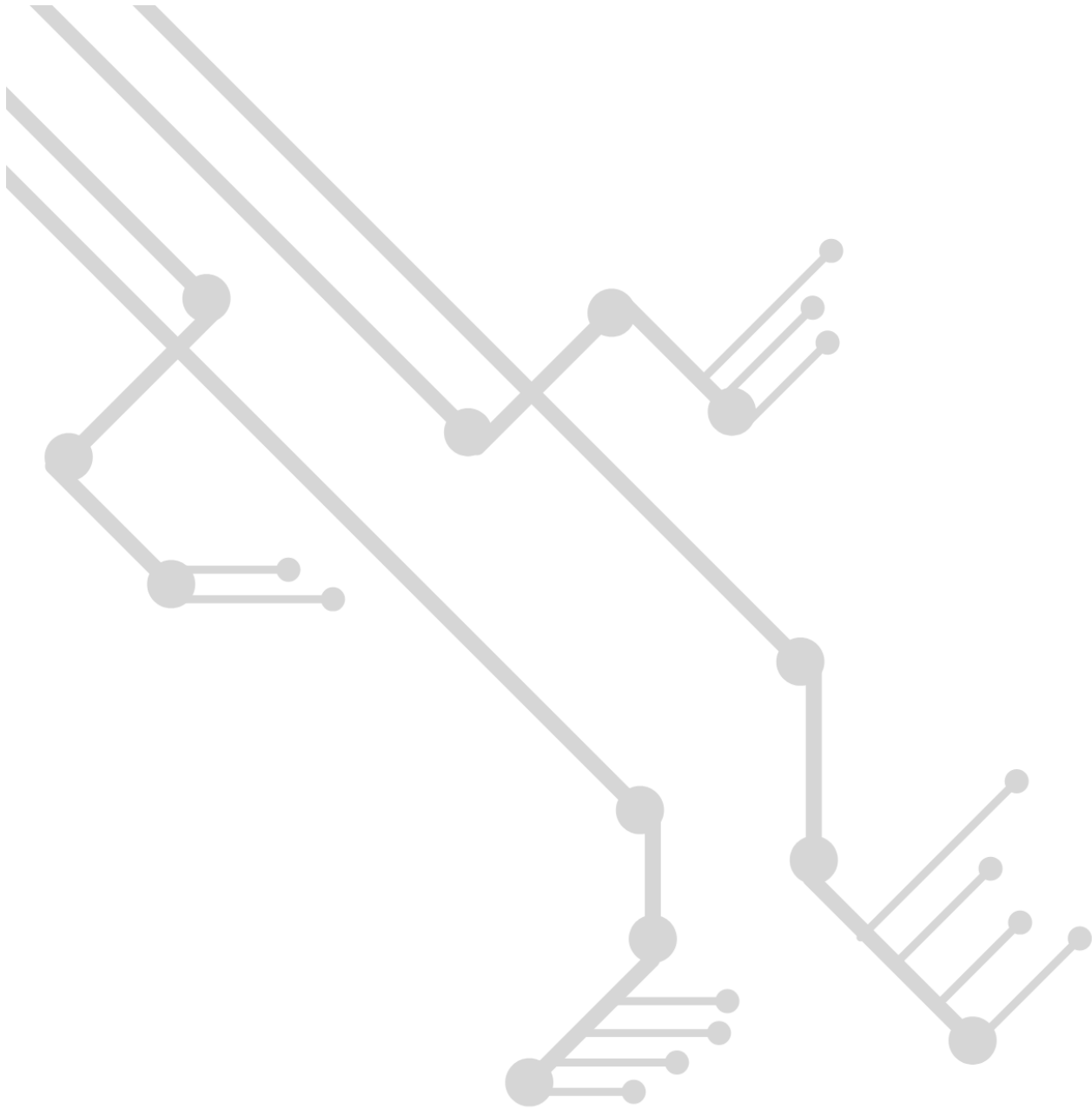
SUMMARY

The VR Art Quest project serves as an immersive VR Escape Room designed to enhance Art History learning. Users are transported to a virtual environment, providing an interactive and visually engaging platform for exploring art concepts. The project successfully addresses the

challenges outlined in Chapter 1, as evidenced by positive user feedback and the favorable results of the EGameFlow questionnaire used for evaluation. However, limitations include a reliance on textbook content for Seni Visual information, platform restrictions limited to computers, and the game being available only in Malay. Future research avenues involve improving content richness, incorporating more quizzes for each VR room, exploring multilingual support for broader accessibility, and keeping abreast of VR technology advancements for continuous enhancement of the learning tool.

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