CHAPTER 7

Resonance: The Balance of Titans

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7.1 INTRODUCTION

The rapid growth of biotechnology and robotics has brought exciting innovations alongside complex ethical and societal concerns. According to [65], the integration of AI in education in Malaysia remains limited despites its ethical implications. Our FYP project is a 3D animation, so we use Blender and Adobe After Effect to visualize and communicate these concerns through a fictional narrative involving a genetically engineered kaiju and autonomous robotics systems. This study adopted a practice-based design, supported by questionnaire feedback from 15 respondents aged 18 to 25 years old. The main goal of the project is to showcase our technical skills in 3D modelling, animation, and visual effects and to evaluate the effectiveness of speculative fiction animation in fostering ethical awareness among young adults. Prior works such as [66] have examined ethics and social implications of robotics in MIT press. Moreover, we want to spread awareness about responsibility in science innovation because

there is a lack of engaging media content in Malaysia that addresses ethical implications of robotics and biotech through animation. This project using speculative fiction and visual effects to provoke thought and have a discussion between scientific knowledge and public understanding. This study contributes to STEM ethics education and promotes the use of visual storytelling in raising scientific literacy. This paper categorized into five sections: Introduction, Literature Review, Methodology, Results and Discussion, and Conclusion.

7.2 LITERATURE REVIEW

7.2.1 ROBOTICS IN MODERN APPLICATIONS

Scientific innovation drives the rapid development of robotics, enabling machines to become smarter, more adaptive, and increasingly autonomous. Complete with advancements in artificial intelligence, sensors, machine learning, and materials science, modern robots are no longer limited to repetitive tasks in controlled environments. According to constructivist learning theory, engaging learners with real-world examples such as robotic innovations help them actively construct knowledge by connecting new technological concepts to their understanding and develop critical thinking skills [67]. According to [68], robotics development is not only transforming what machines can do, but also reshaping the nature of human work by automating complex task and improving skills that are needed in the workforce. He points up that as robotic become smarter, education must make headway for people ready to work with them ethically and successfully.

Nowadays, technology have more developed and there is this current technology, which is sensor technology. This technology is a crucial component in modern robotics, enabling machines to perceive and interact with their environment. It detects physical input like light, heat, motion, pressure, or distance and convert it into signals that a robot's system can process [69]. Advanced sensors like LiDAR (Light Detection and Ranging) create detailed 3D maps of surroundings, essential for applications like

autonomous vehicles and drones. Inspired by the development of autonomous drones [70], our character's AI system mirrors real-world through motion scripting. In addition, progress in machine learning algorithms enables robots to learn from experience and improving their performance over time without explicit reprogramming. These developments have made it possible for robots to operate in complex environments, such as disaster zones, oceans, outer space, and human-centered workplaces [71].

7.2.2 COMBAT ROBOTICS

Combat robots are advanced, remote-controlled, or autonomous machines designed to engage in competitive or tactical battles. These robots are typically built for strength, agility, and resilience, and are often used in entertainment competitions, military applications, and research. While [72] highlights risk of AI in employment, [73] views it as inevitable progress. This duality frames the ethical debate illustrated in our animation. It is remotely controlled by human operators or programmed to operate autonomously, using sensors and artificial intelligence to detect and respond to threats or challenges in real time. These robots are engineered to withstand harsh impacts and deliver powerful attacks. Combat robotics, while initially developed for military applications, have garnered significant public interest through entertainment media such as Batttlebots and Robot Wars. In these events, engineers, students, and hobbyists compete to design the most effective and innovative fighting machines. The arena becomes a proving ground for mechanical creativity, where strategy, design, and quick thinking all play vital roles in determining victory [74]. It represents a unique convergence of mechanical engineering, electronics, and computer science. These technologies had used for competition, research, or national security, they showcase the remarkable potential of robotics to solve complex challenges and perform in high-stakes, high-pressure environments.

7.2.3 ETHICAL ISSUES IN SCIENTIFIC INNOVATION

Technological innovation is also equally growing and advancing day by day. It refers to the development and application of new ideas, tools, methods, or devices that improve or revolutionize how tasks are performed and problems are solved. It plays a vital role in advancing industries, enhancing productivity, and improving quality of life. This innovation frequently emerges from research, experimentation, and collaboration across multiple fields, including science, engineering, and design [75]. According to [76], he argues that disruptive innovations often arise in this way, challenging established industries by introducing technologies that initially seem inferior but ultimately redefine markets and consumer expectations. Moreover, this technology continues to reshape industries like healthcare, communication, transportation, and education. It also creates entirely new markets or ways of living such as smartphones, renewable energy systems, or artificial intelligence [77]. [78] had suggested that these accelerating technological changes are leading us toward a “singularity”, a point where human and machine intelligence unite, radically it transforms the society and human capabilities.

7.3 METHODOLOGY

This research project aims to investigate the development of 3D animation and explore more technology innovations, especially in robotics. This is practiced-based research supported by quantitative data from questionnaire distributed to target audiences, which measures respondent’s perceptions of the animation’s effectiveness in communicating ethical issues, their level of engagement with the visual narrative, and their understanding of the scientific and technological concepts presented. The collected data will be analyzed statistically to identify trends, assess the impact of the animation on viewer’s critical thinking and ethical awareness, and evaluate the potential of animated media as a tool for STEM education and public engagement. The methodology includes making surveys, researching online, and utilizing secondary data such as journal

articles and internal records. The objective is to encourage critical thinking and ethical reflection. Blender was chosen due to its open-source flexibility and strong support for rigging and particle effects [79]. The use of cinematic camera angles during pre-production was designed to enhanced emotional impact, aligned with the goal of promoting ethical reflection among viewers.

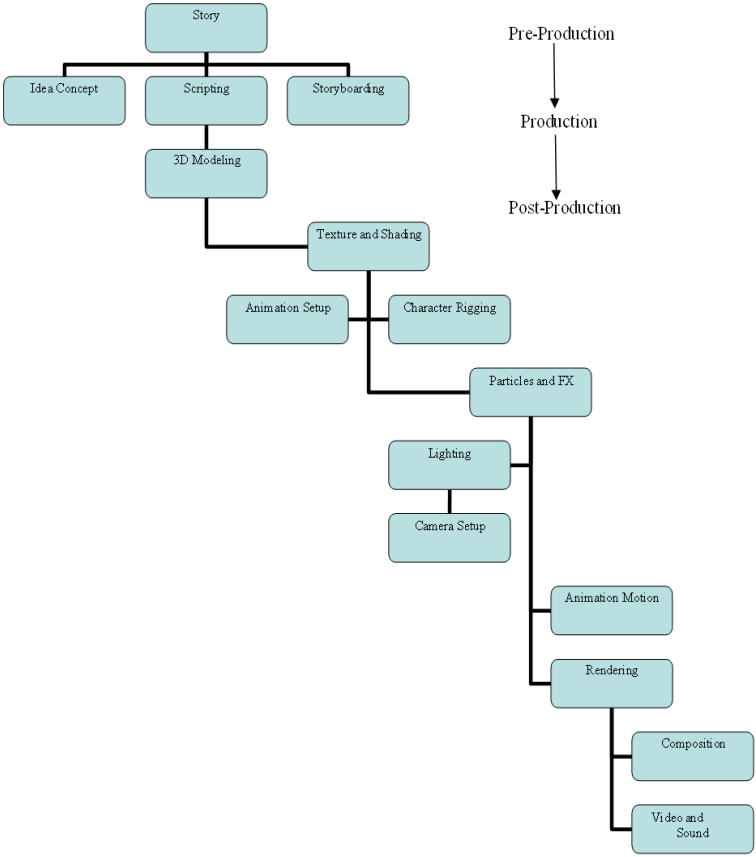

Figure 1: 3D process flow chart

As shown in Figure 1, the pipeline begins with pre-production planning. This phase starts with concept development, and it is crucial because to brainstorming the concept of the story and message or morals to deliver to the audience. The next phase is scriptwriting. It is process of writing the story, dialogue, and key actions for the animation. Script are commonly sets with the plots, character's roles and guides of the tone and pacing of the story. After this phase, the process of storyboarding is beginning. This process is a little bit like previous phase, but it is more visual and was created using 'Storyboarder' by Wonder Unit to visualize pacing and camera movement. Moreover, after the pre-production phase is completed, the production phase begins. This phase starts with 3D modeling. It is the process of creating digital three-dimensional objects or characters using specialized industry-software such as Blender and Maya. The next phase is texturing and shading. It is the process of adding the detail surface images or patterns to 3D models, add some colors, bumps, or realistic material such as wood or metal. Shading is the process of the surfaces reacted to light, controlling highlights and shadows to make objects livelier and more natural. Then, animation setup and character rigging. Animation setup is a process that is done first before character rigging because is like preparation 3D models for movements by creating skeletons, or known as rig, and adding controls for animators to create. Character rigging is a process of building a digital skeleton for a 3D character to create the movement realistically. The last process of this phase is particle and FX. It is more like techniques in 3D animation to create dynamic visual elements such as rain, smokes and more.

Furthermore, the post-production is the last phase of the production. This initial and significant process is lighting. It is the process of placing and adjusting virtual lights in a scene to create mood, highlight to add detail and realistic. The next phase is camera setup, and it involves camera to frame shots, set angles and movements to create a cinematic experience for audience. Afterwards, animation motion and rendering. Animation motion are more to adjust keyframes and timing for animation to appear smoother and more natural. Rendering is the last phase which is the computer processes all the models, lighting and effects

produce the final images or video frames. Following that, composition phase. It is the process that combines all the elements such as characters, background and more into final scene and adjusting the colors or mood, add some effect for clean-up phase. Finally, video and sound editing. This is process where to cutting and refining animated scenes, add transition, and syncing the dialogue, sound effect, and music.

7.3.1 QUESTIONNAIRE

A questionnaire was created and given out to students from 18 to 22 years old from Universiti Tun Hussein Onn Malaysia (UTHM). The questionnaire was conducted by using Google Forms targeting approximately 20 respondents. A convenience sampling method was used due to accessibility constraints. Participants were diploma students in animation aged 18-22. It was to obtain information relevant to research objectives. The main purpose of the questionnaire is to captures the interest of the target audience and evaluate how well the final products works and meets their needs.

7.3.2 ANIMATION DEVELOPMENT PROCESS

A questionnaire was created and given out to students from 18 to 22 years old from Universiti Tun Hussein Onn Malaysia (UTHM). The questionnaire was conducted by using Google Forms targeting approximately 20 respondents. A convenience sampling method w

(a) PRE-PRODUCTION

Pre-production is a crucial phase in the 3D animation pipeline. Itis the foundation for everything that follows by planning out story, visual style, and character, and logistics. This phase starts with concept development. This process is where idea generation happen. It is to brainstorm the concept of the story and message or morals to deliver. At the same time, story development, theme and tone also have plan. To have a good story development, create a brilliant and compelling narrative arc with beginning,

middle, and ending. Additionally, the theme and concept for a story has been carefully decided so that the mood, colors, and theme are perfect and clear. Next, scriptwriting and storyboarding. For this step, a detailed script must have dialog, scene description, key actions and emotional beats. Storyboard is a visual representation of a script through sketches. It helps visualize composition, camera angles, key actions, and scene transition. Moreover, character and background design. A story would be incomplete without character design and background.

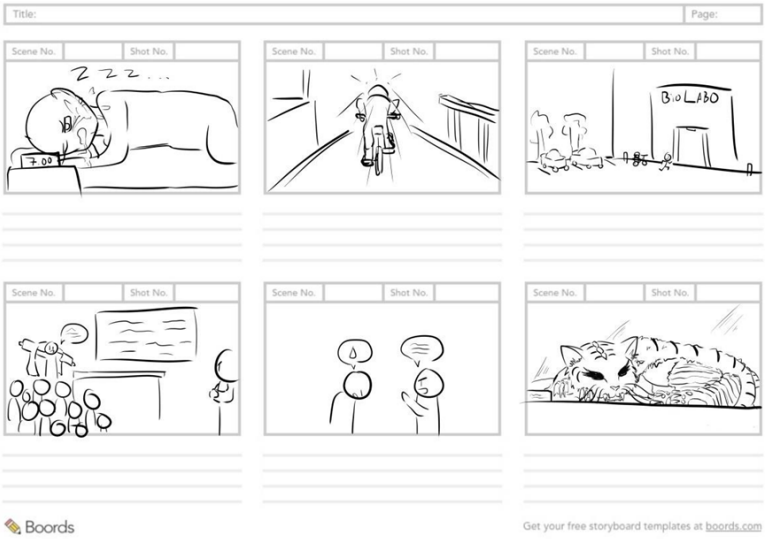

Figure 2: Storyboard

(b) PRODUCTION

The production phase in 3D animation is the process that idea and plans from pre-production turns to reality. This phase start with 3D modeling, and to do this step, is creating the digital 3D models of character, props, and backgrounds. This step includes UV mapping, sculpting and retopology. Next, texturing and shading. This step is applying surface detail to models. For

texturing, it is painting or projecting textures on to 3D models, shading is defined how surface respond to light as example, metallic, glossy, and more. In addition, rigging and this step also crucial for character, and to create the skeleton and controls for models to move. These steps are included joint and bone creation, weight painting and facial rigs. Layout or scene setup is for positioning characters and cameras in each scene based on the storyboard and animation. This process is including camera angles, blocking out movement, and environment placement. Additionally, animating. For this process, bringing the characters to life. Lip-syncing to dialog also had done at the same time. Effects are added for realism or motion in cloth simulation, hair dynamics, particle systems and destruction. Lighting is also playing the important role in production. This step is setting up light to simulate natural illumination. The lighting influences the mood, shadow, and highlights. Lastly, rendering. It is the process of generating the final images from 3D scenes. This process often takes minutes or hours per frame and depends to the animation.

(c) POST-PRODUCTION

The post-production phase in 3D animation is all the models, character or backgrounds are completely rendered and ready to deliver. This phase is focus on polishing visual, adding effects, and ensuring audio quality. This research starts with compositing. It is process of combining multiple rendered layers into frames. There are few steps, color correction and grading, add visual effects such as glows, blurs and more. Green screen and matte painting integration only needed. Next, editing, and for these steps, collect all the final sequence using rendered scenes, transitions, and adjustments. This purpose of this process is to trim, pacing, and arranging shots for narrative flow. Audio and sound effects. This step is to create sound effects that match the visual and to enhance the realism and impact of the animation. Music scoring also similar, but this process is added background music. It is to support emotional tone, enhancing pacing, and connect scenes. In addition, voice sync and final audio mixing. For this step, to align record voiceover with animated characters and balance the dialogue, sound effects, music, and ambient

sounds. Lastly, rendering final output. The steps are exporting the final version of animation into required format and resolutions.

7.4 RESULT AND DISCUSSION

7.4.1 RESULTS

As a part of this study, this questionnaire was created for students aged 18 – 25 years old at UTHM. This questionnaire was created using Google Forms and target around 13 respondents. Google Form was distributed via university email from 10-15 June 2025. Data was exported to Excel and analyzed using basic descriptive statistics. Although questionnaire is fast and accessible, it limits qualitative insights. Future studies may include interview. The main purpose of the questionnaire is to captures the interest of the target audience and evaluate how well the final products works and meets their needs.

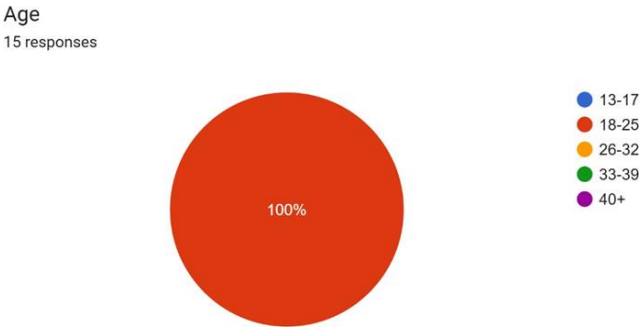

Figure 3: Respondent by age

7.4.2 DISCUSSION

Figure 4, the responses of 14 individuals to the statement: Technological development is prioritized over environmental concerns. Figure 1 shows that 12 out of 14 participants agree, another 2 participants disagree and strongly disagree that technological development should prioritized over environmental concerns.

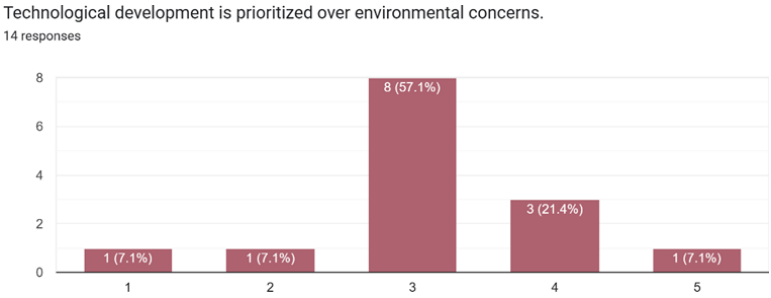

Figure 4: Technological development respondent

Figure 5, the responses of 14 individuals to the statement: Scientific discoveries are often misused in ways that harm the environment. Figure 2 shows that 13 out of 14 participants agree and 1 participant are disagreeing that scientific discoveries often are misused in ways that harm that environment.

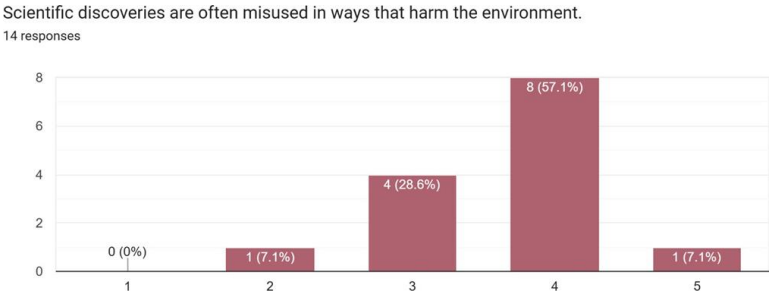

Figure 5: Misused discovered

Figure 6, the responses of 14 individuals to the statement: Society is aware of the ethical implications of scientific applications on the

environment. These findings suggest that students are aware of ethical implications of innovation, which justifies the animation's focus on speculative bioethical conflict.

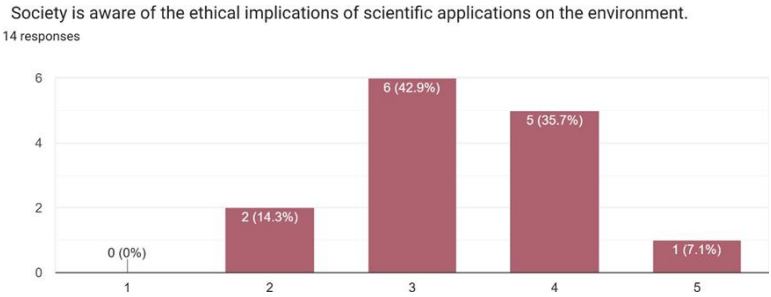

Figure 6: Society awareness

Figure 7, the responses of 14 individuals to the statement: I am concerned about the extinction of animal species caused by human activities. These surveys suggest that students are concerned about the extinction of animal species caused by human activities.

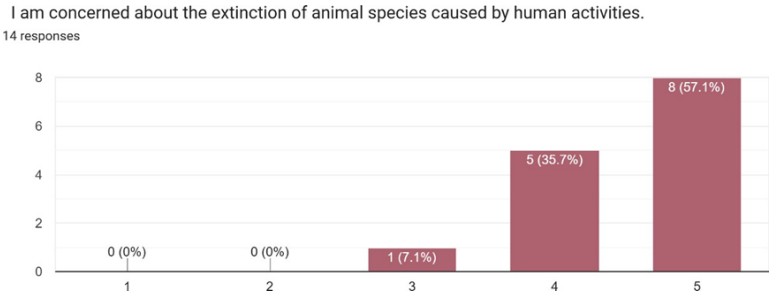

Figure 7: Concerned about the extinction of animal species caused by human activities

Figure 8, the responses of 14 individuals to the statement: Human development poses a significant treat to animal habitats. Figure 5 shows that all of 14 participants agree that human development poses a significant threat to animal habitats.

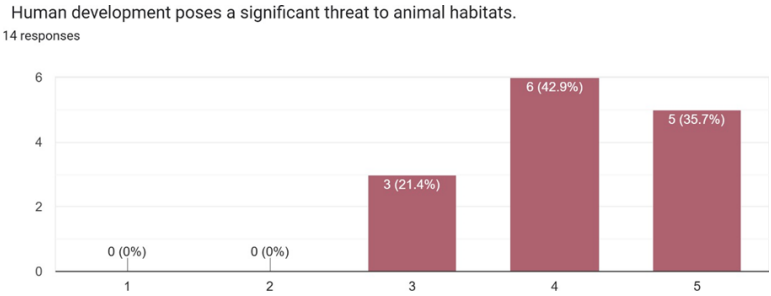

Figure 8: Human development poses a significant treat to animal habitats

Figure 9, the responses of 14 individuals to the statement: More action is needed globally to sustain animal species. Figure 6 shows that 13 out of 14 participants agree and 1 participant are disagreeing that more action is needed globally to sustain animal species.

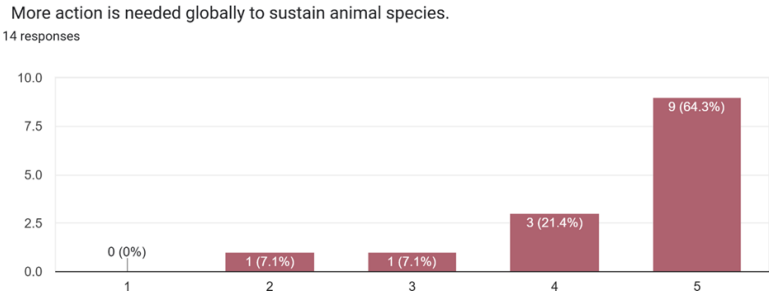

Figure 9: More action is needed globally to sustain animal species

Figure 10, the responses of 15 individuals to the statement: I have a good understanding of what environmental sustainability means. These finding suggest that students are understand of what environmental sustainability meanings.

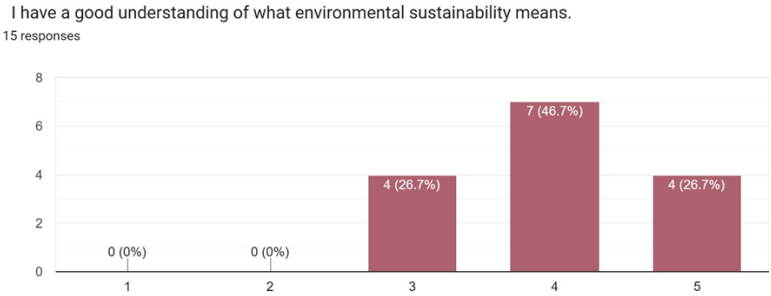

Figure 10: A good understanding of what environmental sustainability means

Figure 11, the responses of 15 individuals to the statement: I regularly seek out information about sustainability and climate issues. Figure 8 shows that majority of participants remains neutral, a few of agree and disagree that they seek out information about sustainability and climate issues.

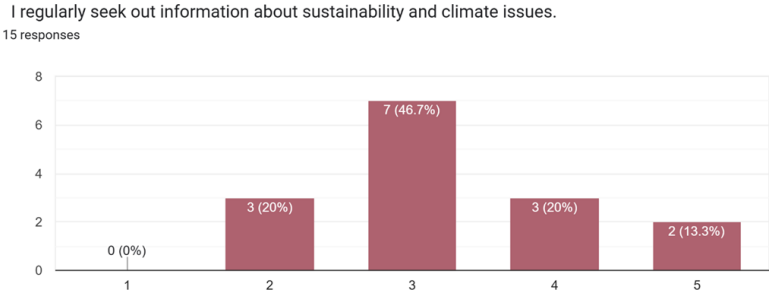

Figure 11: Seek out information about sustainability and climate issues

Figure 12, the responses of 15 individuals to the statement: We should take environmental sustainability seriously. Figure 9 shows that 14 out of 15 participants agree and 1 participant are disagreeing that we should takes environmental sustainability seriously.

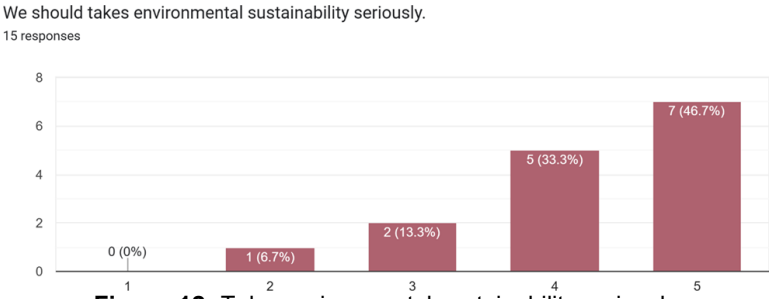

Figure 12: Take environmental sustainability seriously

7.5 CONCLUSION

The fictional narrative involving genetically engineered kaiju and autonomous robotic systems developed in 3D animation project serves as creative and impactful representations real-world concerns. This project explored ethical concerns in biotechnology through 3D animation and raised public awareness via speculative fiction. This study is not only showcasing modeling, rigging, and rendering by using industry standard software like Blender and After Effects. The use of animation proved effective in simplifying complex bioethical concepts for young viewers, though more comparative testing is needed. This project offers a new medium for public engagement on ethics in science, especially among youth.

The author's findings show that students, especially those at UTHM, show that they aware of the environment situation and efforts from the government and authorities to protect and conserve flora and fauna. This level of awareness is crucial in STEM education, where future engineers and scientist must be ready to make decisions not only based on innovation, but also on ethics and sustainability. However, the study is limited by its small sample size and lack of in-depth qualitative feedback. We recommend the integration of animation-based STEM ethics modules in secondary school science curriculum to enhance moral awareness. Furthermore, the story act as a warning and tells the process of how the misuse of scientific knowledge occurs.

The actions of this scientist are gradually driven by his ambitions and wrong intentions. It led to devastating consequences for both nature and society in this world.

To conclude, this Final Year Project contributes not only from the context of animation and storytelling, but more towards a deep and broad discussion about how technology is developed and the role of ethics in science and innovation technologies. It supports an interdisciplinary approach that combines technical skills with social responsibility, aim to inspire the next generation to innovate with clear purpose and integrity and to continue the legacy in the technology industry with ethics. At last, the authors hope that future research could explored interactive or gamified versions of the animation to further enhance engagement and ethical reasoning.