SOCIETY: Jurnal Pengabdian Masyarakat,
Vol. 4, No. 2 (2025): Maret, pp. 249-269
E-ISSN:2827-878X (Online -Elektronik)

Getting Started with Machine Learning in Game Development

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ARTICLE INFO

Article history

Received : 4-2-2025

Revised : 25-2-2025

Accepted : 28-2-2025

Keywords

Game Development; Machine Learning; Ml Agent; Reinforcement Learning; Unity Engine;

ABSTRACT

The webinar and workshop titled "Getting Started with Machine Learning in Game Development", held on January 18, 2025, aimed to deliver foundational knowledge on Machine Learning (ML), with a specialized focus on Reinforcement Learning (RL) and its applications in game development, featuring two main sessions: a public webinar for theoretical education and a hands-on technical workshop. The webinar introduced core ML concepts, including Supervised Learning, Unsupervised Learning, and Reinforcement Learning, while the workshop emphasized the practical implementation of RL using Unity ML-Agents, PyTorch, Anaconda, and the C# programming language, attracting 45–56 participants from diverse institutions and highlighting significant interest in ML applications within the creative industry, particularly game development. Pre-test results (administered prior to the sessions) yielded an average score of 64.68 and a median of 60, while post-test scores (conducted after the sessions) showed marked improvement, with an average of 81.22 and a median of 90, and participant feedback was overwhelmingly positive, with attendees expressing satisfaction regarding the quality of content, expertise of speakers, and overall event organization, underscoring the effective reception of Machine Learning education and its potential to enhance skill development across sectors, including the creative and technology industries.

Webinar dan Workshop "Getting Started with Machine Learning in Game Development", yang diselenggarakan pada 18 Januari 2025, bertujuan memberikan pengetahuan dasar tentang Machine Learning (ML) dengan fokus khusus pada Reinforcement Learning (RL) dan penerapannya dalam pengembangan game. Acara terdiri dari dua sesi utama: edukasi publik melalui webinar dan pelatihan teknis melalui Workshop. Webinar membahas dasar-dasar Machine Learning, Supervised Learning, Unsupervised Learning, dan Reinforcement Learning, sementara Workshop berfokus pada penerapan RL menggunakan Unity ML-Agents, PyTorch, dan Anaconda dengan bahasa pemrograman C#. Acara ini berhasil menarik 45–56 peserta dari berbagai institusi, menunjukkan minat besar terhadap penerapan Machine Learning di industri kreatif, khususnya pengembangan game. Hasil dari Pre-test yang di mana peserta

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mengerjakan tes tersebut sebelum pemaparan materi memiliki nilai rata rata sebanyak 64,68 poin dan median sebanyak 60 poin, sedangkan di Post-Test, yang di mana peserta mengerjakan tes tersebut setelah mendengarkan paparan materi yang diberikan, memiliki rata-rata sebanyak 81,22 poin dan median sebanyak 90 poin. Selain itu, mayoritas peserta memberikan umpan balik positif, menyatakan kepuasan terhadap kualitas materi, narasumber, dan penyelenggaraan acara. Kegiatan ini menegaskan bahwa edukasi teknologi Machine Learning diterima dengan baik dan berpotensi mendukung pengembangan keterampilan di berbagai sektor, termasuk industri kreatif dan teknologi.

A. INTRODUCTION

The advancement of the Industrial Revolution 4.0 has driven the adoption of artificial intelligence (AI)-based technologies, including machine learning (ML)(Raza et al., 2020). ML, a subfield of AI, enables systems to learn autonomously from data through pattern recognition and experience-based decision-making. In the context of human-machine interaction, this technology provides efficient solutions via real-time data analysis, prediction, and automated recommendations. One significant ML approach is reinforcement learning (RL), where a learning agent optimizes its policy through interactions with an environment based on a reward-punishment mechanism (Ibarz et al., 2021).

The implementation of RL has demonstrated transformative impacts across sectors. In robotics, RL has enhanced autonomous navigation capabilities through simulated environmental interactions (Kober et al., 2013). In gaming, the application of RL in developing AlphaGo showcased its superiority in creating complex strategies surpassing human capabilities (Silver et al., 2016). Recent studies further highlight RL's growing potential when combined with digital twins, enabling robots to learn and adapt navigation strategies in real time without human intervention. This approach has proven to improve efficiency and accuracy in robotic operations (Sun et al., 2024).

However, despite RL's rapid global adoption, its implementation in Indonesia's digital gaming industry remains limited. This is attributed to factors such as insufficient understanding of RL's potential in game development and challenges in integrating RL with popular game engines like Unity or PyTorch. Many Indonesian game developers still rely on traditional methods and have yet to leverage AI or RL in their game strategies. These challenges underscore the need for increased education and awareness regarding RL's application in local game development contexts.

In response to these gaps, educational initiatives such as webinars and workshops have been launched to introduce ML concepts in game development. One example is the program "Getting Started with Machine Learning in Game Development", conducted on January 18, 2025. The event included a webinar session (09:00 AM WIB) with 56 participants, covering introductory ML and RL concepts, followed by a hands-on workshop on

implementing ML in the Unity Engine using C#, PyTorch, Anaconda, and ML-Agents. By integrating theory and practice, the program aims to broaden RL applications across healthcare, education, transportation, and game development.

Project-Based Learning (PjBL) based online training programs in website development, as tested by (Lieharyani et al., 2022), showed a 4.81% increase in the average score of participants through a combination of theoretical sessions (live sessions) and GitHub-based project assignments. However, the study also revealed significant weaknesses, namely a decrease in participant participation of up to 65.91% due to technological, psychological, and time management barriers, as well as a training duration that was too long (6 weeks). These findings serve as a critical reference for the "Getting Started with Machine Learning in Game Development" training program to adopt similar strategies-such as the use of pre-test/post-test and the integration of practical projects-while improving on Lieharyani et al.'s weaknesses by condensing the training schedule (from 6 weeks to 1 intensive day) to reduce the risk of dropout and increase the retention of Generation Z participants. In addition, this program extends the scope of PjBL to a more complex technical domain, namely the implementation of Reinforcement Learning (RL) using Unity ML-Agents and PyTorch, which has not been explored in Lieharyani et al.'s study focusing on conventional website development. Thus, while adopting the evaluation framework and methodology of (Lieharyani et al., 2022), this training program offers contextual innovations in learning design and technical tools to address the challenges of online training in the field of Machine Learning.

B. METHODS

To implement the community service program, the authors and team structured the initiative into six sequential stages. The process began with activity socialization (Stage 1), where promotional flyers and registration links (https://forms.gle/fshAPmikWictdcYh6) were distributed across Instagram, LinkedIn, and WhatsApp to maximize outreach. Following this, educational materials (Stage 2) were prepared, including PowerPoint slides tailored for both the webinar and workshop to ensure clarity and engagement. Prior to the event, participants completed a pre-test (Stage 3) via https://forms.gle/6xD1Ce2PBzvJaPxb6 to benchmark their initial understanding of Machine Learning (ML) and Reinforcement Learning (RL). The webinar (Stage 4) then introduced foundational ML concepts, covering RL components, strengths, limitations, and real-world applications in gaming, ensuring participants grasped theoretical fundamentals. Subsequently, the workshop (Stage 5) provided hands-on training in Unity ML-Agents installation, RL implementation, PyTorch-based agent training, and C# programming for ML model deployment, with guided coding sessions. Finally, participants concluded the program by completing a post-test (https://forms.gle/UCwSewKMYGmqfzVMA) and feedback form (https://forms.gle/JWT1DtfmQBvean479) (Stage 6), which evaluated knowledge retention, satisfaction with content, speaker quality, and technical delivery. Pre-test/post-test comparisons and feedback analysis served as metrics for program effectiveness and future improvements.

C. RESULTS AND DISCUSSION

This event took place on Thursday, January 18, 2025, from 09:00 to 11:30 WIB. The event was organized to provide knowledge about artificial intelligence (AI), particularly in the application of Machine Learning, and was conducted online via the Zoom Meeting platform.

To ensure smooth execution, the event followed a structured rundown, as outlined in Table 1 below:

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Table 1. Schedule of webinars and workshops

Activities	Time	PIC (Person in Charge)
Opening	09:00 – 09.05	Mirsanda Amelia Utami
National Anthem "Indonesia Raya"	09:05 – 09:08	Operator
Muhammadiyah Mars Song	09:08 – 09:10	Operator
Tilawah (Quran Recitation)	09:10 – 09:13	Sadin Yusuf Ardika
Webinar Session 1	09:13 – 10:15	Moderator -> Dimas
Q&A Session - Webinar	10:15 – 10:25	Moderator
Workshop Session	10:25 – 11:15	Moderator -> Taufiq Rahman Hakim
Q&A Session - Workshop	11:15 – 11:25	Moderator
Closing	11:25 – 11:30	Mirsanda Amelia Utami

1.1. Activity socialization (Stage 1)

At this stage, the author and the team conducted outreach to the general public through social media, while also aiming to attract interested participants by distributing the flyers that had been created, as shown in Figure 1 below.

Figure 1 Flyer activity

1.2. Stage 2 (Preparation of Activity Material)

In this stage, the presenter prepares the material to be delivered in PPT format to make it easier for participants to understand. The material is structured with a focus on the concept of Reinforcement Learning (RL) and its application in game development. The material covers several key points, including:

a. Introduction to Machine Learning: A general explanation of the concept of Machine Learning and its types (Supervised, Unsupervised, and Reinforcement Learning).

b. Fundamentals of Reinforcement Learning: Concepts of agent, environment, reward, and policy in RL.

c. Implementation of RL with Unity ML-Agents: Explanation of installation, configuration, and use of ML-Agents in Unity for RL simulation.

d. RL Model Training Process: Steps to train an RL model using PyTorch in Unity.

e. Model Implementation in Game Development: How to integrate the trained model into Unity code using the C# programming language.

The webinar material begins with basic theory so that participants can understand how RL works in game development. The activity material can be visually seen in the presentation slides prepared by the presenter.

1.3. Stage 3 (Pre-test Completion by Participants)

In this stage, participants are asked to complete a Pre-test provided by the author and the team. This Pre-test consists of questions related to Machine Learning, elements of Reinforcement Learning, the purpose of Supervised Learning, and real-world examples of Reinforcement Learning. The goal of administering this Pre-test is to gauge the participants' level of understanding before the author and the team conduct the activity. The results show that the Pre-test was completed by 47 participants with a fairly good level of understanding.

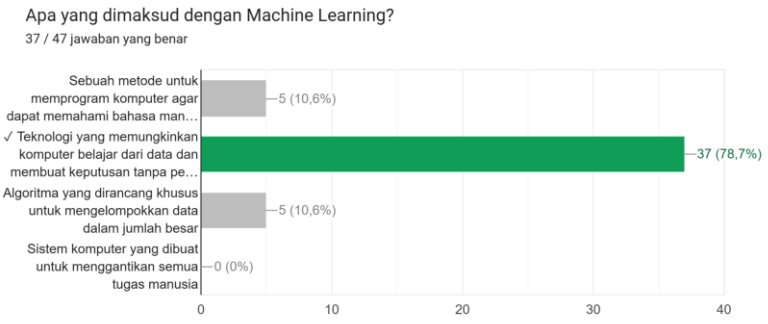

Figure 2 Pre-test Results on Machine Learning

In Figure 2 above, it can be seen that the pre-test was completed by 47 participants, with a correct answer percentage of 78.7% for question number 1.

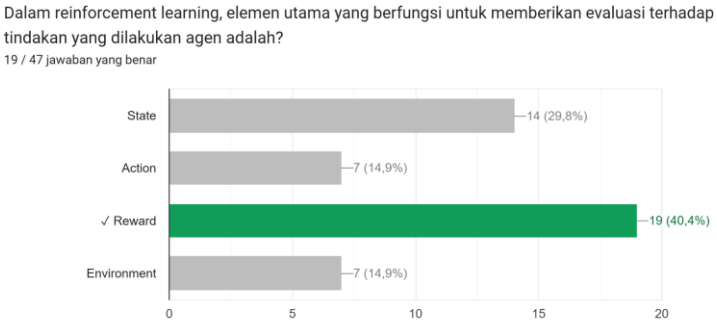

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Figure 3 Pre-test Results on Elements of Reinforcement Learning

In Figure 3 above, the pre-test results on the elements of Reinforcement Learning show that 40.4% of the answers were correct, as completed by 47 participants.

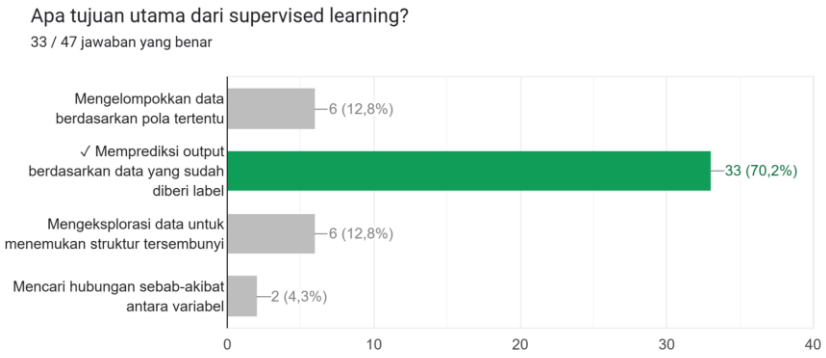

Figure 4 Pre-test Results on the Purpose of Supervised Learning

In Figure 4 above, the pre-test results on the purpose of Supervised Learning show that 70.2% of the answers were correct, as completed by 47 participants.

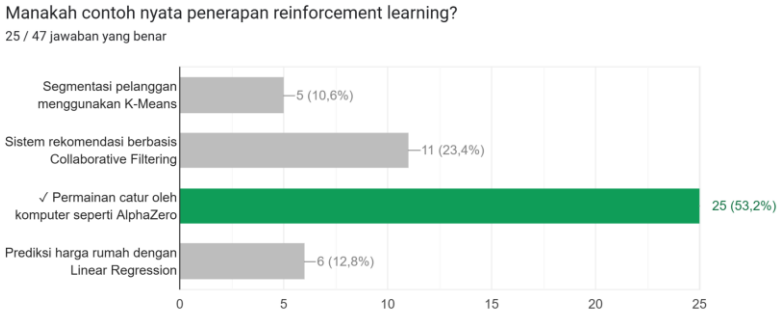

Figure 5 Pre-test Results on Real-World Examples of Reinforcement Learning

In Figure 5 above, the pre-test results on real-world examples of Reinforcement Learning show that 53.2% of the answers were correct, as completed by 47 participants.

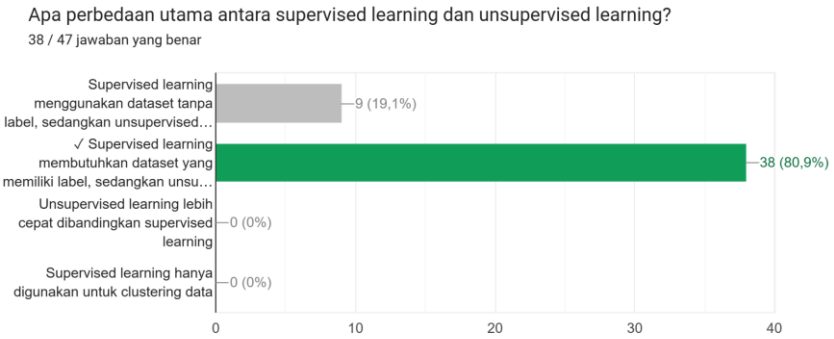

Figure 6 Pre-test Results on the Difference Between Supervised and Unsupervised Learning

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In Figure 6 above, the pre-test results on the difference between Supervised and Unsupervised Learning show that 80.9% of the answers were correct, as completed by 47 participants.

1.4. Stage 4 (Community Education Through Webinar)

In this stage, the webinar presenter delivers the material prepared in the previous stage to participants from the general public. The material presented is adapted based on a case study titled "Getting Started with Machine Learning in Game Development".

Details of Webinar Material:

a. Introduction to Machine Learning

Machine Learning (ML) is a branch of artificial intelligence (AI) that enables systems to "learn" automatically from experience (data) without explicit programming, focusing on the development of algorithms capable of improving performance iteratively through exposure to data (Roihan et al., 2020). In the context of games, Machine Learning can be used to develop intelligent agents capable of adapting to human player strategies, dynamically increasing difficulty levels, and providing a more challenging and realistic gaming experience.

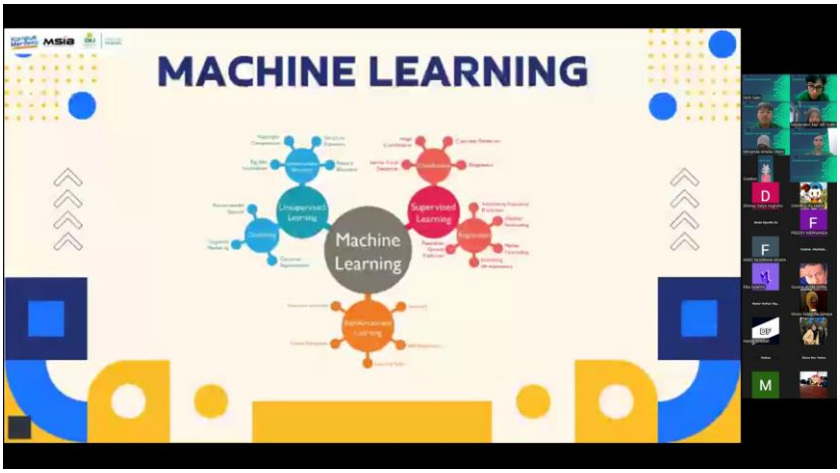

Figure 7 Screenshot Webinar saat penjelasan Machine Learning

In Figure 9 above, the presenter explains Machine Learning in general and also discusses the types of Machine Learning.

b. Introduction to Reinforcement Learning

Reinforcement Learning is an approach in Machine Learning where an agent learns to make optimal decisions through iterative interaction with the environment. Without relying on labeled data, the agent receives feedback in the form of rewards (which can be positive or negative) that reflect the quality of the actions taken. This process relies on exploration (trying new options) and exploitation (using existing knowledge) to optimize long-term cumulative rewards (François-Lavet et al., 2018).

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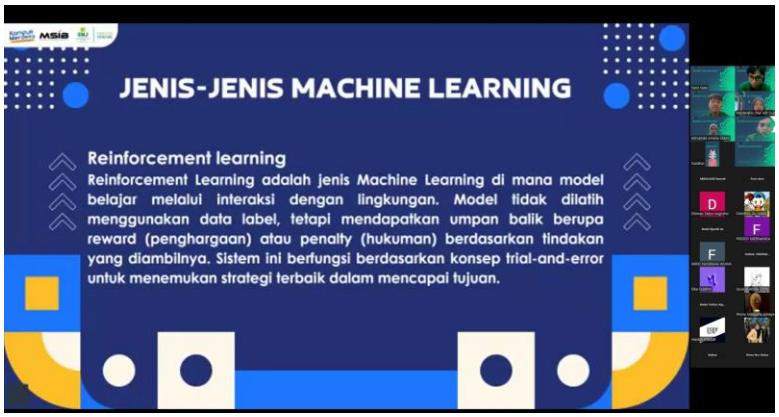

Figure 8 Screenshot of the Webinar During the Explanation of Reinforcement Learning Definition

In Figure 8 above, the presenter explains the definition of Reinforcement Learning.

c. Main Components of Reinforcement Learning

Reinforcement Learning (RL) provides a formal framework for sequential decision-making, inspired by principles of behavioral psychology. The core concept lies in the ability of an artificial agent to learn through dynamic interaction with its surrounding environment, mimicking organic learning processes. The agent gathers experience and uses it to maximize a defined objective through a system of cumulative rewards. In this scenario, the environment can be stochastic, and the information received by the agent may be partial or consist of complex data such as visual input (François-Lavet et al., 2018). The main components of RL include:

- Agent: The learning entity that performs interactions.
- Environment: The external system in which the agent operates.
- State: The representation of the environment's condition at a specific time.
- Action: The step taken by the agent to influence the environment.
- Reward: A numerical signal that evaluates the success of an action.
- Policy: The rule or strategy that determines the mapping of states to actions (can be deterministic or probabilistic).

This framework is relevant for problems where the agent must balance exploration (trying new options) and exploitation (utilizing existing knowledge), which is typically modeled as a Markov Decision Process (MDP) (François-Lavet et al., 2018).

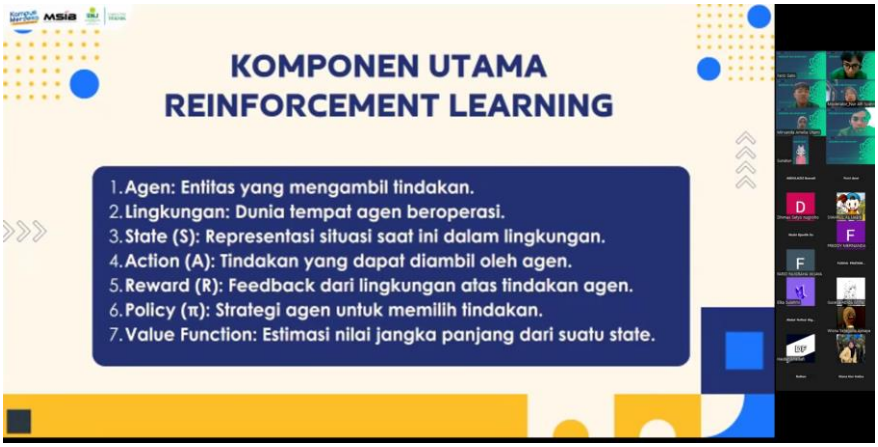

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Figure 9 Webinar Screenshot when explaining the components of Reinforcement Learning

In Figure 9 above, the speaker explains the components of Reinforcement Learning based on the concept of Markov Decision Process (MDP) to introduce the main concepts of Reinforcement Learning.

d. Advantages of Reinforcement Learning

Reinforcement Learning (RL) is a unique approach in machine learning that allows agents to learn autonomously through interaction with the environment. Its main advantage lies in the ability to solve complex sequential problems without relying on labeled data (François-Lavet et al., 2018). Here are the specific advantages:

- Dynamic Adaptation: RL can learn and adapt to environmental changes.
- Complex Problem Solving: Capable of solving problems that are difficult to program explicitly, such as chess games or robotic control.
- No Need for Labeled Data: RL does not rely on labeled data like supervised learning.
- Reward-driven Learning: Helps agents learn through direct feedback from the environment.

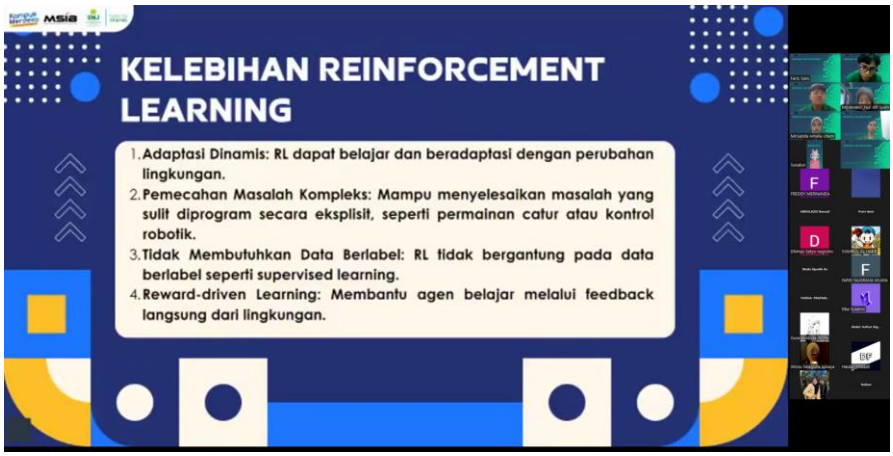

Figure 10 Webinar screenshot when explaining the advantages of Reinforcement Learning

In Figure 10 above, the presenter explains the advantages of Reinforcement Learning.

e. Disadvantages of Reinforcement Learning

Although RL offers an innovative solution to sequential decision-making problems, it has a number of significant limitations, especially in the context of real-world applications. Here are the specific drawbacks:

- Expensive Training Process: Requires many iterations and computational resources to achieve optimal performance.
- Exploration and Exploitation: Balancing exploration (finding new solutions) and exploitation (using the current best solution) can be challenging.
- Reward Dependency: If the reward design is not appropriate, the agent may learn undesirable behaviors.
- Difficulty in Generalization: RL is often difficult to apply to different environments or tasks than the one trained.

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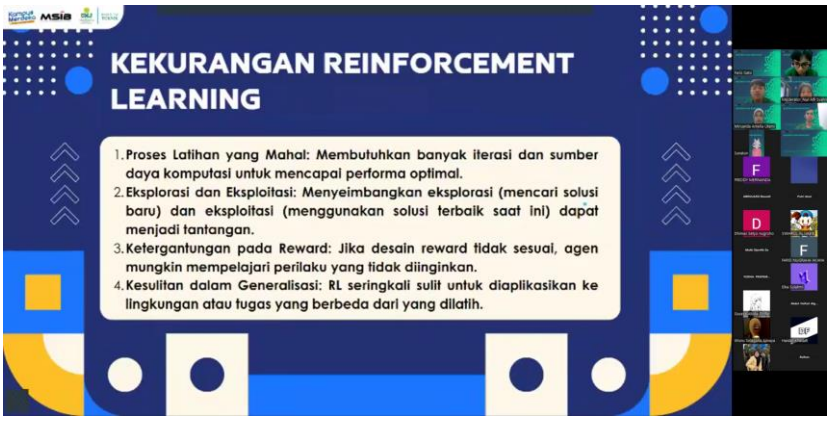

Figure 11 Webinar Screenshot when explaining Machine Learning Disadvantages

In Figure 11 above, the presenter explains the shortcomings of Reinforcement Learning.

f. Application of Reinforcement Learning in the real world

Figure 12 Webinar Screenshot when explaining RL Application in the real world

In Figure 12 above, the presenter explains the real-world application of Reinforcement Learning. The webinar also included an interactive session where participants could ask questions through the chat feature in Zoom. The speaker also asked questions related to the material to test participants' understanding. The result of this webinar is that participants get an in-depth understanding of Machine Learning, types of Machine Learning, the concept of Reinforcement Learning, and real-life examples of the application of Reinforcement Learning.

1.5. Stage 5 (Workshop Training)

At this stage, the Workshop presenters provide direct implementation of the Webinar material that has previously been delivered. This workshop focuses on the application of Reinforcement Learning (RL) in game development using Unity ML-Agents.

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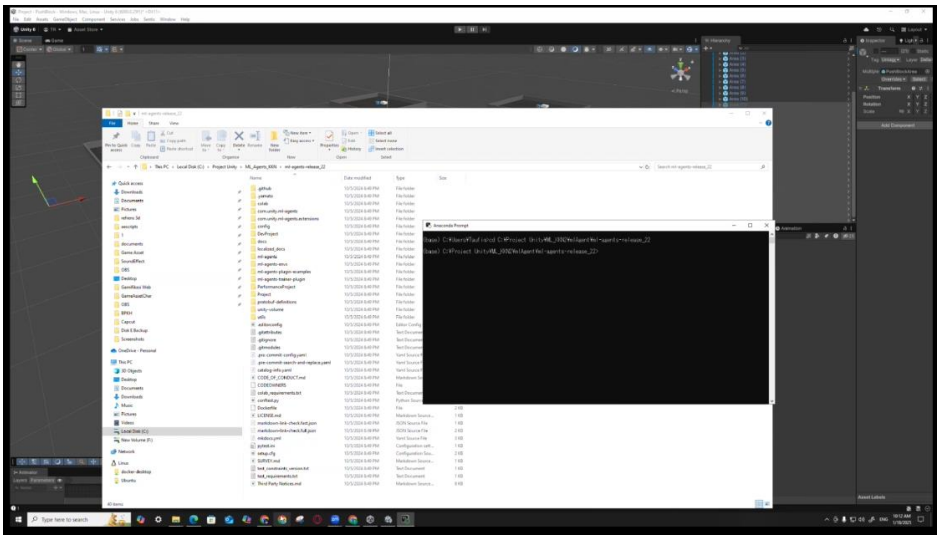

Figure 13 Installation and Configuration of ML-Agents

In Figure 13 above, participants are directed to install and configure Unity ML-Agents on their computers. Previously, participants were encouraged to prepare the necessary devices and software.

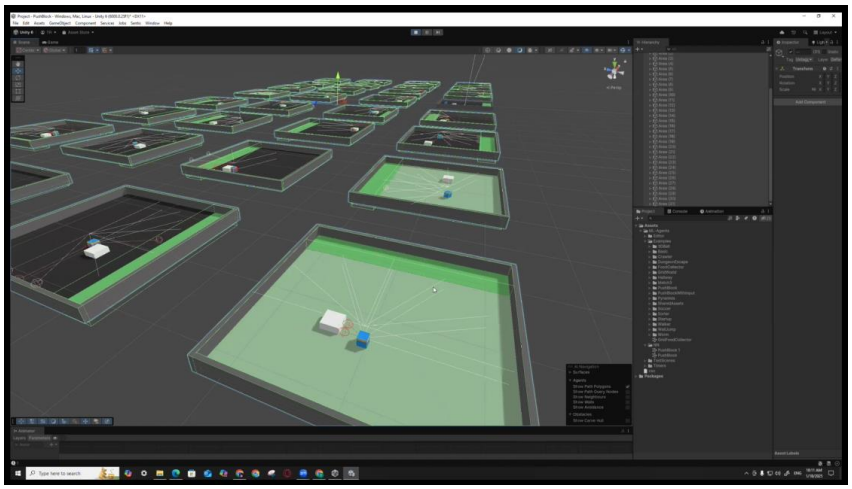

Figure 14 RL Simulation in Unity

In Figure 14 above, the speaker explains the stages of configuring the simulation environment, creating agents, and determining training parameters.

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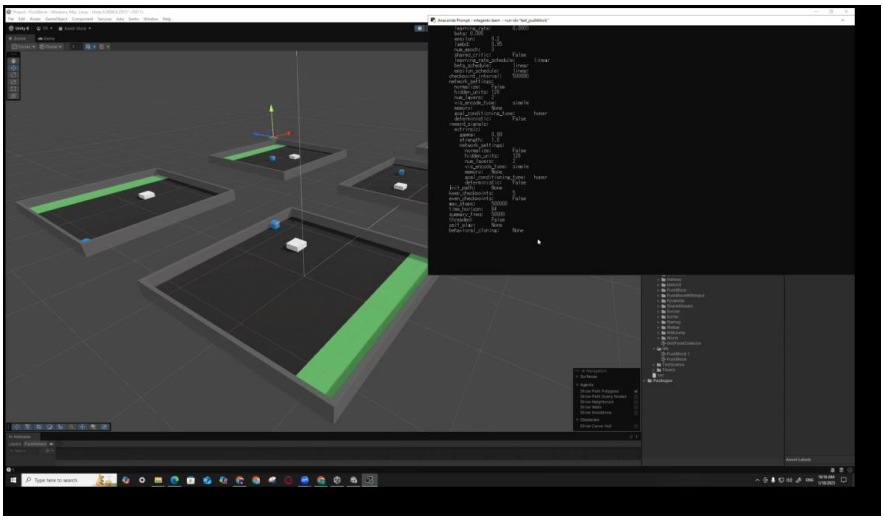

Figure 15 Model Training Process

In Figure 15 above, participants practiced the process of training agents using PyTorch, involving setting rewards and observing training results.

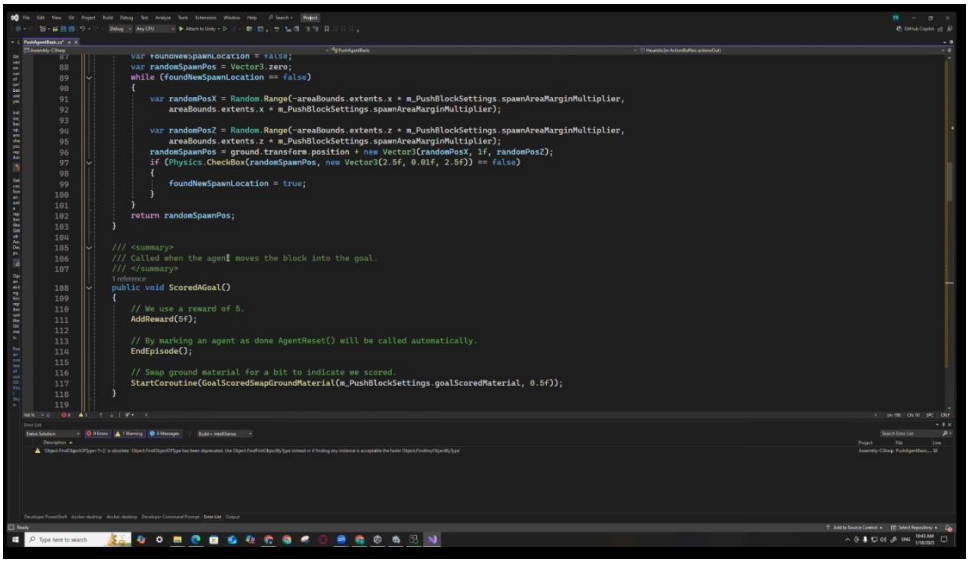

Figure 16 Model Integration into the Game

In Figure 16 above, the presenter shows how to integrate the trained model into Unity using the C# programming language. During the workshop, participants were also given the opportunity to ask questions directly if they encountered technical difficulties or needed further explanation. The result of this workshop was that participants were able to understand and the steps to train the RL model, as well as integrate the model into the project. With this implementation, participants are expected to understand how to develop Machine Learning-based games.

1.6. Stage 6 (Feedback and Post-Test Filling by Participants)

During the activity, participants were asked to fill out a pre-test and post-test containing questions related to the webinar material. This aims to measure participants' knowledge before and after participating in the activity. After the activity is over, participants are asked to fill out a feedback questionnaire in the form of a Google Form to assess and evaluate webinar and workshop activities with the link https://forms.gle/JWT1DtfmQBvean479. In

this feedback questionnaire, a 5 score assessment is used with the following conditions: (5) strongly agree, (4) agree, (3) neutral, (2) disagree, and (1) disagree. The feedback questionnaire questions covered the following aspects:

- Is the webinar and workshop material explained in accordance with the given theme?
- Are the webinar speakers who provide material in accordance with their scientific fields?
- Are the workshop resource persons who provide material in accordance with their scientific fields?
- Is the Webinar resource person able to explain the material well?
- Is the Workshop resource person able to explain the material well?
- Is the quality of online services during the workshop (sound and image) of good quality?

The post-test given is three questions similar to the pre-test and four questions in the form of tests related to the workshop, the results of which can be used as a comparison of the understanding of the participants before and after participating in each Webinar and workshop session, the participants were very enthusiastic about the presentation delivered by the presenters. This can be seen from the feedback questionnaire form that was given at the end of the event session to the participants. In the feedback questionnaire form, it can be seen that the answers to the statements given to the participants on average expressed satisfaction with the webinar and workshop material.

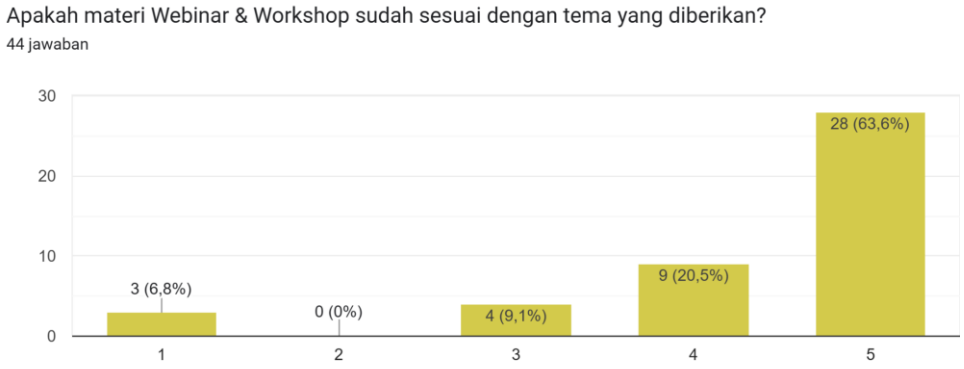

Figure 17 Feedback on Webinar & Workshop material according to the theme

In Figure 17 above, it can be seen that the feedback given by participants strongly agreed that the material was in accordance with the theme with a percentage of 63.6%, 20.5% agreed, and 9.1% were neutral. In the next statement, the feedback results also show positive numbers as in the figure below:

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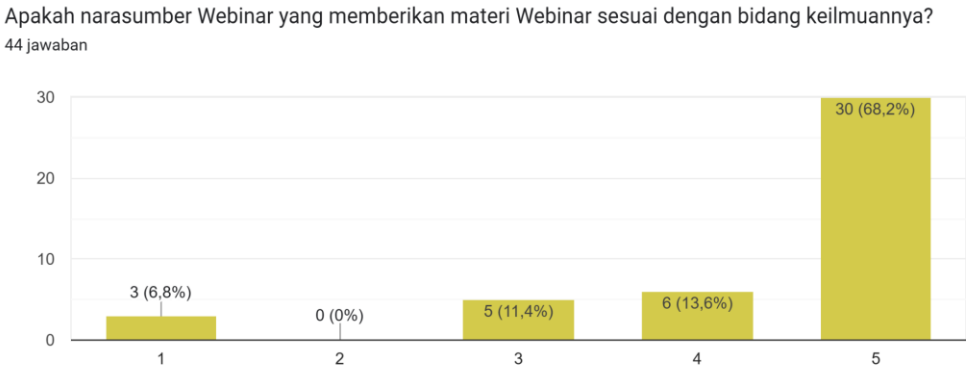

Figure 18 Feedback on webinar presenters according to their knowledge

In Figure 18 above, it can be seen that the feedback given by the participants strongly agreed that the webinar presenters were in accordance with their knowledge with a percentage of 68.2%, 13.6% agreed, and 11.4% were neutral, the feedback results also show positive numbers as in the picture below:

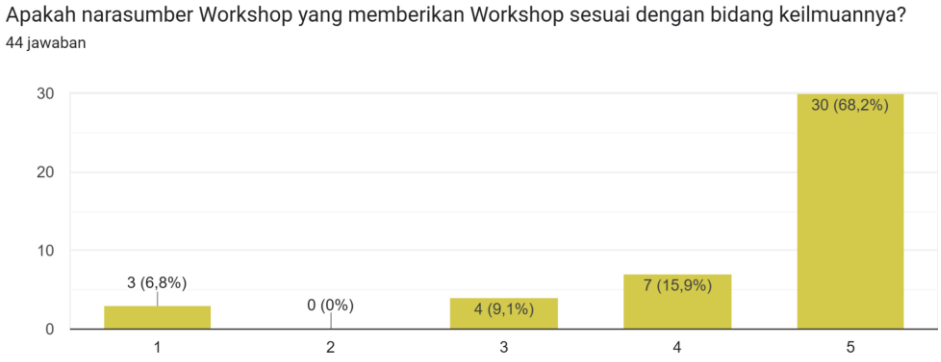

Figure 19 Workshop presenters' feedback according to their knowledge

In Figure 19 above, it can be seen that the feedback given by the participants strongly agreed that the workshop presenters were in accordance with their knowledge with a percentage of 68.2%, 15% agreed, and 9.1% were neutral, the feedback results also showed positive numbers as in the figure below:

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E-ISSN:2827-878X (Online -Elektronik)

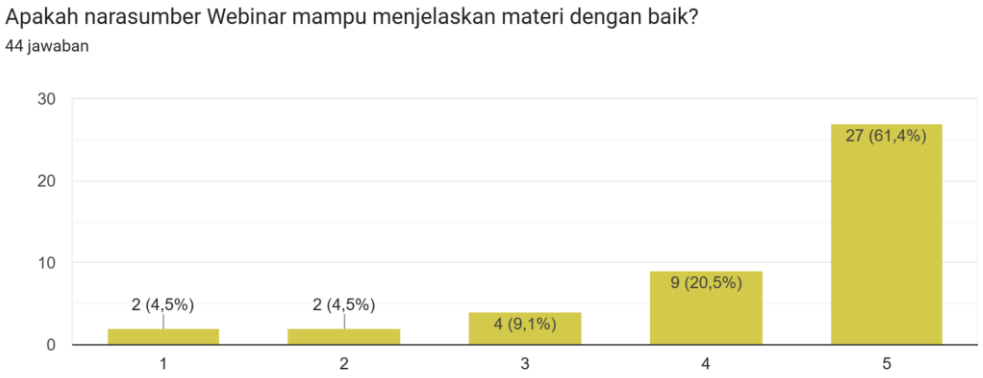

Figure 20 Feedback on webinar presenters being able to explain the material well?

In Figure 20 above, it can be seen that the feedback given by participants strongly agreed that the material was in accordance with the theme with a percentage of 61.4%, 20.5% agreed, and 9.1% were neutral. In the next statement, the feedback results also show positive numbers as in the figure below:

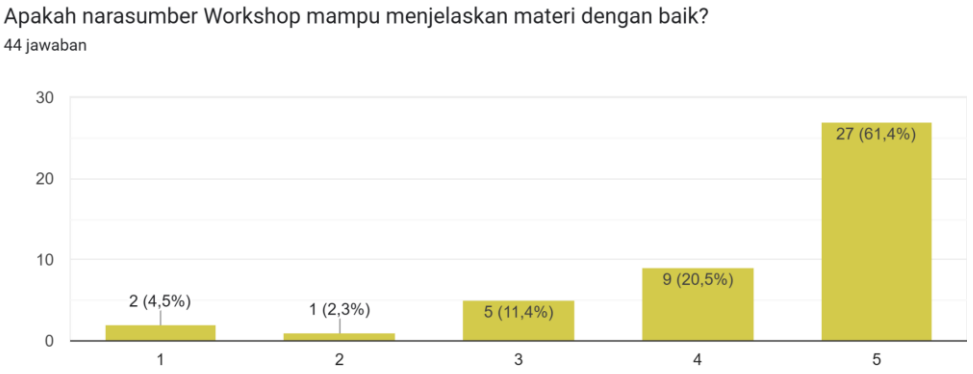

Figure 21 Feedback on workshop presenters being able to explain the material well?

In Figure 21 above, it can be seen that the feedback given by the participants strongly agreed that the material was in accordance with the theme with a percentage of 61.4%, 20.5% agreed, and 11.4% were neutral. In the next statement, the feedback results also show positive numbers as in the figure below:

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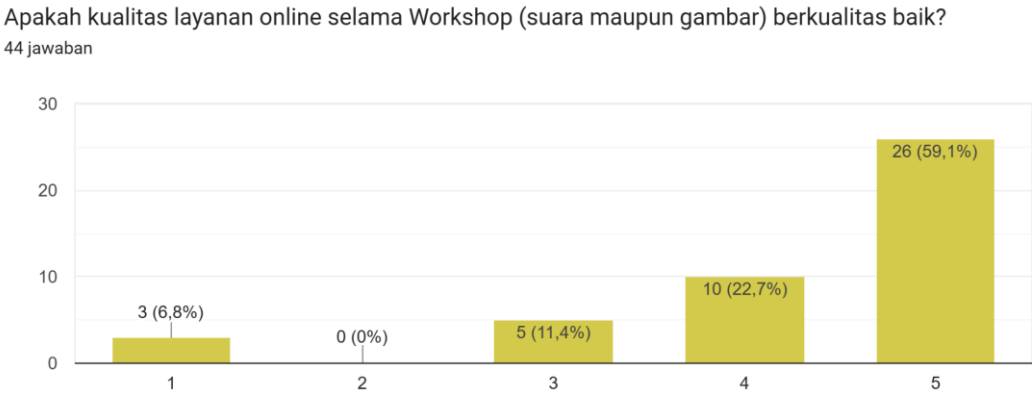

Figure 22 Feedback on online services during the Workshop

In Figure 22 above, it can be seen that the feedback given by the participants strongly agreed that the material was in accordance with the theme with a percentage of 59.1%, 22.7% agreed, and 11.4% were neutral. Based on the questions submitted to the participants and then the participants filled out the questionnaire, it can be seen that the participants gained an understanding of the new material in accordance with the theme of the activity. The response of participants who expressed satisfaction with the material presented indicates that the delivery of material by the speaker is quite good and easy to understand so that they can learn and understand new knowledge. In other words, this activity went well and could be understood by the general public.

In addition to the feedback questionnaire, the participants were also asked to fill out a post-test which was given when the activity was over with the aim of knowing the increase in participants' understanding after participating in this activity. The following are some of the results of filling out the post-test from the participants:

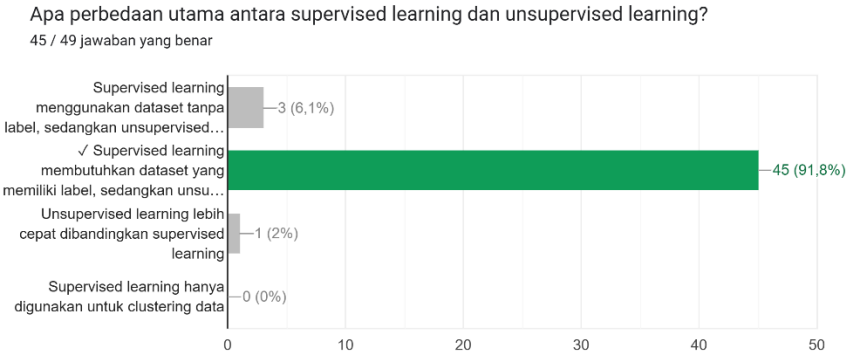

Figure 23 Post-Test Participants Regarding Supervised and Unsupervised Differences

In Figure 23 above, this question is the same question as the pre-test in Figure 6, it can be seen that there is an increase where previously the average participant managed to answer 80.9% and in Figure 23 participants managed to get an average of 91.8%, this proves that participants have begun to understand the difference between supervised learning and unsupervised learning after attending this webinar and workshop until the end.

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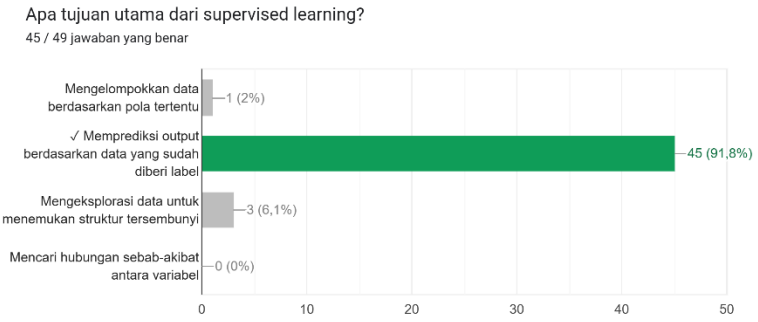

Figure 24 Participants' Post-Test on the main purpose of supervised learning

In Figure 24 above, this question is the same question as the pre-test in Figure 4, it can be seen that there is an increase where previously the average participant managed to answer 70.2% and in Figure 24 participants managed to get an average of 91.8%, this proves that participants have begun to understand the main objectives of supervised learning after attending this webinar and workshop until the end.

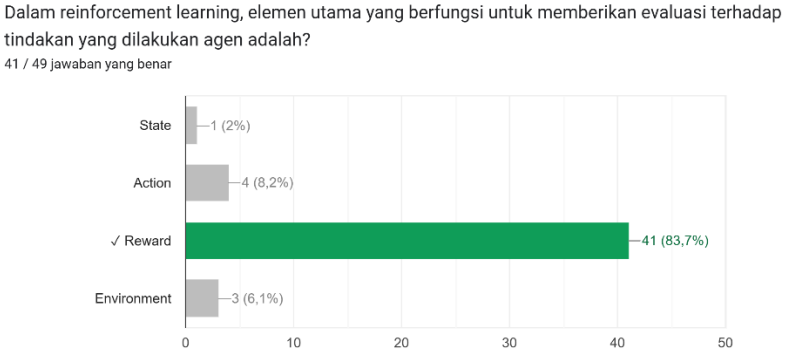

Figure 25 Participants' Post-Test on the main elements that serve to evaluate the actions taken by agents

In Figure 25 above, this question is the same question as the pre-test in Figure 3, it can be seen that there is a significant increase where previously the average participant managed to answer 40.4% and in Figure 25 participants managed to get an average of 83.7%, this proves that participants have begun to understand the elements in reinforcement learning after attending this webinar and workshop until the end.

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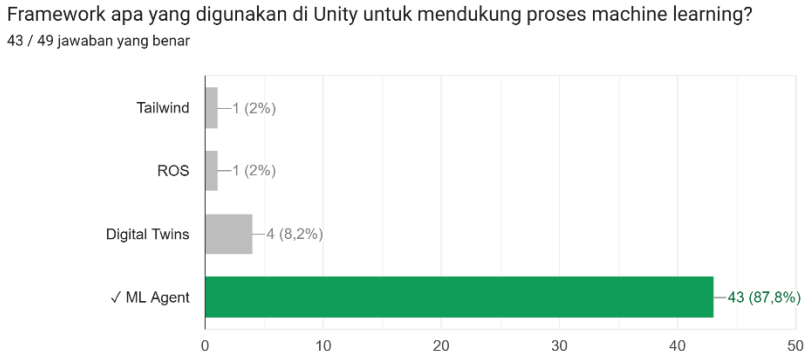

Figure 26 Post-Test Participants Regarding what Framework is used in Unity to support the machine learning process

Figure 26 above shows the results of the Post Test Framework used in Unity to support the machine learning process is 87.8% correct answers filled by 49 participants.

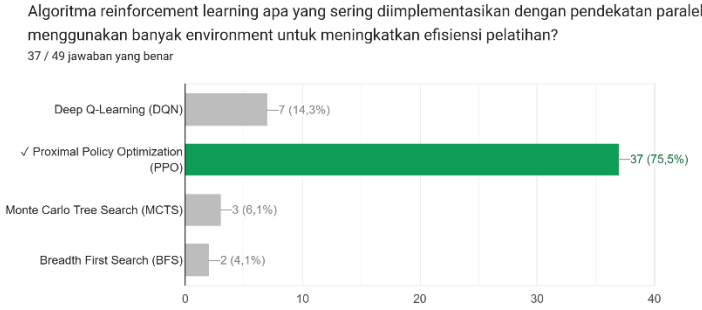

Figure 27 Post-Test Participants Regarding what Framework is used in Unity to support the machine learning process

In Figure 27 above, it can be seen that the Post Test results regarding the reinforcement learning algorithm are 87.8% correct answers filled in by 49 participants.

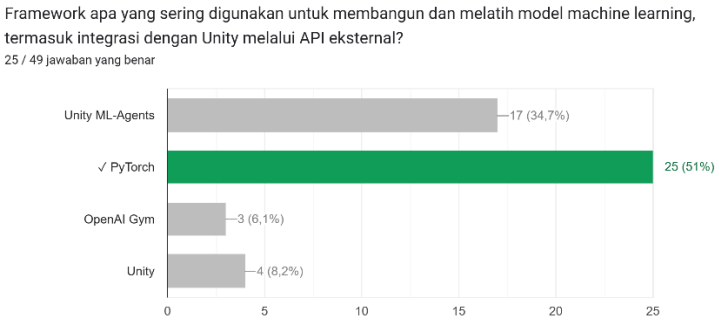

Figure 28 Post-Test Participants Regarding what framework is used in Unity to support the machine learning process

In Figure 28 above, it can be seen that the Post Test results regarding what Framework is often used to build and train machine learning models are 51% correct answers filled in by 49 participants.

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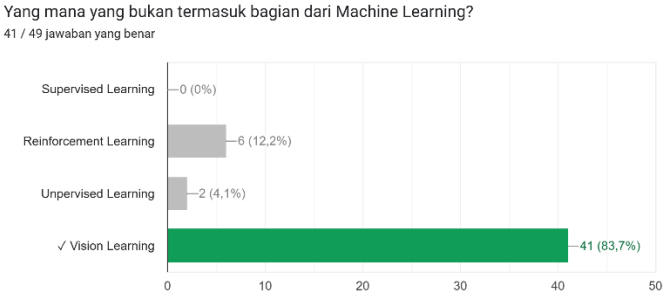

Figure 29 Post-Test Participants Regarding which ones are not part of Machine Learning

In Figure 29 above, it can be seen that the Post Test results regarding which are not part of Machine Learning are 83.7% correct answers filled in by 49 participants.

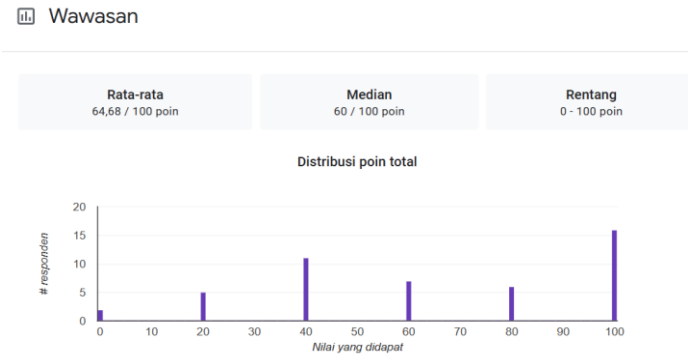

Figure 30 Pre-test Results

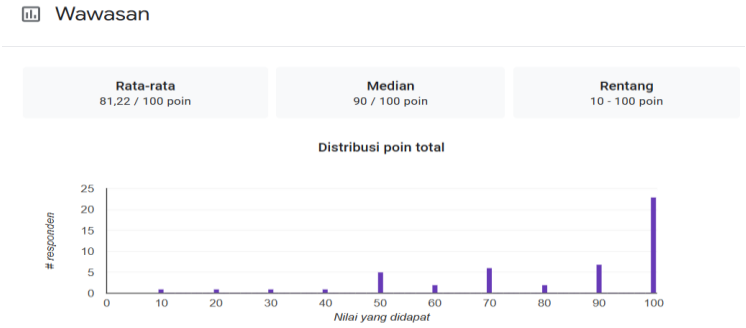

Figure 31 Post-Test Results

It can be seen from figures 30 and 31, that the scores on the Pre-test and Post-test have a difference, the results of the Pre-test where participants take the test before the presentation of the material have an average value of 64.68 points and a median of 60 points, while in the Post-Test, where participants take the test after listening to the presentation of the material provided, has an average of 81.22 points and a median of 90 points. So it can be seen that the average comparison is 16.54 points and the median comparison is 30 points. So it can be concluded that participants tend to be able to answer the test after listening to the material provided.

From the two materials presented by the speakers, the participants seemed enthusiastic about the material that had been presented. It can be seen from the questionnaire about

feedback from this webinar workshop activity, and on average the participants gave positive feedback on the material that had been provided.

D. CONCLUSION

From From the results of the Webinar and Workshop 'Getting Started with Machine Learning in Game Development', held on 18 January 2025 via Zoom Meeting (09:00–11:30 WIB), it can be concluded that the activity achieved its objectives and ran smoothly. The event attracted approximately 45–56 participants from diverse institutions, who engaged in learning foundational concepts of Machine Learning, particularly Reinforcement Learning. The comparative analysis of pretest and post-test scores demonstrated a significant improvement in participants' understanding. The pretest, conducted before the material presentation, yielded an average score of 64.68 points (median: 60), while the post-test, administered after the sessions, showed a marked increase to an average of 81.22 points (median: 90). This reflects an average improvement of 16.54 points and a median increase of 30 points, indicating that participants substantially enhanced their comprehension after engaging with the material. Feedback from the post-event questionnaire further corroborates these results. Participants expressed enthusiasm for the material, with the majority affirming that the content aligned well with the theme and was delivered effectively. Positive responses also highlighted satisfaction with the event's organization and relevance. Collectively, these outcomes underscore the success of the webinar-workshop in fostering knowledge enhancement and engagement among attendees.

E. ACKNOWLEDGEMENTS

First and foremost, we extend our deepest gratitude to Muhammadiyah Jakarta University for its full support in organizing this event. We also sincerely thank the alumni Informatics Engineering Muhammadiyah Jakarta University who generously facilitated the funding for journal publication, enabling the broader dissemination of this work. Our appreciation extends to the speakers and trainers for delivering comprehensive material on Machine Learning and Reinforcement Learning in an accessible manner. We thank all participants for their active involvement, which enriched the discussion and collaboration during the webinar and workshop. Lastly, we acknowledge the dedication of the organizing committee and technical team for ensuring seamless event execution via Zoom Meeting.

F. AUTHOR CONTRIBUTIONS

Include the implementation of the Activity: TRH, DAM, MAU, NAS, SYA, Preparation of materials & coordination of speakers: TRH, DAM, Participant registration & technical preparation: MAU, NAS, SYA, Impact analysis & feedback collection: MAU, NAS, Article preparation: TRH, Presentation of results: TRH, DAM, Supervising lecturer: RDR, Article revision: RDR, RM, Other contributions (Facilitator): RM, PM, NA, SNA, YA.

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