Journal of Advanced Research in Applied Sciences and Engineering Technology

Journal homepage:
https://semarakilmu.com.my/journals/index.php/applied_sciences_eng_tech/index
ISSN: 2462-1943

SALA RANGER Game-Based Learning Media for Endemic Animals Conservation: Case Study West Java Province

Hanhan Maulana[1,*], Rudy Eko Syah Putro[1], Hideaki Kanai[2]

[1] Department of Informatics Engineering and Computer Science, Universitas Komputer Indonesia, Bandung, Indonesia
[2] School of Knowledge Science, Japan Advanced Institute of Science and Technology, 1-1, Asahidai, Nomi, Ishikawa, Japan

ABSTRACT

This study aims to develop an education media that can introduce, inform, and educate people about the importance of maintaining the existence of endemic animals in the study area. This study has four main stages. The first stage is problem analysis and data gathering; The second stage is data and education materials analysis; The third stage is game development using the Multimedia Development Life Cycle (MDLC) method; The last stage is implementation and testing. Sala Ranger has three gameplays; Adventure, side-scrolling, and drag and drop. This study combines the three gameplays to enhance educational content for users. Based on the evaluation result, it was found that Sala Ranger could introduce, inform, and increase public knowledge about endemic animal conservation. Sala Rangers can also provide education so that people have insight about the importance of endemic animals' existence in the study area. By providing insight and educate the people to protect endemic animals, it is hoped that the endemic animal conservation program will be better than before. It's because endemic animal conservation is not only the Natural Resources Conservation Center (BKSDA) duty but also the people in the study area.

Keywords:
Game-based learning; endemic animals' conversation; education media; wildlife knowledge

1. Introduction

Endemic animals are animals that inhabit a specific area. These animals have unique characteristics that distinguish them from animals in other regions [1-3]. West Java is one of the regions that has a variety of animals. Some of these animals have unique characteristics that can't be found in other areas. According to the West Java Natural Resources Conservation Agency (BKSDA), several endemic animals in this area have an endangered status. One crucial cause of the extinction of endemic animals is the lack of people's knowledge of the importance of preserving endemic animals [4-6]. Economic factors are also one of the causes of the decline in endemic animal populations. It is having caused a lot of illegal hunting by people. In addition, people's lack of concern for endemic animal life is another problem. Without realizing it, many people have unknowingly

* *Corresponding author.*
E-mail address: hanhan@email.unikom.ac.id

https://doi.org/10.37934/araset.62.2.171185

damaged the habitat of endemic animals. It is usually happening when preparing land for plantations, agriculture, and residential areas [1, 6-8].

A preliminary study conducted by giving a questionnaire to eighty random people produced the following data: (1) 60% of respondents did not know the status of endemic animal scarcity. Then, (2) 90% of respondents stated that they did not know the types of animals that must be protected. They cannot distinguish between endemic and non-endemic animals. Researchers have tried to build educational media so that people have knowledge about endemic animal conservation. Some researchers-built information media that informs endemic animal species in Indonesia [2]. Some researchers developed games as a medium for delivering information to the public. Other researchers created educational games by providing game-based educational content [9].

This study proposes SALA RANGER. An educational game that aims to provide information to the public about the importance of preserving endemic animals in the study area. We build android based mobile games to maximize familiarity aspect. That's because most people in the study area use Android smartphones. Sala Ranger has three gameplays that aim to enrich the game content. This game is expected to be able to maximize the delivery of information, introduce and educate the public about the importance of preserving endemic animals.

2. Research Framework and Method

This study has six main stages. The first stage is problem identification. This stage examines the problems that exist in the community related to endemic animals and their conservation. The study area is West Java province. This study uses a questionnaire to identify user problems. The target of the questionnaire is the people in the study area. The second stage is data gathering. This stage collects data from various sources related to information about endemic animals in the study area. Information was obtained from the West Java Natural Resources Conservation Agency or BKSDA West Java. The data collected is data on endemic animals, including their habitats and populations. We also collect data related to the conservation of endemic animals. This study uses the data to educate the public regarding endemic animal conservation.

The third stage is data analysis. This stage aims to process conservation materials. It is to make it easier when providing information about endemic animals. This stage processes the data collected in the previous stage. This study selects educational materials in detail so that the delivery of educational materials can be maximized. The data analysis process consists of selecting, sorting and correcting missing data. The fourth stage is game design. This stage designs game material such as the storyboard and other game assets such as characters and backgrounds.

The fifth stage is game development. This stage uses the Multimedia Development Life Cycle (MDLC) method. This study uses Construct 2 as a game engine and Game Character Hub as a medium for creating game assets. This study uses several tools such as Adobe Photoshop, After Effects and other tools to create game assets. The last stage is the testing and evaluation stage. This study uses two testing methods; the first test is functional testing. This test is performed in a developer environment. This test aims to ensure that all functions can run properly. The second testing method is user acceptance testing. This test aims to determine the user's response to the game that was built. Figure 1 describes the research framework.

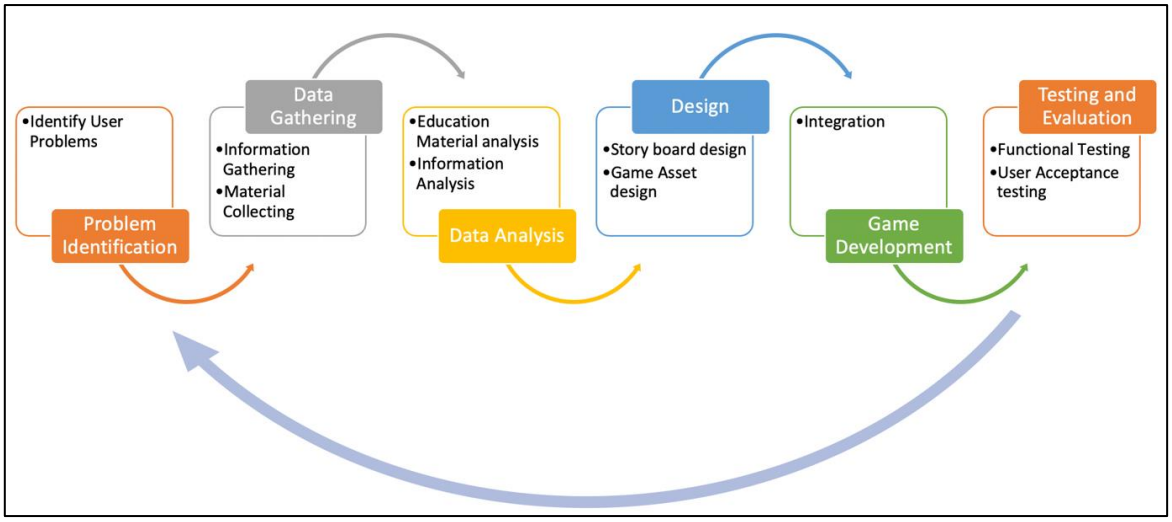

Fig. 1. Research framework

3. Results

The Motivation behind this study is several problems related to the lack of information and education to the public about the importance of preserving endemic animals in West Java. Lack of information and education causes a low level of public awareness in preserving wild animals, especially endemic animals [10, 11]. This low level of awareness has led to rampant hunting and wildlife trade in the community. Information and education provided by the government are only limited to written media and slogans to save endangered animals. This causes the information and education obtained by the public to be limited and not spread evenly.

This study proposes the "Sala Ranger", an action-adventure game. This Game applies mobile technology as a medium to provide information and education about endemic animals in West Java. Sala Ranger is built based on 2-dimensional (2D) graphics. The data collected is endemic animal data and general knowledge about the rehabilitation of these animals. The data resources are data from the Natural Resources Conservation Center (BKSDA) of West Java Province. Table 1 describes the endemic animals' data in the study area.

Sala Ranger is an Action-Adventure genre game. Players will go on an adventure and take action to save endemic animals by defeating hunters and wild animal traders. Sala Ranger has three types of Game Play; Adventure, Side-Scrolling, and Drag and Drop. In Adventure gameplay, players will search for a way to defeat hunters and animal traders. Side-Scrolling gameplay provides animal rescue missions where players will fight hunters and save animals. Then Drag and Drop game plays aim to educate players about animal rehabilitation. Sala Ranger has a gameplay that is supported by several Game Characters. The Main Character is Sala Alexia. Then there's several non-Player Characters (NPC) to support the game story. The following Table 2 describes the character's design in the game Sala Ranger.

Table 1
The endemic animals' data in the study area

No	Name of Endemic animals	Binominal name	Class	ORDO	Current population	State
1	Macan Tutul	Panthera Pardus	Mammal	Carnivore	Less than 500	Threatened with extinction
2	Owa Jawa	Hylobates Moloch	Mammal	Primate	Less than 1000	Threatened with extinction
3	Elang Jawa	Nisaetus Bartelsi	Aves	Bird	Less than 900	Threatened with extinction
4	Kukang Jawa	Nycticebus Javanicus	Mammal	Primate	Less than 1000	Threatened with extinction
5	Kucing Bakau	Prionailurus Viverrinus	Mammal	Carnivore	Less than 1000	Threatened with extinction
6	Surili	Presbytis Comata	Mammal	primate	Less than 1000	Threatened with extinction

Table 2
The characters design in the game Sala Ranger

No.	Character	Name
1		Sala Alexia (Main Character)
2		Budi Danadyaksa (NPC)
3		Rajata (NPC)
4		Srengkara Sato (NPC)

This study introduces endemic animals in the west java province. We design endemic animal characters based on the unique characteristics of each animal. Table 3 shows the endemic animals character design in the Sala Ranger game.

Table 3
The endemic animals character design in the Sala Ranger game

No	Animal name	Animal image	Character design
1	Kukang Jawa (*Nycticebus javanicus*)		
2	Owa Jawa (*Hylobates moloch*)		
3	Surili (*Presbytis comata*)		
4	Kucing Bakau (*Prionailurus viverrinus*)		
5	Macan Tutul (*Panthera pardus*)		
6	Elang Jawa (*Nisaetus bartelsi*)		

This study uses Use case diagrams to describe what users can do on the system. There is one Actor and six related use cases. Figure 2 describes the Use case diagram of the Sala Ranger game. This study uses the Trigger Detection and Collision Detection methods to control the movement of NPCs (Non-Player Characters). The player controls the main character using Joystick. Trigger Detection is used when enemy NPCs are attacked by the main character. When the life bar is “0” the system will call an action to change the NPC character animation to “Lose”. Then on the stage selection interface, the next stage will be available to play. Collison Detection is used when the main

character will interact with NPC characters, and the character shoots bullets at NPC characters who act as enemies. This method is also used when the player removes bullets from the bodies of animals, as well as animals that interact with their food.

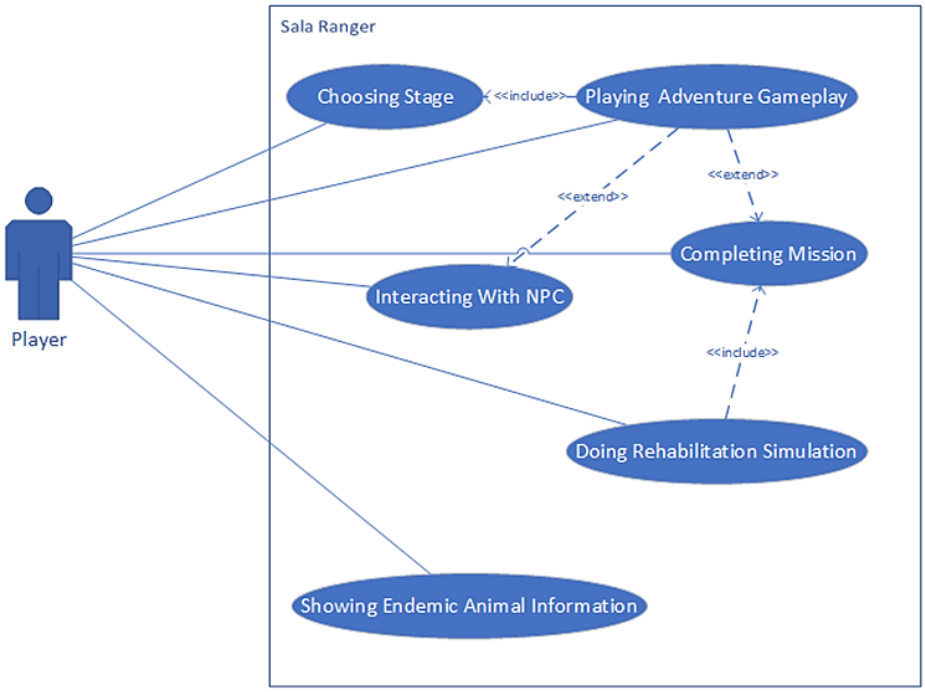

Fig. 2. The Sala Ranger Use case

This educational game was created using the Construct 2 game engine as a tool in making games. Then uses Adobe Photoshop CS6, Adobe Illustrator, Game Character Hub as tools for making game assets such as characters, backgrounds, and user interfaces. We use Intel XDK and PhoneGap as APK Builder. Figure 3 describes the main interface of game Sala Ranger.

Fig. 3. The main interface of game Sala Ranger

Sala ranger target user is the people of West Java. They use "Bahasa" to interact with other people. Therefore, the Sala Ranger game is a game that uses "Bahasa" as the main language. A familiar main language is expected to maximize the educational materials delivery to the public. This Game also use two-dimensional Animation to explain the game storyline. Figure 4 illustrates the story game visualization using two-dimensional animations. To clarify the mission and the information

conveyed, Sala Ranger uses an interactive dialogue method with NPCs. Figure 5 shows an example of a dialogue interface between a Player and NPC.

Fig. 4. The story game visualization using two-dimensional Animations

Fig. 5. Example of a dialogue interface between a Player and NPC

This study evaluates the system using several methods. The first method is functional testing. This testing method aims to ensure all system functionality can run properly. This test is done by providing input to the available functions. This test looks at the response given by the system without seeing the process carried out by each functionality. Based on the results of functional testing, it is found that the entire functional system can run well. The system also provides a response that follows the interactions made by the user. The second test is performance testing. Performance testing aims to find out device performance when running applications. This study uses three devices to test performance. Table 4 describes the hardware specifications and performance test results.

Based on Table 4 this study draws several conclusions. (i) System performance is strongly influenced by hardware specifications. The first device has better hardware specifications than the other devices. It makes the performance of the number one device better than the performance of other devices. (ii) The average frame rate per second is 45 frames per second. Based on the criteria table on the official Game Bench website, the Sala Ranger game is in the Smooth Performance criteria. That means the game has good performance and can display content smoothly. These results are also supported by several theories in the multimedia field which state that to produce smooth movement, the multimedia system requires a minimum of 10 frames per second (10 FPS) [12-17]. The next test is the User acceptance test. This study conducted a qualitative test using a

questionnaire to know the user's response to the system. We designed a questionnaire to find out the user's view of the system. We divided the questionnaire into two sections base on research Objective. Table 5 describes the statements and response choices in the questionnaire.

Table 4
The hardware specifications and performance test results

No	Smartphone specifications		RAM usage	CPU usage	GPU usage	FPS (Frames per second)
1	Type	Samsung C7	252 MB	8%	43%	49
	Processor	Octa-Core 2.0 Ghz Cortex-A53				
	Graphic	Adreno 506				
	RAM	4 GB				
	Battery	Li-ion 3300 mAh				
2	Type	Xiaomi Redmi Note 4	293 MB	9%	37%	51
	Processor	Octa-Core 2.0 Ghz Cortex-A53				
	Graphic	Adreno 506				
	RAM	4 GB				
	Battery	Li-Po 4100 mAh				
3	Type	Asus Zenfone 5	231MB	19%	44%	36
	Processor	Dual-coew 1,6 Ghz, Intel Atom Z2560				
	Graphic	PowerVR SGZ544MP2				
	RAM	2 GB				
	Battery	Li-Po 2110 mAh				
Average			257MB	12%	41 %	45

Table 5
The statements and response choices in the questionnaire

No	**Statement**		**User response**
1	S1	System provides information about what is endemic animals.	Agree Neutral Disagree
	S2	System provides explanation about endemic animals in West Java.	Same as above
	S3	System provides information about Habitat, Foods and Animal Active hour in the wild.	Same as above
	S4	System Game play give enough Information about endemic animal conservation.	Same as above
2	S5	After playing the game Sala Ranger you understand the importance of protecting endemic animals.	Same as above
	S6	After playing the Sala Ranger you understand the importance of endemic animals' habitat.	Same as above
	S7	After playing the Sala Ranger you have insight about the Importance of preserving endemic animals.	Same as above
	S8	I understand not to disturb endemic animals and let them thrive in their habitat.	Same as above

This study uses a Likert scale to assess the user's response to the statements made. We calculated the answer interval from one to three based on the response from the user. Fifteen respondents were involved in filling out the questionnaire. Table 6 explains the average value of the user's response to the given statement. Table 6 describes the result interval for each statement in the questionnaire. This research converts the result interval into a graph to make it easier to process data analysis. Figure 6 describes the conversion result of the questionnaire in a graph.

Table 6
The average value of the user's response to the given statement

No	Statement		Interval result
1	S1	System provides information about what is endemic animals	2.66
	S2	System provides explanation about endemic animals in West Java	2.66
	S3	System provides information about habitat, foods and animal active hour in the wild	2.73
	S4	System game play give enough Information about endemic animal conservation	2.73
2	S5	After playing the game Sala Ranger you understand the importance of protecting endemic animals	2.84
	S6	After playing the Sala Ranger you understand the importance of endemic animals' habitat	3
	S7	After playing the Sala Ranger you have insight about the Importance of preserving endemic animals	3
	S8	I understand not to disturb endemic animals and let them thrive in their habitat	3

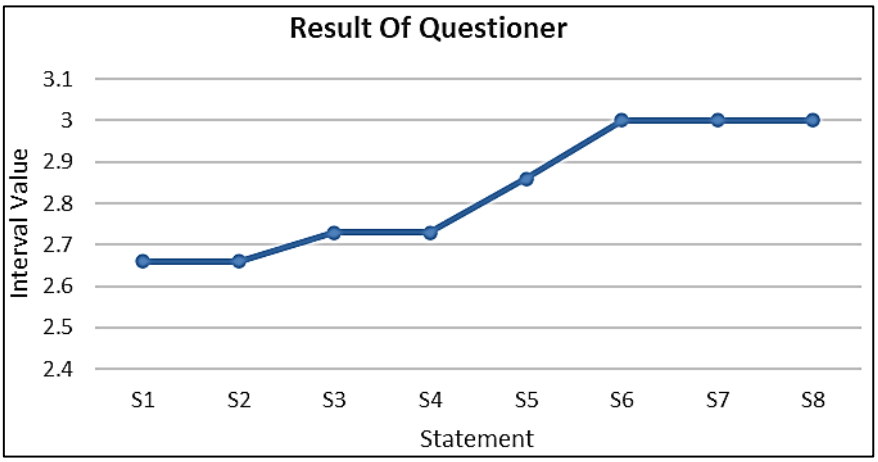

Fig. 6. The conversion results of the questionnaire

Based on the questionnaire recapitulation result, we draw the following conclusions: first, the overall response from the user shows a positive approval with the evaluation statement in the instrument. There are no respondents who disagree with evaluation statements on the test instrument. Second, statements number six to eight get a very positive response, all respondents agree with the statement on the questionnaire. The Sala Ranger Game can provide knowledge about endemic animals. In addition, this game can increase public awareness of endemic animals. These results are in line with previous research which explains that educational games can enrich the presentation of material to users so that users better understand the content contained in educational media [4, 12, 18]. Based on the test results, it was also found that educational games are the right media to educate the public. Games can also be used to convey information to increase people's knowledge [19, 20]. This discovery also proves the theory conveyed by Edgar Dale. According to him, humans remember 10% of what they read, 20 percent of what they hear and 30 percent of what they see, humans will also remember 50 percent of learning if they have an active role in learning process.

Finally, this study adds new information relating to improving teaching and learning process, as shown in Tables 7 and 8. This study is important since the use of game in education has been well-attracted researchers, shown by the increasing number of publications in Figure 7. Detailed information for getting this data is explained elsewhere [21-24].

Table 7
Previous studies on teaching and learning process

No	Title	References
1	A Proposed Integration Model of Project Based Learning and Simulation to Improve the Learning Quality	[25]
2	Exploring Self-Directed Learning Readiness among Undergraduates in ESL Classrooms	[26]
3	Increase Students' Understanding of Mathematics Learning Using the Technology-Based Learning	[27]
4	The ICT Implementation in the TVET Teaching and Learning Environment During the COVID-19 Pandemic	[28]
5	COVID-19: What are the Challenges of Online Learning? A Literature Review	[29]
6	STEM Education in Malaysia: An Organisational Development Approach?	[30]
7	Rabbani Education: Facing Realities and Readiness for the Challenges of Future Education	[31]
8	Review of Design Thinking Approach in Learning Iot Programming	[32]
9	Comparison on the Student's Performances During Physical and Online Learning in Financial Mathematics Course	[33]
10	Aplikasi Inovasi Q-Track Kit Dalam Proses Pengajaran dan Pembelajaran Bagi Modul Teoritikal: Innovative Application of Q-Track Kit in the Teaching and Learning Process for Theoretical Modules	[34]
11	The Effectiveness of Academic Advising on Student Performance	[35]
12	Graphical User Interface for Solving Non-Linear Equations for Undergraduate Students	[36]
13	The Relationship between Selfie-Editing, Self-Esteem, and Social Appearance Anxiety Among University Students	[37]
14	Factors of Technologies-Reliant for 'Pengajian Malaysia'Subject in Online Learning (OLL): A Conceptual Review	[38]
15	Improving Malay Traditional Joget Dance Technique Through Vygotsky Framework Among Female Secondary School Dancers in Ampang, Selangor: The Participatory Action Research	[39]
16	Perception of Biology Students to Flipped Classroom Approach in Biological Control and Environment Conservation	[40]
17	Exploring Science Teachers' Perspectives on STEAM Learning	[41]
18	The Use of Play Therapy Approaches in Identifying Children's Issues and Problems	[42]
19	Issues in the Science and Engineering Education in Indonesia: How to Improve Competitiveness Through STEM Mastery	[43]
20	Evaluating the Technical Quality and Pedagogical Affordances of an English Language Learning (ELL) Website Using a Methodological Framework	[44]

Table 8
Previous studies on game and education

No	Title	References
1	The use of the Natuna Game about the Natural Wealth of the Natuna Marine on National Awareness of the Post-Millennial Generation	[45]
2	Examining the Effects of Online Games on The Academic Performance of Bped Students of Sultan Kudarat State University, Philippines	[46]
3	The Effect of the Team-Games-Tournament Method on Improving the Learning Ability of Student with Hearing Impairment in Multiplication Concepts	[47]
4	Basic Arithmetic Learning Through Math Online Games for Elementary School Students During the Pandemic	[48]
5	Ways to Develop Education for Obtaining General Physical Qualities of Young Wrestlers Through Action Games	[49]
6	Post-traumatic counselling through group games	[50]
7	Game-Based Activity Method: A Case of Grade 5 Students	[51]
8	Designing English Education Game Application for Early Childhood	[52]
9	Application of Scrabble Game in Improving Learning of Simple Sentence Structure on the Student with Hearing Impairment	[53]
10	Effect Small Side Games (SSG) on Playing Skills In Handball Sports	[54]

Table 8. Continued
Previous studies on game and education

No	Title	References
11	Rehabilitation Program for Surgical Shoulder Joint Protrusion Among Team Games Players Injured	[55]
12	Basic Arithmetic Learning Through Math Online Games for Elementary School Students During the Pandemic	[56]
13	Pantas. io: Game-Based Learning to Cultivate Programming Skills for Primary School Students	[57]
14	Active Learning on Students' Interpersonal Skills Impact: An Online Theater Approach	[58]
15	Gamification using Board Game Approach in Science Education-A Systematic Review	[59]
16	Game-based Technology for Elderly with Memory Disorder: Criteria and Guideline of Mobile Psychotherapy Games.	[60]
17	Game Design for an Environmental-Themed 2D Adventure Mobile Game	[61]
18	Searching for Animal Names Through Games	[62]
19	Gamification Implementation in Health Service Website in 5.0 Society Era	[63]
20	A Paradigm Shift from Optimal Play to Mental Comfort: A Perspective from the Game Refinement Theory	[64]
21	Development of an Educational Training Game for Ear Sensitivity of Intervals	[65]
22	A Computational Bibliometric Analysis of Game Advertising using VOSviewer	[66]

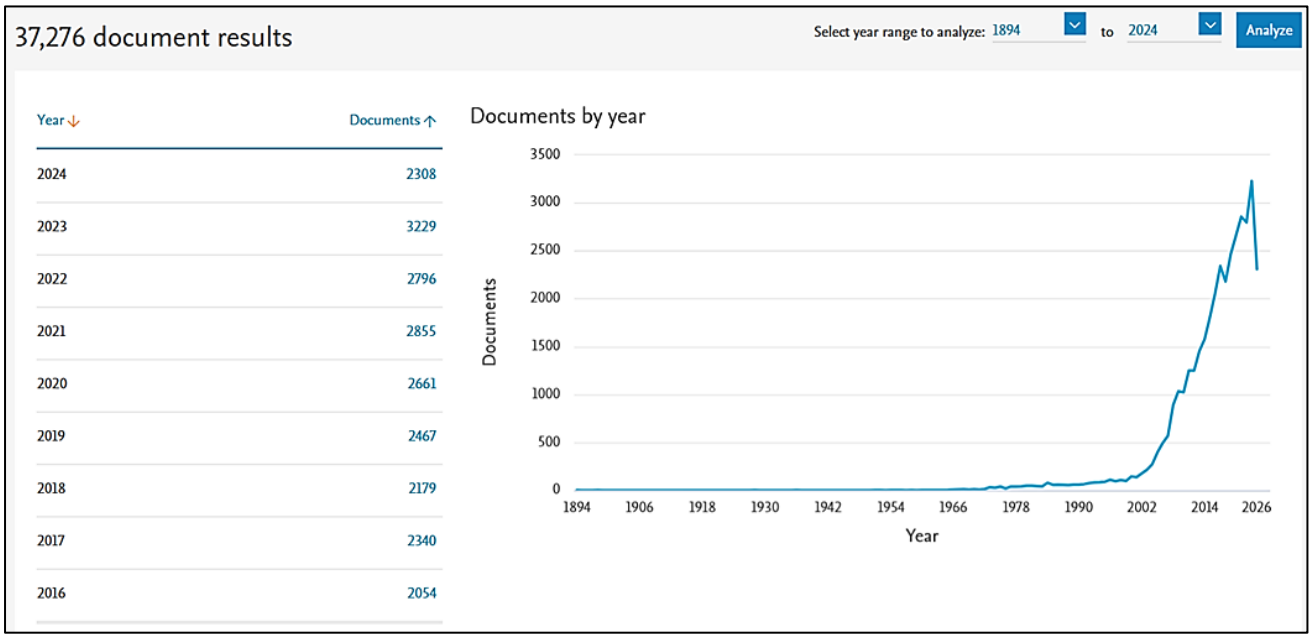

Table. 7. Previous studies on game and education based on the Scopus database taken on September 2024

4. Conclusions

Based on the evaluation that has been done in this study, it is concluded that the Sala Ranger Game can provide knowledge about wildlife. In addition, this game can increase public awareness of endemic animals. Even so, this game still has some Limitations. Currently the game is still a single player game. It is difficult for players to share knowledge about saving wildlife. In future research, improvements are needed by converting games into multi-player games to maximize the knowledge sharing process between communities. By sharing knowledge, it is hoped that public knowledge about the importance of endemic animal conservation will be better.

Acknowledgement

Authors acknowledged the Natural Resources Conservation Center (BKSDA) of West Java Province, the Department of Informatics Engineering and Computer Science, Universitas Komputer Indonesia and also people in West Java Province for supporting this research.

References

[1] Amori, Giovanni, Spartaco Gippoliti, and Kristofer M. Helgen. "Diversity, distribution, and conservation of endemic island rodents." *Quaternary International* 182, no. 1 (2008): 6-15. https://doi.org/10.1016/j.quaint.2007.05.014

[2] Anggraini, Zona, Nurdin Kamil, Siti Dewi Maharani, Ratu Mutiara Wulandari, and Indri Rahmawati. "Indonesian endemic animals domino card about counting 1 to 10 for grade 1 elementary student." In *4th Sriwijaya University Learning and Education International Conference (SULE-IC 2020)*, pp. 287-293. Atlantis Press, 2021. https://doi.org/10.2991/assehr.k.201230.120

[3] Brito, Daniel. "Lack of adequate taxonomic knowledge may hinder endemic mammal conservation in the Brazilian Atlantic Forest." *Biodiversity & Conservation* 13 (2004): 2135-2144. https://doi.org/10.1023/B:BIOC.0000040005.89375.c0

[4] Florenza, Florenza, Andreas Andreas, and Irwan Harnoko. "Board game edukasi pengenalan fauna endemik kalimantan untuk anak." *Rupaka* 4, no. 1 (2021). https://doi.org/10.24912/rupaka.v4i1.16689

[5] Crimes, Delyth, and Gareth Enticott. "Assessing the social and psychological impacts of endemic animal disease amongst farmers." *Frontiers in Veterinary science* 6 (2019): 342. https://doi.org/10.3389/fvets.2019.00342

[6] Pouteau, Robin, Caroline Brunel, Wayne Dawson, Franz Essl, Holger Kreft, Bernd Lenzner, Carsten Meyer, Jan Pergl, Petr Pyšek, Hanno Seebens, Patrick Weigelt, Marten Winter, Mark van Kleunen. "Environmental and socioeconomic correlates of extinction risk in endemic species." *Diversity and Distributions* 28, no. 1 (2022): 53-64. https://doi.org/10.1111/ddi.13438

[7] Hale, K. A., and J. V. Briskie. "Decreased immunocompetence in a severely bottlenecked population of an endemic New Zealand bird." *Animal conservation* 10, no. 1 (2007): 2-10. https://doi.org/10.1111/j.1469-1795.2006.00059.x

[8] Saroyo, Saroyo, Parluhutan Siahaan, Marnix Langoy, and Roni Koneri. "Pendidikan konservasi satwa endemik sulawesi bagi siswa sekolah dasar di kelurahan Batuputih Bawah, Kecamatan Ranowulu, Kota Bitung, Sulawesi Utara." *VIVABIO: Jurnal Pengabdian Multidisiplin* 1, no. 3 (2019): 26-31. https://doi.org/10.35799/vivabio.1.3.2019.26743

[9] Taylor, Christopher A., Robert J. DiStefano, Eric R. Larson, and James Stoeckel. "Towards a cohesive strategy for the conservation of the United States' diverse and highly endemic crayfish fauna." *Hydrobiologia* 846, no. 1 (2019): 39-58. https://doi.org/10.1007/s10750-019-04066-3

[10] Ibrahim, Mohamad Syahrul Nizam, Mohd Ibrani Shahrimin Adam Assim, Shazali Johari, Syarifah Kamariah Wan Mohammad, Syamsul Herman Mohammad Afandi, and Suziana Hassan. "Public awareness on biodiversity conservation and well-being: Case of Gunung Mulu National Park, Sarawak." *GeoJournal* 88, no. 3 (2023): 3471-3496. https://doi.org/10.1007/s10708-022-10818-x

[11] Caldecott, J. O., M. D. Jenkins, T. H. Johnson, and B. Groombridge. "Priorities for conserving global species richness and endemism." *Biodiversity & Conservation* 5 (1996): 699-727. https://doi.org/10.1007/BF00051782

[12] Buyuksalih, Ismail, Serdar Bayburt, Gurcan Buyuksalih, A. P. Baskaraca, Hairi Karim, and Alias Abdul Rahman. "3D modelling and visualization based on the unity game engine–advantages and challenges." *ISPRS Annals of the Photogrammetry, Remote Sensing and Spatial Information Sciences* 4 (2017): 161-166. https://doi.org/10.5194/isprs-annals-IV-4-W4-161-2017

[13] Dwisaputra, Aryo Seto, Retno Indah Rokhmawati, and Muhammad Aminul Akbar. "Evaluasi user experience pada game augmented reality (sub projection mapping): Wall climbing menggunakan heuristic playbility (PLAY)(Studi Kasus: Wahana Jawa Timur Park 3)." *Jurnal Pengembangan Teknologi Informasi dan Ilmu Komputer* 3, no. 2 (2019): 2146-2153.

[14] Laksono, Dany, and Trias Aditya. "Utilizing a game engine for interactive 3D topographic data visualization." *ISPRS International Journal of Geo-Information* 8, no. 8 (2019): 361. https://doi.org/10.3390/ijgi8080361

[15] Metikaridis, Damianos, and Stelios Xinogalos. "A comparative analysis of tools for developing location based games." *Entertainment Computing* 37 (2021): 100403. https://doi.org/10.1016/j.entcom.2020.100403

[16] Sya'ban, Syifa Usya, M. Lahandi Baskoro, and Erik Armayuda. "Perancangan board game edukasi satwa endemik pulau jawa untuk anak usia 7 hingga 11 tahun." *AKSA: Jurnal Desain Komunikasi Visual* 4, no. 2 (2021): 600-611. https://doi.org/10.37505/aksa.v4i2.51

[17] Buyuksalih, Gürcan, Serdar Bayburt, A. P. Baskaraca, Hairi Karim, and A. Abdul Rahman. "Calculating solar energy potential of buildings and visualization within unity 3D game engine." *The International Archives of the*

Photogrammetry, Remote Sensing and Spatial Information Sciences 42 (2017): 39-44. https://doi.org/10.5194/isprs-archives-XLII-4-W5-39-2017

[18] Muktiani, Erlin, Pujiati Pujiati, and Muh Waskito Ardhi. "ULAR tangga satwa endemik: Permainan edukatif sebagai upaya penyadartahuan satwa endemik Indonesia yang dilindungi." In *Prosiding Seminar Nasional SIMBIOSIS*, vol. 3. 2018.

[19] De Castell, Suzanne, and Jennifer Jenson. "Digital games for education: When meanings play." *Intermédialités* 9 (2007): 113-132. https://doi.org/10.7202/1005533ar

[20] Permana, Dicky Reza Edina, Nurkhalis Suazi, and Teguh Cahya Wibawa. "Searching for animal names through games." *International Journal of Research and Applied Technology (INJURATECH)* 2, no. 2 (2022): 14-18. https://doi.org/10.34010/injuratech.v2i2.6939

[21] Rochman, Syaiful, Nuryani Rustaman, Taufik Ramlan Ramalis, Khairul Amri, Alif Yanuar Zukmadini, I. Ismail, and Apriza Hongko Putra. "How bibliometric analysis using VOSviewer based on artificial intelligence data (using ResearchRabbit Data): Explore research trends in hydrology content." *ASEAN Journal of Science and Engineering* 4, no. 2 (2024): 251-294.

[22] Al Husaeni, Dwi Fitria, and Asep Bayu Dani Nandiyanto. "Bibliometric using Vosviewer with Publish or Perish (using google scholar data): From step-by-step processing for users to the practical examples in the analysis of digital learning articles in pre and post Covid-19 pandemic." *ASEAN Journal of Science and Engineering* 2, no. 1 (2022): 19-46.

[23] Azizah, Nissa Nur, Rina Maryanti, and Asep Bayu Dani Nandiyanto. "How to search and manage references with a specific referencing style using google scholar: From step-by-step processing for users to the practical examples in the referencing education." *Indonesian Journal of Multidiciplinary Research* 1, no. 2 (2021): 267-294. https://doi.org/10.17509/ijomr.v1i2.37694

[24] Al Husaeni, Dwi Novia, and Dwi Fitria Al Husaeni. "How to calculate bibliometric using vosviewer with publish or perish (using scopus data): Science education keywords." *Indonesian Journal of Educational Research and Technology* 2, no. 3 (2022): 247-274. https://doi.org/10.17509/ijert.v4i1.57213

[25] Yusof, Anuar Mohd, Radhya Yusri, and Azlin Sharina. "A proposed integration model of project based learning and simulation to improve the learning quality." *International Journal of Advanced Research in Future Ready Learning and Education* 34, no. 1 (2024): 63-76. https://doi.org/10.37934/frle.34.1.6376

[26] Hassan, Norhaslinda, Min Hui Leow, Fenny Thresia, and Lu Qiaoqiao. "Exploring self-directed learning readiness among undergraduates in ESL Classrooms." *International Journal of Advanced Research in Future Ready Learning and Education* 34, no. 1 (2024): 53-62. https://doi.org/10.37934/frle.34.1.5362

[27] Jaafar, Nurulaini, Siti Rohani Mohd Nor, Siti Mariam Norrulashikin, Nur Arina Bazilah Kamisan, and Ahmad Qushairi Mohamad. "Increase students' understanding of mathematics learning using the technology-based learning." *International Journal of Advanced Research in Future Ready Learning and Education* 28, no. 1 (2022): 24-29. https://doi.org/10.37934/frle.28.1.2429

[28] Masrom, Maslin, Mohd Nazry Ali, Wahyunah Ghani, and Amirul Haiman Abdul Rahman. "The ICT implementation in the TVET teaching and learning environment during the COVID-19 pandemic." *International Journal of Advanced Research in Future Ready Learning and Education* 28, no. 1 (2022): 43-49. https://doi.org/10.37934/frle.28.1.4349

[29] Jie, C. Y., and N. Mat Ali. "COVID-19: What are the challenges of online learning? A literature review." *International Journal of Advanced Research in Future Ready Learning and Education* 23, no. 1 (2021): 23-29.

[30] Foi, Liew Yon, and Teoh Hong Kean. "STEM education in Malaysia: An organisational development approach?." *International Journal of Advanced Research in Future Ready Learning and Education* 29, no. 1 (2022): 1-19.

[31] Arifin, Raihan Mohd, Nik Fadhilah Nik Him, Ahmad Shidki Mat Yusoff, and Borhanuddin Ahmad. "Rabbani education: facing realities and readiness for the challenges of future education." *International Journal of Advanced Research in Future Ready Learning and Education* 31, no. 1 (2023): 1-8. https://doi.org/10.37934/frle.31.1.18

[32] Zainal, Salbiah, Rasimah Che Mohd Yusoff, Hafiza Abas, Suraya Yaacub, and Norziha Megat Zainuddin. "Review of design thinking approach in learning IoT programming." *International Journal of Advanced Research in Future Ready Learning and Education* 24, no. 1 (2021): 28-38.

[33] Nor, Siti Rohani Mohd, Adina Najwa Kamarudin, and Nurul Aini Jaafar. "Comparison on the student's performances during physical and online learning in financial mathematics course." *International Journal of Advanced Research in Future Ready Learning and Education* 28, no. 1 (2022): 1-8. https://doi.org/10.37934/frle.28.1.18

[34] Zokhi, Aini Nurrasyidah Md. "Aplikasi Inovasi q-track kit dalam proses pengajaran dan pembelajaran bagi modul teoritikal: Innovative application of q-track kit in the teaching and learning process for theoretical modules." *International Journal of Advanced Research in Future Ready Learning and Education* 27, no. 1 (2022): 20-29.

[35] Jamaludin, Aaishah Radziah, Wan'Atikah Wan Ibrisam Fikry, Siti Zhafirah Zainal, Fatin Shaqira Abdul Hadi, Nawal Shaharuddin, and Nurul Izzati Abd Rahman. "The effectiveness of academic advising on student performance." *International Journal of Advanced Research in Future Ready Learning and Education* 25, no. 1 (2021): 20-29.

[36] Nasir, Sharifah Noha Zahirah Syed Abdul, Nurul Ain Ab Wahab, and Mohd Agos Salim Nasir. "Graphical user interface for solving non-linear equations for undergraduate students." *International Journal of Advanced Research in Future Ready Learning and Education* 30, no. 1 (2023): 25-34. https://doi.org/10.37934/frle.30.1.2534

[37] Lau, Gabrielle Sing Jieh, and Jusiah Idang. "The Relationship between Selfie-Editing, Self-Esteem, and social appearance anxiety among University students." *International Journal of Advanced Research in Future Ready Learning and Education* 26, no. 1 (2022): 1-8.

[38] Kechik, Tuan Siti Mastazameatun Long Tuan. "Factors of technologies-reliant for 'Pengajian Malaysia'subject in online learning (OLL): A conceptual review." *International Journal of Advanced Research in Future Ready Learning and Education* 29, no. 1 (2022): 32-40.

[39] Abd Rahim, Baidruel Hairiel, Leong Ngan Ping, Nor Liyana Izdihar Nor Azman, and Farah Shazleen Shaharudin. "Improving Malay traditional joget dance technique through vygotsky framework among female secondary school dancers in Ampang, Selangor: The Participatory Action Research." *International Journal of Advanced Research in Future Ready Learning and Education* 30, no. 1 (2023): 1-12. https://doi.org/10.37934/frle.30.1.112

[40] Ridzuan, Raihana, Wan Nur Asyura Wan Adnan, Zarita Zakaria, Nur Izzati Mohd Noh, and Fazilah Abd Manan. "Perception of biology students to flipped classroom approach in biological control and environment conservation." *International Journal of Advanced Research in Future Ready Learning and Education* 27, no. 1 (2022): 9-15.

[41] Yulianti, Erni, Fatin Aliah Phang, Erti Hamimi Hamimi, Nor Farahwahidah Abdul Rahman, and Hadi Suwono. "Exploring science teachers' perspectives on STEAM Learning." *International Journal of Advanced Research in Future Ready Learning and Education* 34, no. 1 (2024): 131-142. https://doi.org/10.37934/frle.34.1.131142

[42] Ibharim, Nur Shakila, Nor Aishah Othman, and Nurul Iman Abdul Jalil. "Penggunaan pendekatan terapi bermain dalam mengenalpasti isu dan permasalahan kanak-kanak: The use of play therapy approaches in identifying children's issues and problems." *International Journal of Advanced Research in Future Ready Learning and Education* 26, no. 1 (2022): 9-24.

[43] Veza, Ibham, Mohd Farid Muhamad Said, Tri Widodo Besar Riyadi, Mohd Azman Abas, and Zulkarnain Abdul Latiff. "Issues in the science and engineering education in Indonesia: How to improve competitiveness through STEM mastery." *International Journal of Advanced Research in Future Ready Learning and Education* 24, no. 1 (2021): 1-6.

[44] Gani, Nur Anisa Ibrahim, and Hadina Habil. "Evaluating the technical quality and pedagogical affordances of an english language learning (ELL) website using a methodological framework." *International Journal of Advanced Research in Future Ready Learning and Education* 33, no. 1 (2023): 1-15. https://doi.org/10.37934/frle.33.1.115

[45] Ibrahim, Intan Maharani, Karim Suryadi, Cecep Darmawan, and Siti Nurbayani. "The use of the natuna game about the natural wealth of the natuna marine on national awareness of the post-millennial generation." *ASEAN Journal of Science and Engineering* 4, no. 2 (2024): 237-250.

[46] Cabrillos, Lenny E., Jegad D. Gapasin, Jeremy A. Marfil, and Vivencio L. Calixtro Jr. "Examining the effects of online games on the academic performance of BPEd students of Sultan Kudarat State University, Philippines." *Indonesian Journal of Educational Research and Technology* 3, no. 1 (2023): 13-18. https://doi.org/10.17509/ijert.v3i1.43732

[47] Rusyani, Endang, Anwar Saepulloh, Rina Maryanti, Risti Ragadhita, and Dwi Fitria Al Husaeni. "The effect of the team-games-tournament method on improving the learning ability of student with hearing impairment in multiplication concepts." *Indonesian Journal of Multidiciplinary Research* 1, no. 2 (2021): 219-228. https://doi.org/10.17509/ijomr.v1i2.37132

[48] Lathifah, Nida Nabilah, and Rina Maryanti. "Basic arithmetic learning through math online games for elementary school students during the pandemic." *Indonesian Journal of Multidiciplinary Research* 1, no. 2 (2021): 379-384. https://doi.org/10.17509/ijomr.v1i2.38546

[49] Jurayevich, Begimkulov Oltiboy. "Ways to develop education for obtaining general physical qualities of young wrestlers through action games." *Indonesian Journal of Multidiciplinary Research* 3, no. 1 (2023): 153-158. https://doi.org/10.17509/ijomr.v3i1.53558

[50] Hafina, Anne. "Post-traumatic counselling through group games." *Indonesian Journal of Multidiciplinary Research* 3, no. 2: 383-392.

[51] Albion, L., M. R. Kaira, Tatan Tawami, D. A. Fairuz, and Hanhan Maulana. "Designing english education game application for early childhood." *ASEAN Journal of Science and Engineering Education* 1, no. 2 (2021): 117-124. https://doi.org/10.17509/ajsee.v1i2.33754

[52] Rusyani, Endang, Rina Maryanti, Sri Rahayu, Risti Ragadhita, Dwi Fitria Al Husaeni, and Budi Susetyo. "Application of scrabble game in improving learning of simple sentence structure on the student with hearing impairment." *ASEAN Journal of Science and Engineering Education* 2, no. 1 (2022): 75-86.
[53] Ramdhani, Azka Fauzan, and Mochamad Yamin Saputra. "Effect small side games (SSG) on playing skills in handball sports." *ASEAN Journal of Physical Education and Sport Science* 2, no. 1 (2023): 61-68.
[54] Yaseen, Suhair Taha. "Rehabilitation Program for Surgical Shoulder Joint Protrusion among Team Games Players Injured." *ASEAN Journal of Physical Education and Sport Science* 2, no. 2 (2023): 105-116.
[55] Lathifah, Nida Nabilah, and Rina Maryanti. "Basic arithmetic learning through math online games for elementary school students during the pandemic." *Indonesian Journal of Multidiciplinary Research* 1, no. 2 (2021): 379-384. https://doi.org/10.17509/ijomr.v1i2.38546
[56] Dzulkifly, Sumayyah, Yoke Seng Wong, Hoi Yeh Lee, Abu Bakar Ibrahim, and Zhiqiang Song. "Pantas. io: Game-based learning to cultivate programming skills for primary school students." *Journal of Advanced Research in Applied Sciences and Engineering Technology* 50, no. 1 (2025): 178-190. https://doi.org/10.37934/araset.50.1.178190
[57] Nor, Norzuraina Mohd, Lee Hoi Yeh, Wong Yoke Seng, Siti Zubeidah Mohd Ariffin, Tajul Rosli Shuib, Amsalib Pisali, and Amir Hashim. "Active learning on students' interpersonal skills impact: An online theater approach." *Journal of Advanced Research in Applied Sciences and Engineering Technology* 42, no. 1 (2024): 226-238. https://doi.org/10.37934/araset.42.1.226238
[58] Hashim, Najiah Hanim, Nor Omaima Harun, Nur Asma Ariffin, and Nurul Ain Chua Abdullah. "Gamification using board game approach in science education-A systematic review." *Journal of Advanced Research in Applied Sciences and Engineering Technology* 33, no. 3 (2023): 73-85. https://doi.org/10.37934/araset.33.3.7385
[59] ChePa, Noraziah, Laura Lim Sie-Yi, and Sumayyah Adetunmbi. "Game-based technology for elderly with memory disorder: Criteria and guideline of mobile psychotherapy games." *Journal of Advanced Research in Applied Sciences and Engineering Technology* 28, no. 2 (2022): 162-180. https://doi.org/10.37934/araset.28.2.162180
[60] Prasetyo, Muhammad Adhithyas, Chandra Gelar Pamungkas, and Gayuh Budi Luhur. "Game design for an environmental-themed 2d adventure mobile game." *International Journal of Research and Applied Technology (INJURATECH)* 2, no. 2 (2022): 49-57. https://doi.org/10.34010/injuratech.v2i2.7950
[61] Permana, Dicky Reza Edina, Nurkhalis Suazi, and Teguh Cahya Wibawa. "Searching for animal names through games." *International Journal of Research and Applied Technology (INJURATECH)* 2, no. 2 (2022): 14-18. https://doi.org/10.34010/injuratech.v2i2.6939
[62] Ramdhani, Ricky Muhammad, Aditya Dwi Nurrahman, Prayogi Haris Affendi, Leonardi Paris Hasugian, and Agis Abhi Rafdhi. "Gamification implementation in health service website in 5.0 society era." *International Journal of Research and Applied Technology (INJURATECH)* 1, no. 2 (2021): 424-430. https://doi.org/10.34010/injuratech.v1i2.6777
[63] Iida, Hiroyuki, and Mohd Nor Akmal Khalid. "A paradigm shift from optimal play to mental comfort: A perspective from the game refinement theory." *International Journal of Informatics, Information System and Computer Engineering (INJIISCOM)* 1, no. 1 (2020): 47-78. https://doi.org/10.34010/injiiscom.v1i1.4021
[64] Iida, Hiroyuki, and Mohd Nor Akmal Khalid. "A paradigm shift from optimal play to mental comfort: A perspective from the game refinement theory." *International Journal of Informatics, Information System and Computer Engineering (INJIISCOM)* 1, no. 1 (2020): 47-78. https://doi.org/10.34010/injiiscom.v1i1.4021
[65] Salim, Michael Nagaku Milenn, and Hanhan Maulana. "Development of an educational training game for ear sensitivity of intervals." *International Journal of Informatics, Information System and Computer Engineering (INJIISCOM)* 4, no. 1 (2023): 89-100. https://doi.org/10.34010/injiiscom.v4i1.9588
[66] Ginting, Yogie Rinaldy. "A computational bibliometric analysis of game advertising using vosviewer." *International Journal of Informatics, Information System and Computer Engineering (INJIISCOM)* 4, no. 1 (2023): 49-60. https://doi.org/10.34010/injiiscom.v4i1.9571