

Evaluation of User Engagement for Augmented Reality Educational Game using PEEM and Characteristics of Good Model

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Abstract: Puzzle AR Game is an educational game based on augmented reality. In general, the game is an application that has a calculation of user experience to pay attention to the experience gained by users of the use of the application. User experience itself is known to have four components, that are, utility, usability, appeal, and engagement. This research focused on user engagement. The assessment of user engagement on mobile-based augmented reality games must combine two aspects, namely from the game side and the augmented reality side. This research elaborates on an evaluation of the Puzzle AR game was carried out using a model related to augmented reality namely PEEM (Positive Engagement Evaluation Model) and related to the classic game Characteristics of Good Game. The models refer to a conceptual model of user engagement on android games with augmented reality. A total of 15 respondents in this research were children aged 6 to 10 years and were in kindergarten to elementary school education grade 4. The value results obtained were user engagement in the Puzzle AR game is sufficient with an average value of net experience 10.756 after testing the reliability with a score of 0.548 which means quite reliable.

1 INTRODUCTION

Augmented reality is a technology that combines unreal or virtual 3D objects generated from a computer with objects or environments that exist in the real world in real or real time (Azuma, 1997). Not only presenting technological advances but augmented reality which is also being developed at this time has a unique appeal for modern society because of its immersive that can make users feel real interacting with virtual objects brought by the technology. Digital games are also experiencing the same development, especially on smartphone media. Education is one of the fields to implement educational game. It has a positive thing in the form of being able to be a medium of learning a topic along with its entertaining nature. According to Rosa and Shalahuddin (2011), educational games are digital games designed for educational enrichment (supporting teaching and learning) using interactive multimedia technology (Widiastuti, 2012).

Puzzle AR is an educational application game based on augmented reality. This game presents information and simple interactions on animal animations to be played in a single-player with the target of children under ten years. This game was

made in 2018 on behalf of a game developer company named Float Indonesia. This game is still in the development stage. Trials have been held but have not touched all the targets.

The sample of this study is children with educational levels ranging from kindergarten to elementary school, year one to four. The range of education is taken by considering two factors. First, based on the ESRB (Entertainment Software Rating Board) (ESRB, 2019). ESRB is a brief guide to the appropriateness of content in video games and applications to make it easier for customers to choose a game (ESRB, 2019). There are five ESRB categories, namely E means everyone matches any age range, E 10+ means everyone with an age greater than 10 years, T means teen with 13 years of age, M means mature, the adult with an age over 17 years, and AO which means Adults Only 18+ with an age over 18 years. The research sample of this study falls into the E category. Within ESRB (2019), it is explained that the content in this category contains at least cartoons, fantasies or minor violence, and mild and even rare language. While the next category is E 10+. Therefore the lowest level category was chosen, which is a sample of children ranging from those who had attended kindergarten to grade four of elementary

school. Generally, children enter elementary school education when they reach seven years old. The second factor is based on the IPA syllabus (Natural Sciences) material. It is known from Ministry of Education and Culture (Kementerian Pendidikan dan Kebudayaan, 2016), in the scope of things about creatures and living systems, the focus of the material on animals begins in the grade four while below the material on how to care for living things around is still a simple introduction in general only. So that this game is considered suitable as a medium of learning and introduction to animals in a simple way to children with kindergarten education level up to grade four elementary school.

Games also have the value of user experience as applications in general, but the user experience is a broad discussion. There are tons of journals that discuss various components of user experience and evaluation models. Regarding differences in user experience and user engagement, quoting from UX Designer (2015) that user experience has several components, namely utility, usability, appeal, and engagement. Engagement becomes one of the components of the user experience that is related to the convenience of users so that it attracts the user's appetite for repeated use (2015). According to Ganot (2015), user engagement refers to how often and for how long users interact with websites, applications, or other products and take action in them. O'Brien and Toms (2008) also argue that successful technology is not only usable, but they are engaged users (getting users involved). Referring to this understanding, the measurement of user engagement becomes something interesting to study. It can be formulated that user engagement is part of the user experience that focuses on how involved the user is with the application by paying attention to the user's behavior while using the application.

Permadi and Rafi (2015) used 8 user engagement models to be formulated into 8 potential attributes that can be used to measure user engagement in an augmented reality game on Android. The models used to consist of four user engagement models related to digital games including ES for Video Games, Characteristics of Good Game, UE in Games, Game Flow, and two user engagement models related to augmented reality technology including Mixed Fantasy Triad, and PEEM.

From this formulation, 8 potential attributes were formed to measure user engagement in an augmented reality game on android, namely clear goals, satisfaction, focused attention, mixed fantasy, perceived usability, challenge, interaction, and social. The reason Permadi and Rafi conceptualize a user

engagement model by combining user engagement models related to digital games and augmented reality technology is referring to Wetzel [9] that in designing an augmented reality game, designers need to cover all aspects by combining elements in the game digital classic with AR technology to enhance user experience. This method is taken because there is still a lack of studies that discuss user engagement aimed at mobile games based on augmented reality. The model that was brought in Wetzel (2008) also had not yet been tested because it was only a concept. To do the trial, it takes a long time so two models are chosen that are considered sufficient to represent each aspect Positive Engagement Evaluation Model (PEEM) (Rutledge & Neal, 2012) related to augmented reality technology and Characteristics of Good Games (Malone & Lepper, 1987) related to digital games.

2 THEORETICAL FRAMEWORK

2.1 User Engagement

User engagement is often equated with user experience even though these two things have their respective meanings. The core aspects that affect the success of user experience are utility, usability, appealing, and engaging (What is UX Designer? 2015). So if the user experience discusses user satisfaction and feelings when using the product widely, user engagement is more about measuring the likelihood of the user to reopen the application, the repeated use, and perform a series of actions in the application. User engagement refers to how often and how long users interact with websites, applications, or other products and take action in them (Ganot, 2015). So it can be concluded that user engagement is part of the user experience that focuses on discussing how involved the user is with the application by paying attention to how the understanding and behavior of the user while using the application.

2.2 Positive Engagement Evaluation Model (PEEM)

PEEM is a matrix model formulated based on psychological theory, narrative transport theory, and several neurological concepts to evaluate user engagement and the effectiveness of interactive immersive media such as augmented reality (Rutledge and Neal, 2012). PEEM developed by Rutledge and Neal (2012). The 9 evaluation elements of user engagement in PEEM are goals, attention, concentration, interaction, content, identity,

collaboration, and attitudes, enjoyment & satisfaction.

The goal is an element that acts as motivators of human behavior and these goals continue to be inherent in the human mind when carrying out any interaction. The progress of the process experienced by players to achieve goals is the dominant source of value in optimal user engagement. The goal of this element is a clear, task-oriented component so that the game becomes productive while still having narrative-based experience.

Attention is an element to measure how well the player's attention to the game and this is the most important component in augmented reality user engagement. This relates to how the game creates a focus that involves the physical and mind of the player so that it affects the subconscious that makes it focus. This element also investigates the tasks in the application and their sequence and whether the controls are easy to understand or not.

Concentration is talking about the player's attention to the game on an ongoing basis. Optimal engagement can occur when all the energy and skills are mobilized by the player to complete a challenge or task.

Interaction is an element that investigates whether the application presents a good and clear development from one task to another or from one display to another display, does not have significant interruptions such as error messages, and has content that suits user needs.

The content discusses the media objects, images, or videos in the game running smoothly and relevant to the objectives to be achieved or not. Emotions cannot be ignored in this element. Content must have a target of how users' emotions to be achieved towards the content presented, such as triggering a sense of adventure, curiosity, and pleasure.

Identity talks about building the skills of players. Skills can be built through effective interactive design and responsive progress feedback as challenges become increasingly difficult. When a player realizes his success in completing a challenge, he will have positive confidence in his competence and trigger intrinsic motivation to continue playing.

The collaboration deals with the social connections of players. Social needs are one of the most powerful forces of persuasion. Humans are neurologically connected to look for social bonds. Social perception, competition, collaboration, and other social activities can arouse the motivation of players to play again and increase user satisfaction.

The results of emotional Attitudes, Enjoyment, and Satisfaction are good. it will provide a positive

experience for repeated use and motivation to share their experiences with others. The reward system will encourage players' intrinsic motivation. The achievement will increase the positive attitude and emotions of the player. Starting from clear progress markers such as scores, leader boards, and social validation such as connectivity and social comparison are needed in the game so that the experience of using the internet in the game becomes important in this element.

2.3 Characteristic of Good Game

The second model is the Characteristics of Good Game, developed by Malone and Lepper (1987), focuses on evaluating classic digital games (Permadi & Rafi, 2015). Elements to evaluate user engagement on classic digital games are challenge, curiosity, control, and fantasy.

Challenge is the main principle in intrinsic motivation. Challenges that are too easy or too difficult will get low intrinsic. While challenges that are difficult in the middle will make the challenges interesting. To make activities in the game feel challenging, the game must provide goals that go up and down. Not always high or not always low. Feedback is also needed to increase the player's individual confidence.

Curiosity becomes an element that is related to the curiosity of players who are divided into sensory and cognitive curiosity. Sensory curiosity stimulates curiosity that involves the five senses such as textbook examples that are full of color, thus stimulating the eye to want to pay attention to the next pages. While cognitive curiosity is the existence of cognitive impulse to realize the "perfect size" in the game. For example, players see the object of plants in the game with a garden background behind the house. Players will have the desire to water because knowledge in general plants needs water to live.

Then there are controls related to the player's ability to control what he does and determine his destiny in the game. The biggest strength of a game is its control. A high number of control values can be obtained from players who have a learning process during the use of controls. With these controls, the player understands which one is used to walk and perform other actions.

Fantasy becomes an element that can evoke mental images or thoughts based on physical or social situations that are not real. In the aspect of endogeneity, the game must make players able to imagine and think about something seriously first which can improve their skills before achieving what

they want. To attract the emotional aspects, the game also needs to give players satisfaction with success, feeling in charge of the game, and something that does not exist in real life.

3 METHODOLOGY

This research method uses a quantitative approach. The formulation of user engagement evaluation elements is done first, by exploring the understanding of each element in the two evaluation models. The results obtained that all elements have different definitions so that the number of evaluation elements is obtained by 12 elements with total assessment items are 38 items.

The evaluation process refers to Enrique (2012). THE puzzle AR game was reviewed and rated by 15 respondents. These fifteen people consist of five levels of education so that there are three respondents at each level, from kindergarten to elementary school grade four. Data obtained from filling out the questionnaire. Each respondent was left playing the Puzzle AR game then asked to complete an evaluation. Interviews and observations are also conducted to ensure that respondents who are children age 6 to 10 years can understand and assess each item.

Reliability tests used to measure how reliable the results of the research are. Reliability test using the ReCal OIR online tool from the website of Dr. Freelon <http://dfreelon.org/utis/recalfront/recal-oir/>. The range of reliability scores based on Guilford criteria (Guilford, 1956). For assessment using the Likert scale method. Each evaluation element consists of two to four statement items. The final result of this calculation formula is called net experience. The criteria of the net experience will be the data analyzed and the evaluation reference.

For each respondent, the values per element are added and divided by 12 (number of elements) to get the net experience value. The 12 elements consist of 8 elements from the PEEM model and 4 elements from the Characteristics of Good Game. Based on this formula, the lowest net experience value that can be obtained is 3.17 with a total score of 38. While the highest net experience is 15.84 with a total score of 190. To determine the criteria, the Umar [15] scale range formula is used to obtain the results presented in Table 1 while formulation of user engagement elements from the PEEM and Characteristics of Good Game model can be seen in Table 2.

Table 1: User engagement criteria scores

No	Score range	Criteria
1	3.16 – 5.696	Very Less
2	5.697 – 8.232	Less
3	8.233 – 10.768	Sufficient
4	10.767 – 13.304	Good
5	13.305 – 15.84	Very Good

4 RESULT AND DISCUSSION

4.1 Result

The reliability coefficient of the Puzzle AR game is 0.548. That means the research instruments are reliable enough to be analyzed. In the assessment, there are averages to display the average value of the score in each element, and ST DEV (standard deviation) is the consistent value. Standard deviation is a statistical valuation technique used to determine the distribution of data in a sample, as well as how close the individual data points are to the mean or average [16]. The more the standard deviation is close to 0, the more consistent the ratings given by the respondent to the element. Consistency in value becomes important as a reliable measurement of whether or not the score on an element. An element can be said to be good if the high average value obtained is also accompanied by a standard deviation value close to 0. The comparison chart attached in Table 3.

The net experience category gained from kindergarten age trainers is good. Kindergarten got the second-highest grade after grade three. The highest value with good value consistency is in the Content, Curiosity, and Control elements. The content talks about the richness of images, video, and sound. Kindergarten respondents have the same high rating of the experience of realizing the many variations of images and sounds in the game. Overall, the ratings given between the respondent were classified as consistent.

Kindergarten respondents have a fairly uniform assessment. Even so, there are still elements with the lowest value, namely the elements of Collaboration and Attitudes, Enjoyment, and Satisfaction. This shows that players feel the lack of collaboration features and the feeling of wanting to play again is due to the rewards given in the game.

Table 2: Evaluation instrument for user engagement from PEEM and characteristics of good game model.

Evaluation Model	Indicator	User Experience	Explanation
PEEM	Goals	I feel the purpose of this game is to display animals in the form of augmented reality (appears after confronting the camera)	The activities and objectives are clear
		The tasks and activities given make sense with the aim of animal recognition	The given task directs the player to reach the goal
		I understand how to achieve my goals and feel I can do it (Ex: I can explain how to hear animal sounds by following instructions)	Steps that lead to easy goals with a solution that can be managed
	Attentions	I can play it with smooth stages	Seamless task sequence
		I understand the use of UI controls (2D buttons and joystick)	UI controls are easy to understand and follow
		Pictures and sounds helped me understand the Puzzle AR game	Visual or hearing support improves understanding
	Concentration	Playing Puzzle AR makes me interested and feel challenged	The UI maintains the player's attention and the appropriate level of challenge
		I can say what I have to do and what I do it for	The task is easy to understand and the purpose is clear
		I got helpful feedback for directions to reach the goal	Feedback can provide learning through task completion
	Interaction	I thought of a strategy for playing the Puzzle AR game	Players have many ways to feel control, such as personalization, activity choices, or filtering
		I don't feel disturbed if there are error messages in the game	There are no disturbances such as configuration, error messages, or irrelevant data.
		Help by sending messages to others through the application makes the game feel personal.	Interaction, assistance, and delivery of messages from the use of social behavior applications (first-person communication).
		The tasks in the game according to my needs and skills	Content and tasks adjust to the needs and skills of users
	Content	Pictures and videos are many and run smoothly	Sound, touch and rich media (imaging, overlays, video, enhanced display) are seamless
		I feel adventure and pleasure	Content designed to target certain emotions (wonder, adventure, fun, intrigue)
		The game runs well and no images, videos or audio interferes with my goal	Content designed to match costs to eliminate task interruptions
		Pictures, videos or audio make sense with their activity and purpose	Content is relevant to the task and supports the logic and purpose of the activity
	Identity	It was fun playing the Puzzle AR game and made me imagine a lot	Activities provide the integration or imaginative projection of users into experiences
		Puzzle AR Games improve my skills and knowledge	Development of skills and structured mastery
		There is evidence of progress (appreciation/reward) as the achievement	Responsive feedback from progress and achievement
	Collaboration	I can compare Puzzle AR games through links or social media	Integrated social connections or Comparisons (social network link)
		I received other people's responses through the Puzzle AR game	Validation, strengthening feedback from social elements
		I can change the content as I wish	The ability to create, participate or personalize content
	Attitudes, Enjoyment, Satisfaction	Gifts and awards make me want to play again	The inherent motivation or reinforcement to repeat or repeat an activity (emotional, reward, or social)

		I can collaborate or share my experience playing Puzzle AR about the scores or awards that I get	Opportunities for comparison or competition (scores, prizes, badges)
		There is a feature where I can rate, comment, or vote	There are ratings, comments or 'send to friends' features
Characteristic of Good Game	Challenge	I know the Puzzle AR game is a game to find information about animals	Objectives: Activities must be clear, some goals have been set
		I felt the score I got was uncertain	Uncertain results: varying degrees of difficulty, selectively revealed, randomness
		I get a lot of feedback in the form of words of encouragement	Feedback must be frequent, clear, constructive, and encouraging
		My self-esteem is increasing, because I always get scores and positive feedback	Self-esteem: activities must have a level of difficulty that is assessed, and feedback techniques to enhance a sense of competence
	Curiosity	I want to know what animals and animal sounds are in the Puzzle AR game	Sensory curiosity increases because of the variability of audio and visual effects
		I want to know all the actions in the game by running all the action buttons on the animal.	Cognitive curiosity: Curiosity can be enhanced by the existence of teaching techniques that make players feel surprised, interested because they are aware of the incompleteness that must be completed
	Control	Puzzle AR Games give me a hint when I'm playing a game.	Contingency: activities must provide a responsive learning environment
		I can control the game if I want to achieve a certain goal. Ex: if I want a crocodile to dive, then I must first walk it into the water	Choice: the activity must provide and emphasize moderate level choices on various aspects of the learning environment
		I gained enthusiasm by successfully acting like animals	Power: the activity must allow the player to gain strength
	Fantasy	I also felt what the animal I was playing was feeling	Emotional aspects: fantasy must be designed to attract students' emotional needs
		I understand all the explanations given in the Puzzle AR game.	Cognitive aspects: fantasy must provide an analogy for the material presented for learning
		Playing the Puzzle AR game made me have to think and learn something from the game to get the desired results.	Endogeneity: fantasy must have an integral (overall) relationship, endogenous (derived from the deepest instincts), and material learned

The average value of net experience in this grade has the lowest level among others. The value of user engagement obtains sufficient criteria. The highest average value is found in the Content element with a consistency value of 1.15 which is close to uniformity. Respondents averaged the wealth and smoothness of graphics and audio in the game. It's just that respondent 6 gives the lowest value than another respondent.

This is because the respondent is not actively playing an android game so that it has found some difficulties when playing it. The consistent element values are in the Collaboration, Attitudes, Enjoyment, and Satisfaction and Interaction elements. But the value given is low. All respondent agreed to disagree with statements on the elements of Collaboration, Attitudes, Enjoyment, and Satisfaction, and Challenge. respondent both felt they had not found collaboration, feedback reward, and feeling

challenged in playing the Puzzle AR game with satisfactory value. The element with the most inconsistent value is Goals. respondent 6 claimed not to be able to understand the purpose of augmented reality in the Puzzle AR game so he gave a low rating. For children who rarely have experience playing games or are not interested in playing third or first-person games will find it difficult because they need to adapt to the UI control layout in the game.

Table 3: Comparison of user engagement evaluation scores

Model	Indicator	Kindergarten					1st grade ES					2nd grade ES					3rd grade ES					4th grade ES				
		Resp. 1	Resp. 2	Resp. 3	Avg.	ST DEV	Resp. 4	Resp. 5	Resp. 6	Avg.	ST DEV	Resp. 7	Resp. 8	Resp. 9	Avg.	ST DEV	Resp. 10	Resp. 11	Resp. 12	Avg.	ST DEV	Resp. 13	Resp. 14	Resp. 15	Avg.	ST DEV
PEEM	Goals	14	13	13	13.33	0.58	15	15	9	13.00	3.46	14	11	15	13.33	2.08	13	13	15	13.67	1.15	15	14	14	14.33	0.58
	Attentions	13	13	13	13.00	0.00	15	14	9	12.67	3.21	12	13	14	13.00	1.00	14	14	13	13.67	0.58	13	13	10	12.00	1.73
	Concentration	12	13	13	12.67	0.58	13	12	7	10.67	3.21	8	6	13	9.00	3.61	11	11	14	12.00	1.73	12	13	14	13.00	1.00

Kindergarten respondents have a fairly uniform assessment. Even so, there are still elements with the lowest value, namely the elements of Collaboration and Attitudes, Enjoyment, and Satisfaction. This shows that players feel the lack of collaboration features and the feeling of wanting to play again is due to the rewards given in the game.

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In grade two elementary players, the average value of net experience falls into the moderate category. They gave the second-lowest net experience rating after grade one. There was an increase in scores on Goals, Attentions, Interaction, Collaboration, Attitudes, Enjoyment, and Satisfaction, Challenge, Control, and Fantasy scores compared to the grades given by grade one respondent, Control and Fantasy become the elements with the best value because high scores are also consistent. Fantasy explains the intrinsic motivation of the player based on the player's ability to guess and imagine what he can experience as a Puzzle AR game player. This means that players feel the same intrinsic motivation when playing the Puzzle AR game, likewise experience in understanding the controls of the Puzzle AR game. At this level, respondent begins to feel understands what animal is being played and how it is explained. Interaction has a low consistency value. One respondent (respondent 9) gave the lowest rating on items that discussed strategies, interruption of error messages, and help features to others. Puzzle AR Games are considered capable of fulfilling the characteristic elements of being responsive to their activities while playing. The lowest score is in the Attitudes, Enjoyment, and Satisfaction and Collaboration elements which means that the grade two respondents also feel the same deficiency as the previous grade.

The net experience value at the elementary school level of grade three is the highest and the score is classified as good criteria. The assessment given was quite positive especially for respondent 11 who felt the highest involvement. The highest value is in the Curiosity and Attentions elements which also

have high consistency value. This shows that grade three elementary school players have the same value in terms of playing the Puzzle AR game smoothly, understanding what to do next, and curiosity about what the players can do in this game. At this level of education, players begin to be curious about what they can find in the Puzzle AR game. Even so, the value given by the respondent is less uniform. The lowest consistency score is in the Attitudes, Enjoyment, and Satisfaction element reaches a score of 5.69 then followed by the Identity and Challenge elements. That is, there is an imbalance in the experience of respondent regarding feeling satisfied with appreciation, and feeling challenging when playing the Puzzle AR game. respondent 11 was satisfied with the rewards and challenges in the game. But for another respondent the game only provides the experience of playing the game without getting a satisfying reward to the player.

In the level of education with the oldest players, the average score of net experience is good. High and consistent average values are found in the Goals, Control, and Fantasy elements with a consistency value of 0.58. Departing from the focus of Control, Goals and Fantasy elements, it can be analyzed that grade four elementary school players uniformly assume the game can provide clear play direction to feel the augmented reality features, understand the purpose of the Puzzle AR game, be able to use controls, and increase motivation intrinsic to imagine what could happen in this game. The Interaction is based on explaining the criteria, discussing clear steps, few interruptions, and responsive games to the user. This element has a high average value but is not consistent. respondent 13 gave a fairly low rating on this element because it had experienced a slight error while playing. The Challenge element has also decreased in value compared to other education classes. For grade four respondents, the Puzzle AR game is less challenging and the score doesn't raise the player's self-esteem. The respondent began to understand that this game was just a simple animal recognition game that didn't have a difficult mission. The lowest value is in the Attitudes, Enjoyment and Satisfaction, and Collaboration aspects. At all levels of education, these two elements have the lowest value, which means that the respondent feels dissatisfied with the collaboration and reward features of the game.

Evaluation scores per element obtained from the total of all samples can be useful to provide more detailed information about which elements are of good value and need improvement. Goals have good grades but are slightly volatile between levels of

education. Had experienced a decrease in grade one respondent because there was one respondent who did not understand how to play android games. Then the scores go up and down until the grade four elementary respondent gives the highest rating which means they understand the purpose of this game the most.

Initially, Attentions got grades that were ascending and stable, slightly increasing in grade three but later scores dropped. Grade three respondents have a little higher attention but then grade four respondents give lower value. Even though it is still in the good category, it indicates that the level of grade four respondent attention to the Puzzle AR game is not as enthusiastic as the other respondent groups. Significant value fluctuations also occur in the Challenge element. Feeling challenged in this game is considered insufficient. Had a high value in the grade three respondents but dropped back the same as kindergarten respondents. For concentration overall, it's good value. Starting with a high enough value but then dropped on the grade two respondents. This is because some respondents feel less interested and less attention to instructions. Then the value increases again and the value is slightly higher than the kindergarten respondent. The Interaction element also experienced the same thing, initially the high-value element but dropped in the grade one and then back up with a value that is not too different from the initial value. One respondent is enough to influence the average rating of the elements. One respondent feels that the game doesn't match his skills so a lot of low marks are given.

Content gets a very high value, then decreases and then rises again but not as high as the value of the kindergarten respondents. This might be due to that for the kindergarten respondents; the content is still very interesting and is something they have just met so that interest in the content is still very high and enthusiastic. Value is still in good criteria. For Identity, it has an ascending graph and gets high marks on grades three and four. The Puzzle AR Game can show its identity as an animal introduction game in augmented reality and the respondent can absorb the information provided in the game well.

Collaboration and Attitudes, Enjoyment, and Satisfaction get the lowest scores that fall into the bad category among all elements even though there is an increase for grade three respondents. Both of these elements talk about the experience of the player's feelings in the form of repeated use, telling others, ease in share Puzzle AR game information, and collaborate. The point of most concern is collaboration, where almost all respondent feel they

disagree with the collaboration capabilities of the Puzzle AR game feature.

Then there are the Curiosity, Control, and Fantasy elements that get good grades. In the Curiosity element, the results are obtained that the grade four respondents gave a lower value than the kindergarten respondent even though it had risen in the grade three respondents. It appears that the kindergarten and grade three that were sampled in this study had the same high curiosity towards the Puzzle AR game. In the Control element, there is a decrease in grades in elementary grade one respondent but then experiences ups and downs that end with a value that is not much different from the kindergarten value.

The Fantasy element becomes the most stable element after Attentions. The highest score is in grade three respondents. This means that the Fantasy felt by the respondent is quite good and does not have differences between respondent even with different age ranges.

4.2 Discussion

Evaluation of user engagement using the PEEM model and Characteristics of Good Game in an educational game based on augmented reality produces an evaluation element of 12 with different characteristics. These elements are Goals, Attention, Concentration, Interaction, Content, Identity, Collaboration, and Attitudes, Enjoyment & Satisfaction, Challenge, Curiosity, Control, and Fantasy.

The evaluation value of user engagement on the Puzzle AR game using a combination of the PEEM model and the Characteristics of Good Game is 10.756 which means it is sufficient. Some results were divided into evaluation results based on the level of education and assessment per element. Overall education level, respondent grade one elementary school experience the lowest user engagement experience due to the influence of one respondent who is not familiar with android games. But then followed by respondent grade two, then grade four, kindergarten, and the highest is in grade three. Grade four respondents, scores start to decline due to simple gameplay, not having too challenging missions is considered to be inappropriate for children of this level of education.

The element with the highest consistency is Curiosity. Almost all respondent agrees that Curiosity is very good in the Puzzle AR game. Curiosity itself discusses the desire of players to know about content and controls in the game. Control has the highest average value. This means that the controls on the

Puzzle AR game are judged to be understood even by kindergarten respondent. The elements with the lowest values are Attitudes, Enjoyment and Satisfaction, and Collaboration. This element talks about games that can tell activities to others, ease in sharing information about the Puzzle AR game to others, and can collaborate. Dominantly, the respondent considered that the game has not been able to provide feedback in the form of satisfying rewards and collaboration capabilities as expected.

From the findings of this evaluation the following technical recommendations to increase the value of user engagement in the Puzzle AR game:

1. To increase the value of attitudes, enjoyment, and satisfaction, the game needs to add simple missions by utilizing actions that can be done by each animal and then provide a scoring feature to increase the sense of challenge and enjoy the appreciation in the form of assessment.
2. To increase the value of collaboration, add multiplayer features where between Androids can play and interact with one another in the same scene and at the same time to improve the assessment of collaboration.
3. Add comments or share the results of playing to social media to increase confidence and open opportunities for indirect game recognition for those who do not know the Puzzle AR game.
4. Add features giving encouraging words and responsive hints when players are detected by the game less able to complete the mission and achieve its goals which can increase the value of interaction.
5. Increase the stock of animal animations in the game along with clear and valid educative information so that the game experiences become more professional and the content value increases.

4.3 Limitation

Characteristics of Good Game model has a very classic rating indicator based on the source which gives examples of very simple games such as darts and mathematics games while the current game has more complex gameplay. It is expected that the user engagement evaluation research on android games based on augmented reality can use a combination of PEEM evaluation models with the latest evaluation models so that the elements are more suitable and by

the gameplay of existing android games at present. It is also expected that the subsequent studies will have higher number of respondents with a more diverse range of age and education level, hence, a wider Puzzle AR game can be studied.

5 CONCLUSION

The PEEM and Characteristics of Good Game models provide user engagement score results in the Puzzle AR game within sufficient criteria. But the Puzzle AR game also requires some improvement such as adding simple missions, scoring, multiplayer, comments, and sharing, encouraging words, hints, and animal animations stock.

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