Additive Ratio Assessment (ARAS) Method in The Selection of Popular Mobile Games

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ABSTRACT

Dealing with using smartphones was growing will increase the sales value of the mobile game industry, both from local and foreign developers. It can impact the increasing number of start-ups trying to get involved in the game industry, as well as a large number of job opportunities for those who want to be strengthened in the development of mobile games. This opportunity become the main sector in the domestic creative industry. In Indonesia, the development of mobile games was deemed necessary to analyze the most popular mobile game products that assist by criteria of game. It shows the market trend currently. The researcher hopes this result can provide for developers to choose the type of game to be strengthened based on certain categories .The mobile games involved in this research are Garena Free Fire, Mobile Legend: Bang Bang, PUBG Mobile, Higgs Domino Island, Ragnarok X: Next Generation, Rise of Kingdoms: Lost Crusade, Roblox, State of Survival: Survive The Zombie Apocalypse, Genshin Impact, Coin Monster, Minecraft, Clash Royale, Clash of Clans, Ragnarok M: Eternal Love, State of Survival: The Walking Dead Collaboration. The research was an Additive Ratio Assessment (ARAS) method with the results of 5 recommended mobile games. The test is carried out with a sensitivity test which shows the criterion of "not containing violence" which is the most sensitive criterion among other criteria.

1. Introduction

Mobile games are types of games that are usually played on mobile phones [1][2]. It also refers to any game played on portable devices, including mobile phones (feature phones or smartphones), tablets, PDAs to handheld game consoles such as the PSP and Nintendo Wii U with or without network availability. Nowadays, mobile games have been developed to run on various platforms and technologies. The most widely supported platforms are iOS and Android. The mobile version of Microsoft Windows 10 (formerly Windows Phone) is also still actively supported, although, in the market share, it is less competitive than iOS and Android.

According to Newzoo's data, the value of the mobile gaming industry in 2021 will reach US$90.7 billion. However, that number includes the total consumer spending only, without calculating the income from advertising. The App Store is still the biggest contributor. Around US$41.1 billion or 45.3% of the mobile game industry's revenue comes from the App Store. Meanwhile, Google Play contributed US$28.2 billion or around 31.1% of revenue to the mobile game industry. About 23% worth US$21.3 billion, came from third-party app stores. The growth rate of the mobile game industry in 2019-2024 is 11.2%. So, in 2024, the mobile game industry is expected to be worth US$116.4 billion. China is still the country with the largest mobile game industry.

The value of the mobile game industry in the country reached US $ 31.4 billion. Meanwhile, the second place is held by the United States, with the mobile game industry worth US$14.8 billion, followed by Japan (US$12.4 billion). South Korea took the 4th position with US$4.2 billion in the mobile game industry and India took the 5th position with US$2.2 billion value. Indonesia is in 8th position with US$1.5 billion of mobile game industry value. In Indonesia, as much as the US $ 1.3 billion of revenue for the mobile game industry comes from Google Play. The App Store only contributed US$210 million and third-party app stores US$35.8 million. The one thing that drives the growth of the mobile game industry is the increasing number of smartphone users in the world. The more people who use smartphones, the bigger the mobile game market. During the 2019-2024 period, the average growth rate (CAGR) on the number of smartphone users in the world was 6.1%. In 2021, it is estimated that the number of smartphone users in the world will reach 3.9 billion people, up 6.1% from last year. Meanwhile, in 2024, the number of smartphone users is expected to reach 4.5 billion people.

Dealing with uses smartphones was growing will increase the sales value of the mobile game industry, both from local and foreign developers. It can impact the increasing number of start-ups trying to get involved in the game industry, as well as a large number of job opportunities for those who want to be strengthened in the development of mobile games. This opportunity become the main sector in the domestic creative industry. In Indonesia, the development of mobile games was deemed necessary to analyze the most popular mobile game products that assist by criteria of game. It shows the market trend currently. The researcher hope this result can provide for developers to choose the type of game to be strengthened based on certain categories.

2. Material and Method

The subject of this study takes criteria from mobile games in general and various genres. The referenced mobile game through best-selling mobile games in Indonesia, such as Mobile Legends, PUBG, Call of Duty Mobile, Free fire, etc.

The game selection uses the Additive Ratio Assessment (ARAS) method, that used for ranking criteria. Research using the ARAS method has been commonly used. In a study conducted by [3] using the ARAS method for decision making in determining the beneficiaries of livable houses based on 8 criteria, namely; raw materials for cooking, house status, number of children, income, floor type, roof type, wall type, and house area that used 10 alternative data. The results obtained from this study are 6 alternatives that are recommended to get the benefits of livable houses. Furthermore, research by [4] introduced a new ARAS method with a case study on evaluating the work atmosphere in an office space. The purpose of this study was to determine the steps to improve the office environment where they work. This research aims to find out the suggestion for replacing the indoor air, humidity, air temperature, lighting intensity, airflow rate, and dew point. The weight of the criteria in this study used the pairwise comparison method. The ARAS method is also used in this research [5] to identify indicators of corporate social responsibility and determine company ratings based on these indicators. Researchers used the SWARA and ARAS methods to evaluate and rank the data. Meanwhile, the research on mobile games has also been conducted by [6] who analyzed the revenue model of the most popular games on Google Play. The discussion focuses on the quantitative distribution of the application sales model and the free model in terms of quality and number of downloads. Based on the results, it was found that there is no promising revenue model for the application. The study [2] investigated the relationship between mobile game addiction and mental health outcomes. This study examines the relationship between the addition of mobile games with social anxiety, depression, and loneliness among adolescents. The results of this study revealed that male adolescents tend to be more socially anxious when using mobile games addictively. Meanwhile, a study conducted by [7] examined the relationship between online mobile game addiction and loyalty to the purchase intention of applications in online mobile games. The results indicated that (i) online mobile game addiction has a significant positive relationship with online mobile game loyalty; (ii) online mobile game addiction has a positive relationship with online mobile game in-app purchases, and (iii) online mobile game loyalty increases game users' intention to purchase online mobile in-game applications. Furthermore, research was conducted by [8] regarding virtual communication in online games. The purpose of this study was to determine the virtual communication in the Mobile Legends game. The results of this research indicated that virtual communication occurs in the Mobile Legends game, namely virtual worlds, virtual communities, chat rooms, MUD&Bot, interactivity, and multimedia because of the interaction and communication carried out in the Mobile Legends and using the internet network. Virtual communication greatly influences the effectiveness of communicating and with the facilities provided by Mobile Legends players can communicate without having to meet face to face. Then research [9] was to determine the player's verbal communication in the Mobile Legends: Bang Bang game and the non-verbal communication of players in the Mobile Legends: Bang Bang game. The results showed that in the game Mobile Legends: Bang Bang there are verbal communication channels in the form of discord, microphone, and voice chat, non-verbal communication in the form of stickers, emojis. While the form of verbal communication is Mabar (playing together), the squad (teams or groups playing in games), non-verbal forms of communication in the form of special terms such as noob, AFK, GG, GGWP, savage, buff, etc. On user experience, research conducted by [10] discusses providing game analysis evaluations to increase user acceptance of Mobile Legend. The online Mobile legend games were analyzed using a questionnaire game design factor with research variables namely Game Goal, Game Mechanism, Interaction, Freedom, Fantasy Game, Narrative, Sensation, Game Value, Challenge, Social, Mystery, and Plot. In general, the results indicated that the mobile legend application is very visible from the results of respondents' analysis data. About 76%, freedom by percentage, 77%, and fantasy games by percentage, 75%. According to [11] tested mobile in the context of their content and evaluated the situation faced by children through document analysis in several age ratings, game scores, access permissions, the inclusion of advertisements, in-game purchases, encouraging consumerism, the inclusion of violence, bad habits, and educational values. The results indicated that 90% of mobile games encourage consumerism and 50% contain elements of violence and fear.

In addition to several studies on mobile games, the average refers to the negative impact of the mobile game. Therefore this study was deemed necessary to select the types of popular games based on several criteria using the ARAS method. a sensitivity test was carried out for the test. The Additive Ratio Assessment (ARAS) method test is one of the multiple-criteria decision-making methods based on the concept of ranking using the utility degree, namely by comparing the overall index value of each alternative to the overall index value of the optimal alternative.

The steps in the ARAS Method [12][13]:

1. Formation of a decision-making matrix:

$$X = \begin{bmatrix} X_{0i} & X_{0j} & \cdots & X_{0n} \\ X_{i1} & X_{ij} & \cdots & X_{in} \\ \vdots & \vdots & \ddots & \vdots \\ X_{ni} & X_{mj} & \cdots & X_{mn} \end{bmatrix} (\, i = 0, m \,; \ldots .\, j = 1, n \,) \quad (1)$$

Where:

M = Number of Alternatives

N = Number of Criteria
Xij = Performance value of alternatives against criteria
Xoj = optimum value of criteria J

If the optimum value of criteria is J (xoj) is not known, then: [F2]

$$x_{oj} = \text{Max}\frac{Max}{i} = x_{ij} \text{ if } \frac{Max}{i} . x_{ij} \text{ is Preference}$$

$$x_{oj} = \text{Max}\frac{Min}{i} = x_{ij} \text{ if } \frac{Min}{i} . x_{ij} \text{ is Prefeerable} \quad (2)$$

2. Normalization of the decision matrix for all criteria
   a. If the criterion is benefited (max), then normalization is carried out following the following rules:
   $$X_{ij} * = \frac{X_{ij}}{\sum_1^m = 0\, x_{ij}} \quad (3)$$
   where $X_{ij} *$ is the normalization value.

   b. If the criteria are non-benefit, then normalization is carried out following the following rules:
   Stage 1
   $$X_{ij} = \frac{1}{X_{ij}}$$
   Stage 2 (4)
   $$R = \frac{X_{ij}}{\sum_1^m = 0\, x_{ij}}$$

3. Determines the weight of the normalized matrix
   D = [dij] m x n = rij.wj (5)
   Where:
   wj = criterion weight
4. Determine the value of the optimization function
   $$S_i = \sum_i^n = 1\, d_{ij} : (i = 1,2, \dots .m : j = 1,2, \dots ., n) \quad (6)$$
   Where S_i is the value of the alternative optimization function i. The greatest value is the best one, and the least value is the worst. Taking into account the process, the proportional relationship with the value and weight of the criteria studied influences the final result.
5. Determining the highest rank of alternative
   $$K_i = \frac{S_i}{S_o} \quad (7)$$
   where:
   S_i and S_0 are the values of the optimality criteria.
   Ki = the value of the alternative ranking level
   Si = the optimum value for the alternative i
   So = the optimum value for the optimal alternative

3. Result and discussion

To determine the selection of popular mobile games, a simple hierarchy will be made consisting of 3 levels of goals or main objectives, criteria, and alternatives. Table 1 shows the data on the alternatives used in this study.

Table 1 Game Alternatives

Alternative	Description
A1	Garena Free Fire
A2	Mobile Legend: Bang Bang
A3	PUBG Mobile
A4	Higgs Domino Island

Alternative	Description
A5	Ragnarok X: Next Generation
A6	Rise of Kindoms : Lost Crusade
A7	Roblox
A8	State of Survival : Survive The Zombie Apocalypse
A9	Genshin Impact
A10	Coin Monster
A11	Minecraft
A12	Clash Royale
A13	Clash of Clans
A14	Ragnarok M: Eternal Love
A15	State of Survival : The Walking Dead Collaboration

Table 2 shows the alternatives made from content that does not contain violence, does not contain pornographic elements, is entertaining, is game graphics, and is creative.

Table 2 Alternative Data

Alternative	Not Containing Violence	There is No Pornography Element	Entertaining	Game Graph	Creativeness
A1	Good Enough	Good	Good	Good Enough	Good Enough
A2	Good	Good	Good	Good	Good
A3	Good	Good	Good	Good	Good
A4	Excellent	Excellent	Good	Good	Good
A5	Good	Good	Good	Good Enough	Good
A6	Good	Good	Good	Good	Good
A7	Excellent	Good	Good	Good Enough	Good
A8	Good	Good	Good	Good Enough	Excellent
A9	Good	Good Enough	Good	Excellent	Good Enough
A10	Excellent	Excellent	Good	Good	Good
A11	Excellent	Excellent	Good	Good Enough	Excellent
A12	Excellent	Excellent	Good	Good	Excellent
A13	Excellent	Excellent	Good	Good	Excellent
A14	Good	Good	Good	Good	Good
A15	Good	Good	Good	Good	Excellent

Table 3 is a table of criteria which is the criteria used that consists of information, types, and weights that have been determined.

Table 3 Criteria Weight

Criteria	Description	Type	Point (%)
C_1	Not Containing Violence	Benefit	15
C_2	There is no Pornography Element	Benefit	30
C_3	Entertaining	Benefit	20
C_4	Game Graph	Benefit	15
C_5	Creativeness	Benefit	20

Table 4 is a table of alternative value weights, which have been compiled according to needs starting from the name and weight value, each of them has a different entry for each level.

Table 4 Criteria Conversion

Name	Point
Strongly Bad	1
Bad	2
Good Enough	3
Good	4
Excellent	5

From the alternative data in Table 2, the next step is to determine the suitable alternative to rate each criterion as shown in Table 5.

Table 5 Input Criteria

Alternatif	C1	C2	C3	C4	C5
A1	3	4	4	3	3
A2	4	4	4	4	4
A3	4	4	4	4	4
A4	5	5	4	4	4
A5	4	4	4	3	4
A6	4	4	4	4	4
A7	5	4	4	3	4
A8	4	4	4	3	5
A9	4	3	4	5	3
A10	5	5	4	4	4
A11	5	5	4	3	5
A12	5	5	4	4	5
A13	5	5	4	4	5
A14	4	4	4	4	4
A15	4	4	4	4	5

The next step was to determine the suitable alternative way to rate each creation. In this study, all the criteria of benefit type were used MAX. Then the normalization process is carried out. The results of the calculation of the normalized decision matrix are as follows:

A*=

[0,073529 0,073529 0,0625 0,084746 0,064516]
[0,044118 0,058824 0,0625 0,050847 0,048387]
[0,058824 0,058824 0,0625 0,067797 0,064516]
[0,058824 0,058824 0,0625 0,067797 0,064516]
[0,073529 0,073529 0,0625 0,067797 0,064516]
[0,058824 0,058824 0,0625 0,050847 0,064516]
[0,058824 0,058824 0,0625 0,067797 0,064516]
[0,073529 0,058824 0,0625 0,050847 0,064516]
[0,058824 0,058824 0,0625 0,050847 0,080645]
[0,058824 0,044118 0,0625 0,084746 0,048387]
[0,073529 0,073529 0,0625 0,067797 0,064516]
[0,073529 0,073529 0,0625 0,050847 0,080645]
[0,073529 0,073529 0,0625 0,067797 0,080645]
[0,073529 0,073529 0,0625 0,067797 0,080645]
[0,058824 0,058824 0,0625 0,067797 0,064516]
[0,058824 0,058824 0,0625 0,067797 0,080645]

The weights in Table 4, the results of the matrix multiplication that have been normalized to the criteria weights are as follows.

[0,011029 0,022059 0,0125 0,012712 0,012903]

[	0,006618	0,011765	0,0125	0,007627	0,009677	]
[	0,008824	0,017647	0,0125	0,010169	0,012903	]
[	0,008824	0,017647	0,0125	0,010169	0,012903	]
[	0,011029	0,022059	0,0125	0,010169	0,012903	]
[	0,008824	0,017647	0,0125	0,010169	0,012903	]
[	0,006618	0,013235	0,0125	0,007627	0,012903	]
[	0,011029	0,022059	0,0125	0,012712	0,012903	]
[	0,008824	0,017647	0,0125	0,010169	0,016129	]
[	0,008824	0,017647	0,0125	0,010169	0,009677	]
[	0,011029	0,022059	0,0125	0,012712	0,012903	]
[	0,011029	0,022059	0,0125	0,012712	0,016129	]
[	0,011029	0,022059	0,0125	0,012712	0,016129	]
[	0,011029	0,022059	0,0125	0,012712	0,016129	]
[	0,008824	0,017647	0,0125	0,010169	0,012903	]
[	0,008824	0,017647	0,0125	0,010169	0,016129	]

To determine the value of the optimization function, by adding up the value of the criteria for each alternative from the results of matrix multiplication with weights as in equation (6). The results showed:

S0 =	0,06573
S1 =	0,04997
S2 =	0,05723
S3 =	0,05723
S4 =	0,06339
S5 =	0,05488
S6 =	0,05723
S7 =	0,05694
S8 =	0,05774
S9 =	0,05260
S10=	0,06339
S11=	0,06390
S12=	0,06625
S13=	0,06625
S14=	0,05723
S15=	0,06008
	1,044157

Next determine the highest-ranking level of each alternative, by dividing the alternative value against alternative 0(A_0) as in equation (7). The results can be seen as follows:

Table 6 K Value

A	**K**
A0	0,06919145
A1	0,052598477
A2	0,060235802
A3	0,060235802
A4	0,066724423
A5	0,057768774
A6	0,060235802
A7	0,059931648
A8	0,060776199
A9	0,055369658

A10	0,066724423
A11	0,067264819
A12	0,069731847
A13	0,069731847
A14	0,060235802
A15	0,063243226

From the calculation results of the highest-ranking level of the alternatives where the value of each is sorted from the highest value to the lowest value, the following results are obtained:

Table 7 Alternative Final Result

Alternative	Score (K1)	Ranking	Selection
A12	0,069732	1	Recommended
A13	0,069732	2	Recommended
A11	0,067265	3	Recommended
A4	0,066724	4	Recommended
A10	0,066724	5	Recommended
A15	0,063243	6	Not Recommended
A8	0,060776	7	Not Recommended
A2	0,060236	8	Not Recommended
A3	0,060236	9	Not Recommended
A6	0,060236	10	Not Recommended
A14	0,060236	11	Not Recommended
A7	0,059932	12	Not Recommended
A5	0,057769	13	Not Recommended
A9	0,05537	14	Not Recommended
A1	0,052598	15	Not Recommended

Based on the calculation above, out of 15 mobile games that meet the predetermined criteria, only 5 popular mobile games in Indonesia are recommended, namely "Minecraft, Clash of Royale, Clash of Clans, Roblox, and Coin Monster".

Testing

Researchers employed a sensitivity test for each criterion to carry out and to find out how sensitive the criteria are[14]. The more sensitive the value obtained from each change, the more important these criteria have an important role in the selection process. For this case, the sensitivity test was carried out by decreasing and increasing the value of the criteria weights as much as -20%, -10%, 0, 10%, and 20%. The results of the sensitivity test can be seen in Table 8-12.

Table 8 Result of Sensitivity Test for Criteria 1

	C1(-20%)		C1(-10%)		C1(0%)		C1(10%)		C1(20%)	
A1	0,055062	14	0,053692	15	0,052598	15	0,051705	15	0,050962	15
A2	0,061018	8	0,060583	8	0,060236	8	0,059952	9	0,059716	9
A3	0,061018	9	0,060583	9	0,060236	9	0,059952	10	0,059716	10
A4	0,065535	4	0,066196	4	0,066724	4	0,067156	4	0,067515	4
A5	0,057927	12	0,057839	13	0,057769	13	0,057711	13	0,057664	13
A6	0,061018	10	0,060583	10	0,060236	10	0,059952	11	0,059716	11
A7	0,057024	13	0,058641	12	0,059932	12	0,060986	7	0,061863	7
A8	0,061695	7	0,061184	7	0,060776	7	0,060443	8	0,060166	8

	C1(-20%)		C1(-10%)		C1(0%)		C1(10%)		C1(20%)	
A9	0,054921	15	0,055171	14	0,05537	14	0,055532	14	0,055667	14
A10	0,065535	5	0,066196	5	0,066724	5	0,067156	5	0,067515	5
A11	0,066212	3	0,066797	3	0,067265	3	0,067647	3	0,067964	3
A12	0,069303	1	0,069541	1	0,069732	1	0,069887	1	0,070017	1
A13	0,069303	2	0,069541	2	0,069732	2	0,069887	2	0,070017	2
A14	0,061018	11	0,060583	11	0,060236	11	0,059952	12	0,059716	12
A15	0,064786	6	0,063928	6	0,063243	6	0,062684	6	0,062219	6

Table 9 Result of Sensitivity Test for Criteria 2

	C2(-20%)		C2(-10%)		C2(0%)		C2(10%)		C2(20%)	
A1	0,051264	15	0,052005	15	0,052598	15	0,053085	15	0,05349	15
A2	0,060798	8	0,060486	8	0,060236	8	0,060031	8	0,05986	8
A3	0,060798	9	0,060486	9	0,060236	9	0,060031	9	0,05986	9
A4	0,065299	4	0,06609	4	0,066724	4	0,067244	4	0,067677	4
A5	0,057719	14	0,057746	13	0,057769	13	0,057787	13	0,057802	13
A6	0,060798	10	0,060486	10	0,060236	10	0,060031	10	0,05986	10
A7	0,060419	12	0,060148	12	0,059932	12	0,059754	12	0,059606	12
A8	0,061473	7	0,061086	7	0,060776	7	0,060522	7	0,060311	7
A9	0,058324	13	0,056683	14	0,05537	14	0,054294	14	0,053396	14
A10	0,065299	5	0,06609	5	0,066724	5	0,067244	5	0,067677	5
A11	0,065973	3	0,06669	3	0,067265	3	0,067735	3	0,068128	3
A12	0,069053	1	0,06943	1	0,069732	1	0,069979	1	0,070185	1
A13	0,069053	2	0,06943	2	0,069732	2	0,069979	2	0,070185	2
A14	0,060798	11	0,060486	11	0,060236	11	0,060031	11	0,05986	11
A15	0,064553	6	0,063826	6	0,063243	6	0,062766	6	0,062368	6

Table 10 Result of Sensitivity Test for Criteria 3

	C3(-20%)		C3(-10%)		C3(0%)		C3(10%)		C3(20%)	
A1	0,050152	15	0,05151	15	0,052598	15	0,053491	15	0,054236	15
A2	0,059676	8	0,059987	8	0,060236	8	0,06044	8	0,06061	8
A3	0,059676	9	0,059987	9	0,060236	9	0,06044	9	0,06061	9
A4	0,067768	4	0,067189	4	0,066724	4	0,066344	4	0,066026	4
A5	0,0566	13	0,057249	13	0,057769	13	0,058195	13	0,058551	13
A6	0,059676	10	0,059987	10	0,060236	10	0,06044	10	0,06061	10
A7	0,059297	12	0,059649	12	0,059932	12	0,060163	12	0,060356	12
A8	0,06035	7	0,060587	7	0,060776	7	0,060932	7	0,061061	7
A9	0,053608	14	0,054586	14	0,05537	14	0,056012	14	0,056549	14
A10	0,067768	5	0,067189	5	0,066724	5	0,066344	5	0,066026	5
A11	0,068442	3	0,067789	3	0,067265	3	0,066835	3	0,066477	3
A12	0,071519	1	0,070527	1	0,069732	1	0,06908	1	0,068536	1
A13	0,071519	2	0,070527	2	0,069732	2	0,06908	2	0,068536	2
A14	0,059676	11	0,059987	11	0,060236	11	0,06044	11	0,06061	11
A15	0,063427	6	0,063325	6	0,063243	6	0,063176	6	0,06312	6

Table 11 Result of Sensitivity Test for Criteria 4

	C4(-20%)		C4(-10%)		C4(0%)		C4(10%)		C4(20%)	
A1	0,053456	14	0,05298	14	0,052598	14	0,052287	14	0,052027	14
A2	0,058896	10	0,059641	10	0,060236	10	0,060723	10	0,061128	10

	C4(-20%)		C4(-10%)		C4(0%)		C4(10%)		C4(20%)	
A3	0,058896	11	0,059641	11	0,060236	11	0,060723	11	0,061128	11
A4	0,067013	4	0,066853	4	0,066724	4	0,06662	4	0,066532	4
A5	0,059925	9	0,058727	9	0,057769	9	0,056986	9	0,056333	9
A6	0,058896	12	0,059641	12	0,060236	12	0,060723	12	0,061128	12
A7	0,06263	8	0,061131	8	0,059932	8	0,058951	8	0,058135	8
A8	0,063687	7	0,062069	7	0,060776	7	0,059719	7	0,058838	7
A9	0,048693	15	0,052404	15	0,05537	15	0,057795	15	0,059815	15
A10	0,067013	5	0,066853	5	0,066724	5	0,06662	5	0,066532	5
A11	0,071804	3	0,069281	3	0,067265	3	0,065616	3	0,064243	3
A12	0,070776	1	0,070196	1	0,069732	1	0,069353	1	0,069037	1
A13	0,070776	2	0,070196	2	0,069732	2	0,069353	2	0,069037	2
A14	0,058896	13	0,059641	13	0,060236	13	0,060723	13	0,061128	13
A15	0,062658	6	0,062983	6	0,063243	6	0,063456	6	0,063633	6

Table 12 Result of Sensitivity Test for Criteria 5

	C5(-20%)		C5(-10%)		C5(0%)		C5(10%)		C5(20%)	
A1	0,054572	15	0,053475	15	0,052598	15	0,051883	15	0,051287	15
A2	0,060371	6	0,060296	6	0,060236	6	0,060187	6	0,060146	6
A3	0,060371	7	0,060296	7	0,060236	7	0,060187	7	0,060146	7
A4	0,068497	3	0,067511	3	0,066724	3	0,066082	3	0,065547	3
A5	0,057281	13	0,057552	13	0,057769	13	0,057946	13	0,058093	13
A6	0,060371	8	0,060296	8	0,060236	8	0,060187	8	0,060146	8
A7	0,05999	11	0,059957	11	0,059932	11	0,059911	11	0,059893	11
A8	0,057281	14	0,059224	14	0,060776	14	0,062044	14	0,063099	14
A9	0,058043	12	0,056557	12	0,05537	12	0,0544	12	0,053593	12
A10	0,068497	4	0,067511	4	0,066724	4	0,066082	4	0,065547	4
A11	0,065407	5	0,06644	5	0,067265	5	0,067939	5	0,068499	5
A12	0,068497	1	0,069183	1	0,069732	1	0,07018	1	0,070553	1
A13	0,068497	2	0,069183	2	0,069732	2	0,07018	2	0,070553	2
A14	0,060371	9	0,060296	9	0,060236	9	0,060187	9	0,060146	9
A15	0,060371	10	0,061968	10	0,063243	10	0,064285	10	0,065152	10

Based on the results of the sensitivity test showed that all C1 criteria have sensitivity in the case being tested, there are differences in the order of the alternatives produced.

6) Conclusion

The highest value is around 15 mobile game names, only 5 meet the predetermined criteria with the selection results obtained being "Recommended". The criterion that "does not contain violence" is the most sensitive criterion among other criteria used in this study.

References

[1] E. N. Aisyah, A. R. Harun, and H. Hardika, “The Analysis of Child Bullying Behaviour of Game Mobile Learning Users, in The Early Childhood Education Management Perspective,” *Int. J. Interact. Mob. Technol.*, vol. 15, no. 9, 2021, doi: 10.3991/ijim.v15i09.21583.

[2] J. L. Wang, J. R. Sheng, and H. Z. Wang, “The association between mobile game addiction and depression, social anxiety, and loneliness,” *Front. Public Heal.*, vol. 7, no. SEP, 2019, doi: 10.3389/fpubh.2019.00247.

[3] B. Satria, “Implementation Of Additive Ratio Assessment (ARAS) Method On Decision Support System For Recipient Of Inhabitable House,” *JITK (Jurnal Ilmu Pengetah. Dan Teknol. Komputer)*, vol. 6, no. 1, 2020.

[4] E. K. Zavadskas and Z. Turskis, "A new additive ratio assessment (ARAS) method in multicriteria decision-making," *Technol. Econ. Dev. Econ.*, vol. 16, no. 2, 2010, doi: 10.3846/tede.2010.10.

[5] D. Karabasevic, J. Paunkovic, and D. Stanujkic, "Ranking of companies according to the indicators of corporate social responsibility based on SWARA and ARAS methods," *Serbian J. Manag.*, vol. 11, no. 1, 2016, doi: 10.5937/sjm11-7877

[6] M. Groeschel and T. SchÃ¤fer, "Analysis of Mobile App Revenue Models Used in the most Popular Games of the Tower Defense Genre on Google Play," *Asian J. Comput. Inf. Syst.*, vol. 8, no. 1, 2020, doi: 10.24203/ajcis.v8i1.6038.

[7] J. Balakrishnan and M. D. Griffiths, "Loyalty towards online games, gaming addiction, and purchase intention towards online mobile in-game features," *Comput. Human Behav.*, vol. 87, 2018, doi: 10.1016/j.chb.2018.06.002.

[8] C. V. Wijaya and S. Paramita, "Komunikasi Virtual dalam Game Online (Studi Kasus dalam Game Mobile Legends)," *Koneksi*, vol. 3, no. 1, 2019, doi: 10.24912/kn.v3i1.6222.

[9] E. Valentina and W. P. Sari, "Studi Komunikasi Verbal dan Non Verbal Game Mobile Legends: Bang Bang," *Koneksi*, vol. 2, no. 2, 2019, doi: 10.24912/kn.v2i2.3899.

[10] M. Huda, "Analisis User Experience Pada Game Mobile Legend Versi," *J. Ekon. Dan Tek. Inform.*, vol. 8, no. 1, 2020.

[11] İ. Göksu, A. Aslan, and Y. E. Turgut, "Evaluation of mobile games in the context of content: What do children face when playing mobile games?," *E-Learning Digit. Media*, vol. 17, no. 5, 2020, doi: 10.1177/2042753020936785.

[12] S. Jovčić, V. Simić, P. Průša, and M. Dobrodolac, "Picture fuzzy ARAS method for freight distribution concept selection," *Symmetry (Basel).*, vol. 12, no. 7, 2020, doi: 10.3390/SYM12071062.

[13] N. Liu and Z. Xu, "An overview of ARAS method: Theory development, application extension, and future challenge," *Int. J. Intell. Syst.*, vol. 36, no. 7, 2021, doi: 10.1002/int.22425.

[14] R. Trevethan, "Sensitivity, Specificity, and Predictive Values: Foundations, Pliabilities, and Pitfalls in Research and Practice," *Front. Public Heal.*, vol. 5, 2017, doi: 10.3389/fpubh.2017.00307.