Bit-Tech

Vol.4, No.3, April 2022
Available online at: http://jurnal.kdi.or.id/index.php/bt

The Design of the Solar System Educational Game Using Forward Chaining Based on a Mobile Application

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Article history:

Received 28 March 2022;
Revised 12 April 2022;
Accepted 22 April 2022;
Available online 25 April 2022;

Keywords: {use 5 keywords}

Solar System
Mobile Game
Forward Chining
Educational Game
Software Engineering

Abstract

Technological developments especially in software are not in line with developments in the field of education. This is because most of the modules used by teachers are still in the form of printed books. Some subjects require the help of pictures to provide understanding to children. One of them is natural science subjects, especially the solar system. Therefore, this study aims to design a solar system educational game application using multimedia-based forward chaining. The making of this educational game application uses the Unity game engine with the forward chaining method. The solar system educational game application is a game application that combines games with the explanation of the solar system material in it and is implemented on an android smartphone.

I. INTRODUCTION

The condition of the location of the Bosscha Observatory in Lembang now does not meet the environmental criteria of an observatory for observing research-scale astronomy. This arises because light pollution is getting higher, making it increasingly difficult for people living in urban areas to find views of the sky full of stars. This condition is very different when compared to the previous few decades. In the past, gazing at the starry night sky could be a very exciting activity for children. Through these activities, parents can teach their children many things, from astronomy to dreams, which are their life goals for some children.

The combination of game aspects, educational content, and learning principles eventually forms an educational game. Educational games are a form of game created with the aim of learning but still being able to experience playing and having fun. Then the use of the Forward Chaining method in making educational games will provide better challenges for players as well as encouragement for players to continue to improve their abilities and knowledge so that they can continue to advance to the next level of the game.

In the data approach, the player's ability will be validated through the level of play that has been achieved. The approach starts from input information and then tries to conclude, then looks for information that is by the IF part of the IF-THEN rules [1].

II. RELATED WORKS/LITERATURE REVIEW (OPTIONAL)

A. Educational games

Educational games are one type of media used to provide teaching and increase the knowledge of users through unique and interesting media [2].

B. Solar system

The solar system is a collection of celestial bodies that revolve around the sun as its center. Our solar system as a whole consists of eight planets [3].

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ISSN 2622-2728 (online) 2622-271X (print)
doi: 10.32877/bt.v4i3.426

C. Expert system

An expert system, also known as a knowledge-based system, is a computer application intended to assist decision-making or problem-solving in a specific field. This system works by using knowledge and analytical methods that have been defined in advance by experts in their field of expertise. This system is called an expert system because its functions and roles are the same as an expert who must have knowledge and experience in solving a problem. The system usually serves as an important key that will help a decision support system or executive support system [4].

D. Forward Chaining

Forward Chaining is a method used to find every possible conclusion based on several reasons or rationale given [5]. Forward Chaining in this approach tracking starts from input information and then tries to conclude, tracking forward looking for facts that are by the IF part of the IF-THEN rules [1].

DATA	⇨	RULE	⇨	CONCLUSIONS
A = 1 **B** = 2		IF **A** = 1 AND **B** = 2 THEN **C** = 3		**C** = 3

III. METHODS

Construction Method Making methods for the rules of the solar system educational game using the forward chaining method as follows,

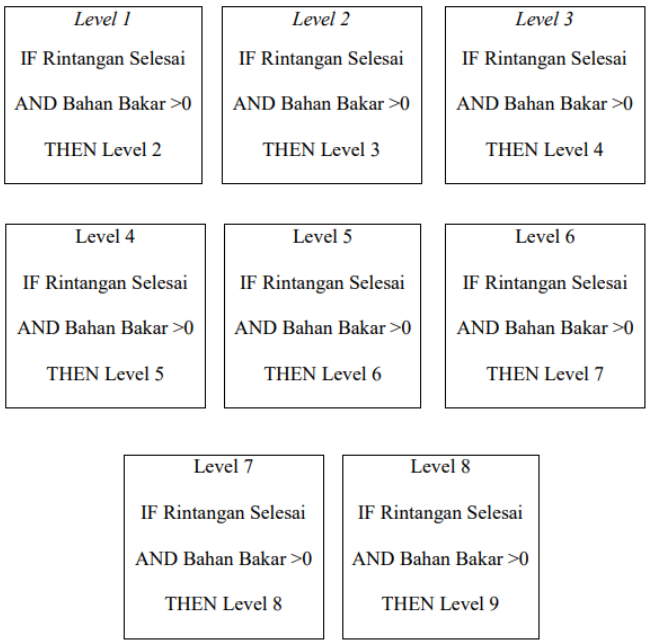

Fig. 1 Construction Method

Then, from the results of the construction method above, details are made for the conditions of the obstacles that must be met and the condition of the fuel supply that must be achieved by the user by providing the identification code as follows,

TABLE 1.
Game Condition Construction Results

No	Condition	Code
1	Level 1 Obstacle Successful	N01
2	Level 2 Obstacle Successful	N02
3	Level 3 Obstacle Successful	N03
4	Level 4 Obstacle Successful	N04
5	Level 5 Obstacle Successful	N05
6	Level 6 Obstacle Successful	N06
7	Level 7 Obstacle Successful	N07
8	Level 8 Obstacle Successful	N08
9	Level 9Obstacle Successful	N09
10	Level 1 Obstacle Fail	N10
11	Level 2 Obstacle Fail	N11
12	Level 3 Obstacle Fail	N12
13	Level 4 Obstacle Fail	N13
14	Level 5 Obstacle Fail	N14
15	Level 6 Obstacle Fail	N15
16	Level 7 Obstacle Fail	N16
17	Level 8 Obstacle Fail	N17
18	Level 9 Obstacle Fail	N18

TABLE 2.
Fuel Construction Results

No	Condition	Code
1	**AND** Fuel > **0**	A01
2	**AND** Fuel < **0**	A02

Flowchart Design
The program flowchart design of the solar system educational application is,

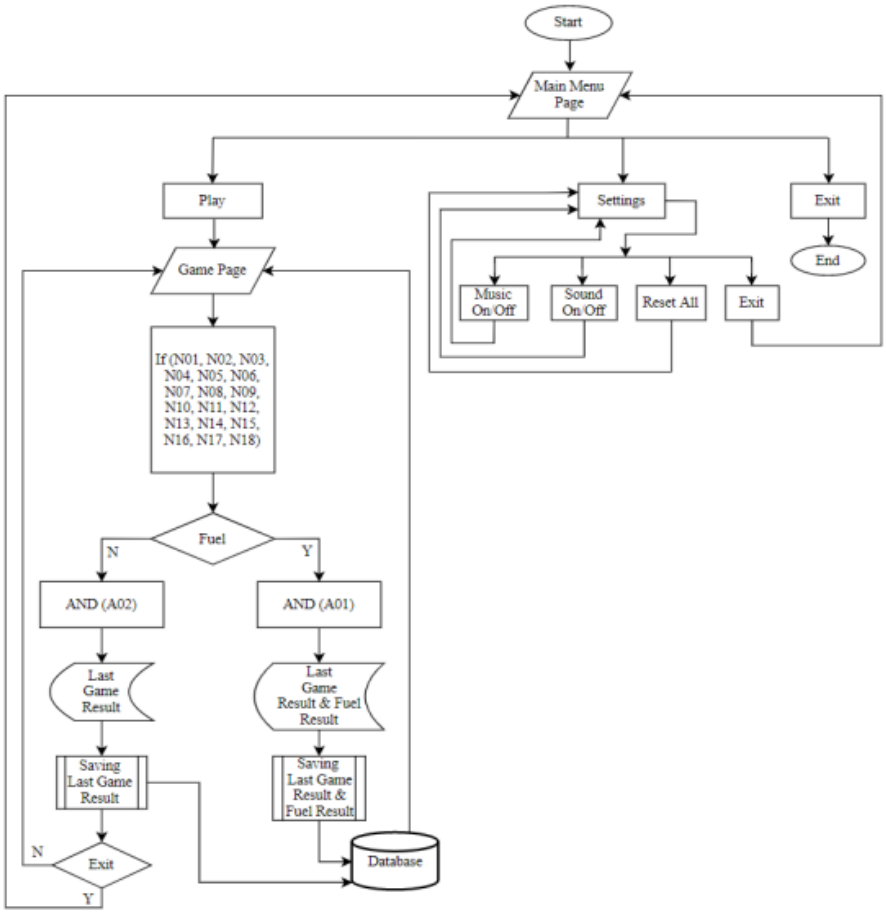

Fig. 2 flowchart design of the solar system educational

IV. RESULTS

Game The application of the forward chaining method in the game is in determining whether the user has met a condition that must be achieved to continue the game to the next level. If the user has met the predetermined conditions, then the user can continue the game to the next level. However, if the user has not succeeded in fulfilling the predetermined conditions, then the user must repeat the game until he can meet the predetermined conditions and proceed to the next level. The following is a representation of game conditions, representation of game reviews, and representation of game levels,

TABLE 3.
Representation of Game Condition

No	Condition	Code
1	[N01, N02, N03, N04, N05, N06, N07, N08, N09, N10, N11, N12, N13, N14, N15, N16, N17, N18]	Q1
2	[A01, A02]	Q2

TABLE 4.
Representation of Game Review

No	Condition	Code
1	Get information about planets	P1
2	Fail	P2

TABLE 5.
Representation of Game Level

No	Code	Description
1	T01	Proceed to the next level
2	T02	Repeat back to level

Attached is also an inference tree for game conditions and reviews as well as an inference tree for game results,

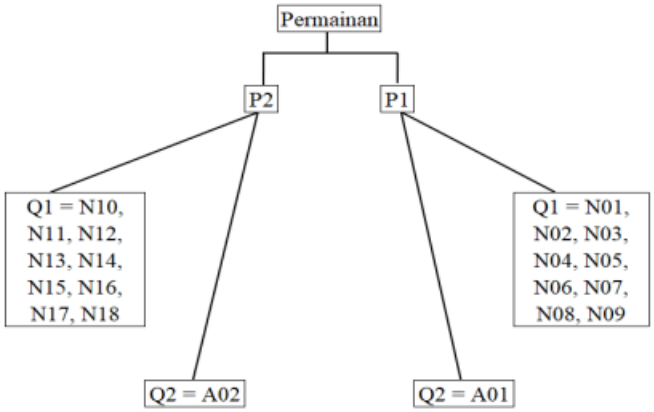

Fig. 3 Inference Tree of Game Condition and Game Review

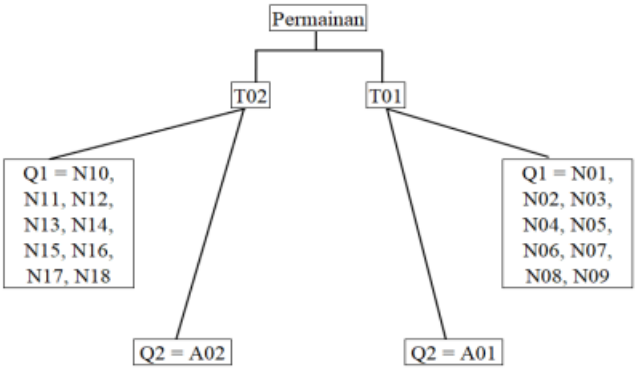

Fig. 4 Inference Tree of Game Result

From the results of the questionnaire, the calculation of the presentation of learning application needs by parents of children is as follows,

TABLE 6.
Questionnaire Result

Question	Grade (%)			
	Strongly agree	**Agree**	**Just agree**	**Don't agree**
1	60	30	10	0
2	40	20	40	0

3	30	40	10	20
4	40	50	10	0
5	60	40	0	0
6	60	30	0	10
7	60	30	10	0
8	50	40	10	0
9	60	20	20	0
10	40	50	20	0
11	20	40	30	10
12	30	50	20	0
Total	550	440	170	40
%	45.8%	36.7%	14.2%	3.3%

Based on the presentation table of the overall results of the questionnaire, it was found that the total responses strongly agree and agree from the parents of the children got a total score of **82.5%.** Meanwhile, responses that quite agree and disagree from the child's parents get a total score of **17.5%.**

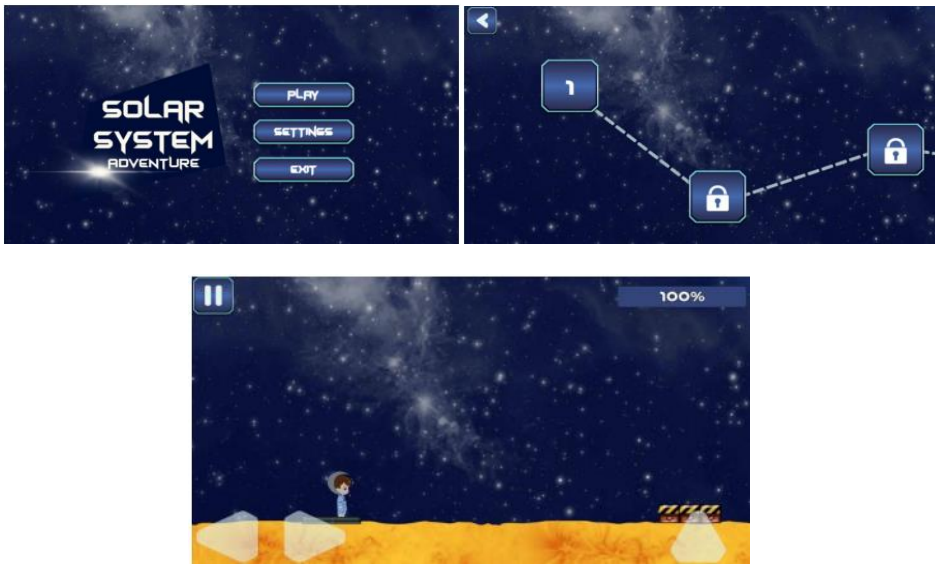

Fig. 5 The Game Review

V. DISCUSSION

Game The use of forwarding chaining in the game algorithm which functions to determine whether the player has the right to advance to the next game level or not has been tested with the following results:

Rules:

IF Q1 = 'N01, N02, N03, N04, N05, N06, N07, N08, N09' AND

Q2 ='A01'

THEN P1 AND T1

IF Q1 = 'N10, N11, N12, N13, N14, N15, N16, N17, N18' AND

Q2 =' A02'

THEN P2 AND T2

Testing:

1. Q1 = N01' AND Q2 ='A01' THEN P1 AND T1
2. Q1 = 'N02' AND Q2 ='A01' THEN P1 AND T1
3. Q1 = 'N03' AND Q2 ='A01' THEN P1 AND T1
4. Q1 = 'N04' AND Q2 ='A01' THEN P1 AND T1
5. Q1 = 'N05' AND Q2 ='A01' THEN P1 AND T1
6. Q1 = 'N06' AND Q2 ='A01' THEN P1 AND T1
7. Q1 = 'N07' AND Q2 ='A01' THEN P1 AND T1
8. Q1 = 'N08' AND Q2 ='A01' THEN P1 AND T1
9. Q1 = 'N09' AND Q2 ='A01' THEN P1 AND T1
10. Q1 = 'N10' AND Q2 ='A02' THEN P2 AND T2
11. Q1 = 'N11' AND Q2 ='A02' THEN P2 AND T2
12. Q1 = 'N12' AND Q2 ='A02' THEN P2 AND T2
13. Q1 = 'N13' AND Q2 ='A02' THEN P2 AND T2
14. Q1 = 'N14' AND Q2 ='A02' THEN P2 AND T2
15. Q1 = 'N15' AND Q2 ='A02' THEN P2 AND T2
16. Q1 = 'N16' AND Q2 ='A02' THEN P2 AND T2
17. Q1 = 'N17' AND Q2 ='A02' THEN P2 AND T2
18. Q1 = 'N18' AND Q2 ='A02' THEN P2 AND T2

VI. CONCLUSIONS

Departing from the background of the problems that have occurred in elementary school-aged children in studying the solar system material in the form of a book module and through problem identification and problem formulation, trials and evaluations have been carried out on the application of educational games for the solar system using multimedia-based forward chaining. with the following conclusions :

1. Can make learning media in the form of solar system educational games for children.
2. This solar system educational game application can be used by children.
3. The solar system educational game application can help parents to more easily introduce the solar system to their children based on the results of a questionnaire with a score of 82.5%.
4. Can use the forward chaining method in making educational games for the solar system.

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