New Normal After Education Game Design Pandemic Uses Approaches Agile Scrum Application of Finite State Machine (FSM) Method

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Abstract

Game is an application that infers human behavior into software, and players who play the game feel they are entering the game world. Games can be used as a medium for information and education. The current rise of Covid-19 requires every individual to implement health protocols in their daily life. This term is called new normal. New normal is a change in behavior to continue carrying out normal activities but with the addition of implementing health protocols to prevent Covid-19 transmission. Unfortunately, in everyday life, the application of the new normal is less effective so that in one area, new cases have emerged and the PSBB must be re-applied. The new normal themed educational game can be a fun information medium for the community, with the New Normal After Pandemic educational game, it is hoped that it can educate the public in implementing health protocol rules. This game was created using Construct 2 software because it is based on HTML 5 which is specifically for 2D platforms. 2D designs are created using Corel Draw X7, Easy Paint Tools SAI and Adobe Photoshop. The final result of this study is a game application that applies the FSM (Finite State Machine) control system design method in each level rule and uses the Agile Scrum system development method with a process of 2x sprint iterations.

Keywords: game, education game, new normal, finite state machine, agile scrum

1. Introduction

The development of technology and games is indeed very fast, with online games and offline games. In general, a game is an application that infers human behavior into software, and the user who plays the game feels that he is entering the game world [1]. In ancient times, games were only played traditionally such as card games, chess, snakes and ladders, hide and seek, and others. As technology develops, the game is developed into more modern technology. The development of the use of artificial intelligence is very rapid in this information age, many technologies that utilize artificial intelligence systems or AI (Artificial Intelligence) in technology, especially in game making. Games do not only rely on display design, environment, and culture, but also implement artificial intelligence, so that the game being played will be much more attractive to players because there is an element of conflict that will occur in a game being played [2].

Covid-19 cases in Indonesia continue to increase every day, after 2 March 2020 confirmed positive indications of 2 people, this shows that there is a lack of public awareness in complying with the rules of the Covid-19 health protocol. Therefore, it is necessary to apply high discipline in the implementation of the Covid-19 health protocol such as a clean and healthy life (washing hands with soap or hand sanitizer and using masks), independent case reporting, and social control. According to Wiku Adisasmita, Chair of the Expert Team for the Task Force for the Acceleration of Covid-19 Handling, new normal is a change in behavior to continue to carry out normal activities but with the addition of implementing health protocols to prevent Covid-19 transmission. The main

principle of the new normal is to be able to adjust to the pattern of life, socially aware that this will have an effect. The reason is, there are rules mentioned in the health protocol to maintain social distancing by reducing physical contact with other people. People will live a new normal life until a vaccine is found and can be used as an antidote to the Covid-19 virus. Several experts and world health experts have confirmed that the earliest possibility of finding a vaccine is in 2021. This means that people have to live a new normal life until next year, or even more. Therefore, changing behavior will be the key to optimism in dealing with Covid-19 by implementing health protocols according to government recommendations or what is known as the new normal [3]. The community must carry out an adaptation process with a new normal life, especially changes in policies and regulations according to the development of Covid-19, optimization of digital technology, and consistent implementation of the Covid-19 protocol. The development of Covid-19 cases in Indonesia shows that there has been a decrease in confirmed cases, and an increase in recovered patients in several provinces. This shows that the implementation of the new normal in some areas is possible.

However, the government's plan to implement the new normal was opposed by the public, one of which was the appearance of the hashtag #IndonesiaAbnormal on Twitter and it became a trending topic. Netizens think that the government made the mistake of taking this policy because Indonesia's situation is actually not fine, considering the number of new Covid-19 sufferers continues to increase. In its application, the new normal is still ineffective, so that in one area, new cases emerge and the PSBB must be re-applied. Therefore, it is necessary to have information media about life after the implementation of the new normal in the form of educational games to make it more interesting, more fun and many other positive things, in order to increase public awareness.

Designing an educational game New Normal After Pandemic, it is hoped that it can educate the public about life after the new normal is implemented. This game has a complex story element accompanied by simple game rules that make it easy for users to understand this game because it is implemented using artificial intelligence with the Finite State Machine (FSM) control system design methodology which makes it easier to regulate the behavior of objects when there is a change in state or condition in the game.

2. Research Methodology

2.1. Educational Games

Educational games are games that are packaged to stimulate thinking, including increasing concentration and solving problems. Games also have a very good appeal because they are able to provide a new experience so that the information stored in them can be conveyed and remembered by all users, most people have a high curiosity about everything around them even things they have just seen [4].

2.2. Finite State Machine

Finite State Machine or commonly abbreviated as FSM is a control system design methodology that describes the behavior and nature of a system by using several things, namely State, Event, and Action. Each state can move to another state if it meets predetermined conditions. The application of the Finite State Machine provides various game mechanism responses to the actions taken so as to give the impression of cause and effect [5].

Figure 1. Finite State Machine Method [6]

2.3. Agile Scrum

Scrum is a software engineering method that uses the principles of an Agile approach, which rests on the strengths of team collaboration, incremental product and iteration processes to achieve the final result [6]. Scrum is a method that uses iterations, additional frameworks for the project to be created and product or application development. The work cycle used during product development is called a Sprint [7].

Figure 2. The Scrum Method

1. Product Backlog

The product backlog is the initial planning for the production phase. The product backlog is a representation of the pre-production phase to facilitate execution of development plans during the production phase. The product backlog acts like a "user requirement" for game development, and helps in game development project management because for each task or task, the developer must determine the estimated time required for the game [8].

2. Sprint

Sprint is a time limit for completing a product slice. The stages during one sprint consist of Sprint Planning, Daily Scrum, Development, Sprint Review, Sprint [9].

a. Sprint Planning

Sprint planning is an activity in which the Scrum team plans what will be done in the next sprint. At the sprint planning stage, each developer must understand what achievements must be completed during the sprint.

b. Daily Scrum

Daily scrum is an activity with a time limit of 10 minutes per day so that the team can synchronize their work and plan what to do the next day.

c. Development

At this stage the team starts to do work to produce a product according to the results of the sprint planning.

d. Sprint Review

Sprint review is an activity that is carried out at the end of each sprint to review the pieces of product that have been worked on and which have not been completed.

e. Sprint Retrospective

The sprint retrospective is an opportunity for the Scrum team to review itself and make plans for improvements to be made over the next sprint.

3. Focus Factor

The focus factor is the calculation of velocity divided by work capacity. Velocity is the approximate amount of work completed on a sprint. Velocity is also called the estimated number of times a sprint is accomplished. The focus factor calculation is done after the sprint is over, using this formula a team can find out the estimated work time to be able to complete the sprint that is about to start. As for the team that is already running, the focus factor can be used as a reference for further software development. So that the team can find out the estimated time software development will be completed.

If the development team is completely new to the sprint and cannot see the previous performance, it can be seen that the focus factor of other development teams with the same condition can be seen. If you still don't find another development team, then the focus factor can be filled with a default value of 70% or 0.7 or by guessing because the guess only applies to the first sprint so that it will have statistics on the next sprint and can continuously measure the focus factor [10].

4. Burndown Chart

The burndown chart is a simple graph that is used to monitor and analyze team performance and find out the progress of the development process that is being carried out. Burndown charts are the best way to illustrate the relationship between the amount of work remaining at any point in time and the progress of the development team [5]. Burndown chart consists of ideal task remaining lines and actual task day remaining, which represent changes in the estimated amount of work day. Ideal task remaining is a reminder line of estimated estimates that should be completed at the point of the workday. Actual task day remaining is the remaining estimated reminder line. A work day is the day the development team works in one sprint.

If the actual line continues to be above the ideal line, then there is more work left than expected and the project will experience delays. If the actual line continues to be below the ideal line, then there is less work left and the project will be expected to finish ahead of schedule [5].

3. Result and Discussion

3.1. Sprint Planning

1. Product Backlog

The Product Backlog is a list of all the needs that need to be in the product and is the main source of the list of requirements for all changes that need to be made to the product [7]. Following is the conditioning of the backlog item according to the functional item from the author's side.

Table 1. New Normal After Pandemic Sprint Backlog Items 1

No	Item Backlog	Code Backlog
1.	Users can access applications to learn and play	A
2.	Users can find out how to use the game	B
3.	Users can learn a new normal life	C
4.	Users can find out what new normal means	D
5.	Users can find out the terms of the new normal	E
6.	User can learn health protocol rules	F
7.	Users can implement health protocol rules in their daily life	G
8.	Users can answer questions about the new normal life	H
9.	User can terminate the application	I

Table 2. Item Backlog New Normal After Pandemic Sprint 2

No	Item Backlog	Code Backlog
1.	Users can access applications to learn and play	A
2.	Users can find out how to use the game	B
3.	User can know game information maker	C

No	Item Backlog	Code Backlog
4.	Users can learn a new normal life	D
5.	Users can find out what new normal means	E
6.	Users can find out the terms of the new normal	F
7.	User can learn health protocol rules	G
8.	User can see which level to complete	H
9.	Users can implement health protocol rules in everyday life by completing the dress up level	I
10.	Users can implement health protocol rules in everyday life by completing the level of washing hands properly	J
11.	Users can implement health protocol rules in everyday life by completing the physical distancing level in public vehicles	K
12.	User can terminate the application	L

2. Game Menu Structure

The design of this new normal after pandemic educational game has several scene displays that are adjusted to the existing menus. The game menu structure itself is a clearer picture in the preparation of the game. The game menu structure can be seen in the following figure:

Figure 3. Sprint Game Menu Structure 1

In the sprint 1 game menu structure, the game starts with the main menu in which there is a New Normal Life menu which contains a submenu for the definition of new normal, new normal requirements and health protocol rules, then the How to Play menu which is the procedure for using the game, the Play menu for start playing the game by selecting a character to dress up then answering questions and the Exit menu to exit the application.

Figure 4. Sprint Game Menu Structure 2

In the sprint 2 game menu structure, the game starts with the main menu which includes menu features:

a) New Normal Life menu

The New Normal Life menu contains the meaning of new normal, new normal requirements and health protocol rules that the user must understand.

b) Menu Info

The Info menu contains information on the new normal after pandemic educational game maker.

c) Menu Description

The Description menu contains a brief description of the new normal after pandemic educational game.

d) Start Menu

In the Start menu there is a level selection to start playing the game. If the user succeeds in completing one level it will continue to the next level, if not successful then the user must repeat the game at that level. At level 1, the user is required to help the character choose clothes and wear objects according to the health protocol (dress up) rules and answer the questions that are already available. After completing level 1, the user must complete level 2, which is how to wash hands properly. Furthermore, at level 3 the user must perform physical distancing in public transportation.

e) Menu How to Play

The How to Play menu is a more detailed explanation for playing the new normal after pandemic educational game.

f) Menu Guide

The Guide menu is a brief procedure for using the new normal after pandemic educational game.

g) Exit menu

The Exit menu is used to exit the new normal after pandemic educational game.

3. Use Case Diagram

Figure 5. Use Case Diagram Sprint 1

Figure 6. Use Case Diagram Sprint 2

Game Scenarios Rule Game uses the Finite State Machine (FSM) Method with 3 different levels. Level 1 At level 1, the user is required to complete 4 missions given by the mother character, including:

- Mission 1: help Anna wear the costume accompanied by the rules of health protocol to go to school. If it is on time, the user must answer question 1 correctly. If the time runs out and the user answers incorrectly then repeat.

- b) Mission 2: helping Dad to wear costumes accompanied by the rules of health protocol to go to the office. If it is on time, the user must answer question 2 correctly. If the time runs out and the user answers incorrectly then repeat.
- c) Mission 3: helping Grandpa wear costumes accompanied by health protocol rules to go to the mosque. If it is on time, the user must answer question 3 correctly. If the time runs out and the user answers incorrectly then repeat.
- d) Mission 4: helping Mother to wear costumes accompanied by the rules of health protocol to go to the mall. If it is on time, the user must answer question 4 correctly. If the time runs out and the user answers incorrectly then repeat.

Table 3. Rule Game Level 1 New Normal After Pandemic

No	Code	State Name/Event/Action
1.	M1	Mission 1
2.	M2	Mission 2
3.	M3	Mission 3
4.	M4	Mission 4
5.	J	<u>response</u>
6.	LV1	Level 1
7.	LV2	Level 2

Table 4. Analysis of Rule Game Level 1 New normal after pandemic

No	Name	Code Rule	Rule	Action
1.	Mission 1	JP1	If J true Then M2 Else repeat	If the answer is correct, go to mission 2, if it is wrong then repeat
		WH1	If M1 time has run out and J false Then repeat	If in mission 1 time runs out, and the answer is wrong then repeat
2.	Mission 2	JP2	If J true Then M3 Else repeat	If the answer is correct, continue to mission 3, if wrong then repeat
		WH2	If M2 time has run out and J false Then repeat	If in mission 2 time runs out, and the answer is wrong then repeat
3.	Mission 3	JP3	If J true Then M4 Else repeat	If the answer is correct, continue to mission 4, if it is wrong then repeat
		WH3	If M3 time has run out and J false Then repeat	If in mission 3 time runs out, and the answer is wrong then repeat
4.	Mission 4	JP4	If J true Then LV3 Else repeat	If the answer is correct, proceed to level 3, if it is wrong then repeat
		WH4	If M4 time has run out and J false Then repeat	If in mission 4 the time runs out, and the answer is wrong then repeat

After determining the game rule and analyzing the game rule at level 1, then create a finite state machine diagram which can be seen in Figure 7.

Figure 7. Finite State Machine Level 1

At the second level, the user must direct the character to wash their hands properly. The user has to turn on the tap by touching the “On” tap switch to let the water flow. Then the user must stop hand movements by touching the "Stop" button. Hand movements should stop just above the running water. After that, users must take soap to clean their hands so they are clean from germs. If time is up then repeat.

Table 5. Rule Game Level 2 New Normal After Pandemic

No	Code	State Name/Event/Action
1.	L1	Step 1
2.	L2	Step 2
3.	L3	Step 3
4.	L4	Step 4
5.	L5	Step 5
6.	M1	touch
7.	M2	flow
8.	M3	rinse
9.	M4	pick up
10.	M5	laundry
11.	LV2	Level 2
12.	LV3	Level 3

Table 6. Analysis of Rule Game Level 2 New Normal After Pandemic

No	Name	Code Rule	Rule	Action
1.	Hand Touching the Faucet Switch	TMK1	If M1 tap switch Then water M2	Touching the faucet switch, water flows
		TMK2	If M1 tap switch and air M2 Then the tap is truns off	Touching the tap switch and running water, the water tap turns off
2.	Touching Hand Gesture Stop Button	TMS1	If M1 stop button and hands on the water M2 Then hand stopped Else unsuccessful	Touching the Stop button and the hand on the running water, the hand movement stops
3.	Hand Wash	MCT1	If hand stopped and water M2 and M4 soap Then M5 hand Else Gagal	Tangan berhenti dan air mengalir dan mengambil sabun, maka mencuci tangan
		MCT2	If MCT1 Then kuman hilang Else unsuccessful	If you wash your hands, you will lose germs

No	Name	Code Rule	Rule	Action
4.	Remove germs	MK1	If MCT2 Then LV3 Else unsuccessful	If the germs are gone, proceed to level 3
		WH	If time has run out Then repeat	If time's up, repeat

After determining the game rule and analyzing the game rule at level 2, then create a finite state machine diagram which can be seen in Figure 8.

Figure 8. Finite State Machine Level 2

The third level, the user must place the character according to the vehicle being boarded by keeping a distance from other passengers.

Table 7. Rule Game Level 3 New Normal After Pandemic

No	Code	State Name/Event/Action
1.	K1	Character
2.	D1	Sit
3.	S1	No Cross
4.	S2	Cross
5.	LV3	Level 3
6.	F	Finish

Table 8. Analysis of Level 3 Game Rules New to Normal After the Pandemic

No	Name	Code Rule	Rule	Action
1.	Character Sitting	KD1	If Character D1 and seat S1 Then F	The character sits, the chairs do not cross, then the game is over (finish)
		WH	If time has	If time's up, repeat

No	Name	Code Rule	Rule	Action
			run out Then repeat	
		KD2	If Character D1 and seat S2 Then unsuccessful 1	The character sits, seat cross, then fails

After determining the game rule and analyzing the game rule at level 2, then create a finite state machine diagram which can be seen in Figure 9.

Figure 9. Finite State Machine Level 3

3.2. Sprint

a) Sprint 1

Sprint 1 will start on May 29, 2020. Sprint 1 consists of 4 developers who will work on the product. The work estimate at the beginning of the sprint uses a focus factor default value of 0.7, because there is no previous reference. By knowing the estimated value and the value of the first focus factor, the ideal work capacity value is 30.00. To find out the estimated working time, the ideal work capacity value is divided by a team of 4 developers to get a value of 7.50. The estimated time for sprint 1 was rounded from 7.50 to 8 days. At this stage, determine the menu features in the game according to the backlog in the planning stage, as shown in table 9:

Table 9. Fitur Menu Game Sprint 1

Code Backlog	Fitur Menu Game	Estimasi
A	Main course	2
B	Menu How to Play	1
C	New Normal Life menu	1
D	Submenu Understanding New Normal	2
E	Submenu New Normal Requirements	2
F	Submenu Health Protocol Rules	2
G	Dress Up the Character	5
H	Multiple Choice Questions	5
I	Menu Exit Application	1

The development process in sprint 1 is faster than the initial estimate of 8 working days to 7 working days. The actual number of team work days is 63 working days. Sprint 1 is the start of the team carrying out the sprint, so that the sprint execution time is added until the estimate runs out to find out the team's focus factor value which will be used to calculate the estimated time of the next sprint. The value of the focus factor with an estimated velocity of 21 and a work capacity of 63 days, then the value of the focus factor on sprint 1 is 0.33 or 33%.

b) Sprint 2

Sprint 2 starts on August 18, 2020. Sprint 2 consists of 4 developers who will develop products. The work estimate for sprint 2 uses the focus factor value obtained in sprint 1, namely 0.33. By knowing the estimated value and focus factor value, the ideal work capacity value uses the second formula, the result is 90.91. To find out the estimated working time, the ideal work capacity value is divided by the developer team of 4, then the value is 22.73. The estimated time for sprint 2 is rounded from 22.73 to 23 days. At this stage, determine the menu features in the game according to the backlog in the planning stage, as shown in table 10 below:

Table 10. Sprint Game Menu Features 2

Kode Backlog	Fitur Menu Game	Estimasi
A	Main course	2
B	Menu Guide	1
C	Menu Info	1
D	New Normal Life menu	2
E	Understanding New Normal	2
F	New Normal Terms	2
G	Health Protocol Rules	2
H	Level Selection	2
I	Level 1	5
J	Level 2	5
K	Level 3	5
L	Menu Exit Application	1

The development process in sprint 2 is slower than the initial estimate of 23 working days to 37 working days. The actual number of team work days is 44 working days. The value of the focus factor with an estimated velocity of 30 and a work capacity of 44 days, then the focus factor value on sprint 2 is 0.68 or 68%.

3.3. Burndown Chart

At the beginning of the sprint, actual task day remaining is below the ideal task remaining line. This condition indicates that the sprint is completed earlier than the predetermined time estimate. It can be seen that on the 8th day, 4 hours remain from the preset time. This is because each team member shares tasks according to their respective expertise and is sufficient to master the software used in the making of this game.

Figure 10. Burndown Chart Sprint 1

In Sprint 2, the actual task day remaining line is above the ideal task remaining line, which indicates that the sprint is not completed as per the predetermined estimate, there is a lot of work remaining in sprint 2, and the project is experiencing delays. This is because the developer has not fully mastered the Construct 2 software so it takes a long time to complete the project.

Figure 11. Burndown Chart Sprint 2

3.4. Closure

Black box testing is carried out to determine the functionality of the software that has been made based on the use case diagram at the planning stage. Black box testing in this study uses a decision table and a state transition table. Decision table testing is done to test the functionality of the new normal after pandemic educational game in integrating each interface page. This test can be seen in table 11.

Tabel 11. Decision Table

Test Case	Test Scenarios	Expected results	Achievement	
			Yes	No
Open the Application	App icon to start opening new normal after pandemic educational game	Applications can be open	√	
Selecting the New Normal Life menu	New Normal Life Menu button to view New Normal material	New Normal Life page can be opened / displayed	√	
Selecting the Start menu	Start Menu button to select game level	Start page can open / appear	√	
Choosing a Level	Level 1 button to start Gameplay level 1	Gameplay 1 is open	√	
	Level 2 button to start gameplay level 2	Gameplay 2 is open	√	
	Level 3 button to start gameplay level 3	Gameplay 3 is open	√	
Choose the	Info button to view author information	Info page can be	√	

Test Case	Test Scenarios	Expected results	Achievement	
			Yes	No
Info button		opened / displayed		
Selecting the Description button	Description button to see a brief description of the game	Description page can be opened / displayed	√	
Choose the How to Play menu	How to Play Menu button to see a detailed explanation of how to play the game	The How to Play page can be opened / displayed	√	
Selecting the Guide menu	Menu button Guide to see a quick guide to using the game	Guide page can be opened / displayed	√	
Choose a sound button	Sound button to stop the backsound	The sound stopped	√	
Choose the Exit button	Exit button to exit the game	The Exit page can be opened / displayed	√	

The state transition table test is used in this study because it is in accordance with the finite state machine (FSM) method.

Table 12. State Transition Table Level 1

	T1	T2	T3	T4	T5	T6
Start State	LV1	M1	M1	M2	M2	M3
Event	Ready	JP1 true	JP1 false	JP2 true	JP2 false	JP3 true
Action	Start game	Next state	Reload	Next state	Reload	Next state
End State	M1	M2	LV1	M3	LV1	M4

	T7	T8	T9	T10	T11	T12	T13
Start State	M3	M4	M4	M1	M2	M3	M4
Event	JP3 false	JP4 true	JP4 false	WH1	WH2	WH3	WH4
Action	Reload	Next state	Reload	Reload	Reload	Reload	Reload
End State	LV1	LV2	LV1	LV1	LV1	LV1	LV1

Table 13. State Transition Table Level 2

	T1	T2	T3	T4	T5
Start State	LV2	L1	L1	L1	L2
Event	Ready	TMK 1	TMK2	WH	TMS1
Action	Start game	Water is on	Water is off	Reload	Hands stop on the water
End State	L1	L2	L1	LV2	L3

T6	T7	T8	T9	T10	T11
L2	L3	L3	L4	L4	L5
≠TMS1	MCT1	≠MCT1	MCT2	≠MCT2	MK1
Hands stop not on the water	Take out the soap	Reload	Hand Wash	Reload	Missing Germs
LV2	L4	LV2	L5	LV2	LV3

Table 14. State Transition Table Level 3

	T1	T2	T3	T4	T5
Start State	LV3	K1	S1	K1	S2
Event	Start game	D1	KD1	D1	KD2
Action	Drag and Drop	sit	succeed	sit	Reload
End State	K1	S1	F	S2	LV3

3.5. Interface Game

Figure 12. Main Page

Figure 13. Health protocol rules

Figure 14. New Nomal terms

Figure 15. Level Selection

Figure 16. Level 1 Mission 1

Figure 17. Exit

4. Conclusion

Based on the results of testing and implementation that have been carried out, the conclusions of the Final Project Research entitled "Finite State Machine (FSM) Method in Designing the New Normal After Pandemic Educational Game Using the Agile Scrum Approach" are as follows:

- 1) The application of the Finite State Machine method in designing the educational game New Normal After Pandemic is found at each level. At the first level, FSM is applied to the rules for completing 4 missions and 4 questions, at the second level it is applied to the rules for running water, hand movements stop and use soap so that germs are lost. And at the third level it is applied to the rules of not sitting in cross places;
- 2) Adjustments to the Agile Scrum method in the educational game New Normal After Pandemic have been implemented at each stage of the game development and development phase and have been running well, can be seen on the burndown chart for each sprint carried out.

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