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ACTIVE CHOICE IS TENDENCY OF PLAYERS: CASE STUDIES OF MOTIVATION CLASSIFICATION IN THE MOTIVATION BEHAVIOR GAMES

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ABSTRACT

To assess the motivation level of player interest is difficult; many instruments are potentially biased, unreliable and invalid test. Whereas, in serious game is important to know the motivation level. If the motivation level can be measured well, the mastery learning can be achieved. Mastery learning is the core of the learning process in serious game. To classify the motivation level of players, researchers propose a Motivation Behavior Game (MBG). MBG improves this motivation concept to monitor how players interact with the game. This game employs Learning Vector Quantization (LVQ) for optimizing the motivation behavior input classification of the player. Training data in LVQ use data observation from the teacher. Populations of motivation behavior classification in this research are pupils when playing the game. Mostly players Motivation Behavior Game have motivation behavior category are Active Choice. Some of them have Mental Effort category, and a few included in the group Persistence. Thus, the general level of interest of the player is still to trial.

Keywords: *Active Choice, Motivation Classification, Learning Vector Quantization (LVQ), Motivation Behavior Game (MBG)*

1. INTRODUCTION

From previous research, researcher knows that the serious game support the education process. Marsh et al [1] and Clark [2] stated that serious game is learning through games which contain pedagogical aspects and is part of e-learning tools/media [3]-[5]. Clark [2], Arnseth [6] and Smith [7] further states that learning method using game is better than the conventional one since animations of learning material in game activates students' long term memories.

On the other hand, game learning has an inverse relationship with learning test in many instances. Clark [8] gives details, pedagogy in games is often based on unguided discovery such as; minimal guidance and only high skill works, overwhelming discovery evidence without any assistance for beginners/novices learners [9][10], discovery technique design and some game cause memory overwork and decrease the learning process [11].

Overload will not occur if the level of motivation behavior players is controlled. Inal, & Cagiltay [12] explains the research of Csikszentmihalyi, emphasized the balance between an individual's skills and difficulties of tasks. He theorizes that the occurrence of flow experiences depends on this balance, and that if the balance does not exist between the individual's skills and the task, flow experiences cannot occur. Heavier duty resulted in the faster frustration; the challenges are too easy, getting bored quickly.

Proper classification of motivation behaviors can be used to control the level of difficulty of the game. Providing an appropriate level of difficulty to the level of motivation behavior in a game scenario will balance the emotions of players. Researcher cannot provide an appropriate difficulty level of

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task if the motivation behavior of players is unknown.

Serious games, like every other tool of education, must be able to show that the necessary learning has occurred. Specifically, games that teach also need to be games that test. Fortunately, serious games can build on both the long history of traditional assessment methods and the interactive nature of video games to provide testing and proof of teaching [13]. In other words, researcher can say that serious games should be reliable as a teaching aid as well as an assessment device.

In contrast, Clark [8] in *Evaluating the Learning and Motivation Effects of Serious Games* explains that the tests of learning are often unreliable and invalid. Learning cannot be measured by self-report, because there is an opportunity to manipulate data.

In this research researcher propose the Motivation Behavior Game (MBG) to eliminate the data manipulation of learning tests in serious games. MBG is a model of indirect measurement of motivation levels. MBG is a players' motivation characteristics measurement by observing the players' motivation behavior. The value of motivation behavior can be taken from the indicators that appear when a game takes place.

MBG is Pedagogic Player Character (PPC) based on artificial intelligent agent. MBG can forecast the motivation character of players. Learning Vector Quantization (LVQ) method is used in MBG. LVQ is used to classify players' the motivation level. The teachers' data are neuron vector to use in learning or supervising data in LVQ method. Three multi objective classifications in MBG are; mental effort, persistence, and active choice. In this research, students are respondent players demonstrates.

2. RELATED WORK

2.1. Motivation Measurement In Games

It is almost universally accepted that there is a positive correlation between motivation and learning. Instructional designers must pay more attention to motivational constructs when designing instruction and games. Bernard and Cannon [14] investigate the use of an emoticon based instrument, supporting the investigation with a study involving undergraduate students. At the end of each class period, the students were asked to indicate their level of motivation before and after the decision making process, but before disclosure of results. Students used a 5 item, emoticon anchored scale ranging from Highly Unmotivated to Highly Motivated. In this studies have already noted the possibility of measurement bias resulting from administering questions relating to both motivation at the beginning of the class period and the end of the class period at the end of the period. Another possibility is that use of emoticons was too simplistic for the purpose.

Educational virtual games and simulations (EVGS) are also noted as agents that may enhance user motivation and satisfaction and subsequently engage learners in innovative and timely ways. Higher levels of success in EVGS' are measured by the intrinsic motivational factors created by the activity [15]. Konetes [15] is analyzing the applications of learning simulations and games through the lens of the intrinsic and extrinsic motivational factors associated with different academic EVGS use. Learning to better control and apply these motivational concepts could enhance the value of educational simulations and magnify their impact and effectiveness.

Derbali and Frasson [16] investigated players' motivation during a serious game. The assessment of motivation was made using questionnaire (after Keller's ARCS model) and electroencephalography (EEG).Thirty three volunteer subjects took part in the test. Each subject was placed in front of two computers: one for playing and one for answering the questionnaires. The results have shown that the EEG wave's patterns are correlated with the increase of motivation during certain parts of a serious games play.

The motivation research in the game [14]-[16] is an extrinsic motivational. Thus, the motivation measurement process is still done separately of the game.

2.2. LVQ Method In Serious Game

Many study use LVQ method for classification data in game. Syufagi et.al. [17] are designing the motivation measurement in game pedagogic. This research focus on single objective motivation, it is classification level of mental effort only.

A Cognitive Skill Classification Based on Multi Objective Optimization Using Learning Vector Quantization for Serious Games [18] is LVQ method research to classification and optimization in multi objective cognitive skill players.

Harini [19] is studies Comprehensive Learning Achievement Affectivity using the LVQ method in serious game. This studies is propose LVQ

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architecture to classify effective and ineffective use of time in serious game.

Abramson and Wechsler [20] shows that the distributed representation found in Learning Vector Quantization (LVQ) enables reinforcement learning methods to cope with a large decision search space, defined in terms of equivalence classes of input patterns like those found in the game of Go. In particular, this paper describes S[arsa]LVQ.

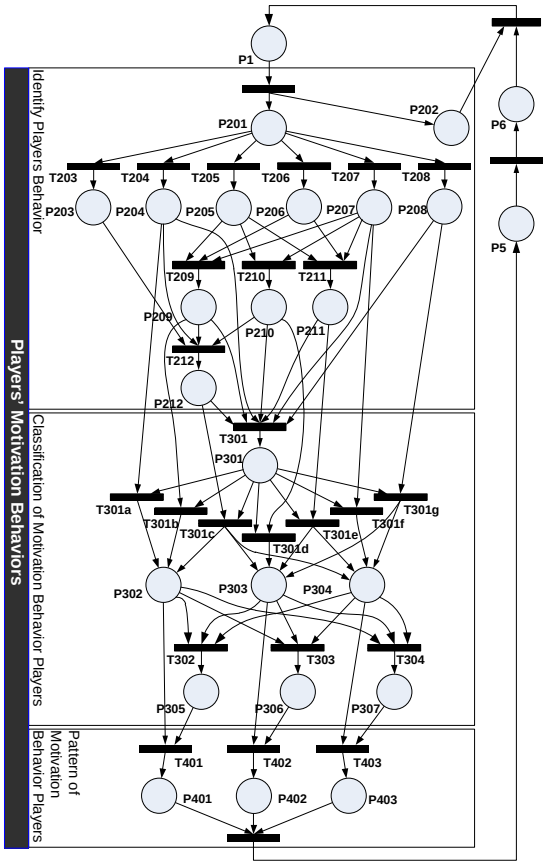

Figure 1: Motivation Behavior Game Model

2.3. PETRI NET In Games

Araújo and Roque [21] describes an alternate approach to the modeling of game systems and game flow with Petri nets. They are provided a case study to show that Petri Nets can be used with advantages over other modeling languages.

Clempner [22] are introducing a new modeling paradigm for shortest path games representation with Petri nets. In this sense, he is change the traditional cost function by a trajectory-tracking function which is also an optimal cost-to-target function.

Brom et.al. [23] present a technique for specifying plots of these scenarios, which underpins the story manager of Europe 2045. The technique is based on a modification of Petri Nets. On a general level this paper discusses the strengths and weaknesses of implementation of Petri Nets in virtual storytelling.

3. METHODOLOGY

Design system of MBG is illustrated in a model of Motivation Behavior Game with Petri net and modeling functions use the LVQ method. Model of Motivation Behavior Game with Petri net is shown in Figure 1, the interpretations detail of places on MBG model is shown in Table 1, and Table 2 is show detail of transition.

Table 1: Place on Motivation Behavior Game Model

Place	Interpretation
P1	Problems arise in the game
P201	Players resolve the problem
P202	Players avoid / leave the problem
P203	Number of overlook in tests or to avoid in games (***o***)
P204	Number of how many to search info (***i***)
P205	Number of wrong / lost (***m***)
P206	Number of the players is Uncertainty/to Decline (escape) (***c***)
P207	Number of true / win (***b***)
P208	Number of how much using time to finish the job (***t***)
P209	Fixes the value of Pick Question/Playing the Game (***q***)
P210	Fixes the value of Try to Answer / to Finish (***tr***)
P211	Fixes the value of Self Efficacy / Ability (***e***)
P212	Step report of player at some stage (***st***)
P301	Fixes the value of maximal (***max***)
P302	**LVQ** Method to classify the Players Motivation behavior of Active Choice (***ac***) into; Low Active Choice (ac_1), Semi Active Choice (ac_2) or High Active Choice (ac_3)
P303	**LVQ** method to classify the Players Motivation behavior of Persistence (***ps***) into; Low Persistence (ps_1), Semi Persistence (ps_2) or High Persistence (ps_3)
P304	**LVQ** method to classify the Players Motivation behavior of Mental Effort (***me***) into; Low Mental Effort (me_1), Semi Mental Effort (me_2) or High Mental Effort (me_3)
P305	Value is one or zero
P306	Value is one or zero
P307	Value is one or zero
P401	Value is Active Choice (***ac***) or zero
P402	Value is Persistence (***ps***) or zero
P403	Value is Mental Effort (***me***) or zero
P5	Motivation Leveling algorithm
P6	Responds to the players level of motivation behavior as the reference to selection of problem in game

The three main part of MBG are; i) Identify players behavior, ii) Classification of motivation behavior players, and iii) Pattern of motivation behavior players.

Many methods can be used for classifying data. Learning Vector Quantization (LVQ) is the data classification method used in this research. LVQ is supervised Artificial Neural Network (ANN) using

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competitive learning method developed by Kohonen et al. [24], used in guided training from layers in ANN competition. Competitive layers will automatically learn to improve the classification of input vector performance periodically. When some input has very close distance vectors, those vectors will be grouped in the some class.

Table 2: Transition on Motivation Behavior Game Model

Transition	Interpretation
T203	The result of overlook in tests or to avoid in games
T204	The result of how many to search info
T205	The result of wrong / lost
T206	The result of the players is Uncertainty (cancel) / to Decline (escape)
T207	The result of true / win
T208	The count of how much using time to finish the job
T209	Average of lost (***m***), cancel (***c***) and win (***b***) value
T210	Average of lost (***m***), and win (***b***) value
T211	Sum of 30% lost (***m***), 20% cancel (***c***) and 50% win (***b***) value
T212	Average of avoid (***o***), search info (***i***), pick question (***q***) and try to answer (***tr***) value
T301	Obtain the highest value of the ***m***, ***b***, ***c***, ***q*** or ***tr*** (***max*** value)
T301a	Divide the ***i*** value by the ***max***
T301b	Divide the ***q*** value by the ***max***
T301c	Divide the ***st*** value by the ***max***
T301d	Divide the ***tr*** value by the ***max***
T301e	Divide the ***e*** value by the ***max***
T301f	Divide the ***b*** value by the ***max***
T301g	Divide the ***t*** value by the ***max***
T302	Set (one value) if then value of High Active Choice (ac_3) in **LVQ** method is higher of value of High Persistence (ps_3) or value of High Mental Effort (me_3), else reset (zero value)
T303	Set (one value) if then value of High Persistence (ps_3) in **LVQ** method is higher of value of Active Choice (ac_3) or value of High Mental Effort (me_3), else reset (zero value)
T304	Set (one value) if then value of High Mental Effort (me_3) in **LVQ** method is higher of value of High Persistence (ps_3) or value of Active Choice (ac_3), else reset (zero value)
T401	To multiply
T402	To multiply
T403	To multiply

Figure 2 is a LVQ method contained in place of petri net. LVQ used to classify data of input vector in MBG into three clusters. The input vector of LVQ is the weight of variables in MBG, namely; weight of trying to answer, picking up questions, competency, errors, and cancellation. The outcome of LVQ is three clusters of motivation behavior data type, namely; mental effort (*me*), persistence (*ps*) and active choice (*ac*) motivation behavior motivation behavior with three levels of clusters each.

Some researchers use the optimum method based on LVQ [25, 26]. *L* is classification of MB optimum conditions. *L* is defined at three probability optimum conditions, namely; i) mental effort, ii) persistence, and iii) active choice. MB is the classification of MBG outcome that can be defined at nine probability optimum conditions, namely; i) high mental effort, ii) semi mental effort, iii) low mental effort, iv) high persistence, v) semi persistence, vi) low persistence, vii) high active choice, viii) semi active choice, and ix) low active choice.

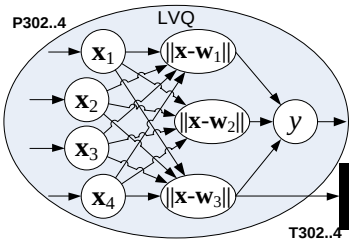

Figure 2: LVQ method in P302, P303 and P304 of Motivation Behavior Game Model

Figure 3 is Action Flow of MBG. The first MBG will be identifying players. Furthermore, players will be classified based on the character of motivation behaviors tests in each state. Data obtained from the evidence of the players in each state that is the outcome of classification process of motivation behaviors by using the LVQ method.

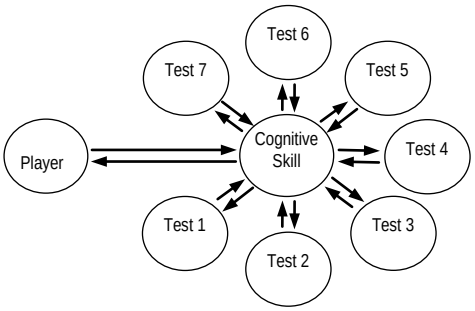

Figure 3: Action Flow of Motivation Behavior Game Model

In previous studies [27] discussion focused on detail of petri net models, detail of model function, and multi-object character. However, the research was conducted testing on only one state. In the present study was developed for seven states. All states in MBG provide only one level of cognitive difficulty. Each player will be identified as many as seven times include the seven state existing.

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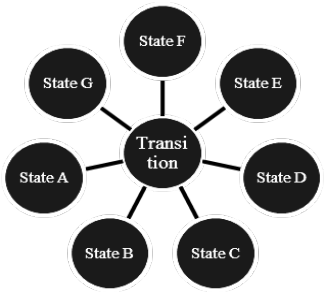

Figure 4: Scenario of Motivation Behavior Game Model

Scenario game at MBG is shown in Figure 4. Players must complete the tasks within each state. After completing the task of the player will return to later transition into another state. Game is complete if the player has completed the task of all existing state.

4. RESULTS AND ANALYSIS

Rresearcher conducted a survey to twenty teachers to obtain three characteristic of motivation behavior. The aims of choosing teachers as the respondents is to get the ideal motivation behavior characteristics based on the assumption that teachers are the best motivation behavior evaluator. It is also the consideration that teachers have the qualification as pedagogic assessors which is shown by their diplomas, certificates, and teaching experience. Therefore, teachers are reliable in determining the parameters of motivation behavior indicators.

The population is senior high school teachers that consist of two groups, twelve respondents are the math and science teachers, and eight respondents are the social teachers.

Teachers will give weight of the variable reference can influence the value of type (*L*) and class (*C*) of motivation behavior. Variable reference from teachers includes; using time (*t*), correct/victory (*b*), self-efficacy (*e*), step report (*st*), try to answers (*tr*), pick questions (*q*), and search info (*i*).

Parameters of motivation behavior characteristic value can be used as a motivation behavior reference. The reference of motivation behavior is the value of ideal motivation behaviors. Values of the parameters in the motivation behavior reference data obtained from the classification of the teachers' survey data. Data of motivation behavior characteristic from teachers will be applied on learning rate of the LVQ motivation behavior pattern.

Populations of motivation behavior classification in this research are 33 pupils, including; 18 male and 15 female. The respondents are students in a senior high school. The ages of respondents are 16 to 19 years old. Respondents are used to test the MBG system. MBG base on LVQ will classify the student's motivation.

Value of *t*, *b*, *o*, *c*, *m*, and *i* are taken when students play the game. The variable of *t*, *b*, *o*, *c*, *m*, and *i* are players' characteristic of motivation behavior. These variables are the input of MBG.

Figure 5: Screen Shoot of Transition Place

From Scenario of Motivation Behavior Game in Figure 4, screen shoot transition place at MBG is shown in Figure 5. Players must be go in this place to choice the state. Players who had entered into a certain space (state) cannot do it again. Player is directed to take the new state.

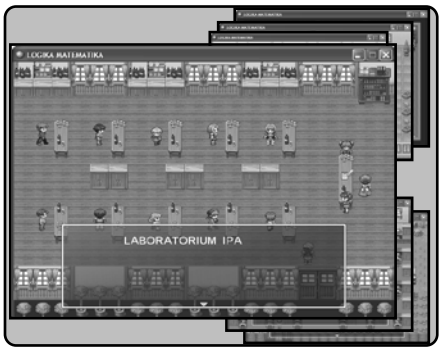

Figure 6: Screen Shoot of State Place

Screen shoot one of state place at MBG is shown in Figure 6. Of the transition location, players will be entered into one of the existing state space (one of seven states). Players must complete the tasks in each state. Players can not leave the room before completing the task at least 75% of all available tasks. This done for players to mastery learning.

4.1. Value Of Motivation Behaviors

The data observation from the teacher is ideal data that can be used as training data in LVQ

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method. LVQ training outcome is used as weight value reference of motivation behavior classification. Table 3 is the result of LVQ training (from data teachers) includes; weight of using time (*t*), weight of correct/victory (*b*), weight of self-efficacy (*e*), weight of step report(*st*), weight of try to answers (*tr*), weight of pick questions (*q*), and weight of search info (*i*). The value of Table 3 is a reference weight value of motivation behaviors in the MBG. The Table value is showing the character of motivation behavior reference which is in accordance with the players' character.

Table 3: Weight of Motivation Behavior Reference

using time (*t*)	correct/ victory (*b*)	self-efficacy (*e*)	step report (*st*)	tray to answers (*tr*)	pick questions (*q*)	search info (*i*)	class (*C*)	motivation behavior type (*L*)
0.86	0.16	0.15	0.37	-	-	-	low	Mental Effort (*me*)
0.14	0.87	0.82	0.90	-	-	-	semi	
0.12	0.83	0.85	0.14	-	-	-	high	
0.10	-	0.86	0.50	0.90	-	-	low	Persist-ence (*ps*)
0.81	-	0.10	0.90	0.13	-	-	semi	
0.90	-	0.13	0.10	0.10	-	-	high	
-	-	-	0.12	-	0.50	0.50	low	Active Choice (*ac*)
-	-	-	0.82	-	0.10	0.14	semi	
-	-	-	0.87	-	0.88	0.87	high	

4.2. Motivation Behavior Classification

From chapter 3, it can be stated that, this research is a method implementation in game to know the three motivation behaviors from 33 players (students), and three motivation levels in each motivation behavior

Of the 33 players will get the 231 players data. Each player completes 7 states (state A ... state G), in each state would be classified motivation behavior players (C_1, C_2 and C_3). Based on the C_1, C_2 and C_3 will be determined type of motivation behavior based on the optimum value. Table 4 shows results of experiments in State G (examples one of state) and Table 5 in all State. Table 5 shows the number of players who are classified in the C_1, C_2 and C_3, which can be determined the type of motivation behavior players (*L*).

4.3. Analysis Of Motivation Behavior Characteristic

The characteristic of motivation behavior are divided into three objective groups, namely; mental effort, persistence, and active choice motivation behavior. Mental effort motivation behavior is the first objective motivation performance of the players during the process of completing a game mission, who are characterized as; always confident with high level of efficiency to using time, never make mistakes, have a high competence (high self-efficacy), and effective to finish the tasks thoroughly.

Table 4: Results of Experiments in State G

ID respond-ent	mental effort class (C_1)	per-sistence class (C_2)	active choice class (C_3)	motivation behavior type (*L*)
1	semi	low	high	active choice
2	semi	low	high	active choice
3	semi	low	high	active choice
4	semi	low	high	active choice
6	semi	low	high	active choice
9	semi	low	high	active choice
12	semi	low	high	active choice
13	semi	low	high	active choice
15	semi	low	high	active choice
16	semi	low	high	active choice
17	semi	low	high	active choice
19	semi	low	high	active choice
20	semi	low	high	active choice
22	semi	low	high	active choice
24	semi	low	high	active choice
25	semi	low	high	active choice
27	semi	low	high	active choice
31	semi	low	high	active choice
32	semi	low	high	active choice
21	low	low	semi	active choice
28	semi	low	semi	active choice
29	low	semi	semi	active choice
30	semi	low	semi	active choice
5	semi	low	semi	mental effort
7	semi	low	semi	mental effort
8	semi	low	semi	mental effort
10	semi	low	semi	mental effort
11	semi	low	semi	mental effort
14	semi	low	semi	mental effort
18	semi	low	semi	mental effort
26	semi	low	semi	mental effort
23	low	semi	semi	persistence
33	low	semi	semi	persistence

Persistence motivation behavior is the second objective motivation performance at the time of completing the mission of the game. Persistence have objective characteristics includes; tend to low self-efficacy, low efficiency to using time, few of try to answer, and finish the tasks thoroughly,

Active choice is the third objective performance of the players' motivation during serious games. The characteristic of active choice includes; tend often to search information, always respond to get the questions, low efficiency in solve the problem thoroughly.

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Table 5: Results of experiments in All State

State	mental effort class (C_1)			per-sistence class (C_2)			active choice class (C_3)			motivation behavior type (L)		
	high	semi	low	high	semi	low	high	semi	low	mental effort	persistence	active choice
A	4	29	0	0	4	29	24	3	6	9	0	24
B	1	32	0	0	2	31	16	0	17	11	0	22
C	3	29	1	0	5	28	14	2	17	14	0	19
D	1	28	4	2	9	22	15	18	0	6	3	24
E	0	32	1	0	2	31	18	15	0	6	0	27
F	0	30	3	0	8	25	14	19	0	9	1	23
G	0	29	4	0	3	30	19	14	0	8	2	23
all										**63**	**6**	**162**

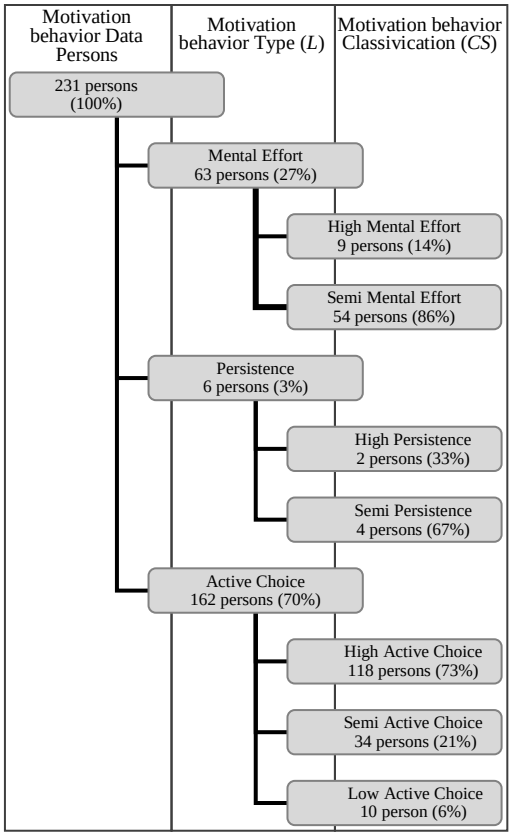

Figure 7: Classification of Motivation behavior

On Motivation behavior Classification (CS) is more dominant at high levels of classification. Thus the optimum level of classification is higher. So the type Motivation behavior (L) of players will be more definitely lead to one type of motivation behavior that exists (Mental Effort, Persistence, or Active Choice)

Classification of motivation behavior is depicted in figure 7. From the results of 231 experimental data of players, type of Motivation behavior players are divided into 27% (63 players data) are the Mental Effort, 3% (6 players data) is Persistence, and 70% (162 players data) is a Active Choice Motivation behavior.

All Players with the mental effort type of motivation behavior classified to 14% (9 players' data) is High Mental Effort, and 86% (54 players' data) is Semi Mental Effort. All Players have motivation behavior persistence type classified to 33% (2 players' data) is High Persistence, and 67% (4 players' data) is Semi Persistence. While the active choice motivation behavior type classified to 73% (118 players' data) is the High Active Choice, 21% (2 players' data) is Semi Active Choice, and 6% (10 player data) is Low Active Choice.

5. CONCLUSION

In MBG modeling research, researcher gets the model of MBG with Petri net and function of motivation behavior identification. LVQ method is used to classify player's characteristic in playing games. In MBG classification research, game can identify player's motivation behavior. Players can be classified in three motivation behavior clusters namely; i) mental effort, ii) persistence and iii) active choice, by result are 51% high active choice (118 from 231 persons), 23% semi mental effort (54 from 231 persons), 15% semi active choice (34 from 231 persons), 4% low active choice (10 from 231 persons), 4% high mental effort (9 from 231 persons), 2% semi persistence (4 from 231 persons), 1% high persistence (2 from 231 persons). Thus, there are many players who have motivation level is active choice. One reason is the application of this research has not been setting the appropriate level of difficulty. In a further research, MBG can provide feedback to determine the level or used as a guide in game. Individual behavior can influence the scenario changes in game. MBG can be fun and personality challenges in serious game.

To wrap up, it can be concluded that the MBG is embed sensitivity of teachers in the game, cause MBG data training is taken from the teachers. Dominant characteristic of the all the players is active choice. More than half (70%) players have a active choice characters. It can be concluded that, the player is still a trial in the games.

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