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The Gamification of Covid-19 Pandemic as an Active Learning Tool in Disaster Education

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***Abstract*—COVID-19 likely affected our daily life for a long time. Skill to monitor this pandemic is important in order to increase our adaptability particularly during these tough times. Generally, a non-science learner always tends to ignore news related to the scientific contents of COVID-19 as they claimed they are lack of scientific knowledge's background. Thus, this work aims to increase their understanding particularly on scientific contents of COVID-19 by integrating disaster education into game mechanics in order to motivate better behavioral outcomes and simultaneously able to increase awareness and scientific knowledge on COVID-19. In this work, we integrate disaster risk management approaches via gamification strategy by introducing game elements such as goals and conflicts and gameful experiences in non-game context called gamification of COVID-19.**

Keywords—disaster education, COVID-19, active learning, gamification

I. INTRODUCTION

Reducing disaster risk is a foundation for sustainable development. Public awareness and scientific knowledge of disaster risk management are equally important during crisis to ensure public can act in timely and appropriately and this can be done through disaster education. To date, there has been increased attention on preventive strategies aimed at saving lives when disaster strikes especially during the COVID-19 pandemic. Public education through disaster education is preferably one of the least expensive and effective tools to improve awareness among the public during the crisis.

Interestingly, pedagogy on disaster education has moved from simple to complex and reflective pedagogical relationship. However, the effectiveness of such disaster education pedagogy should be improved to "replace fear" to "greater awareness" to raise healthy adaptability among the public during the crisis. The flexible and dynamic approach such as context-oriented activities, experiential learning exercises such as tasks, simulations, game-playing, and scenario exercises should be implemented to replace conventional and formal method of learning [1].

Contrary to the formal methods of pedagogy on teaching and learning, gamification method is an alternative solution to stimulate the active experimental learning both formal pedagogy and non-formal pedagogy [2]. However, to the best of our knowledge, no prior studies have been conducted especially on gamification of COVID-19 and thus this work aim to develop an active learning tool for disaster education specifically on COVID-19 pandemic via gamification.

II. DESIGN OF THE GAME

Generally, the core gamification elements constructed in this work were using "ifs" and "estimation" where leaners need to evaluate the impact of the pandemic and to prepare the control measure and to avoid exponential growth of the pandemic by using basic reproduction number, R [3]. The goal of the game is to maintain the R <1, see equation 1.

$$R = \frac{number\ of\ the\ new\ infectious\ case}{number\ of\ existing\ case\ of\ 7\ days\ ago} \quad [1]$$

In this game, each player was assigned to maintain his district and to work simultaneously with other players to find active cases, to provide medical treatment, to maintain the living condition and to maintain the income generation of his district. Each player needs to apply appropriate measure according to the task in order to control the R.

A. The Objective of the Game

The goal of the game is to minimize the rate of new infectious cases and players will be tested based on the following criteria and the flowchart of the game is shown in fig. 1.

1) Knowledge: Players will be tested on his understanding and skill on calculating variables of pandemic control, social phenomena on the possibility of subsequent events and the consequence of his control measure.

2) Attitude: Players need to work in a team and to make the collaborative decision while selecting the appropriate policies to control the outbreaks.

3) Scenarios: Each player will be given a scenario card and he needs to decide on an individual level whether imposing a lockdown for 4 weeks and losing income generation of his city or to run and open his district normally although the chances the infectious reproduction will be increased according to the population density.

B. The Sequence of Playing

1) Decide: In each turn, player need to decide whether to impose or not to impose a lockdown in order to stop public activities in his district. After the player has made his decision, he needs to decide his control measure. In each turn, players can impose up to 3 control measures. However, some control measures requires a cost to execute it and therefore players must collaborate among themselves on strategies to curb the outbreak and at the same time maintaining the financial status of his district.

2) Scenario card: The scenario cards for each turn may vary from the increasing numbers of infectious patients or decreasing the gross productivity of the district. Severity of the damage will depends on the control measures taken by each player before he draws the scenario card.

Each player will draw 3 scenario cards during his first turn and numbers of the scenario cards will increase in each turn as follows;

Week 1 = 3 cards

Week 2 = 4 cards

Week 3 = 5 cards

Week 4 = 6 cards

Week 5 = 6 cards

At the end of each turn, players need to calculate the reproduction number (R) and income generation of his district. Each player will be asked to reflect and to consider the appropriate control measure to be taken on his next turn and to assess his financial status. The amount of debt (if any) will be automatically deducted when the district generates revenue in the next turn.

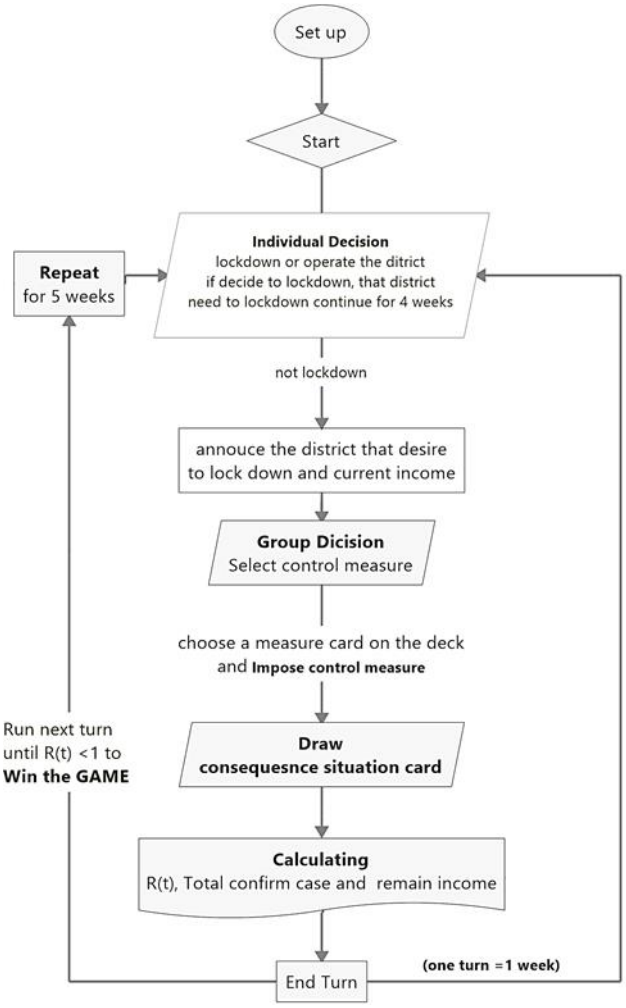

Fig. 1. Game flowchart.

C. Rule of The Game

1) Game mechanic: To achieve the goal of the game, each player has to control the outbreak of the pandemic by retarding the infectious reproduction to lower than 1 and to maintain the income generation of his district. The game may end if the player goes bankrupt or emerging infection remains uncontrolled.

*2) Time:*Playing duration is about 45 minutes (10 minutes per turn plus 5 minutes for the game set up) and 1 turn equals to 1 week.

III. Data Collection

The game testing and data collection was conducted in June-August 2020 to two different groups of respondents as follows;

- The first group was 37 middle school teacher of Trairattananaphirak School.

- The second group was 138 university students of GEN223 Disaster Preparedness subject from King Mongkut's University of Technology Thonburi

The qualitative and quantitative data on quality of the game design were collected during pre and post-game through Quizziz online platform, which consists of quality of the game design, learning competency (knowledge, attitude and practice) and disaster awareness (planning and monitoring, disaster perception and coordination).

IV. RESULTS

Most of the respondents showed a high level in the knowledge domain and practice domain but showed low and medium level in the attitude domain. The respondents evaluate the quality of the tool as a high level for all components. Most of the respondents perceive that the great component of the feedback which give useful information to decisions making and consequences whereas the lowest is the component of emotional Entailment.

The researcher used the path analysis to displays "How game influence disaster awareness". It found that the linkage between the quantitative and qualitative is; Disaster awareness is influenced by learning competency higher than tool quality. It can assume that knowledge may influence a direct relationship with disaster perception while the component of fun in the game may be a major factor that motivates self-learning and influence disaster awareness.

Accordingly, If without engagement, the activity remains uninteresting while with too much engagement, reflection may be lost. the research assumes that the decision-making component of game design may be the main factor incubate the skill of pandemic monitoring. Because of the learner gives the feedback that they obtained the planning skill by using logical thinking and recognised that leadership and decision making is important to problem-solving. As same as, the qualitative result shows that learners obtained amusement and fun as number one of the affective domain's feedback.

Therefore, the researcher assumes that an appropriate game-design-based gamification need to create fun and amusement for learner along with practising problem-solving. The outcome of disaster education with the gamification of COVID-19 pandemic is consequently cultivating disaster awareness. This educational tool can contribute to the ability to monitoring and evaluating the pandemic situation, the understanding of the mechanism of pandemic's growth rate and the understanding of the collaboration during the disaster event.

A. Structural Equation Model (SEM)

To analyse Structural Equation Model (SEM) for path analysis with influence the factors influencing on learning competency and the quality of tool toward disaster awareness. The influencing factors and influencing paths was determined the path influencing and constructed validity by Mplus 6.11. The data of the questionnaire were categorized into nine sets as table1. All nine observable variables were put into a correlation and covariance matrix to present primary data for the observation.

TABLE I. CORRELATION COEFFICIENT MATRIX AND COVARIANCE OF OBSERVABLE IN THE FACTORS INFLUENCING ON LEARNING COMPETENCY, QUALITY OF TOOL TO DISASTER AWARENESS

	Know	**Att**	**Prac**	**T1**	**T2**	**T3**	**Plan**	**per**	**Coor**
mean	3.3	0.92	2.38	3.55	2.31	2.43	4.89	6.53	4.74
STD.	0.78	0.68	0.93	0.57	0.54	0.63	0.96	1.29	1.08
Know	1								
Att	0.05	1.00							
Prac	0.25	0.21	1.00						
T1	0.29	0.07	0.08	1.00					
T2	0.35	-0.04	0.04	0.46	1.00				
T3	0.15	0.07	0.07	0.21	0.63	1.00			
Plan	0.25	-0.02	0.06	0.13	0.35	0.22	1.00		
Precept	0.37	0.05	0.16	0.35	0.53	0.44	0.46	1.00	
Coor	0.19	0.05	0.24	0.26	0.36	0.18	0.28	0.43	1.00

*Correlation is significant at the 0.01 level (2-tailed)

The researcher used a matrix to show the correlation coefficient to analyze influent paths affecting. After the model was adjusted for fit according to the recommendations of modification indices, it was found that the model has parameter values as shown in Table 2, that is p-value= 0.051, chi-square (χ2)= 42.153, df= 29, RMSEA=0.52, CFI=0.947, TLI= 0.934 and SRMR=0.083. These are similar to the principles of consideration. This model has fit with the empirical data.

TABLE II. THE STRUCTURAL EQUATION MODEL'S GOODNESS OF FIT INDEX

Fit index type	**Acceptable value**	**Observe value**
p-value	>0.05	0.051
χ^2/df	<2	χ^2=42.153 /df=29
RMSEA	<.08	0.52
CFI	>.90	0.947
TLI	>.90	0.934
SRMR	>.08	0.083

Analysis of influence paths found that learning competency and quality of tool are direct influence to disaster awareness which obtain the variable coefficient weight is as shown in fig. 2, this research results show that disaster aware on COVID-19 pandemic is influenced by the existing learning competency related COVID-19 (TE=3.841) higher than educational tools quality (TE=0.256). It could be said that existing public pedagogy can raise disaster awareness to educate the people.

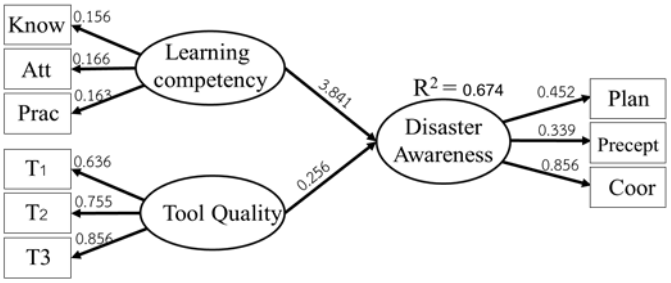

Fig. 2. The structural equation model of the factors influencing on learning competency, the quality of tool to disaster awareness.

When considering the total effect (TE), it found that learning competency is the variable which direct influence on the awareness (TE=3.841). The variables in this set have the elements as follows: knowledge relevant COVID-19 (Know= 0.156), the attitude on pandemic control (Att=0.166) and the practice on pandemic monitoring (Prac=0.163). In comparison, the researcher considers the loading factor of this observed variable set then found that the component of the learning domain as knowledge, attitude and practice are similar influence.

Then the quality of the tool, it is the variable which direct influence on the awareness (TE=0.256). The variables in this set have the elements as follows a component of learning (T1=0.636), a component of decision (T2=0.755) and a component of fun (T3=0.856). The researcher considers the loading factor of this observed variable set then found that the highest influence factor is the component of fun, second is the component of decision and the third is the component of learning.

For disaster awareness, it is the variable which direct influence from learning competency (TE=3.841) and quality of tool (TE=0.256). The variables in this set have the elements as follows: coordination (Coor=0.856), planning and monitoring (Plan=0.452), disaster perception (Percept=0.339), The estimation parameter (R2) was equal to 0.674. The researcher considers the loading factor of this observed variable set then found that the highest influence factor is coordination while planning and monitoring, disaster perception are similar influences.

B. Qualitative result

The respondents give feedback after playing the game by a focus group approach with the respondent in the teacher group. They found that they are not only obtained basic knowledge of basic practice to deal with COVID-19. The big advantage of this game is a problem-solving skill. The situation based-learning that applied in daily life situation, It contributes an increasing problem-solving skill of the learner. Due to the pedagogy that integrated content relevant pandemic control into a situation based learning to lead the player to take analytical thinking throughout the game. It is better than another approach because the mechanism of the game forced players making understand by themselves, obtained knowledge can embed into the memory better than lecture and answer the solution. Thus this style of learning is a good tool that can increase the skill of adaptability and creativity into a life skill of the learner.

While the collaborative strategic in the game also lead the learner performed collective action. It makes them realize “One man show” cannot solve this societal problem. In societal problem solving it needs to rely on the collaboration of other people in the allocation and agreement. The interdependent and collaboration is not only an information sharing but also broad-minded and teamwork with respect to other decision during performed group decision making in the game.

Moreover, planning skill is an educational achievement that the player found in the game. It comes through the game component that players have to predict the trend of increasing patients. The players who have to decide to impose the control measure, they need to foresee and discuss advanced planning for the consequence of each sequence of the game.

In summary, the compiled qualitative data showed that; the result of psychomotor and cognitive domain which is most respondent (29 responses) obtained a lot of up to date knowledge, secondly, they obtain the understanding of control measure of COVID-19 pandemic (7 response), similar to an obtained the planning skill by using logical thinking (6 response) and the lowest opinion that the respondent gives feedback is a fluently thinking (6 response).

For affective domain‘s feedback, it shows that the respondents have amusement and fun (29 responses), excites with uncertainty throughout playing game (10 response) and happy to playwork as a team and collective problem solving (6 response) and the lowest opinion that the respondent gives feedback is obtained confusing at first but fun when understanding (2 response).

V. CONCLUSION AND DISCUSSION

A. Conclusion

Created game is an effective learning tool. Gamification is a powerful method for catalyzing attention because games contribute to engagement for any learning experience. Learners are attracted by the fun (affective) then rewarded with knowledge and skills. This is an impact of game utilization regarding the purpose of affecting learning-related behaviours or attitudes transformation.

B. Discussion

The linkage between quantitative and qualitative result is "How game influence disaster awareness". Due to researcher notices the finding from the qualitative and quantitative result particularly path analysis that showed; Disaster awareness on COVID-19 pandemic is influenced by learning competency higher than the educational tool. It made the result's discussions following research question are;

- Knowledge may have a direct relationship with disaster perception. Due to the raw data show the different age group being a different result. The learner who are over 26 years old showed higher disaster perception than the learner in under 26 years old group. Whereas the learner who are under 26 years old showed higher coordination and collaboration higher than the learner in over 26 years old group. The result is consistent an idea of crisis communication which the Centers for Disease Control and Prevention of the United States (CDC) state that different age group may have different risk perception depend on their prior life-experience. Therefore raising disaster awareness, learning facilitator supposed to convey the knowledge as an input or substrate of disaster perception before the game playing in an appropriate way according to the age group of the learner to calibrate an inclusive knowledge [4].
- The decision component in the game may influence disaster awareness in the same direction. Due to the feedback in the qualitative result presented that learners obtained the planning skill by using logical thinking. Moreover, they recognized that leadership and decision making is important to problem-solving. Thus it can be said the game design may cultivate the skill of pandemic monitoring by inducing decision making skill.
- An appropriate game-design need to be fun. Although the quantitative result presents that the component of fun has ranked as the first of the influencing factor correspond to the qualitative result that showed an affective domain on the amusement and fun are motivated self-learning in the workshop. Therefore, the researcher assumes that an appropriate game-design-based gamification needs to create fun and amusement for learner along with practising problem-solving.

REFERENCES

[1] M. Benadusi, "Pedagogies of the unknown: unpacking 'Culture'in disaster risk reduction education," Journal of Contingencies and Crisis Management, vol. 22, no. 3, pp. 174-183, 2014.

[2] K.M. Kapp, The gamification of learning and instruction fieldbook: Ideas into practice. John Wiley and Sons, 2013.

[3] M.R. Francis. Just how contagious is COVID-19? This chart puts it in perspective. Popular Science [Internet]. Popular Science. 2020 [cited 2020 Feb 20]. Available from: https://www.popsci.com/ story/ health/how-diseases-spread

[4] U.S. Department of Health and Human Services. CERC: Introduction. In Crisis and emergency risk communication (CERC) manual.2018 Available from: https://emergency.cdc.gov/cerc/ppt/CERC_Introduction. pdf.