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A Development of Gamified Learning for Nursing Students' Public Health Investigation Process

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Abstract: This paper aimed to present the development of gamification elements that contributed to the formation of competences in investigation process in a community health nursing course. There were 10 steps of public health investigation process using a gamified learning model. Results: The story of gamified learning demonstrated the first step to the last step of disease investigation. An instructor designed learning activities by creating a learning situation in each step of disease investigation such as filling in the blanks with the correct words and a true-false test. The instructor created individual learning style and utilized learning outcomes as indicators of learners' cognition. Moreover, the instructor determined the motivation during the game through competition and collecting coins. Learners with low scores were required to repeat playing while those with the highest scores were rewarded. This gamified learning model is expected to promote nursing students' knowledge in investigation process.

Keywords: Gamified learning, nursing students, public health, investigation

1. Introduction

Investigation is an epidemiological activity conducted to rummage the facts about the occurrence of diseases and public health problems. Investigation involves looking for information about distribution of the disease and environmental pathogens. The investigation process is based on scientific principles.

The Bachelor of Nursing Science Program requires learning about epidemiological investigation in a community nursing course. Most of the teaching is carried out with a lecture method. Therefore, the students may have little working experience in investigation (Chang, Chao, Xiao, & Chien, 2021). Previous research also showed learning gains from gamification as it could create learning environments to increase learners' motivation (Butler & Bodnar, 2017).

Karl Kapp (2012) described gamification as using game-based mechanics and game thinking to engage people, motivate action, promote learning, and solve problems. Accordingly, a gamification is designed to enhance understanding, apply knowledge, and a cognitive apprenticeship in the courses of undergraduate students (Ko & Ko, 2021). Gamification is an interesting and innovative approach in the nursing field, as a replacement to traditional practices and appropriate to nursing teaching (Grech & Grech, 2021). Talita Candida CastroI and Luciana Schleder Gonçalve (2018) examined the effect of gamification on increasing competences in nursing informatics based on teaching and learning criteria, and content structure. The results showed that gamification contributed to the formation of competences among nursing students by positively influencing the teaching-learning process. The gamified learning design helped to promote the learning process of nursing students as it was another teaching resource for motivation and meaningful learning.

Investigation process consists of 10 steps as shown in Figure 1. The right implementation of investigation process leads to effective disease control and prevention. For effective learning of nursing

students, we are interested in developing the elements of gamification that contribute to the formation of competences in nursing investigation process.

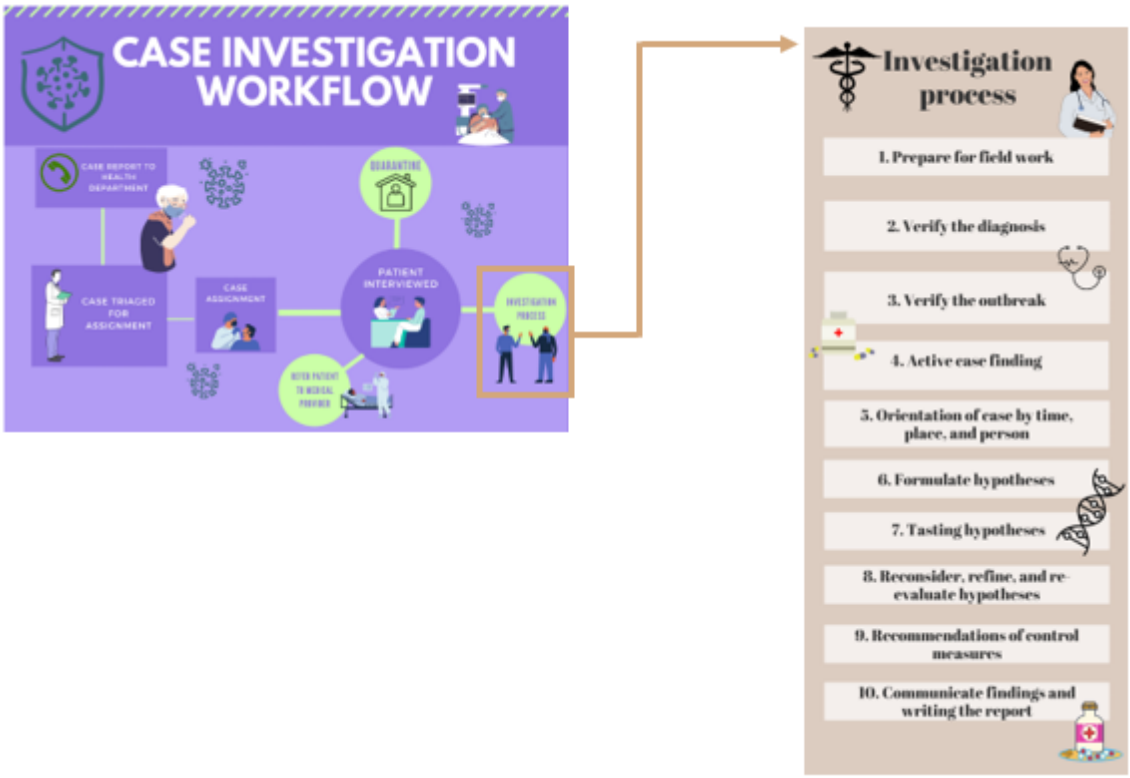

Figure 1. COVID-19 case investigation workflow and 10 steps of disease investigation.

2. The development of Scratch Gamification based on Public Health Investigation Process

2.1 Public Health Investigation Process

Public health investigation process consists of 10 steps (Department of Disease Control, 2020). The first step is the preparation for field work in which health professionals must have a good team with appropriate scientific knowledge, supplies, and equipment to carry out an investigation before initiating field work. The second step is to verify the diagnosis using clinical findings and laboratory results. The next step is the verification of the outbreak which involves verifying that a cluster of cases is indeed an outbreak. The following step is active case finding about the case definition using clinical criteria — restrictions by time, place, and person. The next step is orientation of case by time, place, and person. The sixth step is the formulation of hypotheses called descriptive epidemiology in which the outbreak is characterized by time, place, and person. This step may be repeated several times during the course of an investigation as additional cases are identified or as new information becomes available. After a hypothesis that might explain an outbreak has been developed, the next step is to evaluate the plausibility of that hypothesis. Hypotheses are evaluated either by comparing them with the established facts or by using analytic epidemiology to quantify relationships. When analytic epidemiology is unrevealing, hypotheses are reconsidered. The next step is recommendations of control measures, as control of the outbreak and prevention of additional cases are the primary goals. In the final step, the findings, and outcomes are written in a report, and communicated in an effective manner (Manitoba Health, 2021; Ikechukwu, Ilochi, & Nwafor, 2019).

2.2 Gamified Learning

The gamified learning development process can be divided into six steps (Kapp, 2012; MacMeekin, 2017) as follows:

2.2.1 Instructors define and explain learning outcomes as indicators for public health investigation process.

2.2.2 Instructors design gamified learning that can challenge their learners. Thus, learners can apply the learning outcomes to future work.

2.2.3 Instructors determine the story of gamified learning from the first step of the disease investigation to the full process of the disease investigation.

2.2.4 Instructors design learning activities by creating a learning situation in each step of the disease investigation such as filling in the blanks with the correct words and a true-false test.

2.2.5 Instructors design individual learning style, and utilize learning outcomes as indicators of learners' cognition.

2.2.6 Instructors determine the motivation of the game through competition and collecting coins. Learners with low scores must repeat playing. Learners with the highest score will be rewarded

3. Illustrations

We developed gamified learning for disease investigation (COVID-19 infectious disease scenario). The gamification consists of 10 scenes. For example, the first scene is the preparation for field work step. The second scene is the verification of diagnosis step, and the last scene is the step of communication of findings and writing report as shown in Figure .2

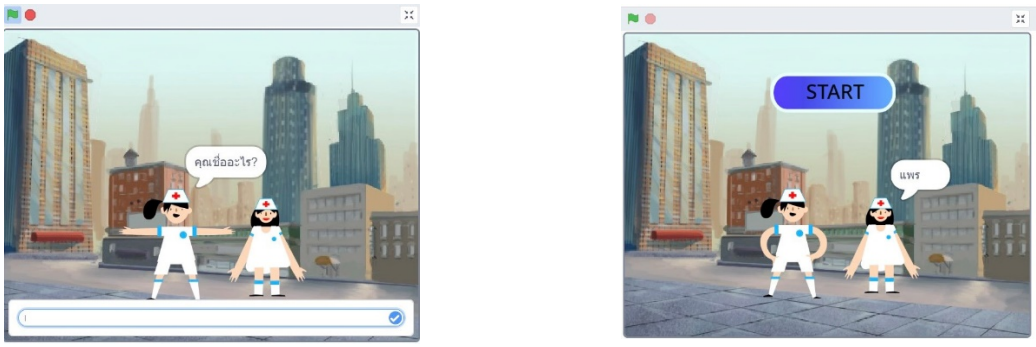

Figure 2. The example of gamification scenes

In each step of the gamified learning process, learners are evaluated step by step until all 10 steps of gamified learning process are covered. There are various assessments. For example, the learners choose the images that correctly match with knowledge, equipment, and team in the preparation for field work step, and fill in signs and symptoms of COVID-19 infection disease (The National Institute for Communicable Diseases, 2020) as shown in Table 1.

Table 1. *Investigation Process, The Scenes, and Gamified Learning Process*

Investigation process	Scene	Gamified learning process
1. Prepare for field work	A health professional is prepared with appropriate scientific knowledge, supplies, and equipment to carry out an investigation before initiating field work. A good field investigator must be a good manager and collaborator.	A learner chooses the right images with knowledge, equipment, and team.

Table 1. *Investigation Process, The Scenes, and Gamified Learning Process (Continues)*

Investigation process	Scene	Gamified learning process
2. Verify the diagnosis	Verifying the diagnosis consists of three methods. First, review the clinical findings and laboratory results. Second, find it useful to visit one or more patients with the disease. Third, summarize the clinical features using frequency distributions.	A learner fills in signs and symptoms of COVID-1 9 infection disease.
3. Verify the outbreak	A health professional verifies that a cluster of cases is indeed an outbreak.	A learner identifies whether the graph is true or false in showing the outbreak of the disease.
4. Active case finding	The clinical criteria are as follows: - fever ≥ 37.5°C - clinical symptoms: fever or chills, cough, shortness of breath or difficulty breathing, fatigue, muscle or body aches, headache, loss of taste or smell, sore throat, congestion or runny nose, nausea or vomiting, and diarrhea	A learner chooses the patient who requires investigation.
5. Orientation of case by time, place, and person	A health professional clarifies outbreak by **time** (e.g., persons with onset of illness within the past 2 weeks), by **place** (e.g., residents of Wuhan) and by **person** (e.g., persons with positive COVID-19 PCR test result).	A learner explains the next step by time, place, and person.
6. Formulate hypotheses	This process is called descriptive epidemiology in which the outbreak is characterized by time, place, and person.	A learner makes a descriptive hypothesis to investigate the disease.
7. Tasting hypotheses	Typically, hypotheses in a field investigation are evaluated using a combination of environmental evidence, laboratory science, and epidemiology.	A learner identifies a true or false analytic epidemiology study.
8.Reconsider, refine, and re-evaluate hypotheses	When analytic epidemiology is unrevealing, the hypotheses are reconsidered by convening a meeting of the case-patients to look for common links or visiting their homes to look at the products on their shelves. New vehicles or modes of transmission should be considered.	A learner explains the next step.

Table 1. *Investigation Process, The Scenes, and Gamified Learning Process (Continues)*

Investigation process	Scene	Gamified learning process
9. Recommendations of control measures	The primary goal is the control of the outbreak and prevention of additional cases. The health department's first responsibility is to protect the public's	A learner chooses an appropriate strategy to control COVID-19 infection.

	health. Thus, if appropriate control measures are known and available, they should be initiated even before an epidemiological investigation is launched.	
10. Communicate findings and writing the report	The final task is to summarize the investigation, its findings, and its outcome in a report, and to communicate this report in an effective manner. This communication usually takes two forms: an oral briefing for local authorities and a written report.	Summary points: pass or fail.

Learners can repeat a lesson if they have a score that is not high enough to pass an examination or test, as shown in figure 3.

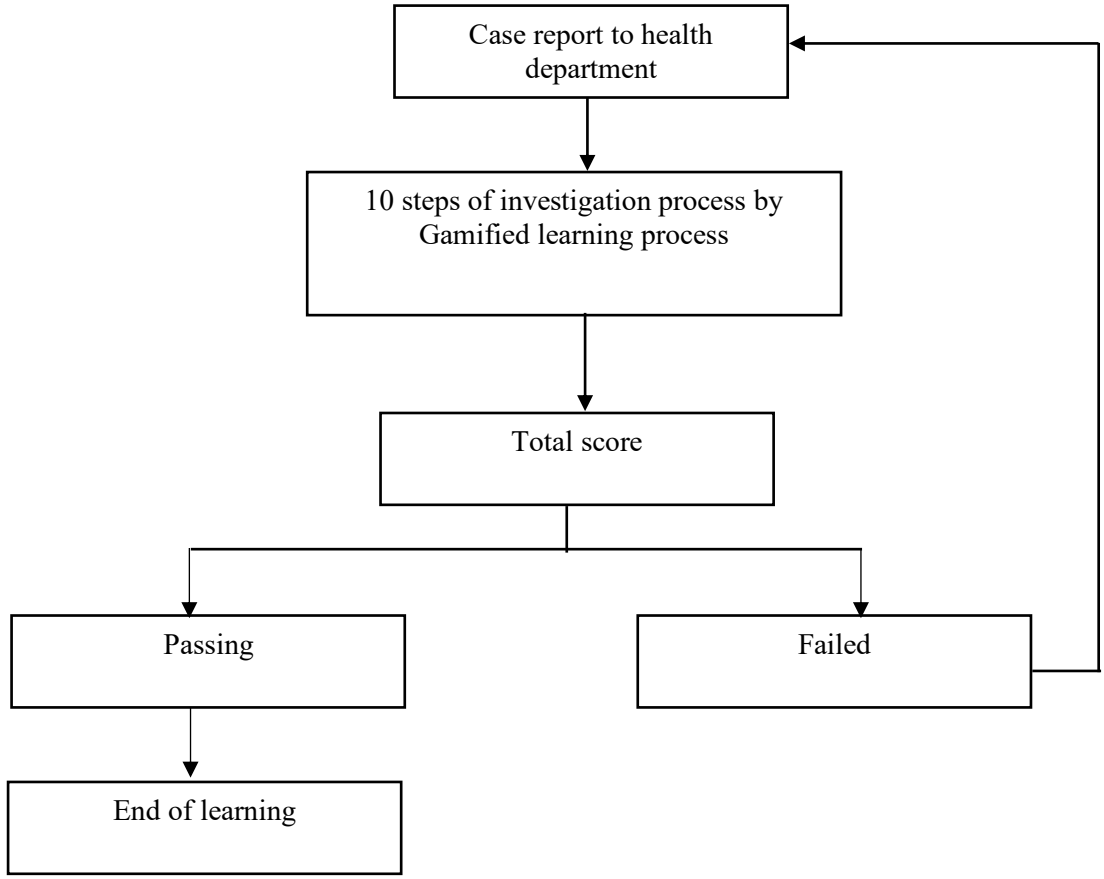

Figure 3. A flowchart of gamified learning process.

4. Conclusion

This paper shares the development of gamification elements that contribute to the formation of competences in investigation process in a community health nursing course. The gamification in COVID-19 investigation process comprises 10 steps. Learners are evaluated step by step until covering all 10 steps of gamified learning process. Nevertheless, learning how to carry out the distinct steps of investigation process can be challenging if students are not able to apply knowledge into practice. The gamified learning can provide an immersive opportunity for students to enhance their understanding of the investigation process and improve their skills. However, our paper has some limitations. This gamified learning has yet to be implemented among nursing students, but it could be implemented in the

forthcoming semester. Hence, the effect of the implementation of this gamified learning needs to be investigated in further research.

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