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ENGAGING IN CREATIVE TEACHING PEDAGOGY BASED ON SLSTAT GAMIFICATION FOR LEARNING STATISTICS

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Abstract

Learning pedagogy and strategy is important to enhance students' interest in the critical subjects or topics. Statistics is one of the subjects studied by UiTM students pursuing a Diploma in Business Transport. An innovative board game called Snake and Ladder for Fun Statistical Learning has been created in order to solve problem in learning probability (the concept in statistical learning). In this study, the traditional board game Snake and Ladder was modified by incorporating the element of learning into the newly created games namely SLSTAT. The games applied to students who took the course. Qualitative method through interview questionnaires has been used to analyse the students' interest of SLSTAT game towards the probability topic and student engagement SLSTAT game in their learning outcome. The outcomes of this game are as follows: (1) Students can apply probability, and (2) they can collaborate to solve probability-related problems. The results show most of students are likely agree that SLSTAT assist their understanding learning probability and this game can be used as part of a classroom learning activity to help students improve their probability knowledge and problem-solving abilities.

Keywords: Probability, SLSTAT, Gamification, Pedagogy, Learning

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Introduction

Many academicians have recently expressed an interest in examining learning pedagogies and strategies for increasing students' interest in critical subjects and, subsequently achieving results in the topic or subject of learning. Previous studies found that students' interests are linked to their decision-making strategies, which can predict their learning outcomes for the subjects or topics they study (Roure et al., 2017). Gamification is a learning strategy that significantly impacts both students' traditional and online classroom engagement and learning activities. In particular, there have been few studies on snake and ladder games in relation to statistical learning.

UiTM students pursuing the Diploma in Business Transport course are required to take the statistics subject, and one of the critical subtopics in this subject is probability. They must understand the concept of probability, apply the proper formula, and solve probability-related problems. Due to the topic's difficulty, an innovative game called Snake and Ladder for Fun Statistical Learning (SLSTAT) was created to help students learn probability topics and concepts.

This study had modified the traditional Snake and Ladder board game by incorporating the element of learning into the newly created SLSTAT game. The game consists of two rounds that can be played in groups or individually. Students are divided into groups and they will then roll the dice to progress from the beginning until the end of the game. Students must follow the game's rules, and penalties will be handed out based on questions with varying levels of difficulty (easy, medium, and hard). The objectives of this study are to develop an innovative board game called Snake and Ladder for Fun Statistical

Learning (SLSTAT) and to investigate the student engagement SLSTAT game in their learning outcome. This paper is structured beginning with a review of teaching pedagogy and gamification, followed by a detailed development of the innovative SLSTAT game, and finally, the findings and conclusions of the study are discussed.

Literature Review

Pedagogy is the approach to quality teaching and learning conducted by educators, which includes teaching principles, techniques, and processes (Ariffin & Yunus, 2017). It is important for educators or teachers to select a suitable method in their teaching and learning strategy to ensure students are able to understand and achieve favourable learning outcomes. A systematic, interesting, and appropriate teaching and learning process can motivate students to actively engage and maintain their motivation levels throughout the active learning session (Salehudin *et al.*, 2015; Othman *et al.*, 2020). It was also observed that integrating technology in classroom routines is a compulsory initiative that needs to be practiced by teachers (Stehle & Peters-Burton, 2019; Rusdin, 2018), especially during teaching sessions in this new Covid-19 pandemic era. The integration of information technology and education learning in connection with pedagogy as well as teaching techniques will facilitate and support students in achieving progress in 21st century learning (Rahim & Abdullah, 2017). In fact, integration of technology could offer opportunities for students to master 21st century skills, as in skills related to collaboration, information and self-accessed learning (Rusdin, 2018; Walser, 2008). The way teachers implement the teaching process also influences 21st century learning outcomes (Stehle & Peters-Burton, 2019; Rusdin, 2018). Lemke (2002) stated that 21st century skills can prepare a new generation of students to deal with possibilities that might arise in the industry, global economy, rapid technological change, information overflow and the necessary use of computers in daily life.

In order to employ 21st century skills to every student, educators face huge challenges as there are numerous skills that need to be applied in a short period of teaching and learning (Yunos, 2015). Salehudin *et al.*, (2015) found that teaching approaches and strategies play an important role in generating students' interest in a subject and can change their perception of the subject that was previously considered difficult. Therefore, the best pedagogical and teaching practices should be applied by using effective methods, such as teaching a subject by employing gamification or game-based learning techniques.

Gamification is an approach that applies game-design elements and game principles in non-game contexts (Deterding *et al.*, 2011; Mahat *et al.*, 2018; Chiu & Hsieh, 2017). By using or applying the characteristics of game elements in a set of activities or processes, some problems could be solved. Thus, by applying the gamification element when learning the subject of statistics, the approach can potentially lead to higher levels of commitment and motivation in student activities and processes. Giang (2013) reported that the use of gaming elements improved the user's capability to learn new skills by 40%. Sakai & Shiota (2016) studied the use of gamification concepts among students when teaching mathematics and found that students were more likely to feel the connection between the subject and society when the gamification concept was incorporated in the teaching and learning process. It was also reported that this approach increased motivation and interest among students. Besides using it for learning statistics as well as due to the benefits of gamification education and creative pedagogy, the computer game concept in STREAM element studies was also examined (Gumennykova *et al.* 2019). Examining the two-way communication between Arduino microcontroller sensors and a robotic system was the main purpose of the study. Five computer games were developed using the scratch software tool based on the STREAM element to strengthen the motivational activity (Gumennykova *et al.*, 2019).

One of the critical topics in statistics is probability, as students find it difficult to understand the concept and solve related problems. In the 21st century, students are easily distracted during class lesson due to several factors, such as social media or peer influence. Students' attention span is short during the normal teaching and learning session. Previous studies (Bradbury, 2016; Mautref, 2019) have found that adults have a maximum attention span of about 20 minutes. Therefore, teaching and learning statistics in this new era of education brings new challenges to both educators and students due to the

ever-changing learning environment. It is important to develop a creative learning pedagogy that involves game-design elements to enhance the learning of statistics.

Thus, the idea of including game-design elements in the learning of statistics could increase the interest of students in learning statistics. This approach could lead to higher levels of commitment and motivation in students who are learning statistics. Applying the characteristics of game elements in classroom activities motivates students to learn in a fun way (Huang & Hew, 2015; Leaning, 2015). Besides, game-design elements involve the concept of winning or losing in any game. Students are motivated to win the game when they are competing amongst each other. Some studies have shown that most students are motivated to work on their learning outcomes during learning activities that involve gamification (Gibson *et al.*, 2015). Therefore, numerous benefits could be potentially forthcoming to students who are learning statistics when gamification is integrated into learning activities in this new era of education.

Methodology

This is a qualitative study, whereby the game development process was based on the traditional Snake and Ladder game. Learning the element of probability was added to the game to create a new game named SLSTAT (Snake and Ladder for Fun Statistical Learning). Details of the game development are explained in Stages 1 and 2 of the game development process. Stage 3 of the game development process measured the learning outcome of the game. The qualitative method was also applied in this stage for collecting feedback from students. Out of all the groups of students who participated in this study, 30% of students were randomly selected for the interview. The feedback was then analysed based on the pattern of their answers.

The game was played by 28 diploma students from the J4BM1173A class at the Pasir Gudang Campus of UiTM Johor. These students were chosen to participate in this study, which was conducted during the statistics lesson, as they were enrolled in the statistics course. The game consisted of two rounds with each round lasting about 30 minutes. At the end of the game, an interview was conducted to record their feedback ragarding the game.

Game Development Process

The Snake and Ladder for Fun Statistical Learning (SLSTAT) game development process consists of 3 stages, namely Input, Process and Outcome (Figure 1). With learning elements added to the original Snake and Ladder game, the newly developed SLSTAT includes interactive features and it is a fun learning tool for students to learn probability.

Stage 1: Input – Defining and Designing

Stage 1 involved the collection of information needed to develop the SLSTAT game as well as the "Input" for developing the game, which includes preparing the contents of the probability questions and designing the characteristics of SLSTAT.

A series of probability questions are identified and designed with three levels of difficulty, namely easy, medium, and hard. SLSTAT's characteristics were designed as a board game so that it can be played by a group of students. Board games help students to learn in a group. Hence, SLSTAT encourages interactive learning.

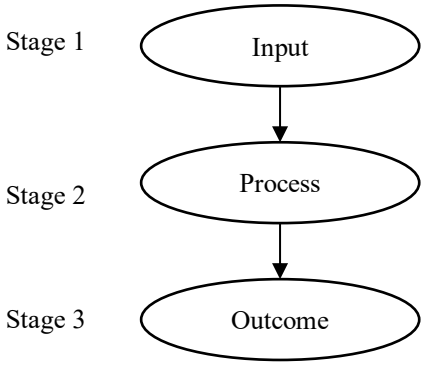

Figure 1. The SLSTAT Development Process

Stage 2: Process – Development and Application

Stage 2 is regarding the development of rules for the SLSTAT game, which is a newly developed game based on the traditional Snake and Ladder game. The basic rules of the Snake and Ladder game are still applied but learning elements concerning the topic of probability were added. This product consists of the SLSTAT board game, dice, cone pointer, and probability questions with three levels of difficulty (easy, medium and high level). Figure 2 shows the rules of the SLSTAT game.

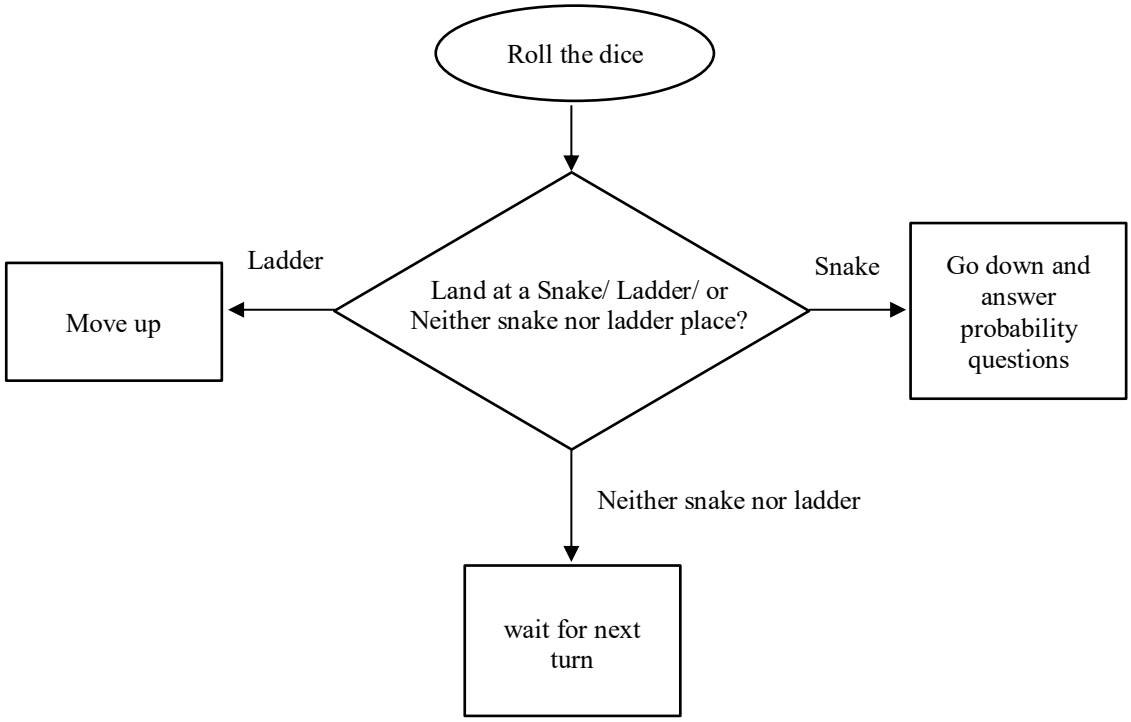

Figure 2. Rules of the SLSTAT Game

To begin the game, each group of students take turns to roll the dice. After rolling the dice, the students are likely to land on a place with a ladder or snake or a place with neither a snake nor a ladder.

When landing at the snake's place after rolling the dice, the group needs to go down following the snake's head to the tip of its tail and the whole group will be penalised. The penalty includes answering questions that depend on the length of the snake. An easy question will be given if the snake is short, while a difficult question will be given if the snake is long. The group needs to answer the question and they are allowed to use the textbook as a reference.

However, if a group lands on a ladder's place after rolling the dice, the group needs to go up the ladder. Furthermore, if a group lands at a place, with neither a ladder nor snake, it has to stay at the spot and wait for its next turn. The group which finishes the game first will be the winner of the game.

Stage 3: Outcome – Learning Outcome

Stage 3 measures the learning outcomes of the game. Students' feedback is collected after they have played the game, which is then analysed to investigate the learning outcome obtained from playing the game.

Application and Collection of Data

This SLSTAT game was played by 28 students from the J4BM1173A statistics class in UiTM Pasir Gudang Campus (Johor). Students were divided into 6 groups for the first round with each group consisted of 4-5 students. The first round took around 30 minutes to complete. The game is played on an individual basis and the winner from the first round is selected and they join the battle in the second round where selected students represent their group in this round. At the end of the game, students were interviewed. 30% of students from each group were randomly selected to provide feedback on the game. 1 to 2 students from each group were interviewed. In total, 9 students provided feedback after playing the game.

This study adduced 8 interview questions to collect feedback from the students. The typical interview questions are shown in Table 1 below.

Table 1. Interview questions in the SLSTAT game and engaging learning outcomes

	Questions
1.	Have you ever played the snake and ladder game?
2.	How do you feel when you play this game?
3.	Is it fun to play this game?
4.	Does the activity / game assist you to improve the learning of this topic?
5.	Do you like learning in a group or individually?
6.	Why do you like to play in a group/individually?
7.	How do you learn the topic?
8.	Does the game motivate you to understand and achieve the learning outcome?

Results and Conclusion

This study employed the qualitative method to analyse data, which were in the form of students' responses. From the data that were collected, the words 'happy', 'interesting' or 'fun' were set as keywords used to evaluate a student's satisfaction towards the game. Results were analysed based on how many keywords were mentioned in the students' responses. Below are feedback from students and it is illustrated based on the pattern and learning outcome to facilitate analysis.

Table 2 shows students' responses after playing the game. The observation and interview session concerning students' perception about the SLSTAT game and the outcome of their learning engagement were analysed. Findings show that students included at least one of the keywords (happy, fun or interesting) in their response. Therefore, it can be concluded that every student was satisfied with the SLSTAT game that they played. Majority of students also stated that they understood the application of the probability concept much better after playing this game compared to the conventional game. Implicitly, these games motivate students to compete with each other to become winners and build teamwork in order to solve problems related to probability. However, only two students felt apprehensive when they got to the 'snake' because they then had to answer a question. Overall, most students felt happy, excited, full of fun, and interested to play the game. At the end of the game, the winning teams received an award from the instructor. Thus, this creative learning pedagogy that employs the gamification (via Snake and Ladder Games) strategy can assist and improve students'

understanding of applying difficult topics in the syllabus, such as probability.

Table 2. Students' response to SLSTAT games and engaging in learning outcome after playing the game

No	Students' Response
Student 1, 3, 5	*I have played this game when I was in primary school. But it was a long time ago.* *The game is very interesting and fun.* *I do understand this topic clearly…* *I love learning in a group rather than individually. It helps us and we can discuss questions and compete with other groups.* *It improved me a lot.*
Student 2,4	*This is my first time playing this game.* *I feel happy and excited when learning something new.* *Much better understanding* *It improves my skills in the topic of probability.*
Student 7,9	*Have played the game before.* *Very interesting and fun* *Hope to answer more questions because the topic is quite difficult, and more exercises and activities should be introduced in other learning approaches.* *I give new insight in teaching and learning activities.*
Student 6,8	*I already know and have played this game before but not using this new approach.* *I am scared to land on the snake because I/we need to answer questions.* *Not fair for those who only land on the ladder.* *It's ok and fun also.* *Overall, it is a good practice for understanding the probability concept.*

As discussed earlier, games are one of the assorted experiential learning methods that engages students' senses, feelings, and emotions. It expresses students' active involvement in their learning process. Ideally, game-based learning could guide students to focus on a goal, choose the correct action, and experience the consequences of their actions (Geroimenko, 2019). The traditional Snake and Ladder game is also considered practical and effective as an instructional learning medium in other social study lessons. According to Syawaluddin *et al.* (2020), the Snake and Ladder learning media concerning social studies seems to be practical and valid. The study also found that elementary school students' interest and learning outcome had effectively improved.

Another study by Roure *et al.* (2017) shows that there is an association between prompt amusement in students' learning strategies and attention demand in learning outcome. Therefore, teachers could enhance students' exploration of learning tasks while creating exciting and stimulating activities. The SLSTAT game reacted and corresponded towards achieving the desired learning outcome as mentioned by Syawaluddin *et al.* (2020) and Roure *et al.* (2017). In addition to encouraging students and enhancing their learning strategies, teachers should consider designing intriguing learning tasks that require higher-order cognitive processes that demand active exploration, as mentioned by Roure *et al.* (2017).

Therefore, creative learning pedagogy in classrooms is important for achieving learning outcomes (Amponsah *et al.*, 2019). According to Kiryakova *et al.* (2018), teachers must address critical concerns related to the adaptation of the learning process for students with varying learning styles, as well as new teaching and learning tools. Learning outcomes should be defined and clearly explained to the students. Thus, it is essential for the instructor to select the appropriate game mechanics and techniques based on the educational content and activities in the learning process. Therefore, it can be concluded that the SLSTAT game can be used as part of a class's learning activity as it enriches students' knowledge and problem-solving skills in probability. It has been strongly suggested that a creative learning method introduced to the classroom will provide a better understanding of collaborative learning and improve students' skills and knowledge.

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