Promoting Student Thinking and Engagement Through Question-Based and Gamified Learning

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2022 IEEE 14th International Conference on Humanoid, Nanotechnology, Information Technology, Communication and Control, Environment, and Management (HNICEM) | 978-1-6654-6493-2/22/$31.00 ©2022 IEEE | DOI: 10.1109/HNICEM57413.2022.10109470

***Abstract*— Student engagement and enrichment are key factors as learners have shifted from the traditional classroom to the virtual classroom when a flexible learning environment has been in place. It has posed a challenge for educators to shift from traditional educational methods to the utilization of technology-enhanced learning all the more since online and flexible mode were often used since the pandemic. This paper intends to convey that students may exhibit engagement inside the virtual classroom by posting student-generated questions during a discussion forum in the Canvas LMS as question-based inquiries. More so, students have enjoyed and increase their academic performance by playing and participating in a gamified learning activity. This research discussed an activity in encouraging students' learning, curiosity, and involvement in online learning environments. The authors aim for this objective by fusing the 1) utilization of student-generated questions in the goal of promoting learning and thinking, and 2) boosting student engagement through the use of gamified activities which increases students' academic performance. These intentions will be realized in the virtual classroom implementation and its assessment. Employing the Canvas New Analytics, 148 first year-second semester students *questioned* their teacher about a course topic and as their questions were each replied to, they were graded through discussion post with an average grade of 99% for all sections. The game Jeopardy was played as an examination review session for the same sections and 181 students from the four sections have an average grade score of 77.5% in their midterm examination. A course learning objective item is also measured with a university target that at least 60% of students should reach an average grade score of 80% and above. For the CLO target, average of four sections reached 68.3% which is descriptively attained. Generating questioned-based inquiry in the forum discussion showed an increase in engagement and enrichment from students. The findings have a positive impact on them as their posted inquiries and questions gained them grades which indicated high average grade for each section. Utilizing a gamified learning activity in a pure online setting for the school year 2021-2022, allowing the students to participate in educational games is necessary to boost engagement and enrichment as well.**

Keywords— student engagement, student-generated questions, gamified learning activity

I. INTRODUCTION

Over the years, quite several research papers have proposed educational methods to help improve student focus, their learning quality, as well as their academic and personal development experiences. [1] argued that some of the classical educational methods and basic core principles of learning have not been used as educators moved forward in consideration of learner progress, technology, and complex teaching pedagogies. As a result, students have been boxed into specific learning styles. Educators have faced a more challenging role as learner presence have shifted to merely participants in a Zoom conference meeting room or other platforms of its kind. The modes of flexible learning setup and online learning environment have surfaced the start of school year 2020 and have just been starting to shift again to hybrid flexible learning. Having to teach in this environment allowed the educators to instill learner engagement alongside promoting academic performance. [1] stated that teachers in traditional who implement teaching methods have the ability to transmit skills, while the utilization of active learning activities tends to promote learning and increase student academic performance. In this paper, the main objective is to promote student learning, curiosity, and engagement in the online learning space. Specifically, the authors aim for this objective by fusing the 1) utilization of student-generated questions in the goal of promoting learning and thinking, and 2) boosting student engagement through the use of gamified activities which increases students' academic performance. Largely, these intentions will be realized in the virtual classroom implementation and its assessment.

A. Student-Generated Questions

Allowing the learners to formulate questions based on study material also has moderate to large impact on comprehension, recall, and problem-solving [2]. [3] stated that generating questions can stimulate deeper processing and reflection of learning material and retrieval exercises compared to reviewing. In the midterm period of the first and second semester of the school year 2021-2022, a sole activity was given to the students to post their generated question in a Discussion forum in the Canvas LMS. In this study, the Canvas learning management

system was commissioned in the delivery of the instructor's teaching and learning activities alongside Zoom for synchronous sessions in lecture and demonstration.

B. Student Engagement through Gamified Learning Activity

Gamification applications for online courses have been limited. Gamified active learning has the potential to increase student engagement, generate enthusiasm, provide immediate feedback, and more social connections than traditional online course settings [4]. More so, the costs of using an educational game design with effective delivery of game plans and in relation to its course contents can be prohibitively expensive, particularly for instructors with limited knowledge in computerized gaming, as well as a budget for creating such environments to be utilized in classrooms [5]. Theoretically wise, a faculty may find it challenging to look for great educational games fitted for the students aligning the course learning outcomes of a subject in a degree program. The insufficient resources and lack of support from a home university or institution may be a factor as well, not including trainings related to online teaching technology to embed game settings in existing courses.

II. METHODS

The intention of this paper is to implement and assess its two (2) detailed objectives, promote student-generated questions, and boost their engagement and enrichment in the virtual classroom and assess student improvement ability in the said topical section in the course outline. Student participants of this study consisted of four (4) sections totaling to 148 to 181 first year level students in the second semester in the same school year. These students engaged in the incorporation of student-generated questions and a gamified active learning strategy inside the virtual classroom. The range indicated participation in student-generated discussion post and the gamified learning activity, respectively.

A. Thinking and Learning by Question-Based Inquiry

The first objective was to utilize student-generated questions in the goal of promoting learning and thinking. [6] has written that while generating questions is an effective study strategy, it also can be adapted into a classroom activity, whether online or in person. One hundred forty-eight (148) first year students who are studying advanced programming using Java in the second semester were tasked to post their generated question or any inquiry on the topic of Java Exceptions. Using the Discussion menu in the Canvas LMS, the faculty replied to each and every question or inquiry that the students posted. Fig. 1 is a screen capture of the Discussion Forum in Canvas showing a couple of students posting inquiry and question. The reply of the faculty is shown in each thread. The faculty has replied to all four (4) sections of this forum discussion (totaling 148 students), allowing the learners to freely state and inquire any topic about Java Exceptions that are confusing them or further need to dig upon into.

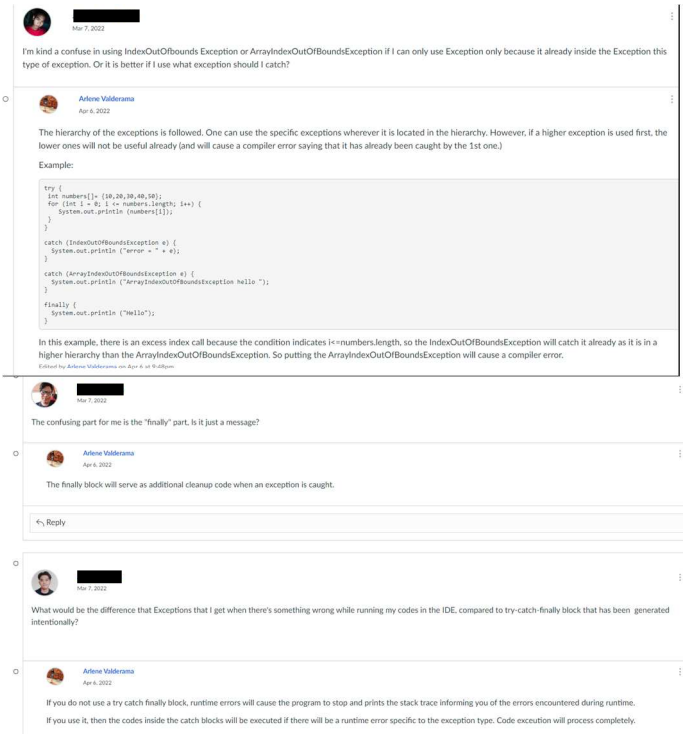

Fig. 1. Screen Capture of the Portion of the Discussion Forum on Java Exceptions in the Canvas LMS

B. Gamified Active Learning

The second objective is to boost student engagement through the use of gamified activities which increases students' academic performance. "Gamified" active learning has been shown to improve students' academic performance and engagement while also assisting them in making more social connections than traditional course settings [7]. The authors stated that one of the special characteristics of the gamified learning activities was to have students submit and assert their answers in a game setting, such as the Jeopardy game. To implement active learning in the virtual classroom, gamified activities were applied such as allowing the students to play and participate in games like Jeopardy as played in the American TV show. In the intention to take advantage to utilize gamified activities, innovation is also key. However, they may be based on existing techniques such as HTML-based games which are also readily available. In this study, the faculty used Jeopardy Labs, which was created by Matt Johnson. Jeopardy Labs has an easy-to-create jeopardy game template. It may be accessed in https://jeopardylabs.com/. The topics, price amounts, answer-type questions, and question-type answers can easily be set and created. Fig. 2 shows a screenshot of the topics and amounts, represented as points to be accumulated to gain winners of the game that was applied in the Advanced Programming course. Student players were enthusiastic as they viewed and read the answer-type question, as how the Jeopardy game in the American TV program does it. Their answers must be in question type.

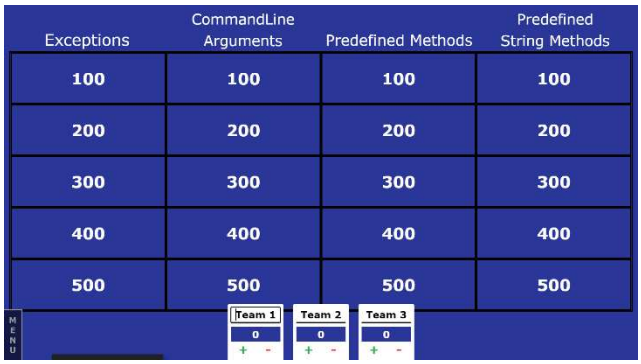

Fig. 2. Jeopardy Screenshot View: Midterm Topics in Advanced Programming

Fig. 3 displays a screenshot of the example of an answer-type question under the Exception category of one hundred points. As students play, they were grouped into teams for a complete participation in the class. They were divided into 3-4 teams depending on the class size maximizing all students who are present in zoom. Even in a group, the team members can talk it out with them via zoom chat which category to choose and the actual question-type answer. To minimize noise in the virtual classroom, each team has a designated spokesperson to choose the category and eventually voice out the question-type answer for that matter. Although other teams can view each other's team chats, the team who had the chance to play has already the advantage. Also, other teams can steal if an answer is wrong. All instances involving selecting the first team to choose category and next team to steal were made through the first member in any team to raise a hand in the Zoom meeting.

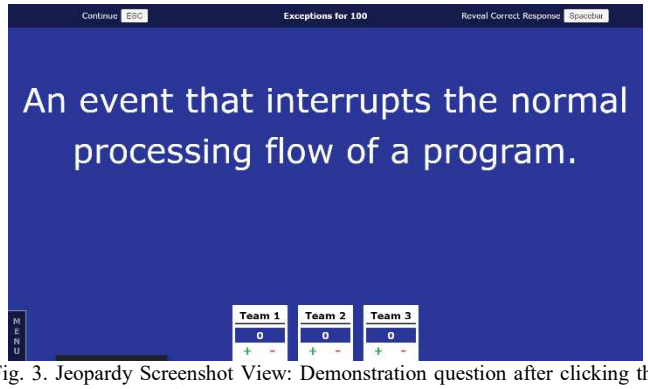

Fig. 3. Jeopardy Screenshot View: Demonstration question after clicking the Exceptions Topic under 100pts

The team who has the highest accumulated points wins. Fig. 4 displays a screenshot of the Jeopardy view: Displaying the question-type answer in the Exceptions topic under one hundred points.

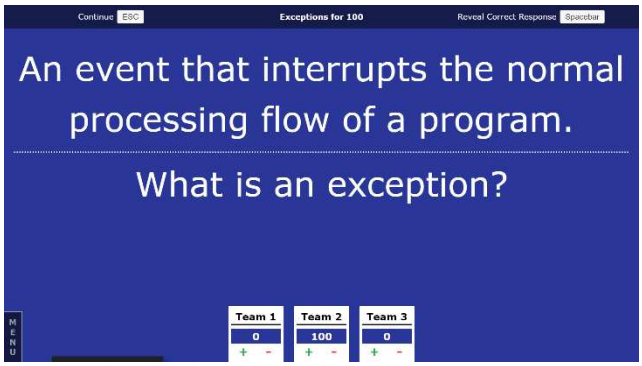

Fig. 4 Jeopardy Screenshot View: Displaying the question-Type Answer in the Exceptions Topic under 100pts

III. Results and Discussion

A. *Boosting Student Thinking and Learning*

In order to increase the students' learning and thinking through boosting learner engagement, the authors present the total questions and inquiries of students who made replies in the Discussion Forum for the course code ITC C106 which is Advanced Programming descriptively.

This information may be retrieved in the Canvas LMS using New Analytics. Canvas website description [8] about this includes that New Analytics is an LTI tool installed at the account level and can be made visible in all courses. Two of the applicable uses of New Analytics Tool are 1) view average course grade analytics as an interactive chart graph or a data table, and 2) compare the course average with an individual assignment, course section, or student filter using the chart graph comparison or data table comparison.

In line with this, table I presents the participations of the students in the specific discussion post where they will post their student-generated question or inquiry about Java Exceptions. For section 101i, there are forty out of 50 students who posted. They were graded using a Discussion rubric criterion as shown in Fig. 5.

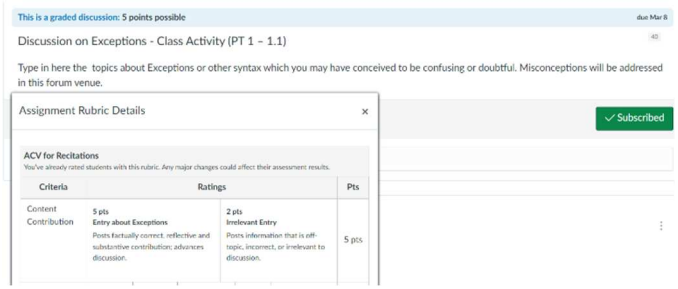

Fig. 5. Rubric Criterion for Discussion Forum on Student-Generated Questions about Java Exceptions

In the discussion post, section 101i where 40 of 50 students posted their question or inquiry, the section has an average grade of 98% with a low of 60% and a high of 100%. This pertains to the percentage from Canvas New Analytics where two of the forty participation posts are in the range of 60-65% grade range and thirty-eight are in the 95-100% grade range. Missing number of students (10) in the posts indicate no posting.

For section 102i where 47 of 56 students posted their question or inquiry, the section has an average grade of 98.3% with a low of 60% and a high of 100%. This pertains to the percentage from Canvas New Analytics where two of the forty participation posts are in the range of 60-65% grade range and forty-five are in the 95-100% grade range. Missing number of students (9) in the posts indicate no posting.

In presenting the result for section 103i where 41 of 49 students posted their question or inquiry, the section has an average grade of 100% with a low of 100% and a high of 100%. This pertains to the percentage from Canvas New Analytics where forty-one participation posts are in the range of 95-100% grade range. Missing number of students (8) in the posts indicate no posting.

For the last section 104i, only half of the class participated as the section has a number of students who has either officially or unofficially withdrawn. There are 20 of 40 students who posted their question or inquiry, the section has an average grade of 100% with a low of 100% and a high of 100%. This pertains to the percentage from Canvas New Analytics where all twenty participation posts are in the range of 95-100% grade range. Missing number of students (20) in the posts indicate no posting. Table I presents these results.

TABLE I. NEW ANALYTICS AVERAGE GRADE OF STUDENT PARTICIPATION AND PERFORMANCE IN THE DISCUSSION

ITC C106 Section	Number of students who posted question or inquiry	Average grade using rubric criterion
101i	40 of 50	98%
102i	47 of 56	98.3%
103i	41 of 49	100%
104i	20 of 40	100%

For all sections, there are high percentages of participations respectively 80%, 84%, 84%, and 50%. This implies that for this high participation rate adding the average grades shown in the Table 1 for all four sections, students were immersed in topic, and it promoted thinking and learning as they have met the criterion in posting their own generated questions or inquiries.

B. Gamified Activity

In the intention to boost student engagement through the use of gamified learning activity using the game Jeopardy, the faculty initiated the game before the Midterm examination of the students. All term major examinations and laboratory exercises of the course syllabus were measured using the Course Learning Outcome 3 of each course and its target is that 60% of the students have reached an average score of 80% and above. To present the results, section 101 has gained 63.4% attainment of CLO 3, 102i has 75.5% CLO 3 attainment, section 103i has 73.4% CLO 3 attainment, and section 104i has 61.1% CLO 3 attainment. CLO 3 was attained as all sections' midterm laboratory exercises and examination achieved grades leading to the results. Table II displays the CLO 3 percentage result for all sections.

TABLE II. CLO 3 PERCENTAGE

ITC C106 Section	CLO 3 Percentage (Target-60%)
101i	63.4%
102i	75.5%
103i	73.4%
104i	61.0%

As for the New Analytics presentation of the student academic performance for the midterm examination, section 101i has an average score of 80% where 47 of 47 students have taken the exam. Section 102i has an average score of 78% where there are 53 of 54 examination takers. Section 103i has and average score of 80% of 49 of 49 takers, and section 104i has an average score of 72% where 32 of 32 students have taken the examination. Table III shows these results.

TABLE III. NEW ANALYTICS AVERAGE GRADE MIDTERM EXAM SCORE

ITC C106 Section	Number of Midterm Exam Takers	Average grade using rubric criterion
101i	47 of 47	80%
102i	53 of 54	78%
103i	49 of 49	80%
104i	c	72%

In the light of the Jeopardy game successfully played and engaged by the learners, their scores in the game were part of their performance task and were graded according to the rubrics in Fig. 6.

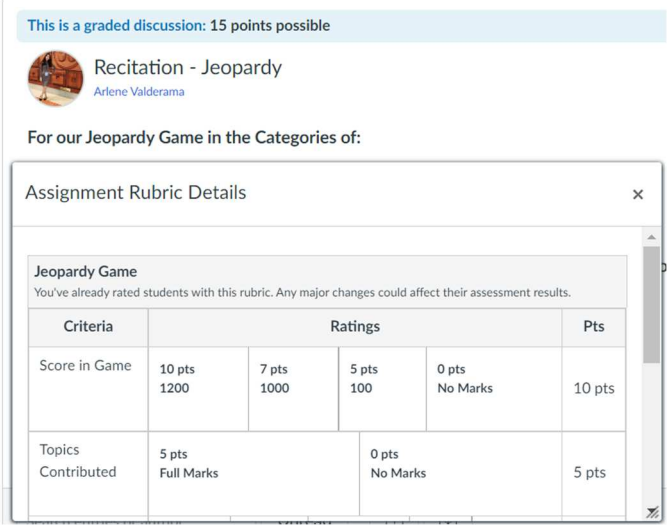

Fig. 6 Rubrics for Jeopardy Game as a Performance Task for Section101i

Each question scores 100 to 500 for each topic, having five questions for each topic as shown in Fig. 2. For each section, all total scores show differently in each rubric. As seen in Fig 6, for section 101i, the three teams scored 1200, 1000, and 100, respectively. This differs for the other sections. Fig. 7 shows a

screenshot of the actual Canvas Grades menu for the results for section 101. Thus, to be scored individually even in a team, they needed to type the topic, or the answer they have contributed to their team. This item shows in the rubrics in Fig. 6. The rubrics core is distinct for each section.

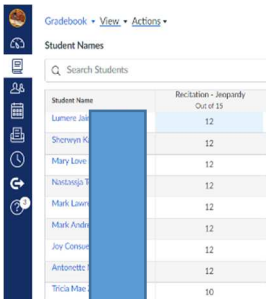

Fig. 7 Cropped Screenshot of Jeopardy Game Results from Canvas Grades Menu

The students posted their team score and the topics in a Discussion post created to document the team score even as this was already known after the game. This also shows to follow Canvas as the platform for grading even a faculty uses outside resources or third-party sites to maintain student engagement activities such as Kahoot! IT, Quizziz and the like. Fig. shows a sample screenshot of the discussion post.

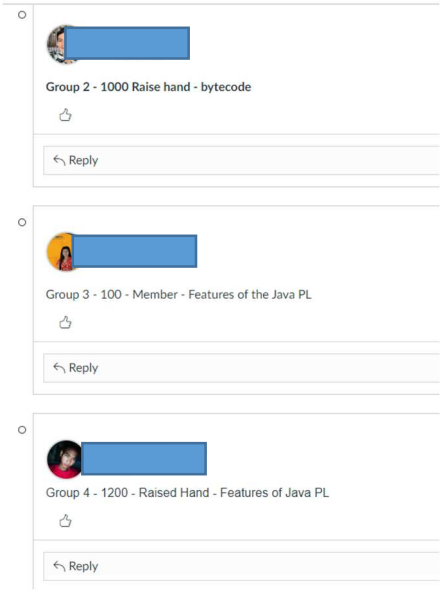

Fig. 8 Screenshot of Student Replies of their Team Score and Topic or Answer contributed

Clarificatory in this research paper's objectives, promoting learning and thinking for the students was conducted to the midterm period and was limited to a certain topic content from the course syllabus. The topic was Java Exceptions where it was the first time the first-year students have engaged into.

Boosting learner engagement using the active learning strategy was employed through the Jeopardy game was limited as well to topics on Java Exceptions, Command Line Arguments, Predefined Methods, and Predefined String Methods. Participants of this paper was conducted to first year Bachelor of Information Technology students during the second semester.

IV. Conclusions

Students are naturally curious, with a strong underlying motivation to explore, learn and understand their world. Classroom activities, therefore, need to take advantage of this inherently energetic and curious nature in order to become a lifelong activity for them who are willing to learn, are able to learn, and want to learn new things [9]. This is especially realized in the online environment and while this modality must support learning continuity, it was evident that online classes have become a place for students to socially engage with others to meet various psychological needs to buffer pandemic stress. [10]. This is why this study focused on enrichment and engagement.

The results of this study in presenting the students capacity to create and post questions and inquiries about a course topic in the middle of the semester in the Advanced Programming course indicated high student participation. But more importantly, their questions which were addressed individually in the thread indicated a high student academic performance through the Canvas New Analytics tool. These show an increase that engagement and enrichment from students. Further, the findings have a positive impact on them as their posted inquiries and questions gained them grades which indicated high average grade for each section. This finding was also in similitude to the study of [11]. where the students not only enjoyed the exercise, but many have called it a "rewarding experience" and additionally gaining seven percentage points higher on their final exam.

In the interpretation of utilizing a gamified learning activity in a pure online setting for the school year 2021-2022, allowing the students to participate in educational games is a must to boost engagement and enrichment as well. This proves as well that gamifying a course, thus engaging games as a course activity makes it an effective method for students to learn concepts as well [12]. The game Jeopardy played before the Midterm examination served as the students' reviewer while enjoying in the virtual classroom as they play it and more importantly helped them increase their midterm examination performance. The students exhibited how to work in a team collaboration. This particular results of the study also poses a challenge for educators transforming to hybrid flexible learning as onsite students need teaching and learning tactics to fit the characteristics and learning needs of those who are online participants. As [7] has put it, online instructors may need to challenge themselves and employ more instantly interactive gamified learning activities to increase students' engagement. And as for the students, who may be regarded as early adults, have higher chances to be involved in online communities where they may communicate social information in a variety of ways [13] especially if their developmental learning were fructified in participating in active learning in their tertiary stages in universities.

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