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Development of a Contextualized Digital Game on Typhoon Preparedness for Grade 8 Learners

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Abstract

In the Philippines, typhoons are the most frequent natural disaster and can occur at any time of the year. Most of the studies on typhoon preparedness reported inadequately prepared or with low to moderate levels of preparedness. Even though these topics are already embedded in the K-12 curriculum with constructed diagrams and illustrations, their understanding of these concepts in Typhoon preparedness is not assured as they leave their formal schooling years. To address this issue, this study developed contextualized digital game as supplementary teaching material in teaching typhoon preparedness for Grade 8 learners in Junior High School to improve decision making and response knowledge of students in the occurrence of typhoon. The researcher utilized the ADDIE Model to developed digital game on typhoon preparedness based on the game element preference of the learners. Upon development, one hundred eighteen (118) respondents were chosen to test the reliability of the application which composed of grade 8 learners, in-service science and ICT teachers and CDRRMO personnel. Further, ISO 25010 was adapted assessing the project. The results showed that the game is strongly acceptable and gives appropriate output in terms of disaster preparation garnering a total mean of 4. The achievement test was used to measure the learners' achievement levels. Results showed a significant difference in the mean score of the learners in their pretest and posttest scores. The significant improvement in posttest scores suggests that the contextualized digital game intervention was successful in achieving its intended objectives. Hence, it indicates that the game designed to provide useful and accurate information on typhoon preparedness while promoting active participation and motivation, effectively enhanced the students' understanding and awareness of disaster preparedness measures. Also, the findings validate the contextualized digital game as a valuable educational tool for disseminating information on natural calamities such as typhoons.

Keywords: Game based learning, digital game, typhoon preparedness

1. Introduction

The Philippines is one of the most world's disaster-prone countries due to its geographic location in the Pacific Ring of Fire and along the boundary of major tectonic plates and at the center of a typhoon belt, making the country susceptible to multitude of hazard which are regularly impacted by floods, typhoons, landslides, earthquakes, volcanic eruption, and droughts (Bollettino et al., 2018). The northernmost province of the island, Misamis Occidental, experienced flooding-related damage to infrastructure, homes, and crops as a result of the presence of typhoons in Mindanao. No previous research on the management of earthquake, typhoon, and flood catastrophes in Oroquieta City, Misamis Occidental was found. Thus, the goal of the current study is to look at how prepared and informed the learners areas for various natural calamities.

The Department of Education (DepEd) reiterated the need for strengthening the capacity of schools to enable them to respond in the event of disasters and emergencies to save more lives and ensure resilience. The role of educational institutions is very significant to create environmentally aware and eco-conscious learners (Rogayan & Nebrida, 2019). Various stakeholders should collaborate in exerting more effort to enhance students' environmental literacy in the Philippines (Gatan et al., 2021). Some studies have claim that learners in junior high school have low to moderate practice in disaster preparedness. In the study conducted by Hipolito (2019) learners in Pampanga have moderate practice in disaster preparedness in school; Rogayan et al. (2022), revealed that grade nineth learners in Zambales assessed themselves to be often prepared for the occurrences of the different disasters. Even though these topics are already embedded in the K-12 curriculum with constructed diagrams and illustrations, their understanding of these concepts in Typhoon preparedness is not assured as they leave their formal schooling years.

In the realm of teaching science and technology recently, digital game-based learning (DGBL) has dominated. Digital game-based learning has received a lot of interest in educational settings because of the positive correlation between Digital Game Based Learning (DGBL) and motivation, instructors are now more interested in learning these strategies than in using more conventional ones (Alsawaier, 2018). DGBL is a learning and teaching approach that utilizes digital games/game-based environments to create intriguing, engaging, entertaining, and challenging activities and experiences with the goal of achieving learning objectives and producing learning outcomes that can be objectively measured (Coller & Scott, 2009). The game-based learning in science education is an effective method to help students achieve the learning goals and support their learning of scientific knowledge (Li & Tsai, 2013; Wang & Zheng, 2021).

Thus, this study was to develop contextualized digital game that provide useful and accurate information that show and enforce the measures that can be taken against teaching typhoon concept. In addition, it also aimed to determine the level of awareness and preparedness in disaster that will be used as an alternative tool for disseminating information regarding natural calamity through game development. This contextualized digital game aims to highlight the importance of active participation and motivation, which provides an interactive and engaging environment among the learners.

2. Objectives of the Study

This study was conducted to develop a contextualized digital game on Typhoon Preparedness for Grade 8 learners. Through this study, a digital game-based served as supplementary learning resources in teaching Typhoon Preparedness concepts to improve decision making and response knowledge of learners in the occurrence of typhoon. Specifically, the study aimed to:

2.1 Develop a contextualized digital game on Typhoon Preparedness based on the element preference of the learners in terms of:

a. Earth Science topic
b. Scientific Character
c. Game Setting
d. Help Preferences
e. Activity Mode
f. Scientific Attitudes

2.2 Determine if there is a difference between the pretest and posttest mean scores of the learners;

2.3 Determine the perception of the learners and teachers and perceived usefulness of the panel of evaluators towards the digital game in terms of value/usefulness, interest/enjoyment and perceived choice.

3.Methodology

3.1 Research Design

The study utilized the developmental research design using ADDIE model and used quasi-experimental method research, covering quantitative and qualitative approach. On the validation part, quantity with qualitative support was used in the study. The quantitative approach focused on assessment done to evaluate the digital game and the quality of use of the developed application. The quantitative data were obtained from the scores of the evaluators based on the adapted Likert scale evaluation, students' scores in the pre-assessment test, achievement test, level of awareness of the learners, perception scores in the Survey Instrument on the Game-Based Learning Approach, and readability test. The qualitative approach covers the data that were obtained from the comments and suggestions from the face validation and the perceptions of the teachers gathered from the open-ended survey questionnaire. The study used the quasi-experimental research design (pretest- posttest design) wherein the researcher administered two measures pretest and posttest after exposing the respondents to the intervention, which is the developed digital game.

3.2 Research Participant

The respondents of the study were 107 Grade 8 learners from both private schools with 60 students in two sections of Stella Maris College and 47 students in one section of Deor&Dune Academe. The researcher used purposive sampling method this means that the participants are selected on a certain criterion for a particular purpose. The selection of the respondent's year level is according to the K-12 curriculum guide where the topic Typhoon, falls in the second quarter of Earth and Space Science of the grade 8 level. In addition, five City Disaster Risk Reduction Personnel and six In-service science and ICT teachers evaluated the final version of the develop contextualized digital game and answered the open-ended survey questionnaire for the perceived usefulness of the develop application.

3.3 Research Setting

The study was pilot tested and implemented in a private school namely Stella Maris College and Deor&Dune Academe School of Technology in school year 2023-2024, both schools were located in the City of Orquieta, Misamis Occidental. Each school has the facilities of computer laboratory wherein the learners can play the digital game.

3.4 Data Gathering Procedure

This study employed a Descriptive Developmental Research Design. The ADDIE (Analysis, Design, Development, Implementation, and Evaluation) Model was adapted in the development of the contextualized digital game. In analysis step, the researcher identied the learning gap and needs of the learner respondents through needs of assessment of the respondents' pre-existing knowledge of Typhoon Preparedness using the validated pre-assessment test and the level of awareness of the learners in disaster preparedness using the adapted questionnaire. The validated pre-assessment test was pilot tested in Stella Maris College to the Grade 8 learners for reliability In design step, the contextualized digital game was designed based on preference of the learners and it was based on disasters on typhoon that had occurred on the City of Oroquieta Misamis Occidental. The storyline of the game was based on Disaster Preparedness Activity book that was conceptualized into a digital game. The development of the conceptualized digital game was face validated by the in-service science and ICT teachers and CDRRMO evaluators and tested for readability by the learners. Next step implementation, the digital game was to the Grade 8 learners in the private school of Deor&Dune Academe School of Technology. Lastly in evaluation step, the game was evaluated and validated for the following qualities: Instructional Content, Functional Suitability, Performance Efficiency, and Usability, which are based on ISO 25010 or the Software Product Quality Model (ISO, 2011). Additionally, a comments and suggestion section was added to allow the panel of evaluators to give their subjective feedback and insights. The researcher determined the students' and teachers' perception using the adapted Survey Instrument on the Game-Based Learning Approach Perception Questionnaire.

3.5 Data Analysis

Both quantitative and qualitative analyses were used to determine the achievement level of the respondents who were exposed to the digital game. The qualitative data was derived from the perception and perceived usefulness of the digital game from the results of an open-ended survey questionnaire of the panel of evaluators. The mean rating was used to determine the average scores in the Achievement Test for both the pre-test and the post-test of the learners. The pretest raw scores of the two groups were used to determine the comparability of the Science subject. The t- test was used to test the significance difference between and within groups' pretest/ posttest results and with gain scores.

4. Results and Discussion

4.1 Learners User Profile and Game Element Preferences

Table 1 provides a summary of statistics pertaining to the diverse demographic profiles of one hundred seven (107) Grade 8 learners from two private schools in Oroquieta City, namely, Deor&Dune Academe School of Technology and Misamis University- Oroquieta Unit. The table includes counts and percentage.

Most respondents (85.00%) are between 13 to 20 years old, indicating that the survey primarily targeted adolescents and young adults. Respondents show the highest interest in floods (55.00%) and typhoons (36.67%) among the listed natural disasters, while earthquakes and the solar system are of less interest. In terms of game character reference, majority of respondents (80.00%) preferred the 13 to 20 years old age group in the game, with (55.00%) self-identify as fit, and 58.00% wanted an Asian game character. "Asian" ethnicity refers to all people in Asia regardless of their cultures. It appeared that in most cases, girls also prefer a female character while boys also want a male game character. It can be seen also that they put a high regard to their age such that they want a character of their age. Most respondents (25.00%) prefer gaming in the plaza. The best games provide help options to players when things go wrong. In this study discovering the answers to

solve a problem is most commonly preferred by respondents (45%) instead of being given the answer or hints from a guide (16%). This simply shows that students want to explore solutions on their own when stuck during gameplay.

Table 1 Descriptive Analysis Result for Game Element Preference of Learners

Game Element Preference	Category	n (%)
Age, in years (G1)	13-15 years old	51 (85.00%)
Sex (G2)	Male	35 (58.83%)
Frequency (G3)	Daily	45 (75.00%)
Hours (G4)	1-3 hrs	41 (68.33%)
Game type (G5)	Action & Strategy/ puzzle	29 (48.33%)
Reasons for playing games (G6)	Relaxation, challenges mind	05 (08.33%)
Gadget type (G7)	Cellphone	42 (70.00%)
Player type (G8)	Single player alone	28 (46.67%)
Earth Science topic (G9)	Typhoons	32 (53.33%)
Character Sex (G10.A)	Male	33 (55.00%)
Character Age in years (G10.B)	13-20 yrs old	48 (80.00%)
Character Body Type (G10.C)	Fit	33 (55.00%)
Character Race (G10.D)	Relaxation, challenges mind	05 (08.33%)
Game Setting (G11)	Plaza	15(25.00%)
Help Preferences (G12)	Discovering the answer	27 (45.00%)
Activity Mode (G13)	Active	13 (21.67%)
Scientific Attitudes (G14)	Responsibility and critical mindness	33 (55.00%)

Further, it is much important to note that among the six options of activity mode preference, most of the respondents wanted an active game (43%) as key characteristics in gaming. Game-based learning has emerged as powerful and effective context for nurturing students' problem-solving skills (Kailani,Newton, & Pedersen, 2019). The integrated data mining approaches enable a new genre of behaviors analysis that reveals how students implicitly solve problems rather than just summarizing what they exhibit or perform in games. When asked about the scientific attitude that they want to be integrated in the game, results show "responsibility" and "critical mindness" are endorsed by the majority of the respondents (18%).

4.2 Development of Digital Game on Typhoon Preparedness

The game was named Ready Set Prepare since it aimed to provide on what should a person do before, during and after a natural disaster. The digital game was designed based on the learners' user profile and game element preferences. The programming phase was done by a game developer. Play testing was carried out as soon as the first version of the game came out. The developed game was then submitted for evaluation by the evaluators. After implementing few revisions, the game was implemented to its target users.

The digital game was developed based on the storyboard on Disaster Preparedness Activity. A storyboard will be created to facilitate the game's flow with a goal to provide on what should a person do before, during and after a disaster thus, in this game provide learners with the skills to enable them to be better prepared in a real typhoon situation.

Figure 1. Landing Page of the Digital Game

The landing page contains the other pages of the games namely; start game, settings, high score, and exit game. In the category page, the common disaster in Oroquieta City is projected. Here, the learner clicked on typhoon disaster to be pursued on. This category contains problems that needs to be solve through the correct procedure that is implemented by the player.

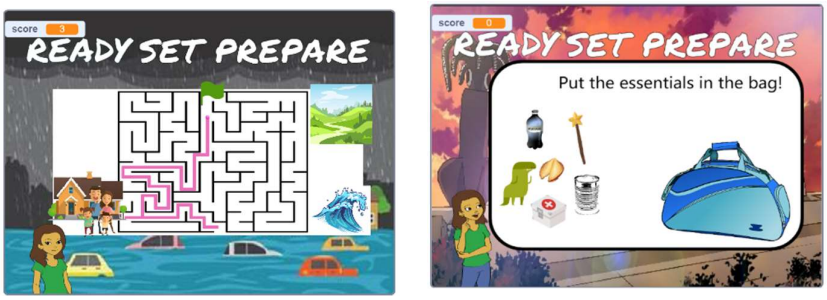

Figure 2. Sample in-game scenario to be solved by the player

In-game scenario contained an actual scenario of particular disaster of typhoon. The questions must be answered by the learner to move on to another level. Along the way they learn how to help prepare their home for a tropical cyclone and interpret cyclone warning systems. They ascertain and purchase emergency kit supplies, prepare a family emergency plan and identify a safe place to shelter with information provided that is specific to each state's emergency procedures.

4.3 Learner's Achievement in the Pre and Post Tests

In this study, the pretest and posttest scores of 107 learners to evaluate the effectiveness of a new teaching intervention were examined. The following frequency table summarizes the distribution of scores for both the pretest and posttest assessments. The table provides insight into the distribution of scores across different scores and to assess the impact of the intervention on student learning outcomes.

Table 2. Performance in the Pretest and Posttest

Score	Description	Pretest		Posttest	
		Frequency	Percentage	Frequency	Percentage
0 – 4		0	00.00	0	00.00
5 – 9	Failed	0	00.00	0	00.00
10 – 14		0	00.00	0	00.00
15 – 19		14	23.00	0	00.00
20 – 24	Passed	38	63.00	21	35.00
25 – 30		08	13.00	38	63.00
Total		60	100.0	60	100.0

As to the average pretest scores of the 107 grade 8 learners in private school in Oroquieta City namely, Deor&Dune Academe School of Technology and Stella Maris College, it ranges from 15 to 25 out of 30 items. Some variables show consistent scores among Grade 8 students, as evidenced by standard deviations of almost 0.00, indicating that almost all respondents scored the same value on the pretest for these variables. Consistency in scores may suggest uniform understanding or responses among students for certain topics or questions. For the average posttest scores, it ranges from 20 to 29. The same with the pretest scores, there is consistency in students' scores that may suggest uniform understanding among students for certain questions. It is also evident that posttest scores were higher than the pretest scores. This might indicate an improvement or gain in knowledge, understanding, or skills among the grade 8 students after they were exposed to the intervention, which in this case is the contextualized digital game on typhoon preparedness.

Table 3 shows the result for the significant difference between the overall pretest and posttest scores of the one hundred seven (107) Grade 8 learners from two private schools in Oroquieta City, namely, Deor&Dune Academe School of Technology and Stella Maris College.

Table 3 Significant Difference for the Overall Pretest and Posttest Scores

Dependent Variable	**Mean Difference**	**Paired t-test test statistic**	**p-value**	**Descriptive Interpretation**
Posttest-Pretest	24.97 – 21.30	t = -7.644	0.0000****	There is significant difference

As to the result for the significant difference between the overall pretest and posttest scores of the learners there is a significant difference between the pre-test and post-test in the achievement scores of the students. The data shows a highly significant difference in the achievement scores for the developed digital game in the pre-test and post-test (M = 3.67) conditions; t = -7.644, p <0.0001. The significant improvement in posttest scores suggests that the contextualized digital game intervention was successful in achieving its intended objectives. It indicates that the game, designed to provide useful and accurate information on typhoon preparedness while promoting active participation and motivation, effectively enhanced the students' understanding and awareness of disaster preparedness measures. Also, the findings validate the contextualized digital game as a valuable educational tool for disseminating information on natural calamities such as typhoons.

4.3 Evaluation of Digital Game on Typhoon Preparedness

The table below shows median responses from teachers and CDRRMO officials to the research instrument. It aimed to understand their awareness, readiness, and perception regarding typhoon-related issues. Analyzing these responses gives insights into their perspectives and preparedness, aiding in improving typhoon preparedness efforts.

Table 4. Median Response of Teachers and CDRRMOs

Variable	Median (IQR)	Qualitative Description
ESDGBA (n=11)		
A	4 (4-4)	Strongly Agree
B	4 (4-4)	Strongly Agree
C	4 (4-4)	Strongly Agree
D	4 (4-5)	Strongly Agree
E	4 (4-4)	Strongly Agree
SIGBLA Teachers (n=6)		
K	4 (3-4)	Strongly Agree
P	3 (3-4)	Agree

The game is introduced to all the respondents and taught them how to play it. Based on the evaluation of different users, it is shown that the game is acceptable and useful to the users garnering an overall weighted mean of 4. The CDRRMO and teachers' median response indicates a significant level of agreement regarding their comprehension and perspective on natural disaster awareness and preparedness. This implies that evaluators, in general, feel adequately informed and maintain favorable perceptions regarding matters concerning natural disasters using the developed digital game on typhoon preparedness.

4.4 Perception of the Teachers and Learners about the Digital Game on Typhoon Preparedness

Table 5. The Overall Median Response for the Level of Awareness and Preparedness Towards Natural Disasters

Variables	**Overall Median Response**	**IQR**	**Descriptive Interpretation**
SIGBLA for Teachers			
Knowledge	4	[3-4]	Strongly Agree
Perception	3	[3-4]	Agree
SIGBLA for Students			
Knowledge	3	[3-4]	Agree
Perception	3	[3-4]	Agree
Attitudes	3	[3-4]	Agree
Level of Awareness of Natural Disaster Preparedness			
Disaster Knowledge	2	[2-3]	Disagree
Disaster Preparedness and Readiness	3	[2-3]	Agree
Disaster Adaptation	3	[3-3]	Agree
Disaster Awareness	3	[3-4]	Agree
Disaster Perception	2	[1-2]	Disagree

Table 5 revealed the overall median response for the level of awareness and preparedness towards natural disasters. Because the data is ordinal (Likert-scale) in nature, median and interquartile range (IQR) as descriptive measures are more appropriate to use than the mean and standard deviation (Field et al., 2012).

The overall median response for teachers indicates a high level of agreement with the knowledge and perception aspects related towards using the developed digital game on typhoon preparedness for teaching and learning. This suggests that teachers generally feel well-informed and have a positive perception regarding natural disaster-related issues. On the other hand, the overall median response for students also indicates a positive attitude towards using the digital game on disaster awareness and typhoon preparedness. Students agree with the knowledge, perception, and attitudes related to dealing with natural disasters, reflecting a level of awareness and preparedness among this group towards using the developed digital game on typhoon preparedness.

As to the level of awareness, the overall median response varies across different aspects. While there is agreement regarding disaster preparedness, readiness, adaptation, and awareness, there seems to be disagreement regarding disaster knowledge and perception. This suggests that while Grade 8 students may feel prepared and aware of disaster-related issues, there may be areas where knowledge and perception need improvement.

5. Conclusion and Recommendations

The digital game has successfully packaged the user profile and game element preferences of the target users into a functional, reliable, portable, usable, performance efficiency and engaging educational digital game. It is shown in this paper, that the contextualized digital game validates as a valuable and essential educational tool for disseminating vital information on natural calamities such as typhoons to raise their awareness in disaster and make them ready during disaster occurrences. After the evaluation process done by different individuals and experts, it is concluded that the developed game is acceptable in different users and can raise awareness for disaster preparedness. Moreover, the overall median response for teachers and CDRRMO indicates a high level of agreement with the knowledge and perception aspects related to natural disaster awareness and preparedness using the developed digital game. Results also revealed a significant difference in the pretest and post-test in their achievement test results which implies that the game's ability to engage learners and facilitate learning indicates effectiveness in delivering educational content and reinforcing important concepts related to disaster preparedness.

With this, it is to recommend the use of this game in different junior high school students in the Philippines to help them become more knowledgeable on what-to-do during disaster. It is also recommended that the game must be included in the program of PDRRMO in raising awareness of disaster preparedness. Additionally, the researcher suggests science educators to develop and implement a digital game on other topics in earth science to improve the learners' performance while engaging them in fun ways of learning.

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