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IONQUEST GAMIFIED DIGITAL LEARNING TOOL AND ACADEMIC PERFORMANCE OF SECONDARY CHEMISTRY EDUCATION

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ABSTRACT

Ionization energy and periodic trends are difficult to understand in their abstract form as a chemistry concept. Therefore, many students do poorly academically and have limited or no conceptual understanding of these topics. This study was to develop and evaluate the "IonQuest" Gamified Digital Learning Tool. Its purpose is to enhance students' ability to understand ionization energy and periodic trends. Specifically, it will determine the lowest level of proficiency among students regarding ionization energy and periodic trends; assess how well students can perform in terms of academics; evaluate how well the learning tool is accepted by the students; identify existing barriers to successful utilization of the learning tool; and propose ideas to enhance its application. A Developmental-Evaluative Mixed Method Research Design model was utilized. Ninety (90) Grade Eight Students from selected Public Secondary Schools located within the Division of Bislig, The City of the Philippines, were participants in this research. Other portions of the research were completed by teacher validators. Data collection included diagnostic testing, a Pre-Test assessment and Post-Test assessment, a Survey with Perception Questions regarding the learning tool, Observation, and Open-Ended Answers. Means, Standard Deviation, Kruskal-Wallis Tests, and Wilcoxon Signed-Rank Tests were applied to collect and interpret the collected data. Results of the study identified that predicting the chemical behavior of an element using the periodic table was the least proficient area for students. Additionally, the study revealed that there was a statistically significant difference (p=0.000) in academic performance after utilizing the tool (Mean = 25.88). High levels of acceptance were reported for both students and teachers. As such, the overall findings support that utilizing a gamified digital learning tool could significantly improve student understanding of Chemistry concepts and academic achievement in Chemistry.

KEYWORDS: *Gamified Learning Tool, Ionquest, Chemistry Education, Ionization Energy, Periodic Trends, Academic Performance*

1. INTRODUCTION

Learning science requires dynamic and flexible teaching aids to aid learners in seeing and exploring patterns, relationships, and meanings related to their subject area, rather than memorizing unrelated bits of information. Chemistry education uses the Periodic Table as the major organizational and explanatory device to systemically organize all elements of the universe while describing fundamental atomic characteristics, general trends, and chemical reactions. To Grade 8 students, the Periodic Table will be one of the most important references they use to understand the composition and subsequent behavior of substances. Using games to support rigorous academic disciplines has been discussed extensively in current literature regarding students' lack of interest in abstract scientific concepts. This study will contribute significantly to advancing chemistry education in the Philippines' public school system by producing empirically based data regarding the impact and acceptance of a localized game-based learning tool created to enhance students' structural understanding of the periodic table. It will help teachers develop new ways to teach difficult topics by developing a new way to provide students with an opportunity to understand concepts taught in chemistry class.

Statement of the Problem/Objectives

This study aims to determine the effectiveness and acceptability of a developed gamified learning application designed to enhance Grade 8 students' understanding of the periodic table of elements.

1. What are the least learned competencies of grade 8 students on chemistry, based on their diagnostic test results?
2. What gamified tool can be developed based on learned competencies?
3. What are the pre-test and post-test results of the students during the field tryout?
4. Is there a significant difference between the pretest and posttest of the students during the field tryout?
5. What are the perceptions of the group of respondents on the developed gamified tool as to:
   5.1 content;
   5.2 format;
   5.3 presentation and organization; and
   5.4 accuracy and up-to-datedness of information

6.Is there a significant difference of the validation rating as perceived by the group of respondents?

2. RESEARCH METHODOLOGY

In addition to covering the research design and methodologies utilized in the study, this chapter also covers the research locale, participants involved in the study, and the ethical considerations that need to be addressed. Additionally, the chapter covered the tools that will be used to collect data and the statistical methods to analyze data. The purpose of this chapter was to aid the researcher in determining what type of information can be collected from the participants.

3. SAMPLING DESIGN

The developmental- evaluative research design was primarily utilized in the study. The research design is divided into two subcategories: developmental research and evaluative research. Developmental research is concerned with developing, testing, and structurally improving instructional products. Evaluative Research for Instructional Innovation Development.

4.STATISTICAL DESIGN AND STANDARD DEVIATIONS

The mean is the average obtained by adding up all the results and then dividing by the number of people involved in the study; it serves as a measure of central tendency. The standard deviation measures the variability of scores, which indicates the degree of similarity between individual scores and themean. **Wilcoxon Signed Rank Test.** This nonparametric statistical method compares the median values of two associated samples. The Wilcoxon Signed Rank Test is often employed to analyze pairs of data where the differences do not have a normal distribution or when the data are categorical. **Single Factor Analysis of Variance (ANOVA).** This parametric inferential technique evaluates whether there exists at least one statistically significant difference among the means of three or more independent sample groups. ANOVA analyzes the ratio of variance between groups to variance within groups

5 . GEOGRAPHIC AREA

Bislig City National High School (BCNHS), located in Barangay Poblacion, represents a huge urban public secondary school with a very high density and diversity of student population, from the center of the city and its peripheral communities. Mangagoy National High School (MNHS), located in Barangay Cauntuan, has been a well-established academic environment providing education to learners from different communities in and around the industrial and commercial area of Mangagoy. Tabon M. Estrella National High School (TMENHS), located in Barangay Tabon, is a learning environment with learners from residential and coastal areas, thus offering both academic and technical vocational track options.

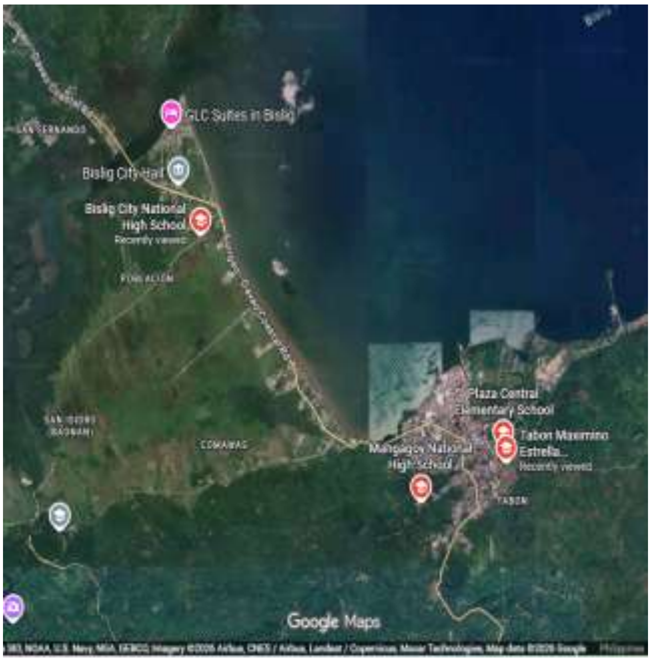

Figure 1. Location Map of the Study

6. RESULTS

Table 1. School Least-Learned Competencies in Grade 8 Chemistry based on the Diagnostic Test Result

School	Most Essential Learning Competencies (MELCs)	Mean Percentage Score	Overall Mean
A	Use the periodic table to predict the chemical behavior of an element. (S8MT-IIIi-j-12)	23 67	
B		35.80	35.02
C		45.60	

The average percent score was 35.02%, which can be described as having a low level of mastery. The above-average finding has confirmed that chemists' behavior prediction is still the largest educational instruction gap, instead of being an individualized gap in this classroom. These findings confirm the relevance of the research problem and validate the urgent need for the development and deployment of a supplementary game-based mobile tool to improve students' conceptual visualization.

Table2. Pre-Test and Post-Test Scores of Students during the Field Try-out

	Group A	Group B	Group C	Overall Average
Pre-Test	17.30	18.43	20.97	18.90
Post-Test	24.57	25.20	27.87	25.88

Overall, there was a very positive increase in performance across all of the classes that participated in this project. As a whole, the average performance increased significantly from a low level to an extremely high level. Thus, the overall result has been given a highly effective label as an instructional intervention

Table 3. Test of Difference Between Pre-Test and Post-Test of the Students during the Field Try-out

	Computed Value	p-value	Decision	Conclusion
Pre-Test vs Post-Test	18.90 25.88	0.000	Reject Ho	There is a significant difference

Although this research study produced positive outcomes, these findings also corroborate many recent studies concerning the convergence of gamification and secondary science instruction. For example, Leaño & Belgica (2023) demonstrated significant long-term advancements in conceptual understanding by their experimental subjects after engaging with a combination of game-based learning strategies. Lampropoulous and Sidiropoulos (2023) and Manipon & Noe (2023) indicated significant increases in post-test achievements of students who had used digital gamified instruction when compared to their pre-test achievement scores.

Table 4. Perception of the Group of Respondents on the developed Gamified Tool

Respondents	Overall Mean	Standard Deviation	Interpretation
Student	4.51	4.50	Strongly Agree
Science Teacher	4.60	4.48	Strongly Agree
Expert	4.27	4.33	Strongly Agree

In general, the average of all of the ratings provided by all three groups of participants represents a qualitative adjective rating of Strongly Agree. Overall, this general finding indicates that regardless of group affiliation, all groups agreed that the developed gamified learning application is viewed positively as being a highly effective instructional tool that is both academically sound and functionally operational.

Table 5. Significant Difference in the Validation Ratings of the Developed Gamified Tool Across Groups of Respondents

	Mean	P-value	Conclusion
Content			
Student	4.5		There is significant
Teacher	4.8	0.0007	Difference
Expert	4.2		
Format			
Student	4.5		There is no
Teacher	4.6	0.1289	Significant difference
Expert	4.2		
Presentation			
Student	4.5		There is no
Teacher	4.4	0.0842	Significant difference
Expert	4.2		
Up-to-Dateness			
Student	4.5		There is no
Teacher	4.6	0.6483	Significant difference
Expert	4.4		

The compiled inferential data shown in Table 6 provide a nuanced qualitative assessment that presents an overall positive consensus along with one area of major divergence. This combined statistical result implies that while stakeholders had total consistency regarding how the tool looked and functioned, they had very different expectations regarding how the chemistry concepts should be packaged and delivered.

CONCLUSIONS

The low mastery level recorded during the diagnostic baseline reveals that traditional, text-based teaching methodologies and static paper charts are inherently limited in helping junior high school students grasp complex subatomic properties. This implies that predicting chemical interactions requires deep spatial and conceptual visualization that rote memorization strategies fail to support. The targeted engineering of the framework proves that digital instructional media are highly effective when their structural game mechanics are directly aligned with empirical diagnostic data rather than generalized curricular goals.

Recommendations

The first recommendation addresses the diagnostic baseline, showing low mastery in predicting elemental behavior due to the limitations of static learning tools. It is recommended that the Department of Education curriculum leaders, division supervisors, and school heads phase out total reliance on traditional paper periodic charts for complex chemical behavior topics. Instead, school authorities should officially integrate dynamic, interactive visualization tools into the standard Grade 8 Science syllabus, specifically allocating dedicated laboratory or classroom hours to ensure abstract subatomic properties are taught through multi-dimensional media

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