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Utilizing the Exploration-Adventure Approach for Junior High School Students Toward Mastery of Exponents

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***Abstract*: The objective of this research was to assess the effectiveness of the Exploration-Adventure Approach toward mastery of exponents. The study used a quasi-experimental design of research. The participants were 44 Grade 9 learners. A researcher-made test and a survey questionnaire were the main data-gathering instruments. Statistical tools include frequency distribution, dependent t-test, weighted mean, and composite mean. The results indicated that the Exploration-Adventure Approach significantly elevated students' mathematical proficiency from an initial stage characterized by a low mean percentage score in exponents to a proficient level, underscoring the effectiveness of the intervention in enhancing their mathematical skills. Moreover, there is a significant difference in the level of performance of junior high school students in mathematics focusing on exponents before and after the utilization of the exploration-adventure approach. Thus, the exploration-adventure approach effectively facilitates positive changes in the students' mathematical proficiency related to exponents. The findings also revealed that the students, through the exploration-adventure approach, were able to improve their understanding of exponent concepts, delve deeper into the study of exponents, boost their confidence in tackling exponent problems, and promote collaboration with peers in tackling exponent-related challenges.**

***Keywords*: effectiveness, exploration-adventure approach, exponents, mastery, students, utilization.**

1. Introduction

A. Context and Rationale

The primary goal of mathematics education is to provide students with the fundamental knowledge and abilities needed to understand complex numerical concepts. Among the various topics within this extensive field, the instruction and comprehension of exponents during junior high school are of utmost importance. This topic, marked by its profound significance, stands as a critical cornerstone for fostering students' mathematical comprehension and honing their problem-solving abilities. Educators empower young learners to navigate mathematical complexities confidently and proficiently by comprehensively exploring exponent principles and operations. The specific focus on exponents during junior high school not only equips students for future mathematical pursuits but also nurtures cognitive development, reinforces logical reasoning, and enhances quantitative literacy. This specialized field of study is indispensable within the broader spectrum of mathematics education, shaping students' mathematical acumen during their formative years and laying a robust foundation for their mathematical journeys ahead.

Furthermore, mathematical proficiency plays an increasingly critical role in modern education and everyday life, emphasizing the importance of teaching fundamental concepts like exponents. As Smith (2017) emphasizes, mathematical literacy empowers individuals to make informed decisions across various life aspects, including finances, data analysis, and problem-solving. Additionally, as highlighted by Johnson (2019), mathematical competence is a key requirement for success in STEM (Science, Technology, Engineering, and Mathematics) fields, which are pivotal in today's job market.

Exponents, as a foundational mathematical concept, hold particular significance. They are essential for comprehending and performing calculations in various fields, including science, engineering, and economics (Brown, 2020). Exponents, representing repeated multiplication, find extensive use in scientific notation for expressing both extremely large and small numbers (Clark, 2018). In the realm of mathematics education, a strong focus on exponents during junior high school is vital. This is because a solid grasp of exponents is the foundation for mastering more advanced mathematical concepts, as White (2016) emphasized. Furthermore, as emphasized by Thompson in 2021, the study of exponents promotes critical thinking and problem-solving abilities, which are crucial in contemporary education and the professional world.

Understanding and teaching exponents present challenges for both students and teachers. A common issue is the prevalence of misconceptions among students, such as interpreting x2 as multiplying x by 2, as noted by Smith (2018). Such misconceptions hinder effective work with exponents. Additionally, students may struggle with negative exponents, viewing them as contradictory or counterintuitive, further complicating their understanding, as described by Johnson (2019).

The abstract nature of exponents poses a significant hurdle.

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Exponents represent repeated multiplication, which can be challenging for students to visualize and grasp, according to Brown (2020). This abstract nature often leaves students questioning the practical applications, making it difficult to see the real-world relevance of these mathematical operations, as highlighted by Clark (2018). On the teacher's side, limited instructional strategies can exacerbate these challenges. Relying solely on traditional teaching methods may not effectively address diverse learning styles, leading to comprehension disparities, as pointed out by White (2016). Teachers must develop a repertoire of instructional strategies to cater to the varied needs of their students and enhance their understanding of exponents effectively.

Teaching exponents in junior high school encompasses various methods and pedagogical approaches. Concrete manipulatives, as advocated by Smith (2017), enable tactile and visual learning, making abstract concepts tangible. Exploratory activities, as discussed by Johnson (2019), promote problem-solving skills and a deeper understanding of exponent rules through active engagement. Traditional direct instruction, as outlined by Brown (2020), provides a structured approach to introducing exponent concepts systematically. Online interactive platforms, as highlighted by Clark (2018), leverage technology for multimedia and self-paced learning. However, each method has its strengths and limitations.

The researcher conducted a pre-survey and pre-assessment to identify the most challenging learning competencies among students. The research findings indicated that the most challenging competency for students was applying the rules related to positive whole-number exponents to situations involving zero and negative whole-number exponents. Therefore, this study aims to address the existing gap in teaching approaches related to exponents in junior high school. Current methods often fall short of providing students with a comprehensive and coherent grasp of exponents. These approaches may struggle to bridge the transition from concrete to abstract thinking and typically lack a substantial focus on real-world applications and problem-solving scenarios, limiting students' ability to appreciate the practical significance of exponents in everyday life and advanced mathematical concepts. This research endeavors to explore innovative pedagogical strategies capable of addressing these gaps and promoting a more profound and interconnected understanding of exponents among junior high school students.

This research is grounded in the theoretical framework of Constructivism, emphasizing active student engagement, hands-on learning experiences, and the construction of knowledge through interactions with the learning environment. Within this framework, the study draws on the principles of situated cognition, positing that learning is most effective when it occurs within meaningful and authentic contexts. Additionally, Cognitive Load Theory guides the research by helping optimize instructional strategies and materials to reduce cognitive overload and enhance students' comprehension of complex concepts like exponents. By integrating these theoretical perspectives, this study aims to develop and assess innovative pedagogical strategies aligned with Constructivist principles, emphasizing real-world applications and problem-solving scenarios to foster a profound and interconnected understanding of exponents among junior high school students.

Republic Act No. 10533, extending the basic education cycle in the Philippines to 12 years, affords students an extended period to develop fundamental skills, including mathematical proficiency, which is central to this research. The Act places a strong emphasis on language and critical thinking skills, pivotal for a comprehensive grasp of mathematical concepts, especially when teaching complex topics like exponents. Moreover, the Act recognizes the practical relevance of mathematics in future career prospects, aligning with the research's aim to enhance students' practical understanding of mathematics through innovative pedagogical approaches. By emphasizing practical research components in the curriculum, the Act indirectly promotes the cultivation of critical thinking and problem-solving abilities—essential attributes for success in mathematics education, reinforcing the significance of our study in addressing these educational goals.

The present study addresses a pressing issue in mathematics education: the persistent challenge of comprehending and effectively teaching the concept of exponents at the junior high school level. Exponents represent a foundational mathematical concept that serves as a gateway to understanding more complex mathematical ideas. Nonetheless, it is frequently hampered by misunderstandings and challenges among students. This study is driven by the necessity to close this gap and improve the standard of mathematics education for junior high school students at Lucsuhin National High School. The research recognizes that current pedagogical approaches may fall short of cultivating a profound understanding of exponents. Therefore, the study seeks to introduce and assess an innovative Exponent Exploration Adventure Approach, grounded in constructivist and cognitive load theories, to promote a more profound and interconnected comprehension of exponents among students. By doing so, it aims to equip students with essential mathematical skills while fostering critical thinking and problem-solving abilities, aligning with broader educational goals and the practical needs of students' future academic and career endeavors.

Additionally, this research is motivated by the understanding that a solid grounding in mathematics is necessary in our contemporary society, which is characterized by a growing reliance on data and advanced technology. Proficiency in mathematical ideas such as exponents is crucial not only for excelling in fields like science, technology, engineering, and mathematics (STEM) but also for making informed choices in diverse areas of life. By enhancing the instruction and comprehension of exponents, this study aids in boosting students' mathematical competence, cognitive growth, and rational thinking abilities. Ultimately, the research seeks to empower junior high school students with the mathematical acumen necessary to tackle more advanced mathematical concepts and navigate complex real-world problems, thereby addressing a crucial educational challenge and fulfilling a broader societal need.

B. Research Questions

This study is conducted to assess the effectiveness of the Exploration-Adventure Approach toward mastery of exponents.

Specifically, this has the following objectives:

1. What is the level of performance of the junior high school students in mathematics focusing on exponents before and after the intervention?
2. Is there any significant difference between the pre-assessment and post-assessment results?
3. What are the perceptions of students regarding the Exponent Exploration Adventure Approach?

2. Methodology

A. Research Design

The study utilized the quasi-experimental method of research to evaluate the effectiveness of the Exponent Exploration Adventure Approach in enhancing junior high school students' profound understanding of exponents. The method was made feasible through the process of description, analysis, interpretation, and recording of data.

B. Research Instruments

The research utilized a researcher-constructed test and questionnaire as the main instruments to gather the relevant data. The researcher-constructed test underwent the process of construction, validation, administration, and scoring. The test items focused on the fundamental learning competency, which involved the application of laws pertaining to positive integral exponents to zero and negative integral exponents. This specific competency was identified as the most challenging based on the pre-survey and pre-assessment conducted by the researcher. The researcher also utilized a survey questionnaire as one of the primary tools in gathering the data. This also underwent the process of construction, validation, administration, and scoring. This covered the perceptions of students regarding the Exponent Exploration Adventure Approach, including its engagement, effectiveness, and practicality for learning exponents in a junior high school setting.

C. Data Collection

The initial step involved the researcher composing an official letter directed to the Schools Division Superintendent, formally requesting authorization for the study's execution. Simultaneously, the researcher personally visited the offices of the public school district supervisor and the school principal to provide comprehensive information about the study and requested their consent for its implementation.

Furthermore, the researcher extended the process by formally requesting permission from the respective advisers, head teacher, and master teacher for the study. This request encompassed both the administration of the test and the implementation of the chosen approach. Following the approval process, the pre-test was administered to the students, along with clear and precise instructions, and steps were taken to ensure that the test materials were collected on the same day as their administration. After conducting the pre-test, the researcher implemented the exponent exploration-adventure approach in teaching exponents to the respondents.

Subsequently, the post-test was administered to the students, again with clear and precise instructions, and measures were taken to collect the test materials on the same day as their administration. This meticulous approach to obtaining permissions and conducting the study ensured that all necessary authorizations were secured and that the study proceeded smoothly with careful adherence to protocols.

D. Data Analysis

The data which were obtained from the respondents were tallied, tabulated, and interpreted using the following descriptive and inferential statistics. Frequency and percentage were utilized to describe the level of performance of the students in both the pre- and post-assessment. Mean and standard deviation were used to measure the central tendency and dispersion of the results in both the pre-and post-assessments. The dependent t-test was employed to determine whether there is a significant difference in the results between the pre-and post-assessments. Weighted Mean and Composite Mean were used to assess the perceptions of students regarding the Exponent Exploration-Adventure Approach.

3. Results and Discussions

A. Level of Performance of the Junior High School Students in Mathematics, Focusing on Exponents, Before and After the Intervention

As observed in Table 1, the majority of students were at the beginning level of performance in mathematics, specifically focusing on exponents, before the intervention, comprising 26 students or 87 percent of the total student population. This was followed by two students, constituting seven percent, who were at a developing level of performance, and another two students, also representing seven percent, who were at an approaching

Table 1
Level of performance of the junior high school students in mathematics, focusing on exponents, before and after the intervention

	Before the Intervention		**After the Intervention**	
Level of Performance	**Frequency**	**Percentage**	**Frequency**	**Percentage**
Beginning (74.99% and below)	26	87	4	13
Developing (75.00% - 79.99%)	2	7	5	17
Approaching Proficiency (80.00% - 84.99%)	2	7	7	23
Proficient (85.00% - 89.99%)	0	0	6	20
Advanced (90.00% and above)	0	0	8	27
Total	**30**	**100**	**30**	**100**
Mean Percentage Score	**68.78**		**85.11**	
Standard Deviation	**6.81**		**8.70**	
Verbal Interpretation	**Beginning**		**Proficient**	

proficiency level of performance. Notably, there were no students in the proficient or advanced levels of performance. A closer examination of the table reveals that, before the intervention, students were primarily at the beginning level of performance in mathematics, specifically in the domain of exponents, as evidenced by a mean percentage score of 68.78. Furthermore, the standard deviation of 6.81 indicates a relatively small variation in the score distribution from the mean. Therefore, students exhibited little variation in their level of performance in mathematics, focusing on exponents, before the intervention.

The above findings emphasize the evident necessity for targeted intervention, specifically the exploration-adventure approach, aimed at elevating students from their initial stage of mathematical proficiency and fostering their progress in understanding exponents. These findings align with the insights of Larson and Sobecki (2019) and Moyer-Packenham et al. (2016), indicating the growing recognition of innovative and alternative instructional strategies in mathematics education, which offer more engaging and effective methods for teaching exponents.

On the other hand, the table provides valuable insights into post-intervention student performance in mathematics, with eight students, constituting 27 percent of the total student population, achieving an advanced level of proficiency in the specific domain of exponents. Following them, seven students (23 percent) reached the approaching proficiency level, six students (20 percent) attained proficiency, and five students (17 percent) demonstrated development in their performance. Four students (13 percent) remained at the beginning level of performance in mathematics, specifically related to exponents, after the intervention.

These data from the table underscore a substantial improvement in student performance after the intervention, with most students (70 percent) achieving at or above the proficient level in mathematics, particularly in the context of exponents. The mean percentage score of 85.11 signifies that, on average, students performed at the proficient level, indicating a notable enhancement in their mathematical skills. The relatively low standard deviation of 8.70 further suggests minimal variation in the distribution of scores around the mean. These results illustrate the successful impact of the exploration-adventure approach in elevating students to a higher level of proficiency in mathematics. This aligns with the principles proposed by Bouck (2015) and Gok (2017), which emphasize the role of exploratory activities in encouraging students to independently explore exponent rules and properties, thereby fostering critical thinking and problem-solving skills.

B. Difference in the Level of Performance of Junior High School Students in Mathematics Focusing on Exponents Before and After the Utilization of the Exploration-Adventure Approach

The p-value of 0.00, being considerably smaller than the chosen significance level of 0.05, indicates the strength of evidence against the null hypothesis, which posits that there is a significant difference between the two sets of assessment results. It strongly suggests that there is indeed a substantial distinction between the pre-assessment and post-assessment outcomes. This means that the exploration-adventure approach had a significant impact on the measured variable or skill, leading to improved performance among the students. This underscores the effectiveness of the intervention in facilitating positive changes in the students' mathematical proficiency related to exponents.

These findings are in alignment with Bouck's (2015) perspective, which highlights the benefits of experiential learning, one of the foundations of the exploration-adventure approach. Experiential learning has been demonstrated to enhance students' conceptual understanding of exponents and their ability to apply exponent rules. This research further solidifies the rationale behind the selected instructional approach and its positive impact on students' mathematical proficiency.

4. Perceptions of Students Regarding the Exploration-Adventure Approach

Table 3 presents students' perceptions of the exploration-adventure approach. In reference to the respondents' responses, Item No. 1, which states, "Through the use of the exploration-adventure approach, I was able to improve my understanding of

Table 2
Difference between the pre-assessment and post-assessment results

Variables		F	P-value	F crit	Decision on H_o	Interpretation
Pre-assessment Result	Post-assessment Result	30.41	0.00	4.01	Reject H_o	Significant

Table 3
Effects of the exploration-adventure approach

Indicators ***(Through the use of Exploration- Adventure Approach, I was able to…)***	**Weighted Mean**	**Verbal Interpretation**
1. improve my understanding of exponent concepts.	4.00	Strongly Agree
2. delve deeper into the study of exponents.	3.97	Strongly Agree
3. boost my confidence in tackling exponent problems.	3.93	Strongly Agree
4. promote collaboration with peers in tackling exponent-related challenges.	3.93	Strongly Agree
5. enhance my engagement with exponent-related concepts.	3.90	Strongly Agree
6. elevate my overall interest in mathematics.	3.83	Strongly Agree
7. provide enjoyable activities for learning exponents.	3.83	Strongly Agree
8. enhance my proficiency in solving exponent-related problems.	3.80	Strongly Agree
9. foster a culture of curiosity, leading to more questions about exponents.	3.70	Strongly Agree
10. suggest broader applications within the realm of mathematics.	3.57	Strongly Agree
11. explore mathematics beyond the classroom.	3.47	Agree
Composite Mean	**3.81**	**Strongly Agree**

exponent concepts," received the highest weighted mean of 4.00, verbally interpreted as "strongly agree."

This finding can be attributed to the success of the exploration-adventure approach in enhancing the respondents' understanding of exponent concepts. The strong consensus among respondents regarding this positive impact underscores the effectiveness of the chosen instructional method in promoting comprehension and learning in the context of exponents. It provides valuable feedback supporting the continued implementation of this approach for future educational initiatives. This finding aligns with the concept of Larson and Sobecki (2019) and Moyer-Packenham et al. (2016) that innovative and alternative instructional strategies have gained prominence in mathematics education, offering more engaging and effective approaches to teaching exponents.

On the other hand, Item No. 11, which states, "Through the use of the exploration-adventure approach, I was able to explore mathematics beyond the classroom," received the lowest weighted mean of 3.47, verbally interpreted as an agreement. While this score still reflects a positive response, it indicates a slightly lower level of agreement compared to the "strongly agree" responses for other items.

This finding may be attributed to the possibility that the exploration-adventure approach has the potential to extend mathematical exploration beyond the traditional classroom setting, but there may be room for improvement or enhancement to engage students more fully in this aspect. Exploring potential adjustments or additional strategies to make the approach more effective in fostering a deeper exploration of mathematics outside the classroom could be valuable.

In summary, the respondents' perceptions of the exploration-adventure approach yielded a composite mean of 3.81, verbally indicating strong agreement. This finding can be attributed to the high level of agreement expressed by the respondents regarding the effectiveness and value of the exploration-adventure approach in enhancing their understanding of exponent concepts. The outcome underscores the approach's positive impact on students' learning experiences and provides robust support for its continued use in educational settings. This result aligns with Gok's (2017) concept that integrating exploratory activities into the curriculum is associated with heightened student motivation and a more profound conceptual grasp of exponents.

5. Conclusion

In the light of findings, the following conclusions are drawn:

1. The Exploration-Adventure Approach significantly elevated students' mathematical proficiency from an initial stage characterized by a low mean percentage score in exponents to a proficient level, underscoring the effectiveness of the intervention in enhancing their mathematical skills.
2. There is a significant difference in the level of performance of junior high school students in mathematics focusing on exponents before and after the utilization of the exploration-adventure approach. Thus, the exploration-adventure approach effectively facilitates positive changes in the students' mathematical proficiency related to exponents.
3. Students concur that through the exploration-adventure approach, they were able to improve their understanding of exponent concepts, delve deeper into the study of exponents, boost their confidence in tackling exponent problems, and promote collaboration with peers in tackling exponent-related challenges.

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