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# Challenges Encountered by First-Year BSED Mathematics in Learning Algebra at Osmeña Colleges

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*Abstract* — This qualitative research identified the challenges encountered by first-year Bachelor of Secondary Education (BSED) Mathematics students in learning algebra at Osmeña Colleges. Using convenience sampling technique, the study employed open-ended question interviews with 17 participants to identify the specific challenges encountered. To fully analyze the collected data, simple percentage used as statistical tool and frequency count. The audiotaped interview was analyzed and interpreted using transcription of the data gathered. Then, researchers examined the interview and data for the similarities and differences of the responses of the participants. This highlighted the different nature of challenges faced by these students, shedding light on their perceptions about the challenges they encountered in learning Algebra. The result revealed that most of the students highlighted the utilization of signs as operation with 70.59% as the significant challenge they encountered. "Grasping expressions consisting higher exponents" and "Simplifying algebraic expressions" revealed 29.41% and 17.65% of the respondents identified to have a challenge encountered in "Understanding the process of problem-solving". The researchers concluded that by equipping students with the necessary skills and knowledge to succeed by addressing these challenges proactively. Based on the identified challenges encountered in this study, the researchers recommend the possible action or solution that the teacher can implement to minimize the difficulties of the students through integration of sign rule, mastery of law of exponent and dedication of teacher in teaching the students. This research contributes valuable insights into the lived experiences of first-year BSED Mathematics students at Osmeña Colleges, shedding light on the complex nature of their challenges and informing institutional efforts to enhance student retention and success. Recommendations are offered for educational stakeholders to implement targeted interventions that foster academic resilience and holistic development among incoming students.

***Keywords — Challenges, Learning Algebra, Difficulties, Expressions, Algebra***

## I. Introduction

Mathematics develops problem-solving skills, logical thinking and critical thinking, which are important in many fields. It equips individuals and sharpens the mind's ability to analyze and evaluate situations. In the Philippines, the Filipino child's right to education is protected by the 1987 Constitution (Section 2, Article 14) which states that learners, however diverse, must receive education that is relevant and of high quality. Recent educational reforms on curriculum and policy have an impact on how basic education is taught. The Republic Act 10533 or the Enhanced Basic Education Act of 2013 aims to protect the rights of all learners by providing 12 years of education instead of 10 years. In the new basic education programme, the mathematics curriculum strongly emphasises critical thinking and problem solving. It covers five content areas, Number and Number Sense, Measurement, Geometry, Patterns and Algebra, and Probability and Statistics. The new curriculum allows students to learn by asking relevant questions and discovering new ideas. The ability to communicate these queries and ideas is given importance in the new curriculum. It recognises the different contexts of Filipino learners, which is an essential tool in influencing their study and use of mathematics (Hamak, S., Astilla, J., & Preclaro, H. R., 2014).

Algebra is a very crucial concept in Mathematics. It deals with the study of rules on operations, relations, constructions, including terms, polynomials, equations, and algebraic structures and algebraic properties. Meanwhile, algebraic properties proved to provide an adequate source of many misconceptions among learners (Cadorna, E. A., Cadorna, E. F., & Taban, J. G., 2021).

Traditionally, many students have found the study of algebra difficult (Norton, S. J., & Cooper, T. J., 2001). According to Booth, J.L. and Koedinger, K.R. (2008), one reason why use of these incorrect strategies may persist is that many of the procedures that students attempt to use are ones that will lead to a successful solution for some problem situations. Unfortunately, without adequate knowledge of the problem features, students are unable to distinguish between the situations in which the strategy will work and the ones where it is not applicable.

Other studies show students' difficulties in solving the problem of one of the algebraic linear equations of two variables in the form of reading errors, comprehension errors, transformations, skill processes and encoding. Another errors in resolving HOTS problems is in the form of a number skill, a skill arithmetic process or relating to calculations, understanding information or information skills, understanding language or language skills and difficulties in understanding representations or visual-spatial skills. This error also include procedures being forgotten. In general, algebra becomes a problem for students (T I Pramesti and H Retnawati, 2019). In addition, poor-performing Filipino students in mathematics can be identified in terms of socioeconomic conditions and non-cognitive and metacognitive behavior. These students in both public and private schools mostly do not have mobile cellphones with internet access, have parents with low status, do not expect to finish a vocational degree, and have underdeveloped discerning and critical thinking skills (Minie Rose C. Lapinid et al, 2022).

Students cannot simply receive knowledge from the teacher and understand it in the way that the teacher thinks about it. As Lambdin states: "A teacher's goal is to help students understand mathematics; yet understanding is something that one cannot teach directly. No matter how kindly, clearly, patiently, or slowly teachers explain, they cannot make students understand" (Unay, O. et al, 2016).

Improving students' mastery of algebra requires finding effective strategies for teaching and learning algebraic topics (Star, J. R. et al, 2015). The K to 12 Curriculum Guide in Mathematics (2012) emphasized that teachers' teaching must be directed to the honing of students' skills on critical thinking and problem solving. Difficulties that students express in word problem solving can be overcome through employing of the different strategies and activities. Student need to be exposed to problem solving using the metacognitive strategies especially in solving non-routine problems to help them develop their problem-solving skills and enhance their potentials as good problem solvers (Casaig, M. E. S., 2019).

First-year students of BSED Mathematics already have a background in Algebra in mathematics, however they are still a beginner of the chosen course program and encountered new concept of algebra that has higher level of concepts. According to Thomas, C. (2010), "As a 9th grade algebra teacher, I find the lack of consistent knowledge that my students bring into my classroom very frustrating. By state mandate, students must reach a particular level of proficiency in order to be promoted to high school. However, when given a pretest, it is obvious that these students lack proficiency in number relations and in the manipulation of rational numbers. With these deficiencies, it is very hard to bring them up to the level of skill in algebra that the state expects. Students who cannot perform basic fractional operations tend to do poorly in or fail Algebra I".

This study aimed to identify the challenges encountered by the first year BSED Mathematics students in learning algebra at Osmeña Colleges. Specifically, it sought answers to the following questions

1. What are the challenges encountered in learning Algebra?
2. What recommendation can be proposed to address the challenges encountered in learning Algebra?

## II. Methodology

***Research Design:*** In this research, a qualitative method of research was utilized to identify the challenges encountered by first year BSED Mathematics students in learning Algebra. Qualitative research methods used for in-depth and further probing and questioning through open-ended and conversational communication. Qualitative interview occurs when a researcher asks one or more participants in general, open-ended questions, and records their answers (Creswell, 2012).

***Population and Sampling.*** The researchers used convenience sampling technique, a non-probability, to select participants in this study. There were 17 students from first-year BSED mathematics who participated in this study. Convenience sampling was used because the distribution of students in the classroom is in heterogenous.

***Research Instruments.*** The researchers gathered the data of this study through open-ended question to find out the challenges encountered by the first-year BSED Mathematics students at Osmeña Colleges.

***Data Gathering Procedure.*** The selected participants of the researchers were interviewed after the respondents' class hour. It was ensured that the respondents understood the study's intent and the data collection process. The researchers informed the student of what to do and had the permission to answer the interview question, "What are the challenges you encountered in learning Algebra? The whole conversation was recorded during the entire process of the interview, and if the respondents answered Minasbate and Tagalog it was transcribed into English. It was also ensured that the data collected would remain confidential so that the information gathered is safe and protected.

***Ethical Consideration:*** Before conducting the research, the researchers informed the respondents their answers will only be used for the purpose in this study. It was explained that their responses will be used and potentially shared in the study, ensuring transparency about confidentiality of their response. Permission were asked that their answer will be recorded. It was ensured that their identity was written in codes, not their real identity and treat the respondents with respect and dignity throughout the research process. Ensured that their perspectives and experiences are accurately represented and not misrepresented and avoid discussing sensitive topics through open-ended question. The researchers ensured that they provided equitable access to participation and fair treatment to respondents from any diverse backgrounds. It was ensured that the researchers sought ethical approval before conducting research and adhere to ethical guidelines and regulations.

***Treatment of the Data.*** To fully analyze the collected data, simple percentage used as statistical tool and frequency count. The audiotaped interview was analyzed and interpreted using transcription of the data gathered. The researchers examined the interview and data for the similarities and differences of the responses of the participants.

## III. Results and Discussion

### 1. Challenges encountered in learning Algebra of the respondents

Out of 17 respondents based on the interviewed, the findings revealed that there are 12 responses shows in common corresponds to 'Utilization of signs as operation". Among of the twelve (12) respondents exhibited difficulties in utilizing signs as operations equations and

expressions involving positive and negative numbers, one of the respondents stated which corresponds to other responses that,

*"I am having a difficulty in the rules of sign, like for example I am confused if the equation is positive to negative. And it is so difficult for me to identify sometimes on what sign I am going to apply next because, they said that the sign of the bigger number will be the sign to be followed, so that is why I am confused." (R8)*

These challenges indicate difficulty in performing basic operations within the context of algebraic expressions, difficulty in managing signs being used particularly when the sign changed across different sides of an equation, illustrating confusion regarding sign rules in algebraic equations, specifically in determining the correct sign to apply based on the numbers involved, which need consistent practice, grasping clear understanding of sign rules, and applying systematic approaches to mathematical expressions. Where one of the respondents match to other responses added that,

*"For me the challenge I encountered in learning algebra is the correct usage of symbols because there are different types of symbols, so sometimes I struggle on how to apply them in the expression." (R17)*

It shows a common struggle among learners who are unfamiliar in working with concrete numbers and navigate the concept of variables and symbols, where this transitioning of concrete numbers to abstract symbols require developing a deeper understanding of how variables represent numbers that can vary and how different operations affect these variables within equations and expressions. As mentioned the correct usage of symbols in Algebra presents as another barrier in Algebra. With various types of symbols indicating operations, variables, and other basic mathematical symbols may find it challenging to recognize which symbol applies in a given context or expression. Where the challenges need familiarizing meanings and roles of different algebraic symbols, exercising verbal descriptions or concrete situations into algebraic expressions using appropriate symbols, and understanding the rules for manipulating symbols such as following order of operations and algebraic identities and formulas.

The findings revealed that 70.59% responses show in common challenges on "Utilization of signs as operation". Where many students found it challenging to interpret and apply signs within algebraic contexts, reflecting issues in understanding algebraic operations. Utilizing signs as operations introducing challenges in learning algebra, particularly when students encounter equations and expressions involving positive and negative numbers. According to the study of Nyiayu Fahriza Fuadiah N. F., Suryadi D. & Turmudi (2016), many students found it challenging to interpret and apply signs as operation within algebraic contexts, reflecting issues in understanding algebraic operations. Utilizing signs as operations introducing challenges in learning algebra, particularly when students encounter equations and expressions involving positive and negative numbers.

Out of 17 respondents based on the interviewed, the findings revealed that there are 5 responses shows in common corresponds to 'Grasping expressions consisting higher exponents". Among of the five (5) respondents exhibited difficulties, one of the respondents stated that,

*"I am struggling if the given exponent is too big, and if the value of the number is getting higher I am having a hard time simplifying the expression especially if the solving process is long." (R11)*

The responses emphasize that it is challenging to deal with large exponents and values, simplifying equations that involve terms with square roots or larger exponents which is difficult to manage complex expressions which requires understanding exponent rules and performing systematic techniques or method for grasping higher-order terms.

The result revealed that 29.41% of the respondents are having a common challenge in "Grasping expressions consisting higher exponents". Where this challenge encountered imply understanding how to interpret mathematical expressions that include powers higher than two. However, exponents and exponential expressions are important mathematical concepts, not much investigation has been done on students' learning difficulties and understanding of exponents. It became clear that students had a fragile understanding of exponential expressions in general. It was observed that such error and understanding have some sort of similarity with lack of background knowledge (Dejene Girma Denbel, 2019). Rational powers would be an obstacle for students' reasoning while working problems involving exponential expression (Christou et al., 2007).

Out of 17 responses from the interviewed, the findings revealed that there are 5 responses shows in common corresponds to in "Simplifying algebraic expressions". Among of the 5 respondents, R5 noted which was also corresponds to the responses of the other respondents that,

*"I've been challenging in some learning numeracy since I practice in acquiring literacy rather than numeracy. When it comes to Algebra, I've been struggling in defining the integers such as the x and y in the expression. I am struggling also on how to define the negative and positive in simplifying an expression." (R5)*

The responses of the respondents show difficulty in transitioning from literacy skills to numeracy skills particularly in the context of algebra. There is a struggle in defining integers like x and y indicating uncertainty in understanding variables as replacement for the unknown value. Added to that, there is confusion about manipulating negative and positive signs when simplifying algebraic expressions, which is important for correct manipulation of terms in the expression. They demonstrate difficulty in comprehending the concept of variables within algebraic expressions where variables are fundamental in algebra that represent unknown or changing quantities or value of numbers, and understanding how it corresponds within the given expressions.

Other respondents also struggled in combining like terms with unlike sign and the arrangement of terms that are not in order, which is essential for simplifying algebraic expressions and equations. Where combining like terms is a primary skill in algebra that involves simplifying expressions by grouping and adding or subtracting terms that share the same variable/sand exponent/s in the given expression. One (1) of the respondents said that,

*"Sometimes I am struggling in combining terms because there are many terms that are not arrange in order." (R1)*

The responds stated that the challenge lies in dealing with expressions where terms are not presented in order which made the expression confusing to the students as it requires additional effort to identify like terms and apply the correct operations, which involve organization skills in algebraic expressions and focusing on systematically identifying and combining like terms of the expression. The response show that the students are having confusion on how to handle the signs correctly after simplifying the terms. The student struggle on knowing when to add or subtract terms based on their signs given, and how to correctly express the sign of the combined term.

The result revealed that 29.41% responses show in common challenges on "Simplifying algebraic expressions". Wherein, in simplifying algebraic expressions means in transforming a complex expression into a simpler form and highlighted difficulties in recognition of variables, and simplifying expressions or equations involving sign/s. According to Eliseo P. Marpa (2019), students considered algebra as a difficult subject in mathematics. Many of the difficulties according to them have sources in the poor understanding of two important concepts – the variable and the algebraic expression (Subramaniam and Banerjee, 2014). In relation to this statement, Mamba (2012) in his analysis of South Africa‟s Grade 12 Mathematics Paper disclosed that algebraic expressions posed many problems to the learners. The skills of the learners in algebra are very poor as reported by Barry (2014). His report also stressed that students‟ difficulties in previous mathematics classes posed challenges in their future mathematics classes. Along this line, it can be conceived that students‟ poor performance in higher mathematics can be influenced by their performance in algebra.

Out of 17 respondents, there are three (3) respondents said that they are having challenges in common corresponds to "Understanding the concepts of problem-solving". It was mentioned that they were struggling in doing the right process of solving the problem in a systematic way, having a difficulty in analyzing and interpreting the problem/s given, and having a difficulty in identifying variables and setting it into equations or expressions. R16 statements which corresponds to the other two (2) responses said,

*"Also, I am having a difficulty in problem-solving like in identifying its variable, how to set into equations, and on how to interpret the problem given." (R16)*

The responses of the students show that they find it challenging to determine the correct procedures to use in solving algebraic problems. Wherein it shows that there is a need to student

for giving clearer techniques or methods on how to approach problem-solving systematically and develop their critical thinking ability. It appeared also that there is a difficulty in interpreting and analyzing the information accurately provided in algebraic word problems, which involves understanding the context of the problem, and identifying the appropriate mathematical approach to solve the problem given. The respondents is also struggling in recognizing the variables being use in the problem, making representation of the problem by formulating algebraic equations that describe the context of the problem, also difficulty in comprehending the statement that affect in formulating appropriate equations of the problem.

The result revealed that 17.65% responses show in common challenges on "Understanding the process of problem-solving". It is where the respondents are having a difficulty in understanding the process of solving the problem given, interpreting the context of the given problem, and struggling in identifying the variables and formulating equations based to the context of the problem. Tambychik, T., & Meerah, T. S. M. (2010). concluded that students faced difficulties in mathematic problem solving due to incompetency in acquiring many mathematics skills and lacking in cognitive abilities of learning. Information skill was found to be the most critical mathematics skills. Although students acquired other mathematics skills, without the transfer of information skill, they could not understand and make effective connection of the information in the problems. Generally, the majority of the students did not acquire this skill utterly. Cognitive abilities in learning such as the ability to recall, memorize and perceive influence the efficiency of problem-solving.

## IV. Conclusion

Based on the findings of this study conducted, the challenges encountered by first-year BSED Mathematics students at Osmeña Colleges revealed that the 70.59% majority of the respondents commonly encountered challenges on "Utilization of signs as operation". This finding revealed the lack of application of systematic methods, familiarization of rules, and understanding of the context in mathematical expressions. Challenges encountered in "Grasping expressions consisting higher exponents" and "Simplifying algebraic expressions" revealed 29.41% and 17.65% of the respondents identified to have a challenge encountered in "Understanding the process of problem-solving". The researchers concluded that by equipping students with the necessary skills and knowledge to succeed by addressing these challenges proactively.

## V. Recommendations

Based on the challenges encountered by the respondents, the researchers recommend the possible action or solution that the teacher can implement to minimize the difficulties of the students, because it appeared to the result that the students commonly respond that they are having a difficulty in utilization of sign.

1. Integration of sign rule: it is recommended by the researchers that the teacher should introduce the sign rule before proceeding to the discussion. Provide assessment to students where they can practice and apply the sign rule.

2. Mastery of law of exponent: the teacher should let the student master the law of exponent and provide structured practice opportunities that begin with guided exercises and transition to independent tasks.

3. Dedication of teacher in teaching the students: the teacher must be dedicated to teach the students and use different strategies to cater the individual needs of the learner.

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Jessa Mae B. Alonzo is a 3rd-year college student, pursuing Bachelor of Secondary Education Major in Mathematics at Osmeña Colleges. Recognized with high honor for her academic excellence and other achievements.

With a strong dedication for her studies, she is dedicated to expand her intellectual horizons and in pursuit of knowledge. She is also committed to inspire her fellow students to strive for intellectual growth and academic excellence.

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Jeslene L. Pusing is an accomplished educator and leader in the field of Mathematics education. She graduated from Osmena Colleges with a Bachelor's degree in Secondary Education majoring in Mathematics in the esteemed batch of 2015. Recognized for her academic excellence and dedication to teaching, she further pursued her passion for Mathematics education and obtained a Master's degree in Teaching Mathematics from the same institution.

With a strong commitment to fostering a love for Mathematics among students, Jeslene has continuously contributed to the field of education. Throughout her career, she has served as a mentor and a role model to countless learners, inspiring them to excel in their studies and embrace the intricacies of Mathematics.