Received: 01 July 2023 | Accepted: 30 June 2024 | Published Online: 30 June 2024
Recoletos Multidisciplinary Research Journal Vol. 12 no. 1 (June 2024)
DOI: https://doi.org/10.32871/rmrj2412.01.17

RECOLETOS MULTIDISCIPLINARY RESEARCH JOURNAL

Conceptual and Procedural Understanding in the Division of Algebraic Fractions

Jomar Cabuquin[1*] and Ferdinand Abocejo[2]

[1] Science and Mathematics Education Department, Eastern Visayas State University, Tacloban City, Philippines

[2] Graduate School, Eastern Visayas State University, Tacloban City, Philippines

*Correspondence: jomar.cabuquin@evsu.edu.ph

Abstract

This study investigated the correlation between conceptual and procedural understanding of the division of algebraic fractions among junior high school students at a government-run university. It utilized descriptive and correlational research designs involving 109 enrolled Grade 8 students as study respondents. A validated algebra test questionnaire was the instrument used for the division of algebraic fractions. The Pearson product-moment correlation or Pearson r was used to assess the correlation between data variables. The findings revealed that the students poorly exhibited conceptual and procedural understanding in the division of algebraic fractions. There was a strong, highly positive, significant correlation between the students' conceptual and procedural understanding in the division of algebraic fractions, which indicated that students' conceptual understanding goes hand in hand with their procedural understanding. Therefore, the higher the level of student conceptual understanding, the higher the level of procedural understanding and vice-versa.

Keywords

algebraic fraction, division, conceptual understanding, procedural understanding

INTRODUCTION

Inadequate knowledge of basic mathematics is one of the reasons why many students need help understanding mathematical concepts, which can lead to problem-solving challenges. Many students feel anxiety whenever they encounter any mathematics problem. Students' attitude toward learning mathematics significantly relates to their performance in the subject, where the "higher the attitude towards Mathematics, the better is the performance in Mathematics" (Andamon & Tan, 2018, p. 104). Likewise, to successfully solve a problem, students should be able to understand the problem or recognize the words in the query. They must learn the procedure of any mathematics problem and understand its concept for better and long-lasting learning (Jolejole-Caube et al., 2019). Understanding the concept influenced the students' mathematical ability (Ghazali & Zakaria, 2011).

In Philippine secondary schools, some teachers concentrate more on procedural than conceptual understanding, where students typically learn rote processes uninterestingly (Gabriel et al., 2013;

Jolejole-Caube et al., 2019). More recently, the mathematics teaching and learning process emphasized conceptual and procedural understanding, a more conventional teaching approach considering mathematical ideas (Ghazali & Zakaria, 2011). Conceptual understanding is the knowledge that includes an in-depth understanding of the underlying ideas behind the performed algorithms (Lauritzen, 2012). It comprises a scenario wherein students need to understand and reconstruct formulas to find a solution to the problem. It also entails recognizing patterns, connecting mathematical concepts, and using logical reasoning to solve problems. Gaining mastery of complex mathematical concepts and the ability to solve problems that may be applied to various fields requires a firm grasp of mathematical concepts.

Meanwhile, procedural understanding is the knowledge that covers the set of interconnected rules or algorithms that students need to follow to answer mathematics problems (Gilmore et al., 2017). It comprises the ability to solve mathematical problems with precision and efficacy using algorithms, formulas, and rules. Students with a solid procedural grasp may execute calculations fast and accurately, but they may struggle with more complicated problem-solving that necessitates a deeper understanding of concepts.

However, the results of the National Achievement Test (NAT) and the country's rank in international examinations have not improved even with these developments in the teaching-learning process (Abocejo & Padua, 2010) and reformations of the present mathematics spiral curriculum (Fernandez & Abocejo, 2014). Critical thinking and problem-solving skills are among the key areas measured in the NAT. Students are scrutinized for their ability to apply mathematical and scientific principles to real-world problems and make informed decisions using logical thinking. Early development of these skills is critical to helping students become effective problem-solvers and decision-makers in academic and real-life situations. Also, there is a need to reinforce and enhance students' mathematical competencies in learning concepts and procedures, specifically problems involving algebraic fractions, which are identified to be "the common difficulties of second-year high school students" (Torio, 2015, p. 570). In the same way, students must have a complete understanding of concepts and procedures to have an in-depth comprehension of Mathematics. This can be realized when mathematics teachers fix "the wrong study method of students that causes the lack of mathematical competence" (Andamon & Tan, 2018, p. 96).

Zembat (2015) stated that schools considered arithmetic operations important in Mathematics education. Hence, students must master the concepts and skills in arithmetic operations early before operating fractions. Elementary teachers train pupils on the four fundamental operations of mathematics: addition, subtraction, multiplication, and division (Brandt et al., 2016; Owi & Ang, 2015), and pupils should master these basic mathematical operations to advance to the next level. However, from the four fundamental operations mentioned, Yorulmaz and Önal (2017) indicated that many students have problems comprehending the division process, which can be an ideal ground for future difficulty in learning the division of fractions. In mathematics, division covers the three other fundamental operations, making it more complex, mainly if it comprises algebraic concepts.

In teaching mathematics at the secondary level, these basic operations, particularly the division, are still applied but at varying levels. Students learned another area in Mathematics, which is Algebra. It is a foundational branch of Mathematics that uses symbols or letters to represent values or quantities (Torio, 2015) and is used in many scientific and mathematical research fields. An algebraic expression can then be a number, a letter (or a variable), a combination of a number, and a variable separated by a plus or minus symbol. As an application of this concept, students are taught how to divide algebraic fractions. At this stage, students are no longer just calculating numbers; they are also to operate algebraic fractions, and new rules are introduced. Algebraic fraction division is a crucial topic of study since it comprises other algebraic operations like addition, subtraction, and multiplication, and makes it more challenging for students to understand. At this point, students hit roadblocks trying to comprehend how algebraic fractions are being divided. Secondary mathematics teachers also need help thinking of the best strategy to help students understand division.

The primary contributor to this paper, responsible for teaching mathematics at the secondary level, encountered various challenges concerning the acquisition of mathematical skills and concepts. Students are having difficulty with the basic lesson on algebraic fraction division, which serves as one of the foundations for learning higher mathematics. Adu-Gyamfi et al. (2019) further noted that the mathematical concept of fraction division presents significant challenges among students. Likewise, based on actual and personal observation, some students understood the rules of algebraic fraction division conceptually but needed help to use these prescribed rules in problem-solving. Some students can follow the procedures but need help comprehending the ideas behind the algorithms. Fan and Bokhove (2014) further argued that algorithm learning had been hampered by a possible contradiction between concepts and procedures, with algorithms being linked with low-level cognition.

In effect, there is an existing problem among students who need help understanding the concepts and the procedures in terms of the division of algebraic fractions in 8th-grade students where the algebraic fraction division concept is initially learned. This situation could seriously impact the mathematics education curriculum. Hence, a school needs to develop an intervention program to neutralize the gap between the concepts and procedures so that students can become more adept in mathematics, specifically in the division of algebraic fractions. Thomson et al. (2017) indicated that a greater understanding of this phenomenon is crucial for educators and policymakers who want to improve mathematics learning outcomes and better prepare students for academic and career success.

Although knowledge regarding the interaction between conceptual and procedural understanding of mathematics has diversified significantly in previous years, there is still an array of important knowledge gaps in this area. The degree to which conceptual and procedural understanding influence one another is an area of research that needs further exploration. While some research suggests that improving a student's conceptual understanding may also improve their procedural fluency, other research hints that these two areas of mathematical proficiency may be more independent than previously believed (Alcock et al., 2016; Hurrell, 2021; Nahdi & Jatisunda, 2020; Rittle-Johnson et al., 2015). One may argue that a solid understanding of concepts inevitably leads to a mastery of procedures (Yuan, 2013); however, students may be able to follow a series of steps to solve mathematical problems without fully recognizing the concepts that make such procedures effective in the first place (Clark et al., 2012; & Hallett et al., 2010).

The interplay between these two domains and success in more difficult mathematical tasks, such as solving algebraic fractions that involve division and logical thinking, is another area researchers should dwell on. The paucity of research in the Philippine setting focusing on mathematical concepts and procedures also pressed the researchers to delve deeper into this area and determine the link between the understanding of concepts and procedures in mathematics. A more profound knowledge of this relationship could result in the creation of more effective instructional strategies that assist students in developing foundational skills in both areas, better preparing them for more difficult mathematical tasks. The researchers further argue that the correlation between conceptual and procedural understanding facilitates better learning in fraction division.

Study objectives

This study examined the correlation between conceptual and procedural understanding of the division of algebraic fractions among junior high school students in a government-run university. Specifically, it assessed the levels of conceptual and procedural understanding of students in the division of algebraic fractions and investigated if a correlation existed between conceptual and procedural understanding in the division of algebraic fractions.

Literature Review

In mathematics education, concerns abound on issues that influence the understanding of difficulties, attitudes, errors, anxiety, algorithms, concepts, and skills of students in mathematics. For instance, in Mexico, Escalera-Chávez et al. (2016) delved into anxiety towards mathematics. They argued that in the teaching-learning process, many students feel a high anxiety level towards mathematics, which can be reduced through constant correct practice. Likewise, Devika (2016) investigated the concept of fractions among primary school learners and identified the difficulties and misconceptions that learners encounter in the classroom while learning fractions and how they can be handled. She identified learners' difficulties and misconceptions while learning fractions and how they can be handled.

It is claimed that the meaning of fraction is not sufficiently understood to help students better understand fractions (Ibañez & Pentang, 2021); there are various definitions of fractions from the part-whole meaning, which was the most commonly used term found in mathematics textbooks (Bastürk, 2016). He further noted that though fractions can comprise many connotations, such as part-whole, ratio, measurement, division, and many more, understanding fractions means understanding all of these connotations. Therefore, the emphasis of this present study is assessing students' conceptual and procedural understanding of the division of algebraic fractions to provide necessary interventions.

Ervin (2017) affirmed that "fractions are an important building block for student success in algebra." As a branch of mathematics, many Algebra lessons deal with concepts that consist of understanding fractions containing letters (variables) and performing the operations of these algebraic fractions. If there are flaws in students' knowledge concerning fractions or rational expressions, they will find it even more challenging to understand the lessons about fractions that include algebraic concepts (Cadorna et al., 2021). Wu (cited in Ervin, 2017) also argued that the best pre-algebra practice must include fractions. It is vital to attain fluency in fractions to get a meaningful knowledge of algebraic concepts. Algebraic fractions may cause anxiety to students if they have no solid foundation in fractions (Hord et al., 2020). The lack of conceptual understanding of fractions may be attributed to the inability of students to view fractions as numbers with whole-number properties (Hwang & Riccomini, 2021).

However, in the present study, the researchers argue that the skill of students to perform the operations on fractions is also vital to attaining fluency in fractions. Students' lack of procedural understanding of algebraic fractions (rational expressions) operations, especially in division operations, is considered a difficulty-causing factor in algebra (Lee & Boyadzhiev, 2020). Students commit errors in Algebraic operations due to the need for more procedural and conceptual understanding of fraction operations and algorithms (Mbeki & Mbekwa, 2022). The finding of Mbeki and Mbekwa (2022) supports the argument of the present study that considers procedural knowledge as a factor that contributes to the difficulty of understanding fractions. Nonetheless, Cananua-Labid (2015) found that the student's conceptual and procedural knowledge could have been more considerably associated.

Every student's success in math is influenced by the learning output from the four operations of multiplication, division, addition, and subtraction (Yorulmaz & Önal, 2017). Usiskin (as cited in Zembat,

2015) emphasized that the operations on fractions should be given adequate attention and interest in the classroom. Gabriel et al. (2013) explained the difficulties experienced by students when they study fractions. The study was only concerned with students' difficulties in addition, subtraction, and multiplication without considering the division operations. Among the four fundamental operations, Zembat (2015) emphasized that the division operation has been given special attention by several studies, especially the division of fractions. The willingness to study the division operation is attributed to its complexity, which is caused by various interrelated processes when performing this operation.

Furthermore, other studies indicated that students' performance in fractions-related problems has deviated from acceptable levels. For instance, the study by Saleh et al. (2023) revealed that students with difficulty effectively applying problem-solving steps faced significant challenges when solving fraction problems. Jayanthi et al. (2021) also mentioned that despite interventions, many students struggle with fractions, indicating a persistent issue in comprehending and utilizing fraction concepts. In the same way, the students' limited understanding of basic fraction concepts and operations could impede their problem-solving skills (Hariyani et al., 2022). However, the division operation is perceived to be challenging for most students (Rodriguez & Abocejo, 2018), particularly in word problems (Simon, as cited in Joutsenlahti & Kulju, 2017). Yorulmaz and Önal (2017) added that students' confusion about the rules of four numerical operations leads to difficulties in comprehending mathematical problems. As a result, if not addressed, students' misperceptions of the rules may later lead to difficulties in solving algebraic problems, particularly in algebraic fraction operations.

Zembat (2015) argued that to understand fraction division better, the mathematics curriculum should think of shifting the traditional 'Invert and Multiply Algorithm' (IMA) to the alternative way known as the 'Common Denominator Algorithm' (CDA) in teaching division of fraction. The claim was based upon the extensive literature analysis that "IMA does not give learners enough opportunity to invent their algorithm because of its complex and algebraically situated mathematical structure." This is in contrast with the study of Ervin (2017) and Joutsenlahti and Kulju (2017), who emphasized that it is through the use of models that students can best understand the idea of how to divide fractions and attain a conceptual knowledge of models could help students to learn more effectively. The findings of the study conducted by Joutsenlahti and Kulju (2017) pointed out that translating mathematical problems in the form of multimodal languages like pictorial language, mathematical symbolic language, and a natural language should be stressed to help and guide students to perceive it as a "division into parts."

On the other hand, Iskenderoglu (2018) asserted that analyzing preservice elementary teachers' conceptual difficulties with fractions, particularly in multiplication and division, helps mathematics educators improve their understanding of fractions. Iskenderoglu's (2018) assertion supports the study of Maelasari and Jupri (2017), who stated that conceptual understanding of fractions is sometimes disregarded in Mathematics instruction. This scenario later causes conceptual difficulties in algebraic fraction operation, especially in the division. The findings derived from the study also revealed that preservice elementary teachers had better performance in problems related to fraction multiplication than their performance related to fraction division (Iskenderoglu, 2018). Indeed, the preceding discussion renders importance to the need to conduct the present study and consider algebraic fraction division as the subject for investigation. As noted earlier, the authors of this paper analyzed not only the students' conceptual understanding but also the procedural understanding of fraction division through an objective assessment of how these factors influence mathematics performance.

Cherng (2017) indicated that inequalities in the classroom are formed by the perception and beliefs of the Mathematics and English teachers about the student's ethnicity. In the study, it was further stated that the teachers' perception of the ability of the students to perform better in a specific subject matter like mathematics is linked with the youth of color. Meanwhile, the study findings did not show solid proof that the teacher is biased in judging students' performance in class considering the racial group of the students (Cherng, 2017). Every student, regardless of color, can achieve and perform better in academic subjects, and they should all be treated equally without bias (Saraspe & Abocejo, 2020). Some studies (Ajai & Imoko 2015; Anjum, 2015; Cabuquin, 2023; Musa et al., 2016) have been conducted to analyze if being a male or female determines academic performance in class. Similarly, students' mathematics performance did not correlate with their demographic profile (Andamon & Tan, 2018).

In its effort to offer a concrete contribution to Mathematics education, the present study pursued an analysis of the conceptual and procedural understanding of the division of algebraic fractions. The goal is to address the literature gaps and determine professional development activities for teachers to help them improve Mathematics instruction and eliminate students' differences in learning the subject matter.

Theoretical Background

The present study is anchored on the Cognitive Development Theory (CDT) advocated by Piaget (as cited in Zembat, 2015), which argues that the reorganization develops logical-mathematical experience or mathematical knowledge of learners' thought processes. The structures are called action schemes, concrete and formal operations, constructed through logical mathematical experiences. Moreover, the CDT anticipates that students learn best when they feel ready to learn. They feel excited and motivated to learn more if they know the reason for learning.

In the context of mathematics learning, CDT sheds light on how children learn mathematical principles and procedures at each stage of mental development. In particular, the theory explains how children develop mathematical skills and create a cognitive framework that enables them to comprehend mathematics. Likewise, one central tenet of Piaget's theory is the assertion that it is an active process that results from the interplay between a child's environment and their natural capacity for information processing. Thus, students learn mathematical concepts and processes by actively experimenting, interacting, and exploring the world around them. The internal representations of mathematical concepts and procedures that allow students to solve problems indicate that students gradually increase their comprehension based on prior knowledge and experiences in dealing with mathematics problems. By allowing students to view and manipulate mathematical concepts in actual circumstances, concrete manipulatives and visual representations can assist students in creating a foundation of mathematical understanding. Further, it is essential to remember that even students of the same age may display different levels of cognitive ability (Ahmad et al., 2016).

As students develop their capacity for abstract thought, metacognition, and deductive reasoning, CDT can be used by mathematics teachers to aid in their assessment processes. Testing may consist of questions requiring students to explain their solutions' meanings rather than merely assessing procedural competence. The CDT can also assist mathematics teachers in uncovering gaps in students' conceptual understanding, adjusting their instructional strategies better to suit the needs of students at various developmental stages, and more effectively evaluating and boosting their mathematical knowledge and proficiency. By developing several solutions to a particular problem, students could gain a more profound knowledge of the fundamental concepts and principles underpinning mathematical operations. In this study, it is given that a student has not yet understood the concept of factoring or any other manipulative skills and would face difficulty in trying to operate algebraic fractions like dividing them. The researchers assessed the students' prior knowledge through a mathematics teaching system, which was subjected to developmental tasks sequentially arranged according to difficulty.

Conceptual framework

Figure 1 shows the conceptual framework of the study. The respondents were assessed based on their conceptual and procedural understanding of the division of algebraic fractions. In addition, the correlation between conceptual and procedural understanding was examined to determine the strength and magnitude of the relationship between the two identified study variables.

Moreover, the following concepts and skills were examined: dividing algebraic fractions whose numerators and denominators are monomial expressions; the numerators and denominators are binomial expressions; the numerators and denominators can be monomial, binomial, or trinomial expressions; factoring monomial, binomial, and trinomial expressions; and finally, simplifying algebraic expressions. The researcher concentrated solely on the stated concepts in algebraic fraction division since they contain basic algebraic skills required in performing algebraic fraction division, which are the necessary foundations for higher learning.

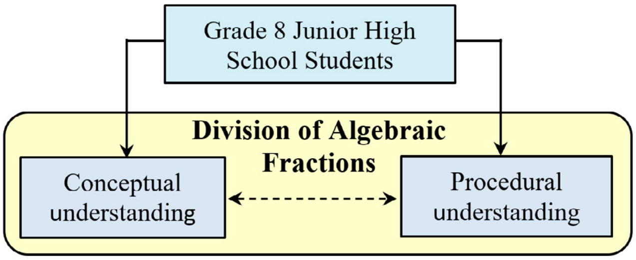

Figure 1. *Conceptual Framework of the Study*

METHODS

Research design

Considering the research objectives and data gathered, the study utilized the quantitative approach using descriptive and correlational research designs to gather relevant and representative data to address the research problems. The descriptive method was employed to depict the levels of conceptual and procedural understanding of students in the division of algebraic fractions. Similarly, descriptive research comprises acquiring data from events, putting together, tabulating, visualizing, and describing empirical evidence without alterations (Suryadi et al., 2021). Meanwhile, the correlational method guided the researcher in investigating the correlation between conceptual and procedural understanding in the division of algebraic fractions.

Research locale and respondents

The study was conducted at a laboratory high school with a teacher education department in a government-run university in the Eastern Visayas region, Philippines. One hundred nine (109) Grade 8 junior high school students (46 males and 63 females) from the said laboratory school were selected since it is also in this grade level where the division of algebraic fractions is first learned by the students under the recommended curriculum. Likewise, most of the student respondents are thirteen years old, which is the typical age for a student in Grade 8, while few are a year older. The respondents of this study came from various localities in the Eastern Visayas provinces, including Leyte, Biliran, and Samar. Additionally, as a district learning center, it is managed and governed by the Department of Education (DepEd), Tacloban City Division.

Research instrument

The research instrument used in this study was a validated algebra test questionnaire. The items were compiled without modifications from mathematics textbooks and with valid references for junior high school students. Before the construction of the test, a Table of Specifications (TOS) was made as a blueprint to guide the researcher in formulating the test items. A TOS ensures that there is a balance between an item that tests lower level and those that test higher-order thinking skills. This TOS was constructed to cover all the concepts and skills necessary for investigating the conceptual and procedural understanding of the division of algebraic fractions. Further, the test contained forty (40) items relevant to the division of algebraic fractions, with clear and definite directions provided so the respondents could understand what to do. The first twenty (20) items in the questionnaire were designed to collect data for the conceptual understanding of students in the division of algebraic fractions. In comparison, twenty (20) items were designed to measure their procedural understanding of the topic. As indicated in the specifications table, the researchers assured that there were enough items to cover all concepts and skills needed for this study.

To ensure the content validity of the instrument, the test draft underwent an expert validation process. This process involved seeking input from experienced mathematics educators, specifically secondary mathematics instructors from the university. These experts carefully evaluated each item for its relevance, clarity, and alignment with the objectives of the study. Following expert validation, it was also subjected to pilot testing from the randomly selected forty (40) Grade 8 students in another secondary learning institution outside the research locale. The items were analyzed in terms of discrimination index and index of difficulty to find out what items needed to be revised, rejected, or included in the final test, which would be utilized in the final data gathering. Two items were found to have a low discrimination index, suggesting that they were ineffective in distinguishing between students of different levels of understanding. Additionally, two items were found to have an inappropriate level of difficulty, either too easy or too challenging. As a result, four items were revised and improved to better target conceptual and procedural understanding of algebraic fraction division for the students.

Data gathering procedure

The researchers followed all the protocols throughout the study, ensuring that permissions were secured before gathering needed data. Test questionnaires were distributed personally by the principal researcher. Before the students answered all questions, the proctor had discussed general instructions and specific directions to guide the students in answering the test. The respondents were given 75 to 90 minutes of allotted time to answer all problems in the test. The students' scores were determined using a mathematics rubric, which evaluated their responses into four levels. A three-point response contains the right answers to the item and displays a thorough understanding of the mathematical concepts or procedures. A two-point response indicates a partial understanding of the mathematical concepts or procedures. In this response, the student addressed most aspects of the problem accurately but made some minor errors or gaps. A one-point response indicates a limited understanding of the mathematical concepts or procedures in the given item. Finally, a zero-point response shows incorrect, irrelevant, incoherent, or containing a correct solution obtained using an incorrect procedure. The principal researcher retrieved the answered questionnaires after the respondents answered all items.

Treatment of data

The gathered data were collated and presented in tabular forms. Frequency counts, standard deviations (SDs), and percentages were computed. The arithmetic mean was computed to assess the students' performance in the algebra test questionnaire involving the division of algebraic fractions. Pearson r was employed to determine if a correlation existed between conceptual understanding and procedural understanding in the division of algebraic fractions. The data gathered were tested at the 0.01 level of significance.

Ethical considerations

The researchers ensured that all respondents were not forced to participate in the study, where they participated of their own free will. The respondents were provided with the needed information and assurance that the test result would solely be used for the study and would be dealt with confidentiality. Likewise, each respondent obtained informed consent, and parental consent was sought and obtained to ensure ethical compliance. Privacy rights were respected, and respondents' identities were treated with confidentiality. Additionally, the results of their participation were duly recognized.

RESULTS AND DISCUSSION

Conceptual understanding in the division of algebraic fractions

Table 1 presents the conceptual understanding of the division of algebraic fractions among other student respondents. Nearly two-thirds (62.39 percent) of the students exhibited poor conceptual understanding, with nearly one-third (30.28 percent) manifesting very poor understanding. Only eight (8) student respondents (7.34 percent) student respondents exhibited an acceptable level of conceptual understanding.

Table 1. *Frequency Distribution by Level of Students' Conceptual Understanding*

Level	Frequency	Percent (%)
Poor	68	62.39
Very Poor	33	30.28
Fair	8	7.34
Total	109	100

Ranges in percent	Description	
≤24	Very poor	Number of cases (N) = 20
25 – 50	Poor	Highest Possible Score = 20
51 – 74	Fair	SD = 2.65
75 – 82	Average	Grand Mean = 6.24
83 - 91	Satisfactory	
≥92	Excellent	

None of them got an average, satisfactory, or excellent performance on the test, indicating a challenge for the teachers in the teaching of mathematics subject in the classroom. Therefore, it becomes imperative that mathematics teachers be aware of why students struggle so they can start taking small steps to resolve this problem.

Andamon and Tan (2018) found out that students commonly possessed an average proficiency level in conceptual understanding, which came out different in this study, where students manifested "poor" conceptual understanding as shown by the grand mean of 6. 24 with a standard deviation of 2.65. It may be because, in contrast with the previous study, this present study focuses on the concept of algebraic fractions, which is perceived to be very challenging for students. Similarly, Cabrillas et al. (as cited in Torio, 2015) revealed that students find the greatest difficulty in problems involving fractions. Moreover, this dismal performance of the students is quite upsetting, so those in mathematics education should take immediate action to reduce this difficulty in understanding the concepts so that students will now be more skilled in solving problems, specifically in the division of algebraic fractions.

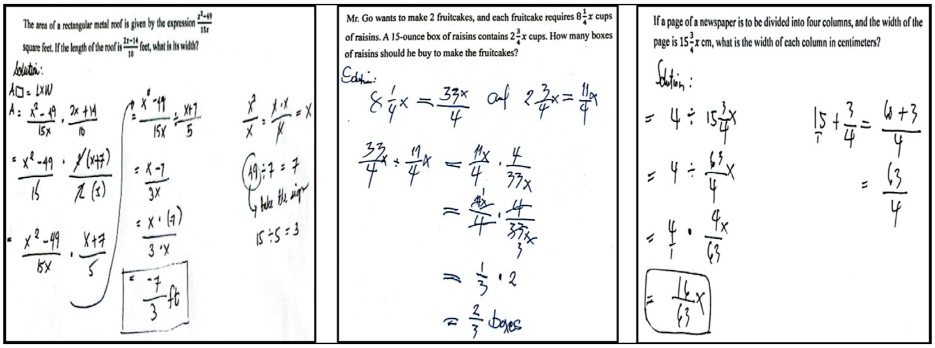

Figure 2. *Examples of students' performance in sample items for Conceptual Understanding*

Figure 2 describes the students' performance in algebraic fraction division in terms of the level of conceptual understanding. Several students showed a lack of comprehension of the operation's fundamental meaning. Rather than approaching the problems as a meaningful exploration of fractions, they appeared to treat the tasks merely as mechanical operations devoid of any context or real-world relevance. They also found it difficult to correctly grasp word problems, which resulted in the faulty execution of mathematical operations. The prevalence of these misconceptions may impede their progress in mastering advanced mathematical topics and refining their problem-solving skills (Jankvist & Niss, 2018; Kang, 2022; Kusuma & Retnawati, 2019). Without grasping the underlying principles, students may face challenges relating algebraic concepts to real-world situations (Agasi et al., 2017; Chan et al., 2012). It is essential to address these misconceptions to provide a strong foundation for future mathematical learning and to promote a more in-depth conceptual grasp.

In addition, the students misinterpreted symbols, confused operations, and employed incorrect formulas because of their difficulty understanding the mathematical language and terms associated with algebraic fraction division. Their capacity to express and comprehend mathematical ideas appears to be hampered by this language barrier. This indicates that early intervention to improve students' comprehension of mathematical terminology and address difficulties with mathematical language can pave the way toward effective communication, understanding of mathematical concepts, and a profound grasp of algebraic fraction division. Likewise, the incapacity to establish connections between concepts impedes their ability to apply prior knowledge to division problems involving algebraic fractions. This also signals that students who cannot grasp how different mathematical concepts are interconnected could find it difficult to transfer knowledge and apply it to unfamiliar contexts. Other studies specified that strategies such as using real-world examples, emphasizing connections between concepts (Maass et al., 2019; Rosa & Orey, 2015), and providing opportunities for meaningful application of mathematical operations can play a vital role in improving students' conceptual understanding (Crooks & Alibali, 2014; Laurens et al., 2017).

Procedural understanding in the division of algebraic fractions

Table 2 presents the procedural understanding of the division of algebraic fractions among student respondents. As can be gleaned from the table, the highest number, more than one-half (55.96 percent) of the total student respondents, demonstrated a poor level of procedural understanding, with slightly more than one-third (33.94 percent) showing a very poor understanding. Moreover, only seven (6.42 percent) exhibited fair procedural understanding, with three (2.75 percent) student respondents manifesting an average procedural understanding. Among the 109 respondents, it is disturbing to note that only one (1) student achieved a score ranging from 83 percent to 91 percent, described as having a satisfactory level of procedural understanding of the algebraic fraction division. This situation reveals that the student respondents have inadequate knowledge of following the prescribed correct algorithms, which is perceived as an ideal ground for future difficulties.

Table 2. *Frequency Distribution by Level of Students' Procedural Understanding*

Level	Frequency	Percent (%)
Poor	61	55.96
Very Poor	37	33.94
Fair	7	6.42
Average	3	2.75
Satisfactory	1	0.92
Total	109	100

Ranges in percent	Description	
≤24	Very poor	Number of cases (N) = 20
25 – 50	Poor	Highest Possible Score = 60
51 – 74	Fair	SD = 9.70
75 – 82	Average	Grand Mean = 19.95
83 - 91	Satisfactory	
≥92	Excellent	

The lack of procedural understanding of students regarding operations on algebraic fractions, specifically on the division operation, is a factor that can cause difficulty in algebra, not only the conceptual understanding of the students in fractions (Laursen, as cited in Ervin, 2017). Correspondingly, Yorulmaz and Önal (2017) added that students' confusion about the rules or algorithms in mathematics operations results in committing errors and difficulties in comprehending mathematical problems. Consequently, this misperception of students on the prescribed rules or algorithms in division leads to difficulties in solving algebraic problems, especially in the algebraic fraction operation. As a result, mathematics teachers may provide extra time to conduct drill lessons and exercises to accommodate students experiencing difficulties in learning mathematical procedures.

Though teaching mathematics in most secondary schools is procedural with little conceptual, poor procedural understanding of students is still evident. If not treated with utmost concern, it could affect the school's overall performance in either regional or national examinations where the procedural aspect of students' learning in mathematics is sometimes stressed.

Figure 3 likewise illustrates the students' performance in algebraic fraction division in terms of the level of procedural understanding. Some students misapplied rules and algorithms specific to algebraic fraction division, leading to inaccurate results. This hints that students lack procedural fluency and precision in their mathematical operations. As a result, providing opportunities for students to engage in repetitive exercises and guided practice can help enhance their procedural fluency. Furthermore, students frequently demonstrated incorrect cancellation of terms in expressions and ignored parentheses. They mistakenly canceled out terms that were not like terms or had common factors, resulting in erroneous simplifications. This lack of precision in executing algebraic fraction division suggests a need for students to pay closer attention to detail during their problem-solving process. Mathematics teachers must emphasize grouping symbols and instructing students about the appropriate times to cancel out terms. This could contribute to improved procedural understanding and enhance the students' problem-solving skills.

Given the fundamental role of procedural understanding in efficiently solving routine problems, educators can implement targeted instructional interventions to enhance students' procedural fluency. Consistent and purposeful practice, coupled with timely feedback, will serve to reinforce their comprehension and promote precision in mathematical operations. Educators can foster a profound appreciation for algebraic fraction division by prioritizing procedural practice, ultimately bolstering students' problem-solving capabilities. Equipping students with procedural fluency will empower them to approach more advanced mathematical topics with confidence and accuracy and prepare them for greater success in tackling complex challenges.

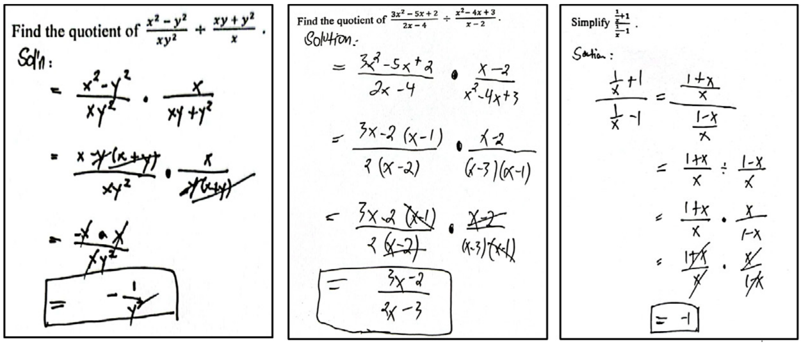

Figure 3. *Examples of students' performance in sample items for Procedural Understanding*

Correlation between conceptual and procedural understanding

Determining the correlation between students' conceptual and procedural understanding of Mathematics could be vital in proposing and developing necessary interventions to reduce, if not eliminate, students' difficulties in learning the subject. As reflected in Table 3, correlation analysis revealed that the student's conceptual understanding and procedural understanding in the division of algebraic fractions exhibited statistical significance ($\alpha < 0.001$); the correlation of 0.975 with a p-value of 0.00 reflects a strong and direct significant relationship between the two variables. It further indicates that students' conceptual and procedural understanding levels go hand in hand. In the same manner, when students' level of conceptual understanding is low, procedural understanding is also low. These findings suggest the need to support students' learning by ensuring they simultaneously understand the concepts and procedures of algebraic fraction division.

For fraction division, it is ideal to consider the different approaches employed by mathematics teachers to assist students in fully understanding the concept and rule in fraction division and to provide necessary interventions that would aid in eradicating this misperception. Furthermore, when there are inadequacies in students' knowledge concerning fractions or rational expressions, they find it even more difficult to understand the lessons about fractions that include algebraic concepts, which could impact, from a broader perspective, the country's standing in both national and international examinations.

In addition, the study findings on the correlation between conceptual understanding and procedural understanding are similar to the findings of Ghazali and Zakaria (2011), where a direct and significant correlation existed between conceptual and procedural understanding in Mathematics. However, the study's findings statistically differ from those of Cananua-Labid (2015), who found that students' conceptual and procedural knowledge was not significantly associated, perhaps because of many factors, such as the language barrier. In the same way, preservice teachers strive hard to solve problems related to division caused by various interrelated processes when performing this operation (Zembat, 2015).

The null hypothesis of no significant relationship between the conceptual and procedural understanding in the division of algebraic fractions among grade eight junior high school students is rejected. However, the resulting significant relationship does not cover the order of acquisition between the understanding of concepts and procedures. Likewise, the result derived from the correlation analysis is restricted to the two variables of the study and may not be sufficient in providing strong evidence of correlation because there can be other variables (like attitude, interest, perception, and study habits of students) that might alter the correlation between conceptual and procedural understanding.

Table 3. *Pearson correlation between students' conceptual and procedural understanding in the division of algebraic fractions*

Variable	Mean	SD	r-value	p-value
Conceptual Understanding	6.24	2.65	0.975**	0.000
Procedural Understanding	19.95	9.70		

** - highly significant at $\alpha < 0.001$

CONCLUSION

This study examined the correlation between conceptual and procedural understanding in the division of algebraic fractions among 8th-grade junior high school students. The results show that the respondents need a better conceptual and procedural understanding of the division of algebraic fractions. The students' conceptual understanding has a crucial bearing on their procedural understanding of the division of algebraic fractions. The higher the students' conceptual understanding, the higher the procedural understanding, and vice versa. The researchers recommend that secondary school teachers develop and enhance the student's procedural competence by providing ample time to practice and review meaningful problem-solving activities, drills, and exercises that should be at par with their mathematical level of understanding.

Furthermore, giving students extended tasks frequently may be considered so they can use their spare time and continue learning the subject outside the classroom. Mathematics teachers must regularly check students' understanding of concepts by asking factual or conceptual questions and encouraging students to explain their responses. Teaching mathematical concepts and procedures simultaneously is encouraged to support and boost students' learning. Likewise, given the needs and expectations of 21st-century education, mathematics teachers should pursue graduate studies and take a vertically articulated program with a mathematics teachers' undergraduate degree to deepen their understanding of the subject and discover new teaching strategies that may help students increase their scholastic performance. The researchers likewise consider that the student respondents' prior mathematics learning experience before getting admitted to the targeted school may have impacted the outcome. Similarly, the present research was performed only in one government-run secondary school institution, and its results may only apply to some secondary schools in the country; thus, more research is needed to validate the findings. Future studies may be conducted to identify other factors that affect students' conceptual and procedural understanding of Mathematics.

REFERENCES

Abocejo, F. T., & Padua, R. N. (2010). An econometric model for determining sustainability of basic education development. *CNU Journal of Higher Education. 4*(1), 40-53. http://www.jhe.cnu.edu.ph/index.php/cnujhe/article/view/39

Adu-Gyamfi, K., Schwartz, C.S., Sinicrope, R., & Bossé, M. J. (2019). Making sense of fraction division: Domain and representation knowledge of preservice elementary teachers on a fraction division task. *Mathematics Education Research Journal, 31,* 507–528. https://doi.org/10.1007/s13394-019-00265-2

Agasi, G., Wahyuono, Y., & Rudhito, M. (2017). Junior high school students' ability to apply algebra in real-world problems. I*nternational Journal of Indonesian Education and Teaching, 1*(2), 206-215. https://doi.org/10.24071/IJIET.2017.010210

Ahmad, S., Ch, A. H., Batool, A., Sittar, K., & Malik, M. (2016). Play and cognitive development: Formal operational perspective of Piaget's theory. *Journal of Education and Practice, 7*(28), 72-79. https://files.eric.ed.gov/fulltext/EJ1118552.pdf

Ajai, J.T., & Imoko, B.I. (2015). Gender differences in mathematics achievement and retention scores: A case of problem-based learning method. *International Journal of Research in Education and Science (IJRES), 1*(1), 45-50. https://files.eric.ed.gov/fulltext/EJ1105194.pdf

Alcock, L., Ansari, D., Batechelor, S., Bison, M., De Smedt, B., Gilmore, C., Göbel, S., Hannula-Sormunen, M, Hodgen, J., Inglis, M., Jones, I., Mazzocco, M., McNeil, N., Scheider, M., Simms, V., & Weber, K. (2016). Challenges in mathematical cognition: A collaboratively-derived research agenda. *Journal of Numerical Cognition, 2*(1), 20– 41. https://doi.org/10.5964/jnc.v2i1.10

Andamon, J. C., & Tan, D. A. (2018). Conceptual understanding, attitude and performance in mathematics of grade 7 students. *International Journal of Scientific & Technology Research, 7*(8), 96-105. https://www.ijstr.org/final-print/aug2018/Conceptual-Understanding-Attitude-And-Performance-In-Mathematics-Of-Grade-7-Students.pdf

Anjum, S. (2015). Gender difference in mathematics achievement and its relation with reading comprehension of children at upper primary stage. *Journal of Education and Practice. 6*(16), 71-76. https://files.eric.ed.gov/fulltext/EJ1079951.pdf

Bastürk, S. (2016). Primary student teachers' perspectives of the teaching of fractions. *Acta Didactica Napocensia, 9*(1), 35-44. https://files.eric.ed.gov/fulltext/EJ1103431.pdf

Brandt, C. F., Bassoi, T. S., & Baccon, A. L. P. (2016). Difficulties of 6th grade elementary school students in solving the four basic fundamental operations: Addition, subtraction, multiplication and division of natural numbers. *Creative Education, 7*(13), 1820-1833. https://doi.org/10.4236/ce.2016.713185

Cabuquin, J. C. (2023). An examination of written work and performance task in general mathematics and precalculus of Filipino STEM learners. *Jurnal Pendidikan Progresif, 13*(2), 375-386. https://doi.org/10.23960/jpp.v13.i2.202317

Cadorna, E. A., Cadorna, E. F., & Taban, J. G. (2021). A cross-sectional study of students' learning progression in algebra. *Universal Journal of Educational Research, 9*(3), 449-460. https://doi.org/10.13189/ujer.2021.090304

Cananua-Labid, S. A. (2015). Conceptual and procedural knowledge in mathematics of preservice teachers in the Countryside. *The Countryside Development Research Journal, 3*(2), 1-6. https://cdrj.ssu.edu.ph/index.php/CDRJ/article/download/107/88/

Cantoria, A. L., & Espinosa E. B. (2016). Predominance of procedural knowledge and between-operation interference as deduced from fraction errors of preservice teachers. *Asia Pacific Journal of Multidisciplinary Research, 4*(4) 75-79. https://oaji.net/articles/2016/1543-1475118889.pdf

Chan, C., Ng, K., Widjaja, W., & Seto, C. (2012). Assessment of primary 5 students' mathematical modelling competencies. *Journal of science and Mathematics Education in Southeast Asia, 35*(2), 146-178. https://hdl.handle.net/10497/16257

Cherng, H. S. (2017). If they think I can: Teacher bias and youth of color expectations and achievement. *Social Science Research, 66*, 170-186. https://doi.org/10.1016/j.ssresearch.2017.04.001

Clark, R., Kirschner, P. A., & Sweller, J. (2012). Putting students on the path to learning: The case for fully guided instruction. *American Educator, 36*(1), 5-11. https://eric.ed.gov/?id=EJ971752

Crooks, N. M., & Alibali, M. W. (2014). Defining and measuring conceptual knowledge in mathematics. *Developmental Review, 34(*4), 344-377. https://doi.org/10.1016/j.dr.2014.10.001

Ervin, H. K. (2017). Fraction multiplication and division models: A practitioner reference paper. *International Journal of Research in Education and Science, 3*(1), 258-279. https://files.eric.ed.gov/fulltext/EJ1126700.pdf

Escalera-Chávez, M. E., Garcia-Santillán A., Cordova-Rangel, A., Gonzalez-Gómez, S., & Tejada-Peña, E. (2016). Anxiety

towards mathematics and educational level: A study on means differences. *European Journal of Contemporary Education, 17*(3) 311-323. http://files.eric.ed.gov/fulltext/EJ1116550.pdf
Devika, R. (2016). Handling fractions and errors in fractions. I-*Manager's Journal on Mathematics. 5*(3), 1-7. https://doi.org/10.26634/jmat.5.3.8223
Fan, L., & Bokhove, C. (2014). Rethinking the role of algorithms in school mathematics: A conceptual model with focus on cognitive development. *ZDM Mathematics Education, 46*, 481–492. https://doi.org/10.1007/s11858-014-0590-2
Fernandez, R. C. C., & Abocejo, F. T. (2014). Child labor, poverty and school attendance: Evidences from the Philippines by region. *CNU Journal of Higher Education, 8*(1), 114-127. http://www.jhe.cnu.edu.ph/index.php/cnujhe/article/view/151
Gabriel, F., Coché, F., Szucs, D., Carette, V., Rey, B., & Content, A. (2013). A componential view of children's difficulties in learning fractions. *Frontiers in Psychology, 4*, 715. https://doi.org/10.3389/fpsyg.2013.00715
Ghazali, N. H. C., & Zakaria, E. (2011). Students' procedural and conceptual understanding of mathematics. *Australian Journal of Basic and Applied Sciences, 5*(7), 684-691. http://www.ajbasweb.com/old/ajbas/2011/July-2011/684-691.pdf
Gilmore, C., Keeble, S., Richardson, S., & Cragg, L. (2017). The Interaction of Procedural Skill, Conceptual Understanding and Working Memory in Early Mathematics Achievement. *Journal of Numerical Cognition, 3*, 400-416. https://doi.org/10.5964/jnc.v3i2.51
Hallett, D., Nunes, T., & Bryant, P. (2010). Individual differences in conceptual and procedural knowledge when learning fractions. *Journal of Educational Psychology, 102*(2), 395–406. https://doi.org/10.1037/a0017486
Hariyani, M., Herman, T., Suryadi, D., & Prabawanto, S. (2022). Exploration of student learning obstacles in solving fraction problems in elementary school. I*nternational Journal of Educational Methodology, 8*(3), 505–515. https://doi.org/10.12973/ijem.8.3.505
Hord, C., Ladrigan, E., & Saldanha, R. L. (2020). A student with a learning disability and multi-step equations with fractions. *Learning Disabilities: A Contemporary Journal, 18*(1), 111-121. https://files.eric.ed.gov/fulltext/EJ1264268.pdf
Hurrell, D. (2021). Conceptual knowledge or procedural knowledge or conceptual knowledge and procedural knowledge: Why the conjunction is important to teachers. *Australian Journal of Teacher Education (Online), 46*(2), 57-71. https://search.informit.org/doi/10.3316/informit.757709794375494
Hwang, J., & Riccomini, P. J. (2021). A descriptive analysis of the error patterns observed in the fraction-computation solution pathways of students with and without learning disabilities. *Assessment for Effective Intervention, 46*(2), 132–142. https://doi.org/10.1177/1534508419872256
Ibañez, E. D., & Pentang, J. (2021). Socio-constructivist learning and teacher education students' conceptual understanding and attitude toward fractions. *Indonesian Research Journal in Education, 5*(1), 22-44. https://online-journal.unja.ac.id/irje/article/ download/12187/10849
Iskenderoglu, T.A. (2018). Fraction multiplication and division word problems posed by different years of preservice elementary mathematics teachers. *European Journal of Educational Research, 7*(2), 373-385. https://doi.org/10.12973/eu-jer.7.2.373
Jankvist, U. T., & Niss, M. (2018). Counteracting destructive student misconceptions of mathematics. *Education Sciences, 8(*2), 53. https://doi.org/10.26822/iejee.2023.283
Jayanthi, M., Gersten, R., Schumacher, R. F., Dimino, J., Smolkowski, K., & Spallone, S. (2021). Improving struggling Fifth-Grade students' understanding of fractions: a randomized controlled trial of an intervention that stresses both concepts and procedures. *Exceptional Children, 88*(1), 81–100. https://doi.org/10.1177/00144029211008851
Jolejole-Caube, C., Dumlao, A. B., & Abocejo, F. T. (2019). Anxiety towards mathematics and mathematics performance of grade 7 learners. *European Journal of Education Studies, 6*(1), 334-360. http://dx.doi.org/10.5281/zenodo.2694050
Joutsenlahti, J., & Kulju, P. (2017). Multimodal languaging as a pedagogical model—A case study of the concept of division in school mathematics. *Education Science, 7*(9), 1-9. https://doi.org/10.3390/educsci7010009
Kang, H. J. (2022). Preservice elementary teachers understanding of fraction multiplication and division in multiple contexts. *International Electronic Journal of Elementary Education, 15*(2), 109-121. https://doi.org/10.26822/iejee.2023.283
Kusuma, U., & Retnawati, H. (2019). Analysis of sixth graders' difficulties in solving Mathematics word problems on whole numbers, fractions, and decimals. *Journal of Physics: Conference Series*, 1320. https://doi.org/10.1088/1742-6596/1320/1/012008
Laurens, T., Batlolona, F. A., Batlolona, J. R., & Leasa, M. (2017). How does realistic mathematics education (RME) improve students' mathematics cognitive achievement? *Eurasia Journal of Mathematics, Science and Technology Education, 14*(2), 569-578. https://doi.org/10.12973/ejmste/76959

Lauritzen, P. (2012). *Conceptual and procedural knowledge of mathematical functions* [Doctoral dissertation, University of Eastern Finland]. University of Eastern Finland Digital Repository. http://epublications.uef.fi/pub/urn_isbn_978-952-61-0893-3/urn_isbn_978-952-61-0893-3.pdf

Lee, H. J., & Boyadzhiev, I. (2020). Underprepared college students' understanding of and misconceptions with fractions. *International Electronic Journal of Mathematics Education, 15*(3), 1-12. https://doi.org/10.29333/iejme/7835

Maass, K., Geiger, V., Ariza, M. R., & Goos, M. (2019). The role of mathematics in interdisciplinary STEM education. *ZDM Mathematics Education, 51*, 869-884. https://doi.org/10.1007/s11858-019-01100-5

Maelasari, E., & Jupri, A. (2017). Analysis of student errors on division of fractions. *Journal of Physics: Conference Series, 812*(1), 012033. https://doi.org/10.1088/1742-6596/812/1/012033

Mbeki, N., & Mbekwa, M. O. (2022). Grade 9 learners' ways of working with Algebraic fractions: Errors and misconceptions. In K.R. Langenhoven, & C.H. Stevenson-Milln (Eds.), *Book of proceedings of the 30th Annual Conference of the Southern African Association for Research in Mathematics, Science and Technology Education* (76-106). SAARMSTE. https://wdetest.com/saarmste/wp-content/uploads/2022/01/Book-of-Proceedings_Long-Papers_30th-Conference.pdf#page=76

Musa, A. K. J., Dauda, B., & Umar, M. A. (2016). Gender differences in achievement goals and performances in English language and mathematics of senior secondary schools' students in Borno State, Nigeria. *Journal of Education and Practice, 7*(27), 165-175. https://files.eric.ed.gov/fulltext/EJ1115862.pdf

Nahdi, D. S., & Jatisunda, M. G. (2020). Conceptual understanding and procedural knowledge: A case study on learning mathematics of fractional material in elementary school. *Journal of Physics: Conference Series,* 1477(4), 042037. https://files.eric.ed.gov/fulltext/EJ1296887.pdf

Owi, W. P., & Ang, K. H. (2015). Mathematical operations from teacher to student: A case study of applied division wheel in primary school. *International Journal of Scientific Engineering and Research, 3*(9), 2347-3878. https://www.ijser.in/archives/v3i9/IJSER15480.pdf

Rittle-Johnson, B. Schneider, M. & Star, J. (2015). Not a one-way street: Bi-directional relations between procedural and conceptual knowledge of mathematics. *Educational Psychology Review, 27*, 587-597. https://doi.org/10.1007/s10648-015-9302-x

Rodriguez, K. F. R., & Abocejo, F. T. (2018). Competence vis-à-vis performance of special education preservice teachers. *European Academic Research, 6*(7), 3474-3498. http://www.euacademic.org/UploadArticle/3707.pdf

Rosa, M., & Orey, D. C. (2015). A trivium curriculum for mathematics based on literacy, matheracy, and technoracy: An ethnomathematics perspective. *ZDM Mathematics Education, 47*(4), 587-598. https://doi.org/10.1007/s11858-015-0688-1

Saleh, S. F., Sirajuddin, N., Ernawati, N., & Damayanti, N. (2023). Analysis of Students' Mathematical Ability in Solving Fraction Problems at Elementary School Level. *AULADUNA Jurnal Pendidikan Dasar Islam, 10*(1), 116–125. https://doi.org/10.24252/10.24252/auladuna.v10i1a9.2023

Saraspe, L. D., & Abocejo, F. T. (2020). Effectiveness of descriptive praise on the English composition skill of bridging students. *European Journal of English Language Teaching, 5*(4), 18-38. http://dx.doi.org/10.46827/ejel.v5i4.3140

Suryadi, Mahardika, I. K., Supeno, & Sudarti. (2021). Data literacy of high school students on physics learning. *Journal of Physics: Conference Series, 1839*(1), 012025. https://doi.org/10.1088/1742-6596/1839/1/012025

Thomson, M. M., DiFrancesca, D., Carrier, S., & Lee, C. (2017). Teaching efficacy: Exploring relationships between mathematics and science self-efficacy beliefs, PCK and domain knowledge among preservice teachers from the United States. *Teacher Development, 21*(1), 1-20. https://doi.org/10.1080/13664530.2016.1204355

Torio, M. Z. C. (2015). Development of instructional material using algebra as a tool in problem-solving. *International Journal of Education and Research, 3*(1), 569-586. http://ijern.com/journal/2015/January-2015/48.pdf

Yorulmaz, A., & Önal, H. (2017). Examination of the views of class teachers regarding the errors primary school students make in four operations. *Universal Journal of Educational Research, 5*(11), 1885-1895. https://doi.org/10.13189/ujer.2017.051105

Yuan, S. (2013). Incorporating Polya's problem solving method in remedial math. *Journal of Humanistic Mathematics, 3*(1), 96-107. https://scholarship.claremont.edu/jhm/vol3/iss1/8

Zembat, I. O. (2015). An alternative route to teaching fraction division: Abstraction of common denominator algorithm. *International Electronic Journal of Elementary Education, 7*(3), 399-422. https://files.eric.ed.gov/fulltext/EJ1068041.pdf

How to cite this article:

Cabuquin, J., & Abocejo, F. (2024). Conceptual and Procedural Understanding in the Division of Algebraic Fractions. Recoletos Multidisciplinary Research Journal 12(1), 225-240. **https://doi.org/10.32871/rmrj2412.01.17**