Jurnal Elemen, 11(1), 108-119, January 2025
https:/doi.org/10.29408/jel.v11i1.27602
e- ISSN: 2442 - 4226

Hybrid didactic design in mathematics learning on fraction: A hermeneutic phenomenology

Ahmad Muzaki [1 *], Ita Chairun Nissa [1], Sri Yuliyanti [1], Masjudin [1], Muhamad Galang Isnawan [2]

[1] Department of Mathematics Education, Universitas Pendidikan Mandalika, West Nusa Tenggara, Indonesia
[2] Department of Mathematics Education, Universitas Nahdlatul Wathan Mataram, West Nusa Tenggara, Indonesia

[*] Correspondence: ahmadmuzaki@undikma.ac.id

Abstract
Although many studies have involved fractions in the elementary school curriculum, research on this topic at the junior high school level has been limited, particularly in identifying the factors causing student learning difficulties and designing alternative didactic approaches to overcome these challenges. Therefore, this study aimed to investigate these aspects. Hermeneutic phenomenology was used in this study. The participants in this research were students from a junior high school in Lombok, Indonesia, consisting of 29 eighth-grade students (aged 14-18), most of whom were female and from the Sasak ethnic group. Instrument, such as fraction operation tests, in-depth interview guidelines, and a hybrid didactic design for mathematics learning. Data related to learning difficulties were analyzed using a thematic analysis approach with NVivo-12 software. The study's findings revealed that students' low ability to operate integers, especially multiplication and division, was a primary factor in learning difficulty. The hybrid mathematics learning design sequence consists of three stages. The first stage encompasses several activities, namely Let's Guess and Let's Read. The second stage involved activities like Let's Search, Let's Discuss, and Let's Conclude. The third stage comprised activities of Let's Practice and Self-Reflection.

Keywords: hermeneutic phenomenology; hybrid didactic design; learning obstacles

How to cite: Muzaki, A., Nissa, I. C., Yuliyanti, S., Masjudin, & Isnawan, M. G. (2025). Hybrid didactic design in mathematics learning on fraction: A hermeneutic phenomenology. *Jurnal Elemen*, *11*(1), 108-119. https://doi.org/10.29408/jel.v11i1.27602

Received: 26 September 2024 | Revised: 8 December 2024
Accepted: 9 January 2025 | Published: 1 February 2025

Introduction

Mathematics plays a crucial role in everyday life (Maass et al., 2019; Man-Keung, 2022; Yolcu et al., 2019) and across various disciplines (Chorlay et al., 2022; Hoffmann et al., 2023; Sandefur et al., 2022). Ideally, students should have a strong understanding of mathematical concepts (Chorlay et al., 2022; Koskinen et al., 2022). Nomerous studies on conceptual and procedural knowledge dealing with fractions have been undertaken fractions multiplication specifically (Hallet et.al., 2010, 2012; Purnomo et.al., 2017).

However, some previous research indicates that there are issues or obstacles in mathematics learning experienced by students (Elia et al., 2016; Lin et al., 2017), particularly concerning fractions (Isnawan et al., 2022; Zhang et al., 2014). Research conducted by Copur-Gencturk (2021) surveyed schools across the United States to assess teachers' understanding of fraction arithmetic. The results of this study showed that teachers' understanding of fraction arithmetic is still limited, and teachers with more teaching experience tend to have deeper understanding. Diputra et al. (2022) conducted a study on elementary school teachers' knowledge of fraction concepts using a qualitative approach based on a case study in Bali, Indonesia. The results of this study concluded that elementary school teachers have limitations in understanding fractions, particularly in regard to the concept of fractions as parts of a whole. Purnomo et al. (2022) used a qualitative approach based on tests and in-depth interviews to assess students' knowledge and difficulties in fraction multiplication at an elementary school in Jakarta, Indonesia. This study found that students' knowledge of fractions is limited, and students struggle to comprehend contextual problems. Although many studies have examined understanding of fractions at the elementary school level (Mohamed et al., 2021; Zuhri et al., 2023), few have been conducted at the junior high school level, especially using the hermeneutic phenomenology approach in hybrid mathematics learning.

In contrast to previous research, the aim of this study is to analyze the factors causing students' learning obstacles in dissimilar fraction addition learning and to design a didactic solution to reduce these obstacles. The design used in this study is hermeneutic phenomenology, which enables the analysis of factors causing learning obstacles and the design of a hybrid mathematics learning didactic design (Keshavarz, 2020; Suryadi, 2019b, 2019a). Several research questions will be addressed in achieving this objective: (1) What is the overview of factors causing students' learning obstacles in dissimilar fraction addition learning? (2) What is the overview of the didactic design for hybrid mathematics learning for dissimilar fraction addition?

Methods

This research design was qualitative design with phenomenological approach. The participant students in this study consisted of 29 female students from a junior high school who had studied fractions, with an age range between 14 and 18 years, originating from the Sasak ethnic group, and having parents who worked as entrepreneurs. There were 29 students who took the fraction test and three students from different categories (low, medium and high) who took part in interview. Three categories of mathematical ability based on fraction test score, namaely low (score test < 60), medium (score test 60 – 79), high (score test 80). In addition to involving student participants, this research also included a mathematics teacher as a participant, aged 26 with approximately five years of teaching experience. The research was conducted in one of the junior high schools in West Lombok Regency, Indonesia. This school was chosen as the research location because it was one of the leading junior high schools in the district, but faced challenges in teaching fraction material.

In this study, the researcher acted as the primary instrument, following a qualitative approach as described by Creswell and Creswell (2018). Several additional instruments were also used in this research. These included dissimilar fraction addition tests, guidelines for in-depth interviews, and a hybrid mathematics learning design for dissimilar fractions. Dissimilar fraction addition tests and in-depth interview guidelines (Brown et al., 2017; Husband, 2020) were applied as tools to collect data related to student learning obstacles. Meanwhile, the hybrid didactic design was used to minimize student learning obstacles, enhance motivation, and optimize students' mathematical abilities (Prihandhika et al., 2022; Ramadhani et al., 2022; Siagian et al., 2022).

As part of the reliability confirmation in this research, seven experts in the fields of mathematics, mathematics education, and psychology conducted content validity tests on the hybrid didactic design in mathematics learning. The content validity ratio (CVR) test was conducted to confirm its validity (Lawshe, 1975). The analysis of the results showed that the CVR value for the hybrid didactic design in mathematics learning was 1. From this, it can be concluded that this design has essential significance in dissimilar fraction addition learning.

This research adopted a qualitative approach (Creswell, 2012; Creswell et al., 2018), using a hermeneutic phenomenology research design (Dangal et al., 2020; Isnawan et al., 2023).

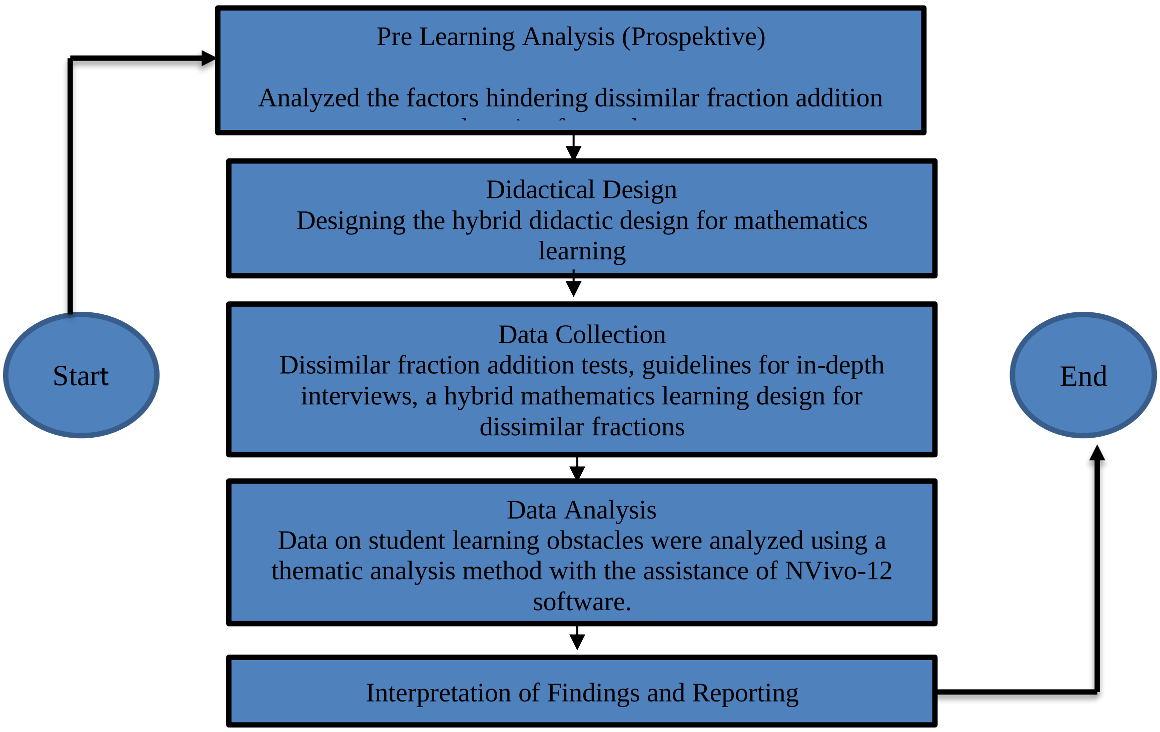


Figure 1. Flow chart hermeneutikc phenomenology

The use of hermeneutic phenomenology in this research was based on two fundamental reasons. First, the design aimed to investigate how learning design influenced students' thinking patterns. In the context of this research, the researcher aimed to explore the impact of dissimilar fraction addition learning previously implemented by teachers, considering factors contributing to students' learning difficulties. Second, the design proposed alternative learning design. On the other hand, this research aimed to investigate the didactic design in dissimilar fraction addition learning as an alternative solution to reduce students' learning obstacles (Suryadi, 2019b, 2019a).

The steps in this research followed the sequence in hermeneutic phenomenology research (Dangal et al., 2020; Isnawan et al., 2022; Laverty, 2003; Stolz, 2013). The first stage was the pre-learning analysis (prospective), where the researcher analyzed the factors hindering dissimilar fraction addition learning for students. The next stage was the researcher designing the hybrid didactic design for mathematics learning. Data on student learning obstacles were analyzed using a thematic analysis method with the assistance of NVivo-12 software (Alhojailan et al., 2012; Dalkin et al., 2020). The thematic analysis approach was chosen for its systematic nature, producing themes that effectively represented the data (Alhojailan et al., 2012; Finkelstein et al., 2019; Nowell et al., 2017). The use of NVivo-12 was chosen for its user-friendliness, ability to handle various types of data, and support in the coding process (Paulus et al., 2015). The steps in thematic analysis involved several stages, from becoming familiar with the data to naming emerging themes (Benavides-lahnstein et al., 2019; Pigden et al., 2019).

In terms of research ethics, three main principles were applied. First, the principle of informed consent, where consent was obtained from students prior to data collection, especially during interviews. Second, the principle of anonymity, where students' identities were protected using codes in data reporting. Third, the principle of confidentiality, where research findings were used only for research purposes and the enhancement of mathematics learning. The validity of the findings in this research was reinforced through method and data source triangulation, regular discussions with fellow researchers, in-depth analysis, and regular data storage in NVivo-12 (Esposito, 2012; Esposito & Moroney, 2020; Heale & Forbes, 2013; Husband, 2020).

Results

What is the overview of factors causing students' learning obstacles in dissimilar fraction addition learning?

After analyzing the content of the data from the mathematics comprehension test and in-depth interviews, information about several emerging themes was discovered, such as T_a (students' inability to execute procedures), T_b (lack of students' mastery of prerequisite material), and T_c (students' ability to present accurate procedures). One of the most prominent themes in this study was students' difficulty in executing dissimilar fraction addition procedures. When performing dissimilar fraction addition, the majority of students tended to combine numerators with numerators or denominators with denominators (Figure 2). As an addition, Figure 2 also showed that the student was less careful. If the intention of the students was to add the denominators, the correct number should have been 6, not 18.

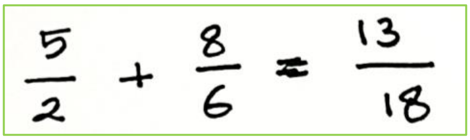


Figure 2: Excerpt of student's response

In relation to T_b, there were at least two types of initial codes that emerged: students encountered difficulties in performing integer multiplication or division operations correctly, and students faced challenges in reducing fractions to their simplest form. The results from the in-depth interviews confirmed these initial findings. Quotations from the interview dialogue between the researcher and the students can be found in Table 1.

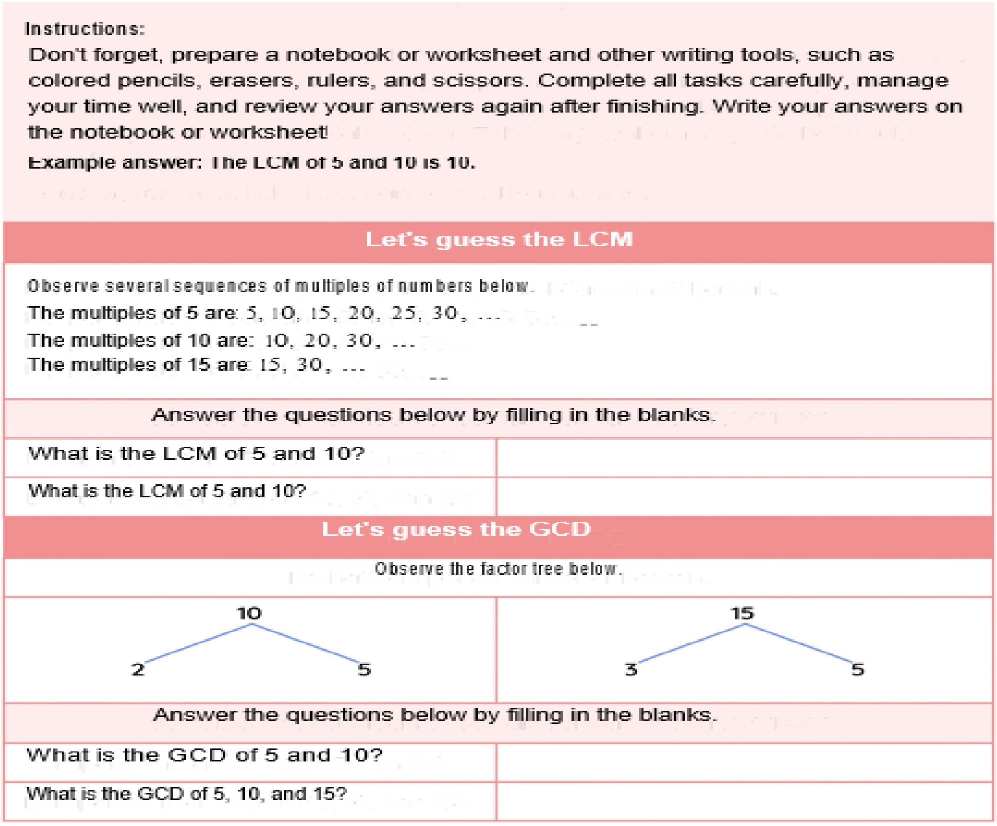
Table 1. Excerpt of interview results

Researcher's question	Student's answer
If simplified, what does 18 per 12 become?	S1: Maybe 0 per 12, sir.
When simplified, what is 3 per 1?	S2: That's the simplest form, sir.
When 16 per 16 is simplified, what is it?	S3: 16 per 16, I can't continue,

Based on this research, it could be stated that the underlying factors for students' learning difficulties in adding different fractions were the students' lack of understanding towards the prerequisite concept. The prerequisite concept referred to here was the students' ability in performing multiplication and division operations on integers.

What is the overview of the didactic design for hybrid mathematics learning for dissimilar fraction addition?

As previously outlined, students encountered learning obstacles due to their low mastery of fundamental concepts, particularly in multiplication and division operations with integers. Therefore, in this research, a hybrid mathematics learning approach was designed with the aim of helping students overcome barriers related to these prerequisites. In the context of this study, these prerequisites were conceptualized within a conceptual framework necessary to comprehend the learning of adding dissimilar fractions. One of the aspects involved the introduction and application of the least common multiple (LCM) concept (to reinforce understanding of multiplication operations) and the greatest common divisor (GCD) concept (to strengthen comprehension of division operations). Figures 3 and Figures 4 provided illustrations of how this prerequisite material was reinforced through the proposed learning approach.



Instructions:
Don't forget, prepare a notebook or worksheet and other writing tools, such as colored pencils, erasers, rulers, and scissors. Complete all tasks carefully, manage your time well, and review your answers again after finishing. Write your answers on the notebook or worksheet!
Example answer: The LCM of 5 and 10 is 10.

Let's guess the LCM

Observe several sequences of multiples of numbers below.
The multiples of 5 are: 5, 10, 15, 20, 25, 30, ...
The multiples of 10 are: 10, 20, 30, ...
The multiples of 15 are: 15, 30, ...

Answer the questions below by filling in the blanks.

What is the LCM of 5 and 10?	
What is the LCM of 5 and 10?	

Let's guess the GCD

Observe the factor tree below.

10 → 2, 5	15 → 3, 5

Answer the questions below by filling in the blanks.

What is the GCD of 5 and 10?	
What is the GCD of 5, 10, and 15?	

Figure 3: Example of strengthening prerequisite material 1 in didactic design

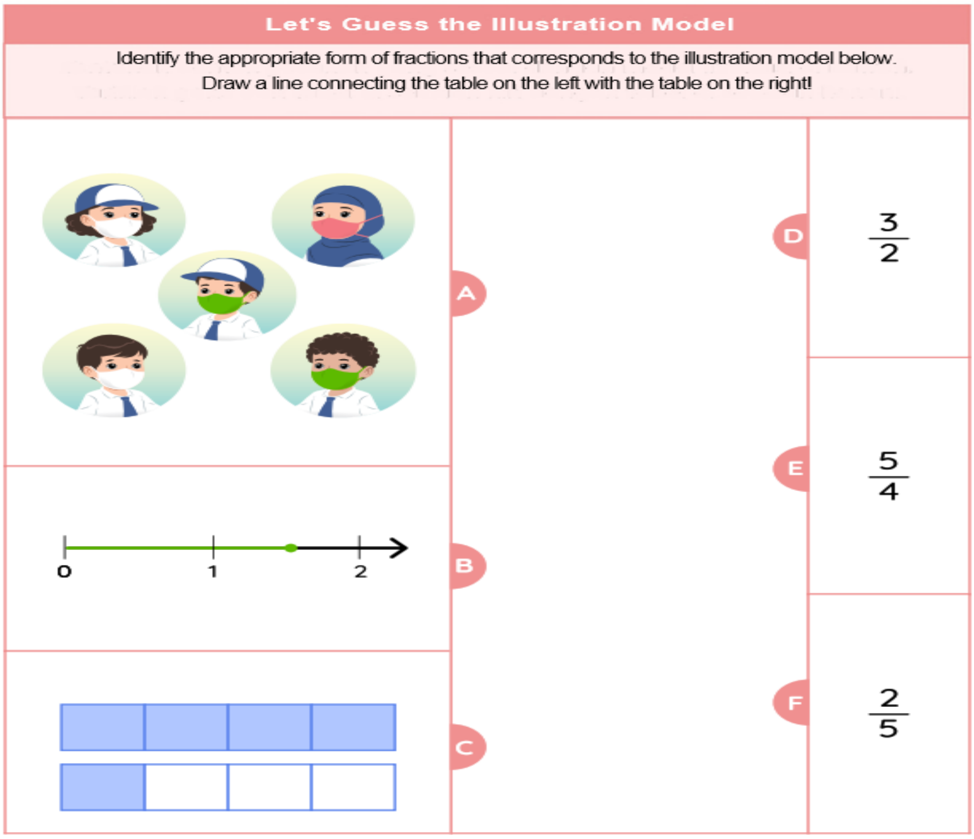


Figure 4: Example of strengthening prerequisite material in didactic design

Further, design of hybrid mathematics learning encompassed a series of comprehensive steps in the implementation of the teaching and learning process. Therefore, the structure of this design was established from the initial stage (preparation) to the final stage (evaluation) in mathematics instruction. The sequence of hybrid mathematics learning design consisted of three stages. The first stage encompassed several activities, namely *Let's Guess* and *Let's Read.* The second stage involved activities like *Let's Search, Let's Discuss,* and *Let's Conclude.* The third stage comprised activities of *Let's Practice* and *Self-Reflection.* In an effort to support students' understanding of the operations of adding different fractions, the instructional design also incorporated various illustrative models, such as the number line, area model, and set of objects. Overall, the hybrid mathematics learning design generated in this study for dissimilar fraction addition material can be accessed through the following link: https://l1nk.dev/7Pj90 .

Discussion

When linked to relevant theories on types of learning obstacles (Brousseau, 2002; Prabowo et al., 2022; Suryadi, 2019b), it was concluded that students encountered ontogenic obstacles characterized by conceptual characteristics. The findings from this study were consistent with several previous theories and research (Lestiana et al., 2016; Makhubele, 2021; Makonye & Khanyile, 2015) that demonstrated how students' limited understanding of integer operations negatively impacted their ability to manipulate dissimilar fractions.

Furthermore, there was an interesting topic worth discussing in this context. That topic concerned students' tendency to add numerators with numerators or denominators with denominators. This tendency was quite common, especially when dealing with different fraction additions. The findings from this study aligned with several prior research works (Alkhateeb, 2019; Dhlamini & Kibirige, 2014; Namkung & Fuchs, 2019; Trivena et al., 2017), which indicated that one of the common answer variations given by students when adding dissimilar fractions was to add numerators with numerators and denominators with denominators.

As previously described, the students encountered issues concerning their lower proficiency in prerequisites, especially in the ability to perform multiplication and division operations with integers. One of the solutions offered in the hybrid didactic design was to reinforce the prerequisites by facilitating the students in finding the LCM and GCD of several integers. Through the activity of searching for the LCM, the students' ability to perform multiplication operations improved compared to before. The same applied to the search for the GCD. By having the students find the GCD, they became more skilled in performing division operations with integers.

Since the instructional design cannot be solely focused on the prerequisites, this research developed a didactic design for hybrid mathematics learning in the form of a comprehensive lesson. The didactic design of hybrid mathematics learning in this study was divided into three stages: *Activity 1 (preparation), Activity 2 (instruction),* and *Activity 3 (evaluation).* These three stages were integrated into the didactic design based on previous theories and research that had revealed how school mathematics learning could be divided into three phases: preparation, instruction, and evaluation (Aylward, 2012; The Learning Centres, 2013).

The didactic design of hybrid mathematics learning was further developed based on the didactic situation, which included action-formulation, validation, and institutionalization (Brousseau, 2002; Prabowo et al., 2022; Suryadi, 2019b). The action-formulation situation was manifested in the *Let's Search* activity. The validation situation was reflected in the *Let's Discuss* and *Let's Conclude* activities. Meanwhile, the institutionalization situation was realized through the *Let's Practice* activity. The didactic situation approach was chosen because it aligned with the philosophical stages of knowledge acquisition (Isnawan, Alsulami, et al., 2023; Suryadi, 2019b, 2019a).

The *Let's Guess* activity in the didactic design of hybrid mathematics learning aimed to ensure that students understood the necessary prerequisites. These prerequisites were emphasized as they were the cause of students' learning obstacles and served as the foundation for understanding the upcoming material (Deeken et al., 2020; Makhubele, 2021). Essentially, this activity was expected to train students' abilities in performing multiplication and division operations with integers. It was hoped that the presence of this activity could minimize the learning obstacles experienced by students. *Let's Read* presented a story related to the importance of fractions from their discovery to the present day. This activity aimed to enhance students' interest and motivation to learn, in line with theories emphasizing the relevance of mathematics in everyday life (Abramovich et al., 2019; Arthur et al., 2022), which could increase students' interest and motivation.

The next step was *Let's Search*, which presented problems that students had to solve to help them understand the operations of adding different fractions. This approach aligned with the *"world of math"* theory that utilized everyday problems to develop mathematical understanding (Hartmann et al., 2021; Tall, 2004, 2008; Tall & Vinner, 1981). *Let's Discuss* aimed to encourage students or groups of students to share their answers and receive feedback from others. This discussion was expected to help students understand and formulate formulas for adding different fractions. This approach was based on social constructivism theory and previous research indicating that group discussions could help students understand mathematical concepts (Ahmad, 2021; Jaworski & Huang, 2014; Sjöblom et al., 2022).

Let's Conclude involved students in formulating a general formula for adding different fractions. This approach was based on learning theories emphasizing that students could build concepts or procedures through problem-solving (Jaworski & Huang, 2014; X. Yang et al., 2020). *Let's Practice* aimed to ensure that students could apply the concepts or procedures they had learned in different contexts (Marfuah et al., 2022; Suryadi, 2019b). This activity consolidated students' understanding of the addition of fractions. This approach aligned with previous theories and research showing that practice could strengthen students' understanding of mathematical concepts. *Self-Reflection* was a form of self-assessment by students, both of the learned concepts and the overall learning process. This approach was based on previous theories and research emphasizing the importance of self-assessment in enhancing the quality of learning (Ghorbanpour et al., 2021; L. P. Yang & Xin, 2022).

Conclusion

In the sequence of explanations above, it could be concluded that one of the main causes of students' learning obstacles in adding different fractions was ontogenic factors. These factors included a low understanding of integer operations. Therefore, a hybrid mathematics learning design was designed to guide students in mastering these prerequisites. This engineering involved a series of activities, including determining the LCM and GCD as the basis for students' understanding of integer operations. The determination of the LCM was used to facilitate students' prerequisite skills related to multiplication operations with integers, while the determination of the GCD was used to help students become accustomed to performing division operations with integers.

As the didactic design of hybrid mathematics learning formed a pattern of instructional activities, the design was developed using the theory of didactic situation as the basis for determining activities in the learning process. This situation consists of the action-formulation, validation, and institutionalization phases. This theory was employed because it was capable of facilitating students in epistemically discovering knowledge. The research then recommended that the findings be considered as an alternative method for teaching the addition of unlike fractions. Furthermore, if possible, future research could explore the impact of implementing the hybrid didactic design in mathematics learning on the existence of learning obstacles previously experienced by students.

Acknowledgment

The researchers express sincere appreciation to all participants who voluntarily provide crucial information for this research. The researchers also wish to extend gratitude to the Universitas Pendidikan Mandalika and Universitas Nahdlatul Wathan Mataram for supporting this research.

Conflicts of Interest

The authors declare no conflict of interest regarding the publication of this manuscript. In addition, the authors have completed the ethical issues, including plagiarism, misconduct, data fabrication and/or falsification, double publication and/or submission, and redundancies.

Funding Statement

This work has not received any specific grants from public, commercial, or non-profit funding agencies.

Author Contributions

Ahmad Muzaki: Conseptualization, preparing research reports and writing article; **Ita Chairun Nissa & M. Galang Isnawan**: Developing instruments, analysis and Interpretation data; **Sri Yuliyanti & Masjudin**: Review and data analysis.

References

Alhojailan, M. I., & Ibrahim, M. (2012). Thematic analysis: A critical review of its process and evaluation. *West East Journal of Social Sciences*, *1*, 8–21. https://faculty.ksu.edu.sa/sites/default/files/ta_thematic_analysis_dr_mohammed_alhojailan.pdf

Benavides-lahnstein, A. I., & Ryder, J. (2019). School teachers' conceptions of environmental education: Reinterpreting a typology through a thematic analysis. *Environmental Education Research*, *26*(1), 43–60. https//doi.org/10.1080/13504622.2019.1687649

Brown, A., & Danaher, P. A. (2017). CHE principles: Facilitating authentic and dialogical semi-structured interviews in educational research structured interviews in educational research. *International Journal of Research & Method in Education*, *42*(1), 76–90. https//doi.org/10.1080/1743727X.2017.1379987

Chorlay, R., Clark, K. M., & Tzanakis, C. (2022). History of mathematics in mathematics education: Recent developments in the field. *ZDM-Mathematics Education*, *54*(7), 1407–1420. https//doi.org/10.1007/s11858-022-01442-7

Copur-Gencturk, Y. (2021). Teachers' conceptual understanding of fraction operations: Results from a national sample of elementary school teachers. *Educational Studies in Mathematics*, *107*(3), 525–545. https//doi.org/10.1007/s10649-021-10033-4

Creswell, J. W. (2012). Educational research: Planning, conducting, and evaluating quantitative and qualitative research. In Educational Research (6th ed.). New York: SAGE Publishing. https//doi.org/10.1017/CBO9781107415324.004

Creswell, J. W., & Creswell, J. D. (2018). *Research design: qualitative, quantitative, and mixed methods approaches* (H. Salmon, Ed.; 5th ed.). Thousand Oaks, California: Sage Publication, Inc. Retrieved from https://id1lib.org/book/3700358/d95149

Dalkin, S., Forster, N., Hodgson, P., Lhussier, M., & Car, S. M. (2020). Using computer assisted qualitative data analysis software (CAQDAS; NVivo) to assist in the complex process of realist theory generation, refinement and testing. *International Journal of Social Research Methodology*, *24*(1), 123–134. https//doi.org/10.1080/13645579.2020.1803528

Dangal, M. R., & Joshi, R. (2020). Hermeneutic Phenomenology: Essence in Educational Research. *Open Journal for Studies in Philosophy*, *4*(1), 25–42. https://doi.org/10.32591/coas.ojsp.0401.03025d

Diputra, K. S., Suryadi, D., Herman, T., & Jupri, A. (2022). Teacher's knowledge of fraction in the perspective of didactic-mathematical knowledge. *Journal of Engineering Science and Technology Special Issue on ICMScE2022*, 136–143. https://shorturl.at/gwyC6

Elia, I., Özel, S., Gagatsis, A., Panaoura, A., & Özel, Z. E. Y. (2016). Students' mathematical work on absolute value: Focusing on conceptions, errors and obstacles. *ZDM-Mathematics Education*, *48*(6), 895–907. https//doi.org/10.1007/s11858-016-0780-1

Esposito, A. (2012). Research ethics in emerging forms of online learning: Issues arising from a hypothetical study on a MOOC. *Electric Journal of E-Learning*, *10*(3), 315–325. https://files.eric.ed.gov/fulltext/EJ985433.pdf

Esposito, M., & Moroney, R. (2020). Teacher candidates' perception of acquiring TPACK in the digital age through an innovative educational technology masters program. *Journal for Leadership and Instruction*, *19*(1), 25–30. https://files.eric.ed.gov/fulltext/EJ1255873.pdf

Finkelstein, S., Sharma, U., & Furlonger, B. (2019). The inclusive practices of classroom teachers: a scoping review and thematic analysis. *International Journal of Inclusive Education*, 1–28. https//doi.org/10.1080/13603116.2019.1572232

Heale, R., & Forbes, D. (2013). Understanding triangulation in research understanding triangulation in research. *Evidence-Based Nursing*, *16*(4), 98. https//doi.org/10.1136/eb-2013-101494

Hoffmann, A., & Even, R. (2023). The mutual contribution between mathematics and other fields: Mathematicians' and teachers' views. *ZDM-Mathematics Education*. https//doi.org/10.1007/s11858-023-01496-1

Husband, G. (2020). Ethical data collection and recognizing the impact of semi-structured interviews on research respondents. *Education Sciences*, *10*(8), 1–12. https//doi.org/10.3390/educsci10080206

Isnawan, M. G., Alsulami, N. M., Rusmayadi, Muh., & Yanuarto, W. N. (2023). Analysis of student learning barriers in fractional multiplication: A hermeneutics phenomenology study in higher education. *Edumatica: Jurnal Pendidikan Matematika*, *13*(1), 11–22. https://doi.org/10.22437/edumatica.v13i01.24190

Isnawan, M. G., Azis, A., & Almazroei, E. E. (2023). Parents' perspectives on distance learning mathematics during the Covid-19 pandemic: A phenomenological study in Indonesia. *European Journal of Educational Research*, *12*(1), 567–581. https//doi.org/10.12973/eu-jer.12.1.567

Isnawan, M. G., Suryadi, D., & Turmudi, T. (2022). How do secondary students develop the meaning of fractions? A hermeneutic phenomenological study. *Beta: Jurnal*, *15*(1), 1–19. https//doi.org/10.20414/betajtm.v15i1.496

Keshavarz, H. (2020). Hermeneutic phenomenology in supporting research and information services: Contributions to information science. *Journal of Information Science Theory and Practice*, *8*(4), 29–39. https://doi.org/10.1633/JISTaP.2020.8.4.3

Koskinen, R., & Pitkäniemi, H. (2022). Meaningful learning in mathematics: A research synthesis of teaching approaches. *International Electronic Journal of Mathematics Education*, *17*(2), em0679. https//doi.org/10.29333/iejme/11715

Laverty, S. M. (2003). Hermeneutic phenomenology and phenomenology: A comparison of historical and methodological considerations. *International Journal of Qualitative Methods*, *2*, 1–29. http://www.ualberta.ca/~iiqm/backissues/2_3final/pdf/laverty.pdf

Lawshe, C. H. (1975). A quantitative approach to content validity. *Personel Psychology*, *28*, 563–575. https//doi.org/10.1111/J.1744-6570.1975.TB01393.X

Lin, Y. W., Tseng, C. L., & Chiang, P. J. (2017). The effect of blended learning in mathematics course. *Eurasia Journal of Mathematics, Science and Technology Education*, *13*(3), 741–770. https//doi.org/10.12973/eurasia.2017.00641a

Maass, K., Geiger, V., Ariza, M. R., & Goos, M. (2019). The role of mathematics in interdisciplinary STEM education. *ZDM-Mathematics Education*, *51*(6), 869–884. https//doi.org/10.1007/s11858-019-01100-5https//doi.org/10.1007/s11858-019-01100-5

Man-Keung, S. (2022). The role of M (mathematical worlds) in HPM (history and pedagogy of Mathematics) and in STEM (science, technology, engineering, mathematics). *ZDM-Mathematics Education*, *54*(7), 1643–1655. https//doi.org/10.1007/s11858-022-01375-1

Mohamed, R., Ghazali, M., & Samsudin, M. A. (2021). A systematic review on teaching fraction for understanding through representation on Web of Science database using PRISMA. *LUMAT*, *9*(1), 100–125. https//doi.org/10.31129/LUMAT.9.1.1449

Nowell, L. S., Norris, J. M., White, D. E., & Moules, N. J. (2017). Thematic analysis: Striving to meet the trustworthiness criteria. *International Journal of Qualitative Methods*, *16*, 1–13. https//doi.org/10.1177/1609406917733847

Paulus, T., Woods, M., Atkins, D. P., & Macklin, R. (2015). The discourse of QDAS: reporting practices of ATLAS.ti and NVivo users with implications for best practices. *International Journal of Science Research Methodology*, *20*(1), 35–47. https//doi.org/10.1080/13645579.2015.1102454

Pigden, L., & Jegede, F. (2019). Thematic analysis of the learning experience of joint honours students: their perception of teaching quality, value for money and employability and employability. *Studies in Higher Education*, 1–14. https//doi.org/10.1080/03075079.2019.1661985

Prihandhika, A., Suryadi, D., & Prabawanto, S. (2022). The investigation of concept image towards derivative representation: A case study of prospective mathematics teachers. *Mathematics Teaching Research Journal*, *14*(4), 148–164. https://files.eric.ed.gov/fulltext/EJ1361737.pdf

Purnomo, Y. W., Pasri, Aziz, T. A., Shahrill, M., & Prananto, I. W. (2022). Students' failure to understand fraction multiplication as part of a quantity. *Journal on Mathematics Education*, *13*(4), 681–702. https//doi.org/10.22342/jme.v13i4.pp681-702

Ramadhani, R., Sri Bina, N., & Syahputra, E. (2022). Flipped classroom assisted autograph in calculus learning for engineering students: A rasch measurement study. *Mathematics Teaching Research Journal*, *14*(4), 36–55. https://files.eric.ed.gov/fulltext/EJ1361735.pdf

Sandefur, J., Lockwood, E., Hart, E., & Greefrath, G. (2022). Teaching and learning discrete mathematics. *ZDM-Mathematics Education*, *54*(4), 753–775. https//doi.org/10.1007/s11858-022-01399-7

Siagian, M. D., Suryadi, D., Nurlaelah, E., & Prabawanto, S. (2022). Investigation of secondary students' epistemological obstacles in the inequality concept. *Mathematics Teaching Research Journal*, *14*(4), 106–128. https://commons.hostos.cuny.edu/mtrj/wp-content/uploads/sites/30/2022/12/06-Siagian.pdf

Stolz, S. A. (2013). Phenomenology and physical education. *Educational Philosophy and Theory*, *45*(9), 949–962. https//doi.org/10.1080/00131857.2013.785355

Suryadi, D. (2019a). *Landasan filosofis penelitian desain didaktis (DDR) [Philosophical foundation of didactic design research (DDR)]*. Pusat Pengembangan DDR Indonesia.

Suryadi, D. (2019b). *Penelitian desain didaktis (DDR) dan implementasinya [Didactic design research (DDR) and its implementation]*. Gapura Press.

Yolcu, A., & Popkewitz, T. S. (2019). Making the able body: School mathematics as a cultural practice. *ZDM-Mathematics Education*, *51*(2), 251–261. https//doi.org/10.1007/s11858-018-1003-8

Zhang, X., Clements, M. A. K., & Ellerton, N. F. (2014). Conceptual mis(understandings) of fractions: From area models to multiple embodiments. *Mathematics Education Research Journal*, *27*(2), 233–261. https//doi.org/10.1007/s13394-014-0133-8

Zuhri, R. S., Wilujeng, I., & Haryanto. (2023). Multiple representation approach in elementary school science learning: A systematic literature review. *International Journal of Learning, Teaching and Educational Research*, *22*(3), 51–73. https//doi.org/10.26803/ijlter.22.3.4