



(RESEARCH ARTICLE)



## Didactical game-Lego in adding and subtracting dissimilar fractions in Grade 4

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### Abstract

This study aimed to improve the performance level of grade 4 learners on addition and subtraction of dissimilar fractions using the didactic game-lego. Lego bricks are manipulative materials that can be connected to form shapes and can be used in fractions. One group pre-test and posttest design was utilized in the conduct of the study. There were 10 participants from the grade 4 class. Mean was utilized to determine the mean scores of learners before and after the intervention. Paired samples t-test was used to determine differences in the level of performance of the learners before and after applying the intervention. Results showed a slight increase in the performance of the group (beginning to developing). However, t-test showed that there was a significant difference in the means of the pre-test and posttest scores when results were subjected to statistical analysis. In conclusion, the slight increase in performance level of the learners was positively affected by the intervention.

**Keywords:** Didactic game; Lego brick; Addition and subtraction of dissimilar fractions

### 1. Introduction

Learning how to add and subtract dissimilar fractions is crucial to pupils, especially in understanding concepts so that they could use them in other topics in Mathematics and also in their daily lives. Despite its difficulty, pupils can add and subtract dissimilar fractions when games are embedded in the activities they are working with.

Addition, subtraction, multiplication, and division are kinds of arithmetic operations which are used in fractions. Compared with the other operations, addition is the simplest operation. Yet, students still have difficulties in learning this topic. For instance, they solve the problems of addition of fractions by adding the numerators, which become the numerator of the solution and adding the denominators, which become the denominator of the solution. In other words, students apply the rule of addition in whole numbers directly to solve the addition of fractions (Rejeki, 2017).

Fractions are one of the basic but poorly understood concepts in mathematics in the elementary school curriculum. This is proven by Askew & Ebbutt (2000) wherein students have difficulty in learning more abstract concepts in fractions.

Further, fractions are one of mathematics topics which have been learned by students since they are in primary school. Understanding the concepts of fractions is very important because fractions are commonly used in daily life. However, in general, students' achievement on this topic is not good enough. The possible cause is that students find some difficulties in learning this topic. In many different countries, empirical studies on students' competencies and conceptions in the domain of fractions have shown enormous difficulties (Rejeki, 2017).

However, fractions can be a tricky concept for students although they often use the concept of sharing in their daily lives. Notation of fractions and formal vocabulary may be some reasons for that. Students may have difficulty with learning fractions since they do not like behave normal numbers (Ardogan & Ersoy, 2003). The concept of fractions has always

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been a complicated subject matter to teach during the course of learning Mathematics in a students' life starting from its introduction during elementary years (Adauto & Klein, 2010).

Namkung et al. (2018) found that students with severe mathematics learning difficulties, as indexed by their whole-number competence below the 10th percentile at fourth grade, were 32 times more likely than students with intact whole-number knowledge to experience difficulty with fractions. Students with less severe mathematics learning difficulties (between the 10th and 25th percentile) were five times more likely to experience difficulty with fractions than students with intact whole-number knowledge.

Likewise, Resnick et al. (2016) found that students with inaccurate whole-number line estimation performance were twice as likely to show low growth in fraction magnitude understanding compared to those with accurate whole-number line estimation skills. Therefore, a critical need exists to improve fractions learning for students with mathematics learning difficulties.

Moreover, according to Lee (2011), students and teachers are facing challenges in teaching and learning fractions. The concepts related to fractions, ratios, and proportions are learned in primary school to cast a solid foundation in proportional reasoning for the understanding of more advanced mathematics in the secondary school curriculum.

Hackenberg and Lee (2015) showed that a limited understanding of particular aspects of the different meanings of fractions affects the ability of students to generalize and to work with fraction concepts. Similarly, Siemon et al. (2015) indicated that learning fractions is difficult because they are commonly used to represent a relationship between numbers rather than an absolute quantity.

Accumulated data from the National Assessment of Educational Progress (NAEP) also provide evidence for students' difficulties with fractions. According to the 2017 NAEP, only 32% of fourth graders correctly identified which fractions were greater than, less than, or equal Namkung, (2019).

National Assessments call on education authorities to improve pupil knowledge levels and competencies. Well-designed curricula and assessment practices enrich classroom experiences, help teachers identify and support disadvantaged pupils and promote the values, attitudes and practical skills needed to face future challenges in their lives (UNESCO, 2015).

According to the K-12 Mathematics Curriculum Guide of the Department of Education, addition and subtraction of dissimilar fractions is introduced in Grade 4. Its immediate pre-requisites are changing fractions to lowest terms, identification of multiples of a given number up to 100, least common multiple of 2 numbers and difference between similar and dissimilar fractions, arranging of dissimilar fractions from least to greatest and vice-versa, and visualization and addition of similar fractions.

For the past Three years, looking at the summative test result during the 2<sup>nd</sup> quarter shows that in school year 2020-2021 during the pandemic 2 out of 14 learners got the test item on adding and subtracting dissimilar fractions correctly. In school year 2021-2022, the summative test result shows that 2 out of 15 learners got the test on adding and subtracting dissimilar fractions correctly. Based from the least learned skills identified during the second quarter of school year 2022-2023 at Tukucan Elementary School, adding and subtracting dissimilar fractions was identified as the least mastered competency. This may be caused by complexity of steps involved and the strategy used by the teacher. The teacher gave activity sheets to check their understanding on the competency but they did not get half of the items correct. Further, pupils got wrong in the items on adding and subtracting dissimilar fractions during the 2<sup>nd</sup> quarter examination. The teacher did remediation after class by demonstrating how to add and subtract dissimilar fractions but the pupils cannot still perform the task.

To validate the result, the mean percentage scores of the same learners were tracked using their scores during their previous activities. In this particular competency on dissimilar fractions, they really got low in dissimilar fraction as shown by their 25% MPS. The historical data for the past 3 years based from the school Form 5 entered in the [lis.deped.gov.ph](https://lis.deped.gov.ph) are shown below: During the school year 2020-2021, the General Average (GA) of Grade 4 learners in Mathematics was 81. In SY 2021-2022, their GA was 82 while their GA for SY 2022-2023 was 80. Basing from the data this prompted the teacher to conduct action research.

The research aimed to introduce the didactical game-lego to improve the performance of the learners in adding and subtracting dissimilar fractions. This is a modified game to help learners master their basic skills in the said competency

since it contains procedures that will help the learners retain the necessary knowledge in operations regarding dissimilar fractions.

The importance of competency in fractions is foundational to acquiring more advanced Mathematical skills. However, achieving competency with fractions is challenging for many students, especially for those with Mathematics learning difficulties who often lack foundational skill with whole numbers (Booth & Newton, 2012; Booth et al., 2014). They are crucial, however, to students' future understanding of concepts such as proportional reasoning that are necessary not only for deeper mathematical understanding but also to support daily activities. These difficulties are often observed across all levels of education beginning from early primary years (Gupta & Wilkerson, 2015).

This study helps the pupils who are hard up in performing addition and subtraction of dissimilar fractions using lego bricks as they enjoy the game. Teachers also can use the strategy to teach the competency and impact the performance of the pupils in school with the use of game. If they will be able to add and subtract dissimilar fractions, they will be able to proceed with higher algorithms.

Results of this study will help other teachers especially Mathematics teachers to create their own interventions so as to improve the skill among learners in adding and subtracting dissimilar fractions. It will also help them design suitable strategies in teaching the art of addition and subtraction of dissimilar fractions. Subject coordinators and administrators can utilize the results of this study as they develop action plans for remediation and intervention programs.

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## 2. Action Research Questions

This study aimed to find out if the intervention "Didactical Game-Lego" would improve the academic performance of Grade 4 learners in Mathematics. Specifically, it seeks to answer the following questions:

- What is the performance level of learners in addition and subtraction of dissimilar fractions before the intervention?
- What is the performance level of learners in addition and subtraction of dissimilar fractions after the intervention?
- Is there a significant difference between the performance level of learners in addition and subtraction skill of dissimilar fractions before and after using the intervention?
- Ho: There is no significant difference between the performance level of learners in addition and subtraction skill of dissimilar fractions before and after using the intervention.

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## 3. Innovation, Intervention and Strategy

Lego bricks are manipulative materials with different colors and sizes that can be connected to form shapes. Lego bricks of the same sizes and shapes were used to show fractions. These were manipulated by connecting the same size, color and shape to add and subtract dissimilar fractions (M4NS-IIf-82.2). Learners used lego bricks to show, add and subtract dissimilar fractions which made them easily understand the concept in adding and subtracting dissimilar fractions. The researcher designed and chose this tool and it attracted the pupils since manipulative learning objects/materials were far helpful compared to the usual board work with explanation.

Lego game is a game with manipulative materials which are blocks with different colors. The blocks can be connected to other blocks. Using these blocks of the same sizes, color and shape can represent fractions. The researcher used blocks of the same sizes with the same colors. When using it to represent fraction the researcher used 2 colors for visualization. Lego games also were used to do the four fundamental operations involving fractions.

Learners nowadays are more interested and can learn fast using manipulative games than just viewing pictures. Thus, Lego were used as an intervention for the identified grade 4 learners of Tukucan Elementary School. This game was very much important and helpful to the learners in order for them to understand the concept of fractions by manipulating objects like the blocks/bricks of the Lego. According to the principles of teaching, learners learn lessons by doing hands on activities and it was in line with the K-12 principles also. Thus, this research was helpful to the learners having difficulty in fractions.

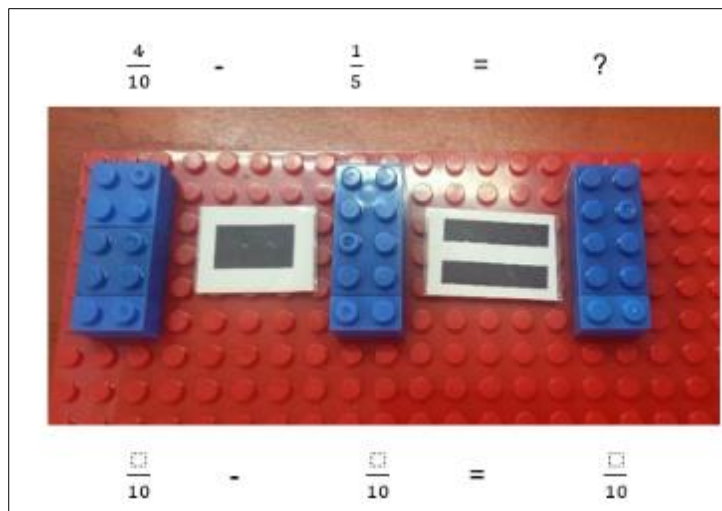


**Figure 1** Sample using Lego Bricks to subtract Dissimilar Fractions

LEGO, with its various shapes were used as tools to facilitate learning fractions in mathematics. LEGO games could stimulate students' creativity, build creativity, and facilitate teachers to be more focus in learning. Using LEGO for learning fractions support students' understanding of the conceptual knowledge of fractions including representing the fractions as parts of a whole, adding fractions and multiplying fractions with the help of area model, (Rejeki 2017).

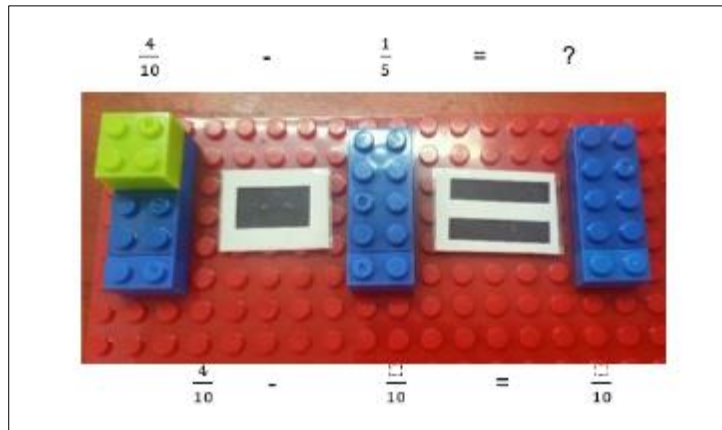
The steps and mechanics of this didactical game-lego are as follows: The learners will be grouped; each group should have 3-4 members. Instruct the learners to choose 2 colors of the sizes of Lego Bricks to be used in representing the fractions. The group will be given 20 minutes to answer 10 items (adding and subtracting dissimilar fractions using Lego bricks). The learner with the highest score (correct answers) will be declared the winner.

In using the lego bricks in representing dissimilar fractions for example:  $\frac{4}{10} - \frac{1}{5} = ?$ . Ask the learners what smaller number can we divide to both denominators then that will be our lower lego bricks in the given example it is 10 by counting the rounded shape. The color blue is the LCD and should be formed and aligned correctly in 3 columns by 10 at the same time as shown in the picture.



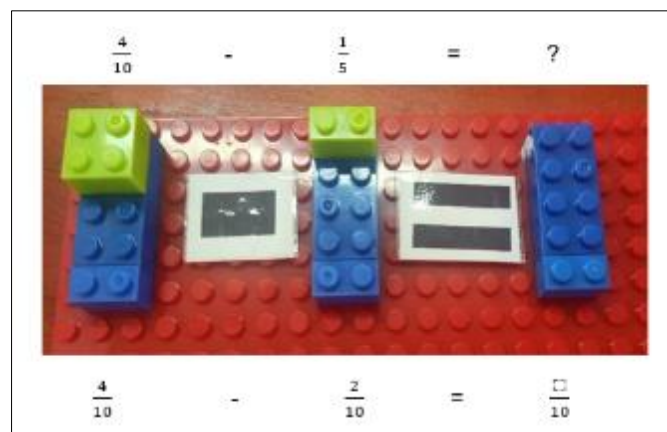
**Figure 2** Sample using Lego Bricks to subtract Dissimilar Fractions for the denominator

Next, ask the learners how many 10 are there in the blue bricks the answer is 1 then ask them to multiply to the numerator 4 the answer will be 4 and they will use another color yellow green that will represent the numerator as shown in the following picture.



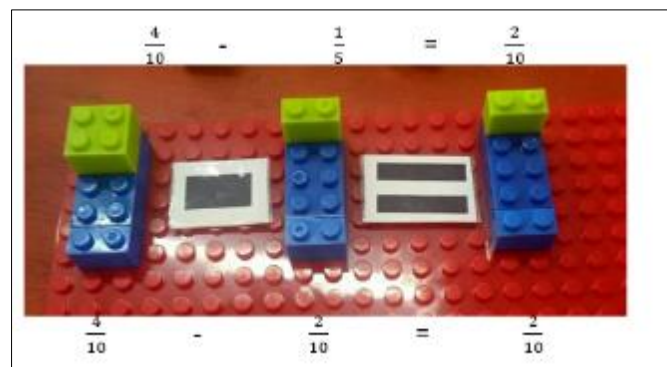
**Figure 3** Sample in using Lego Bricks to subtract Dissimilar Fractions for the numerator

Moving to the next fraction (subtrahend), ask the learners how many groups of 5 are there in the blue bricks the answer is 2 then multiply it to the numerator 1 the answer will be 2 and they will put 2 yellow-green bricks that will represent the numerator.



**Figure 4** Sample using Lego Bricks to subtract Dissimilar Fraction for the numerator (subtrahend)

Finally using the lego bricks add or subtract the fractions using the above bricks in the example given. Subtract first the yellow-green  $4-2=2$  so put 2 yellow-green on top of the blue bricks after the equals.



**Figure 5** Sample using Lego Bricks to subtract Dissimilar Fraction for the numerator

The teacher sourced out to produce LEGO BRICKS for the learners to use during the 1<sup>st</sup> week. The teacher also prepared activity sheets which the learners shown, added and subtracted dissimilar fractions. For the next seven weeks, the

learners used the LEGO BRICKS to show, add and subtract dissimilar fractions. The following steps on the intervention were shown below:

For the first and second week, the pupils were shown the written dissimilar fractions on the activity sheets using the LEGO BRICKS. The researcher gave 10 dissimilar fractions written on an activity sheet per day from Monday to Thursday. For the third and fourth week, the pupils have shown and added dissimilar fractions written on the activity sheet using the LEGO BRICKS. The researcher gave 10 dissimilar fractions written on an activity sheet per day from Monday to Thursday.

For the Fifth and sixth week, the pupils had shown and subtracted dissimilar fractions written on the activity sheets using the LEGO BRICKS. The researcher will give 10 dissimilar fractions written on an activity sheet per day from Monday to Thursday. For the seventh and eighth week, the pupils manipulated, added and subtracted dissimilar fractions written on the activity sheet using the LEGO BRICKS. The researcher gave 10 dissimilar fractions written on an activity sheet per day from Monday to Thursday.

Through these, the performance level of the pupils in adding and subtracting dissimilar fractions improved. The intervention which was implemented on the first quarter of school year 2023-2024. It was administered to the ten identified Grade 4 learners.

The participants answered the pre-test before the intervention. They then answered the activities to be given during the intervention and the posttest thereafter. The researcher monitored the activities of the pupils by guiding them in adding and subtracting dissimilar fractions. Evaluation was done through a posttest after eight weeks. The teacher-made worksheet was administered in the conduct of pre-test and posttest.

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## **4. Action Research Methods**

### **4.1. Research Design**

This study used the one-group pre-test posttest design because one group was tested. Pretest and posttest designs are commonly used in educational research to assess the effectiveness of interventions, programs, or treatments. For example, in a study by Smith and Johnson (2018), the pretest-posttest design was used to assess the effects of differentiated instruction on student achievement. However, in this study the researcher used pretest-posttest design to assess the effect of the Didactical Game-Lego as an intervention to learners in adding and subtracting dissimilar fractions.

### **4.2. Participants and/or other Sources of Data and Information**

There were 10 participants in this study who were hard up in adding and subtracting dissimilar fractions. This study was conducted at Tukuran Elementary School, Tinoc, Ifugao during the first quarter of school year 2023-2024.

### **4.3. Data Gathering Methods**

The researcher used a teacher made worksheet for pre-test and post-test in gathering the data. The worksheets were checked by the school head, the district and division technical working group for its validity. The worksheets were also piloted at the nearby school to check its reliability. Before the conduct of the intervention, the researcher conducted the pre-test to the learners. Within the duration of 8 weeks, the intervention using lego bricks was conducted every 3:30 PM to 4:20 PM in the afternoon. After eight weeks, the post test was conducted to the learners.

### **4.4. Data Analysis Plan**

Mean was used to describe the performance of the pupils in adding and subtracting dissimilar fractions. Paired samples t-test was used to describe the significant difference between the pre-test and post test of the pupils with 0.05 alpha level.

The scoring below was used to describe the level of performance of the learners on the result of their pre-test and posttest:

**Table 1** Proficiency Level and Qualitative Interpretation

Score	Description	Qualitative Interpretation
0-4	Beginning	The learner struggles with his/her understanding; prerequisites and fundamental knowledge and his/her skills have not been acquired or developed adequately to aid understanding.
5-8	Developing	The learner possesses the minimum knowledge and skills and core understandings, but needs help throughout the performance of authentic tasks.
9-12	Approaching Proficiency	The learner has developed the fundamental knowledge and skills and core understandings and, with little guidance from the teacher and/or with some assistance from peers, can transfer these understandings through authentic performance tasks.
13-16	Proficient	The learner has developed the fundamental knowledge and skills and core understandings, and can transfer them independently through authentic performance tasks.
17-20	Advance	The learner exceeds the core requirements in terms of knowledge, skills and understandings, and can transfer them automatically and flexibly through authentic performance tasks.

#### 4.5. Ethical issues

This study was set to seek the approval of the school head, research unit of the district and division office. The learners were informed through the assent form and parental consent was sought. The scores and responses of the respondents to the data-gathering tools were kept confidential. The data gathering was done whole-heartedly and with utmost honesty.

## 5. Discussion

The part of the study discusses the results on the use of Didactical Game-Lego as a strategy to improve the academic performance of Grade 4 learners in Mathematics particularly in adding and subtracting dissimilar fractions.

Table 2 presents the performance level of learners before the intervention. Data shows that the performance level of the learners in addition and subtraction of fractions before the intervention is at the beginning level. This means that the learner struggled with their understanding; prerequisites and fundamental knowledge and their skills in the competency have not been acquired to aid understanding. This implies that the strategy of the teacher such as giving of examples during board discussion, independent work with teacher's guidance were not enough. This finding supports the study of Namkung et al. (2018) wherein students with severe mathematics learning difficulties still experience difficulty with fractions. Also, with the study of Askew and Ebbutt (2000) as cited by Gokalp & Sharma (2010) wherein students have difficulty in learning more using abstract concepts in fractions. In addition, Pupils seemed to master the part-whole concept, whereas numbers and operations posed problems. Moreover, pupils seemed to apply procedures they do not fully understand (Gabriel, et. al., 2013).

**Table 2** Performance Level of Grade 4 Learners in Addition and Subtraction before the Intervention

	N	Mean	Qualitative Description
Pre-Test	1	0	Beginning
	2	0	Beginning
	3	0.5	Beginning
	4	0	Beginning
	5	2	Beginning
	6	0	Beginning
	7	0	Beginning

	8	0	Beginning
	9	1	Beginning
	10	0	Beginning
		0.35	Beginning

Table 3 presents the performance level of learners after the intervention. Data shows that the performance level of the learners in addition and subtraction of fractions after the intervention is at the developing level. This means that the learner possesses the minimum knowledge and skills and core understandings, but needs help throughout the performance of authentic tasks. This implies that the strategy of the teacher such as using of didactical lego game during the lesson development with independent work given by the teachers may have contributed in the improvement of the learners' performance level. This finding was supported by the study of Rejeki (2017) that adding fractions and multiplying fractions with the help of area model helps learners to improve their performance. Also, by using models in different fraction tasks, students can identify the concepts needed to know and discuss why we do certain process in working fractions (Africa, et. al., 2020).

**Table 3** Performance Level of Grade 4 Learners in Addition and Subtraction after the Intervention

	N	Mean	Qualitative Description
Post Test	1	4	Beginning
	2	9.5	Proficient
	3	9	Proficient
	4	2	Beginning
	5	9	Proficient
	6	9.5	Proficient
	7	8	Approaching Proficiency
	8	3.5	Beginning
	9	8.5	Approaching Proficiency
	10	3	Beginning
		6.6	Developing

Table 4 presents the significant difference between the performance of learners before and after the use of didactical game - lego. It can be gleaned from the table below that there is a significant difference on the performance level of pupils in addition and subtraction skills of the learners before and after intervention as indicated by its p-value which is .000. This means also that the null hypothesis was rejected. The range that indicates significant difference is from .00 to .05, thus, the result is significant. This implies that the intervention used by the teacher may be helpful in the improvement of the learners' performance in addition and subtraction of dissimilar fractions. This result was supported by the study of Shin and Bryant (2015) wherein the use of concrete and visual representations was more beneficial to strugglers develop their skills on fractions. The finding also of Salwani, et al. (2018) through manipulative learning, students get the opportunities to create their own learning experiences, which could sufficiently convince their understanding of mathematical concepts, especially in fraction learning.

**Table 4** Difference between the Performance Level of Learners in Addition and Subtraction of Dissimilar Fractions before and after Intervention

	Mean	p-value	Remark
Post Test-Pre test	12.50	0.000	Significant



## 6. Reflection

In the conduct of action research as a researcher, the researcher learned that readiness of the learners should be considered. Though the activities involved a game, attitude must be addressed first. It is needed to let the learners understand the activity and the purpose so that they will do their best. As a teacher, the researcher learned that mastery of skills and improvement of performance are dependent on the values and background knowledge of the learners. Hence, teacher immediately measure the degree of readiness of learners before starting the intervention. In giving intervention involving game specifically lego bricks or any manipulative materials, it is very important to emphasize that the materials will solely be used for its intended use. For instance, the lego bricks should be used only in adding and subtracting dissimilar fractions to avoid learners playing it that will defy the purpose.

The teacher may plan for a sequential or spirally arranged activities using realia, semi-concrete learning materials. The learners may also experience carefully planned and prepared hand on activities even outside the classroom. Then these could be processed inside the classroom to validate findings and experienced and formalize learning. To enhance the Didactical Lego used as intervention materials, color coding of any but same objects can be done in order to lessen the cost spent with the lego brick materials. Stones for example can be colored so the learners can use easily and can be utilized in forming shapes for further discussion on the lesson.

The success of this study depended on the support of technical working group, school head, participation of learners and support of parents concerned and the completeness of materials used during the conduct of the activities.

For future implementation of this study, preparedness and background skills must be identified.

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## 7. Conclusion

Based from the findings, the following conclusions are drawn:

- The learners did not develop the prerequisite and fundamental knowledge in adding and subtracting dissimilar fractions.
- The learners have acquired a minimum understanding of adding and subtracting dissimilar fractions after the intervention but need constant guidance.
- The intervention helped in the performance of learners regarding adding and subtracting dissimilar fractions.

### *Recommendation*

Based from the conclusions, the recommendations are enumerated below:

- To further help the learners under the beginning level, explanations may be accompanied by concrete objects and abstract materials for enjoyment while learning the skills.
- Teachers may enhance the intervention material to further improve the level of performance in adding and subtracting dissimilar fractions.
- May use other interventions that may help develop understanding in adding and subtracting dissimilar fractions.
- Future studies may be conducted regarding Lego bricks in other competencies in Mathematics.

### *Action Plan*

As part of the researcher's professional growth and development, it is indeed vital that results of this study shall be disseminated to the pupils, parents, and other members of the learning community through various forms such as parents- teachers- pupils' conferences. Through these, other interventions and strategies can also be developed in respond to other existing learning difficulties. Parents can also be informed as to how they can further assist their children's learning needs. Learning Action Cells (LAC) sessions and Focal Group Discussions (FGDs) may also be utilized to share this study, the processes done as well as the results to the School Heads and subject coordinators. This is deemed necessary to help the movers of the school plan for remediation programs and intervention strategies thus may help improve the performance indicators of the school.

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## Compliance with ethical standards

### *Acknowledgement*

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### *Disclosure of conflict of interest*

No conflict of interest to be disclosed.

### *Statement of informed consent*

Informed consent from learners and parents was obtained from all individual participants included in the study.

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