Universal Journal of Educational Research 8(1A): 147-155, 2020 http://www.hrpub.org
DOI: 10.13189/ujer.2020.081319

Using Ordering Tasks to Determine Fraction Magnitudes

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Received October 27, 2019; Revised December 2, 2019; Accepted December 24, 2019

Abstract The focus of this study was to investigate the students' ability in ordering four types of proper fractions. Type I: same numerators; Type II: same denominators; Type III: different numerators and different compatible denominators; Type IV: different numerators and different incompatible denominators. The researchers used library search and survey methodology through document search and questionnaire methods. The respondents of this study were 100 fourteen-year old students in two secondary schools from two districts. The results revealed that (i) students could easily order Type I and Type II proper fractions; (ii) students had less difficulty ordering Type II proper fractions compared with Type I proper fractions; (iii) students had difficulty ordering Type III and Type IV proper fractions; and (iv) when presented with tasks on ordering of Type III and Type IV proper fractions, students had most difficulty when ordering Type IV fractions. This showed that students still struggle with determining magnitudes of Type III and Type IV proper fractions. The findings of this study revealed that an appropriate method of instruction should be developed to teach students to order fractions of Type III and IV because the skill of ordering proper fractions is necessary for the development of fraction sense and overall mathematical development.

Keywords Comparing, Ordering, Fraction Magnitudes, Numerators, Denominators

1. Introduction

Fractions are difficult for children to master and thus many children struggle learning fractions (Gabriel, Szucs & Content, 2013; Brown, 2015). Competency with fractions are not only necessary for daily activities, such as dealing with measurements for recipes and financial management but, knowledge of fractions is used in daily life, including budgeting, and understanding mortgage rates to carrying out home repairs (Hansen, 2015). According to many studies, knowledge of fractions is fundamental to later mathematics achievement or development (Bailey, Hansen, & Jordan, 2017), including success with algebra (Rodrigues, Dyson, Hansen, & Jordan, 2016).

Many educators indicate that understanding fraction magnitudes provides the foundation for acquiring knowledge of fraction operations. Moreover, according to Bezuk and Cramer (1989) to be successful in fraction computation, children need to understand not only fraction concepts but ordering and equivalent fractions. In addition, knowledge of fraction magnitude affects how well children perform in fraction arithmetic and their overall performance in mathematics (Siegler, Thompson, & Schneider, 2011). Therefore, fraction magnitude is an important skill that need to be mastered by all students if they want to carry out fraction operations successfully and succeed in mathematics in general.

With reference to the Malaysian Mathematics Secondary School Curriculum Standard, ordering of proper fractions is covered in the form one Curriculum and Assessment Document Standard (Kementerian Pendidikan Malaysia Bahagian Pembangunan Kurikulum, 2015) implemented in the year 2017. Students are taught to compare and arrange positive and negative fractions in order. In other words, students are taught to sort up to four or five proper fractions in ascending or descending order that is from smallest to largest fraction or vice versa. Questions that constitute proper fraction ordering include the following: i. which of the following proper fractions is the largest or the smallest, ii. arrange the following proper fractions in ascending or descending order, iii. given a set of proper fractions, find the fraction in the middle. Therefore, it is important that students learn to order fractions of these three types of questions.

Questions on ordering of proper fractions also appeared in the world level The Trends in International Mathematics and Science Study (TIMSS) international survey. Sample question asked was, which of the following numbers is smallest $\frac{1}{2}, \frac{5}{8}, \frac{5}{6}$ or $\frac{5}{12}$. $\frac{1}{2}, \frac{5}{8}, \frac{5}{6}, \frac{5}{12}$ (TIMSS, 2007). Moreover, a sound knowledge of ordering of proper fractions is needed to answer the PT3 (a compulsory national level examination for form three students in Malaysia) questions not only on ordering of fractions but operations on fractions. Since children need to understand not only fraction concepts but ordering and equivalent fractions, in order to be able to carry out computations with fractions, Bezuk & Cramer (1989) recommended that the teaching of operations on fractions should be taught only after pupils have mastered the concepts and the ideas of the order and equivalence of fractions. Therefore, the objective of this study was to investigate the abilities of Malaysian students in determining fraction magnitudes using ordering proper fractions tasks. The focus of the study was on the abilities of form two students to determine fraction magnitudes by ordering a set of four proper fractions.

2. Literature Review

Geller, Son and Stigler (2017) defined fraction magnitudes as tasks that measure students' understanding of fraction magnitude which include comparing the size of two fractions, ordering sets of fractions in ascending or descending order, deciding where each fraction lies on a number line and even estimating fraction size. Fraction magnitude skill is one of the foundations of fraction sense. Fennell and Karp (2017) defined fraction sense as "involving fraction equivalence and magnitude, comparing and ordering fractions, using fraction benchmarks, and computational estimation" (p. 348). Therefore, understanding fraction magnitudes is essential to developing fraction sense. Since knowledge of fractions is a foundational mathematical skill, research in this area is necessary. This is because not only are fractions integrated in many areas of mathematics such as in trigonometry, prealgebra and algebra, and others, a weak understanding of fractions would render equations in these areas meaningless (Fazio, Dewolf and Sieglar, 2016).

More researchers began to study the importance of knowledge of fraction magnitude in relation to achievement in mathematics. Hansen, Rinne, Jordan, Ye, Resnick and Rodrigues (2017) conducted a longitudinal study to assess the relationship between fraction magnitude knowledge and mathematics achievement. The sample for their study consisted of 536 participants who completed a standardized mathematics achievement test and two measures of fraction magnitude understanding which are fraction comparisons and fraction number line estimation. Their findings suggested that fraction magnitude knowledge and broader mathematics achievement mutually support one another. Hansen et al. (2017) concluded that fraction number line estimation affected mathematics achievement more strongly than did fraction comparisons, possibly because the fraction number line estimation task is a better tool to assess fraction magnitude understanding. Furthermore, Fennell and Karp (2017) argued that proficiency with fractions is not only a prerequisite for success in advanced mathematics but serves as a entry to numerous occupations and contexts past the mathematics classroom. Hurst and Cordes (2018) investigated rational number magnitude and arithmetic performance in both fraction and decimal notation in fourth to seventh grade children. Their results revealed that children do represent the magnitudes of fractions and decimals as falling within a single numerical continuum and that, children can prosess decimal notation much better than fraction notation. They highlighted that fraction concepts are a necessary prior knowledge for higher order mathematics such as Algebra.

Many researchers agree that childrens' difficulty with fractions stems from whole number knowledge bias. According to Bezuk and Cramer (1989), when dealing with fractions, children must change previously learnt rules for whole numbers because these rules often conflict with fraction concepts. For example, with whole numbers, children have learnt that 3 is greater than 2. However, when ordering fractions with like numerators, children learn that $\frac{1}{3}$ is less than $\frac{1}{2}$. Therefore, this new fraction rule conflicts with the whole number rule. In addition, DeWolf and Vosniadou (2015) investigated the effects of whole number knowledge when representing fraction magnitudes through two experiments. In Experiment 1, participants were asked to compare fraction magnitudes where half of the comparisons were consistent with whole number ordering and the other half were not. In Experiment 2, the researchers manipulated the distance between the fraction pairs given. They found that in Experiment 1 participants were comparing the magnitude of the whole fraction rather than just the parts and in Experiment 2, they found that the whole number effect was clearly apparent when the distance between the fraction pairs was very small, They suggested that even adults may rely on alternative strategies to decide on a fraction's magnitude on the number line especially when the magnitudes are close together.

On the other hand, other researchers have found that childrens' difficulty with fractions stem not from whole number knowledge bias but from difficulty understanding that fractions are actually numbers that have different sizes. Fazio and Siegler (2010) stated that fractions are often taught using the idea that fractions is a part of a whole and seldom "as numbers with magnitudes" that "can be ordered from smallest to largest" (p. 10). They believe that children who only understand the part/whole approach to fractions often make errors regarding fraction magnitudes. Furthermore, Gabriel, Coché, Szucs, Carette, Rey and Content (2013), found that "mean percentage of correct responses for comparison of fractions were very low for fractions with common numerators and fractions no common components" (p. 15). In addition, Gabriel (2016) found that typical mistakes happen when comparing fractions $\frac{1}{7} > \frac{1}{3}$, because 7 is larger than 3. Each of these errors are caused by the lack of conceptual knowledge and understanding on the magnitude of fractions. In support, Malone and Fuchs (2017) conducted a study on error patterns in ordering fractions among 227 at- risk fourth grade students who were asked to complete a nine-item ordering test. They found that 81% of problems given were answered wrongly and that almost 65% of mistakes occurred because students used whole number concepts and rules to fractions. Malone and Fuchs concluded that the mistakes were mainly due to fraction magnitude estimation skill, and not to part-whole understanding.

This difficulty in determining fraction magnitudes was also found among Malaysian students. Fadzilah Abdol Razak, Noraini Noordin, Rohana Dollah and Rohana Alias (2012) reported that when given a set of fractions, $\frac{1}{2}, \frac{1}{6}, \frac{1}{9}, \frac{1}{5}, \frac{1}{7}$ only 183 (63.54%) of students were able to arrange the set given in ascending order while the rest of the students, with the exception of two students who did not indicate any response to the question, ordered the fractions in the following manner, $\frac{1}{2}, \frac{1}{5}, \frac{1}{6}, \frac{1}{7}, \frac{1}{9}$ by focusing only on the magnitude of the denominators. In the same study, Fadzilah Abdol Razak et al. (2012) reported that 13-year old students in Malaysia did not have a good conceptual understanding of comparing proper fractions.

According to the Malaysia Education Blueprint 2013-2025 (2013), "lessons did not sufficiently engage students, and followed a more passive, lecture format of content delivery. These lessons focused on achieving surface-level content understanding, instead of higher-order thinking skills" which would provide for conceptual understanding (Ministry of Education Malaysia, 2013, E. 14). Many researchers agreed that conceptual understanding was critical for fraction magnitude understanding. Fazio, Dewolf and Sieglar (2016) found that college students good at mathematics used a variety of strategies depending on the type of fractions involved and that were found to be consistently reliable. However, how fast and accurately a student obtained an answer depended on the type of strategy and how it was carried out. Their findings suggest that students tend to use poor fraction magnitude comparison strategies because of the lack of conceptual understanding of the requirements of effective strategies. Ward (1999) in his study asked students to arrange five fractions, which are represented by dominoes, in ascending order. He found that among the strategies used were: using mental math to re-express the fractions in terms of present's, re-expressing the fractions as decimals to compare the magnitude, obtaining a common denominator for two fractions to compare their magnitude and finding a least common multiple. Ward found that students seemed to lack the inclination and ability to formulate a mental picture of fractions but instead used a common denominator to compare the fractions.

Other researchers stressed on the importance of using the number line to represent fraction magnitude for conceptual understanding (Fennell and Karp, 2017). Booth and Newton (2012) recommended using number lines to develop students' knowledge of fractions. Furthermore, Fazio and Siegler (2010) also suggested using number lines during instruction to effectively ensure that students understand that fractions are numbers with magnitudes and not just part-whole relations. They recommend teachers to have students locate and compare fractions on number lines. According to Fazio and Siegler (2010), students can compare fraction magnitudes simply by placing different fractions on a number line,. In addition, Hansen, Rinne, Jordan, Ye, Resnick, and Rodrigues (2017) found that when solving fraction comparisons, older students used the cross-multiplying technique to obtain the correct answer. They also found that some students might use strategies such as rounding, simplifying, or converting fractions to decimals to place fractions on the number line.

The instruction of fraction magnitude understanding is also facilitated through games and physical models. Cramer, Post and delMas (2016) compared the achievement of students using either commercial curriculum (CC) for initial fraction learning with the achievement of students using the Rational Number Project (RNP) fraction curriculum. The RNP curriculum made use of multiple physical models together with modes of representation-pictorial, manipulative, verbal, real-world, and symbolic. Students using RNP project materials had statistically higher mean scores on the post-test and retention test and on four (of six) subscales: concepts, order, transfer, and estimation. Interview data also showed differences in the quality of students' thinking as they solved order and estimation tasks involving fractions. In addition, Mendiburo (2014) "indicated that most of the 78 students learned to use the computer system to create accurate models in a relatively short period, but not all students learned how to use the models to reason about the correct answers to the problems by the end of the intervention" (p. 76)

Another strategy introduced many decades ago but still not widely used, despite its effectiveness, is the benchmark model. Reys, Kim and Bay (1999) discuss the benchmarks which ought to be established when teaching fractions, such as knowing how a fractional number compares with 0, 1/2, or 1. They found that using benchmarks enables students to estimate and assess the reasonableness of their answers, for example, if students are asked to compare 5/8 with 4/9, usually they would find the common denominator, then convert both fractions to equivalent fractions using this common denominator, and then compare the numerators. However, according to Reys et al. (1999) a far more efficient method to compare magnitudes of fractions would be to compare each fraction with 1/2, and we can conclude that 5/8 is larger than 1/2, since it is larger than 4/8; and 4/9 is less than 1/2, since 4/9 is less than 4.5/9, or 1/2. Furthermore, So (2014) developed a lesson unit to help the students develop a benchmark model that can be used for comparing and ordering fractions. So found that by the end of the unit most students were comfortably using the benchmark model and could comprehence the relationship between the parts and the whole of a fraction. Nevertheless, Gabriel, Coché, Szucs, Carette, Rey and Content (2013) found that children performed better with familiar fractions. They believed that by using a wide range of fractions, children will be exposed to a greater variety of fraction magnitude representations.

3. Methodology

The study was conducted at two secondary normal day schools from the district of Sepang and Nilai in the state of Selangor and Negeri Sembilan respectively. The two schools were selected based on purposive sampling. The researchers conducted a survey based on the questionnaire developed by the researchers and library search based on document search. The survey was carried out at the respective schools in students' own classrooms. Respondents were given as much time as needed to answer 12 tasks on ordering proper fractions of Type I, Type II, Type III and Type IV without the use of calculators. Respondents' demographic data was also collected to understand the profile of respondents. The respondents for this study consisted of 100 fourteen-year old students from those schools and they had already learned ordering of proper fractions.

The survey instrument was developed based on research findings by Behr, Wachsmuth, Post, & Lesh (1984) in which they compared "fraction pairs of three types: same numerators, same denominators, and different numerators and denominators" (p. 323) with some modifications. Questions from the TIMMS 2007 released papers for eighth-grade students and Form One Curriculum and Assessment Document Standard (Kementerian Pendidikan Malaysia Bahagian Pembangunan Kurikulum, 2015) as well as reference books (Kiang, Cheu, & Kian, 2013) were also taken into account when developing the instrument. The instrument contained four types of tasks on ordering of proper fractions. Type I tasks included ordering of proper fractions with same numerators. Example of Type I task is $\frac{1}{3}, \frac{1}{6}, \frac{1}{9}, \frac{1}{2}$. Type II tasks included ordering of proper fractions with same denominators. Example of Type II task is $\frac{8}{9}, \frac{1}{9}, \frac{4}{9}, \frac{5}{9}$. Type III tasks included ordering of proper fractions with different numerators and different but compatible denominators. Example of Type III task is $\frac{1}{2}, \frac{2}{3}, \frac{5}{6}, \frac{5}{12}$. Type IV tasks included ordering of proper fractions with different numerators and different but incompatible denominators. Example of Type IV task is $\frac{5}{6}, \frac{2}{9}, \frac{1}{3}, \frac{4}{5}$.

The instrument was divided into two parts. The first part consisted of questions to collect demographic information on the profile of the respondents. Demographic data collected included students' age, class, sex and mathematics grade for year six Primary School Evaluation Examination (UPSR) exam. The second part consisted of 12 tasks: 3 tasks for Type I; 3 tasks for Type II; 4 tasks for Type III and 2 tasks for Type IV. The instrument was pilot tested at a nearby secondary school. The pilot test consisted of 12 tasks created by the researcher. The sample for the pilot test consisted of 30 Form Two students. The instrument was checked for content validity by an expert panel from two Institut Pendidikan Guru mathematics lecturers and two mathematics school teachers. Kuder-Richardson Formula 20 was used for estimating the reliability of the test. Kuder-Richardson which measures inter-item consistency is routinely used for estimating reliability for one time administration of one test (Mervis and Spagnolo,1995). The KR20 value which was equivalent to the Cronbach alpha coefficient was 0.78. This showed that the instrument has high reliability and is suitable to be used.

4. Results and Discussion

Based on Table 1, analysis of the respondents' profile showed that of the 100 form two students involved in the study, 39% were males and 61% were females. The number of respondents who achieved grade A in the Primary School Evaluation Examination (UPSR) for Mathematics subject were 84%, grade B were 10% and grade C were 6% as in Figure 1.

Therefore, majority of the respondents were high achievers. Analysis of the demographic data also showed that 96% of respondents knew what ordering proper fractions were in ascending order. But only 58% of respondents said they found it easy to order proper fractions in ascending order. However, 91% of respondents were confident that they could solve ordering of proper fractions in ascending order.

Table 1. Respondent Profile

Gender	Male		Female	
	39(39%)		61(61%)	
UPSR Mathematics Grade	A	B	C	D
	84(84%)	10(10%)	6(6%)	0(0%)
	Yes		No	
Do you like to learn Mathematics?	94(94%)		6(6%)	
Do you know what a proper fraction is?	98(98%)		2(2%)	
Do you know what it means to order proper fractions in ascending order?	96(96%)		4(4%)	
Do you find it easy to order proper fractions in ascending order?	58(58%)		42(42%)	
Do you think you can order proper fractions in ascending order?	91(91%)		9(9%)	

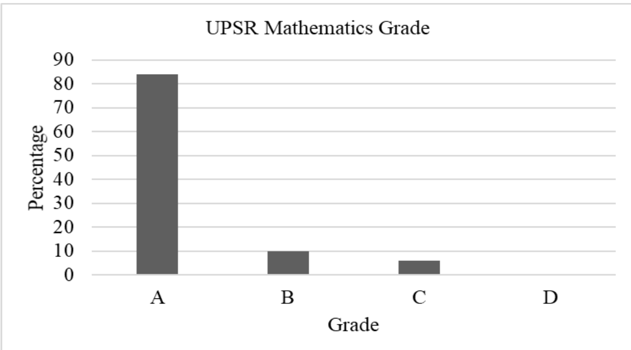

Figure 1. Respondents UPSR mathematics grade

Table 2 shows the results of the analysis for the number of incorrect answers when ordering proper fractions Type I for tasks 1, 4 and 5. The results were interpreted as follows: 17(17%) respondents answered tasks 4 incorrectly; similarly 17(17%) respondents answered tasks 5 incorrectly; 8(8%) respondents answered task 1 incorrectly. A mean of 14 (14%) respondents answered task Type I incorrectly.

Table 2. Number of Incorrect Answers Obtained Ordering Proper Fractions Type I

Task No	Task	Number of incorrect answers (%)
1	$\frac{1}{3}, \frac{1}{6}, \frac{1}{9}, \frac{1}{2}$	8(8%)
4	$\frac{2}{5}, \frac{2}{6}, \frac{2}{8}, \frac{2}{13}$	17(17%)
5	$\frac{1}{4}, \frac{1}{8}, \frac{1}{3}, \frac{1}{15}$	17(17%)
	Mean	14(14%)

The graph in Figure 2 below shows the percentage of incorrect answers when ordering proper fractions Type I.

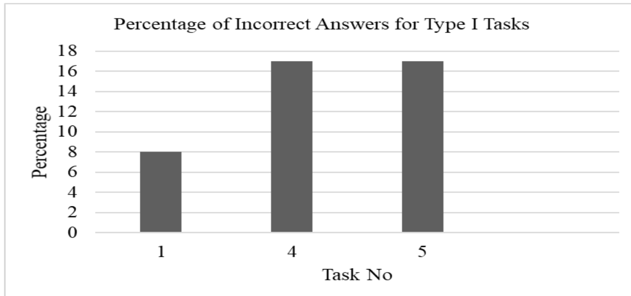

Figure 2. Percentage of incorrect answers for type I tasks.

Table 3 shows the results of the analysis for the number of incorrect answers when ordering proper fractions Type II for tasks 2, 3 and 6. The results were analysed as follows: 21(21%) respondents answered task 2 incorrectly; 1(1%) respondent answered task 3 incorrectly; 0(0%) respondents answered task 6 incorrectly. A mean of 7.3 (7.3%) respondents answered task Type II incorrectly.

Table 3. Number of Incorrect Answers in Ordering Of Proper Fractions Type II

Task No	Task	Number of incorrect answers (%)
2	$\frac{8}{9}, \frac{1}{9}, \frac{4}{9}, \frac{5}{9}$	21(21%)
3	$\frac{1}{11}, \frac{10}{11}, \frac{6}{11}, \frac{5}{11}$	1(1%)
6	$\frac{4}{7}, \frac{1}{7}, \frac{6}{7}, \frac{5}{7}$	0(0%)
	Mean	7.3(7.3%)

The graph in Figure 3 below shows the percentage of incorrect answers when ordering proper fractions Type II

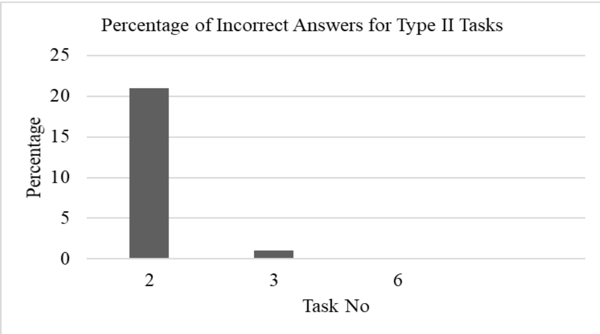

Figure 3. Percentage of incorrect answers for type II tasks.

Table 4 shows the results of the analysis for the number for incorrect answers when ordering of proper fractions Type III for tasks 8, 9, 10 and 11. The results were analysed as follows: 55(55%) respondents answered task 8 incorrectly; 44(44%) respondents answered task 9 incorrectly; 27(27%) respondents answered task 10 incorrectly; 46(46%) respondents answered task 11 incorrectly. A mean of 43 (43%) respondents answered task Type III incorrectly.

Table 4. Number of incorrect answers when ordering proper fractions Type III

Task no.	Task	Number of incorrect answers (%)
8	$\frac{1}{2}, \frac{5}{8}, \frac{5}{6}, \frac{5}{12}$	55(55%)
9	$\frac{1}{6}, \frac{2}{3}, \frac{1}{3}, \frac{1}{2}$	44(44%)
10	$\frac{1}{5}, \frac{4}{5}, \frac{1}{10}, \frac{1}{15}$	27(27%)
11	$\frac{2}{3}, \frac{1}{2}, \frac{7}{12}, \frac{5}{6}$	46(46%)
	Mean	43(43%)

The graph in Figure 4 below shows the percentage of incorrect answers when ordering proper fractions Type III.

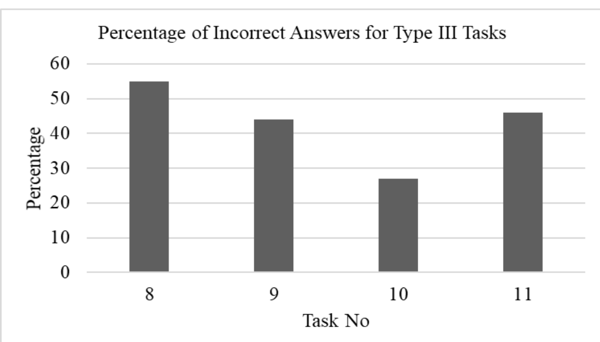

Figure 4. Percentage of incorrect answers for type III tasks.

Table 5 shows the results of the analysis for the number for incorrect answers when ordering of proper fractions Type IV for tasks 7 and 12. The results were analysed as follows: 74(74%) respondents answered task 7 incorrectly; 88(88%) respondents answered task 12 incorrectly; 27(27%). A mean of 81 (81%) respondents answered task Type IV incorrectly.

Table 5. Number of incorrect answers when ordering proper fractions Type IV

Task no.	Task	Number of incorrect answers (%)
7	$\frac{5}{6}, \frac{2}{9}, \frac{1}{3}, \frac{4}{5}$	74(74%)
12	$\frac{1}{4}, \frac{5}{7}, \frac{3}{5}, \frac{4}{13}$	88(88%)
	Mean	81(81%)

The graph in Figure 5 below shows the percentage of incorrect answers when ordering proper fractions Type IV

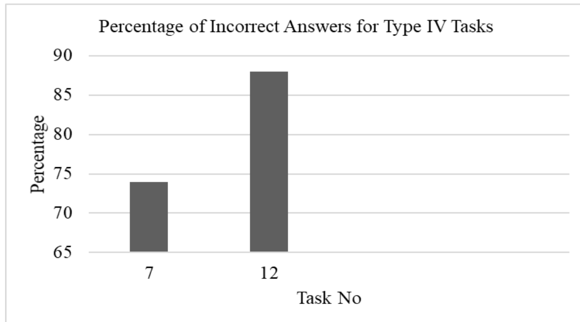

Figure 5. Percentage of incorrect answers for type IV tasks

Table 6 shows the mean percentage of incorrect answers for each type of task. It can be observed that 14% of respondents answered task Type I incorrectly; 7.3% of respondents answered task Type II incorrectly; 43% of respondents answered task Type III incorrectly and 81% of respondents answered task Type IV incorrectly.

Table 6. Task Types Mean Percentage of Incorrect Answers

Fraction Task	Mean Percentage of Incorrect Answers
Type I	14%
Type II	7.3%
Type III	43%
Type IV	81%

The graph in Figure 6 below shows the mean percentage of incorrect answers when ordering proper fractions Type I, II, III and IV.

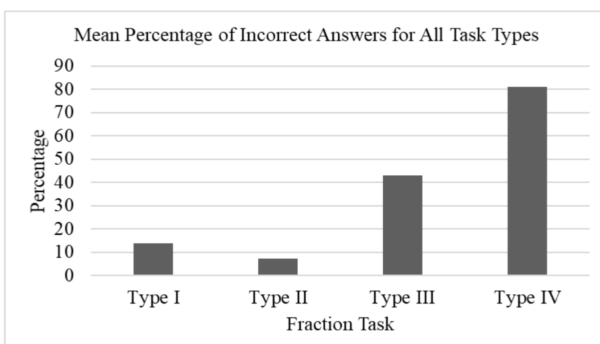

Figure 6. Mean percentage of incorrect answers for tasks type I, II, III and IV

Table 7 shows the percentage of incorrect answers interval for tasks type I, II, III and IV. Task 12, a Type IV task, had a percentage of wrong answer interval of above 75. Tasks 7 and 8, Type III and IV tasks respectively, had a percentage of wrong answer intervals between 50 to 74. Tasks 9, 10 and 11, Type III tasks, had a percentage of wrong answer interval between 25 to 49 while Type I tasks consisting of tasks 1, 4 and 5 and Type II tasks consisting of tasks 2, 3 and 6, had a percentage of wrong answer interval below 24.

Table 7. Percentage of Wrong Answer Intervals for Tasks I, II, III and IV

Percentage of wrong answers Interval	Task	Task Type
Above 75	12	IV
50 to 74	7 and 8	III and IV
25 to 49	9, 10 and 11	III
Below 24	1, 2, 3, 4, 5 and 6	I and II

The results of the investigation reveal that generally, respondents lack the ability to solve ordering of proper fractions even though the respondents were drawn from four intact form two classes, the majority of whom were high achievers. A large number of respondents were unable to solve ordering of proper fractions Type IV (81%) followed by Type III (43%). However, only a small number of the students could not solve ordering of proper fractions Type I (14%) and Type II (7.3 %). These results reveal that (i) students did not have much difficulty ordering proper fractions with same denominators or same numerators; (ii) students had less difficulty ordering proper fractions with same denominators compared with proper fractions with same numerators; (iii) students had difficulty ordering proper fractions with all different numerators and different denominators; and (iv) when presented with tasks on ordering of proper fractions with all different numerators and different denominators, students had most difficulty when ordering fractions with incompatible denominators.

The findings of this study are supported by Gabriel, Coché, Szucs, Carette, Rey, and Content (2013) who reported: When fractions share the same denominator (e.g., $\frac{2}{5}, \frac{4}{5}$), the global magnitude of fractions is congruent with the magnitude of the numerators (e.g., 4 is larger than 2). In this case, pupils could only compare the numerators in order to choose the larger fraction. However, the researchers found that when fractions share the same numerator, the global magnitude of fractions is incongruent with the magnitude of denominators (e.g., $\frac{2}{3}, \frac{2}{5}$). (p. 8).

Gabriel, et al. (2013) also found that “For fractions with no common components, pupils probably only compared numerators and denominators separately. This strategy led to larger error rates”. (p. 8). In addition, Jordan, Resnick, Rodrigues, Hansen and Dyson (2016) in their longitudinal study on the development of fraction knowledge, found that there were three related barriers to the learning of fractions: (a) focusing on the numerator as a counting number and ignoring the denominator and the related whole, (b) not grasping how the numerator and denominator work together to determine the magnitude of a fraction, and (c) failing to understand that fractions are magnitudes that can be represented on a number line. Therefore, it is important to further study strategies respondents use to solve ordering of proper fractions in order to help respondents gain a deep understanding of fraction magnitudes.

5. Conclusions

In conclusion, a large percentage of respondents in this study did not have the ability to solve ordering of proper fractions, especially of Type III tasks which consisted of fractions with different numerators and different but compatible denominators and Type IV tasks, which consisted of fractions with different numerators and different and incompatible denominators. Thus, the respondents of this study have not even achieved general performance level 2 of the Form One Mathematics Curriculum and Assessment Document Standard which states that, “students should be able to display understanding by, for example, explaining a mathematical concept verbally or non-verbally” (Kementerian Pendidikan Malaysia Bahagian Pembangunan Kurikulum, 2015, p. 23)

This research is an important aspect of feedback using ordering tasks to assess knowledge of fraction magnitudes to enhance ordering of fractions strategy with respect to student needs. Therefore, it is appropriate that proper action be taken to address this problem.

The method used in schools to teach ordering of fractions clearly has to be improved so that students have a quantitative and conceptual understanding of fraction magnitudes. Bezuk and Cramer (1989), said that the teaching of fraction magnitudes should emphasize the development of a quantitative understanding of fractions instead of the development of algorithms for doing computations of fractions. They believed that children should understand that $\frac{3}{7}$ is less than $\frac{5}{9}$ not because of a rule they had learn but because they know with understanding and reasoning that $\frac{3}{7}$ is less than $\frac{1}{2}$ and $\frac{5}{9}$ is greater than $\frac{1}{2}$. If Students can reason in this way, then they are deemed to have a quantitative understanding of fractions. Moreover, the practice of teaching fractions emphasizes procedures instead of conceptual understanding of fractions (Gabriel, et al., 2013). An appropriate technique to teach fraction magnitudes could consider informal ordering strategies to make quick estimations of fractions and to decide on the reasonableness of their answers (Bezuk & Cramer, 1989), guiding teachers to help students use sense making to compare fractions (Silbey, 2015) and being able to develop a mental picture of fractions instead of using a common denominator to compare the fractions (Ward, 1999). Many researchers recommend the use of a number line (Fazio and Siegler, 2010; Fennell and Karp, 2017; Jordan, Rodrigues, Hansen and Resnick, 2017) as the main technique or strategy for representing fraction magnitudes in order to develop conceptual understanding. Other researchers also recommend the use of benchmarks (Reys, Kim and Bay, 1999 & So, 2014) for estimating fraction magnitudes. The findings of this study suggest that a greater emphasis on conceptual knowledge of fraction magnitudes, would perhaps improve students' skill in ordering of fractions. Understanding that fractions, like whole numbers, have magnitudes, and thus can be ordered will contribute greatly to the development of fraction sense. Therefore, an appropriate method of instruction should be developed to teach students to order fractions of Type III and IV because the skill of ordering proper fractions is important for fraction sense, fractions arithmetic and mathematical development.

Acknowledgements

Our sincere gratitude to the students who participated in this study, and the school administrators who granted us permission to carry out the survey in their respective schools.

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