IMPROVING ADDING OF TWO PROPER FRACTIONS WITH DIFFERENT DENOMINATORS BY USING 'CATERPILLAR' AND 'CATERPILLAR PAIRS' TECHNIQUES

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Abstract

This action research attempts to improve teacher's classroom teaching of adding fractions with different denominators. Adding fractions with different denominators have always been a problem for the researcher's Year 5 students in the teaching and learning of mathematics. This research was conducted on 23 Year Five students by using techniques of 'caterpillar' and 'caterpillar pairs' in helping students to develop skills appropriate to adding two or more fractions of different denominators. Observation was carried out throughout the teaching and learning using 'caterpillar' and 'caterpillar pairs' technique. Students' exercise books, observations in class and a diagnostic test are the main sources of data to gain insight into the effectiveness of teacher's teaching strategy. Findings indicate that students were able to grasp the concept of adding two or more fractions with different denominators using 'caterpillar' technique and 'caterpillar pairs' technique.

Keywords: Addition of fractions, operations with fraction, primary mathematics, 'caterpillar' technique and 'caterpillar pairs' technique.

Introduction

This study analyses the skills of 23 Year Five students in equating two different denominators. Thus, the study focuses on adding two mixed numbers with different denominators. By using classroom observation, document analysis which is the test given and a diagnostic test, the teacher-researcher identified respondents' skills in adding two or more fractions of different denominators. From Kennedy (1994: 425-427) in Sukayati (2003) stated that fraction comes from the situation of fraction from severally equal parts of a whole as a comparison or ratio meaning that a fraction is the ratio of two whole numbers. Quantitative and qualitative data have been collected in this study. According to Musianto (2002), a quantitative approach includes a process of researching, developing hypotheses, reading across the field, analysing the data and concluding the data to the writing of reports that utilise aspects of measurement, calculation, formulation and numerical methods to obtain assurance of significance and trustworthiness. On the other hand, the qualitative approach is the approach that covers the process of researching, reading across the field, description of phenomena, data analysis and conclusions. In this research, the quantitative approach was used to diagnose the achievement of the actual target group, while the qualitative approach was utilised during the process of interviewing the respondents to gauge the depth of their understanding about equating two different denominators. At the end of this review, the teacher-researcher hopes that the research about 'caterpillar' technique and 'caterpillar pairs'

technique will help respondents to improve their skills in equating two proper fractions with different denominators.

Literature Review

At the beginning of the teaching and learning of equating different denominators, the teacher-researcher used figures to teach fraction because based on Azlin (2010), most teachers use diagram to teach students to add fraction with different denominator. The research by Azlin suggests "fraction strips" as suitable for teaching student in Year 4. However, the teacher-researcher believes that diagram and "fraction strips" methods that were suggested are only suitable for teaching the concept of fraction calculation. Therefore, for Year 5, the teacher-researcher believes that the "caterpillar" technique is suitable to be applied in order to equate two different denominators.

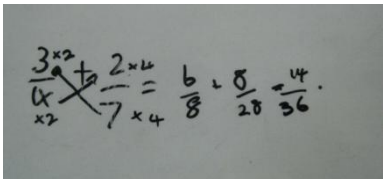
In addition, the teacher-researcher used fraction disc, power point presentation and whiteboard to guide the students. Based on Azlin (2010), the use of figures and suitable examples could attract students to understand the learning especially fraction. Before this, learning and teaching process was uninteresting because the teachers were prone to using chalk and talk during teaching. Thus, the use of figures or suitable examples for teaching fraction and concrete material can increase the students' understanding.

Tajul (1998) in Norazura, Nor Haslina, Nor Amira and Abdol Rahim (2010) stated those teachers who always used the same method and approach would bore pupils. The two teaching methods which involve diagrams and cross-product are regularly used by teachers as they are the suggested methods in Year 5 mathematics textbook. This method will cause pupil easily guessed the teaching method that will be used by the teacher in the classroom.

The teacher-researcher had mentioned that most students at school were facing problems in adding two fractions with different denominator and besides, teachers mentioned having difficulties to teach fraction because they thought this topic was very tough. This statement was supported by Kilpatrick, Swafford & Findell (2001) in Abdul Razak & Ahmad Sofri (n.d). They stated that among the mistakes done by students was solving addition operation in fraction. Common mistake happens when the students add the fraction before equating both denominators. It is due to poor understanding of fraction. Therefore, the teacher-researcher took the opportunity to find the root of this problem and tried to solve it.

Overview

At the early stage, the teacher-researcher had taught the respondents on how to add two fractions with different denominators via power point presentation. Then, the teacher-researcher taught them step by step to add two fractions using cross-products method. However, both methods of teaching were not as effective as shown in Figure 1, in the samples L001, L002, L023 and P003. All the students' responses in Figure 1 showed that both methods were not able to help low achievers to equate fractions with two different denominators.



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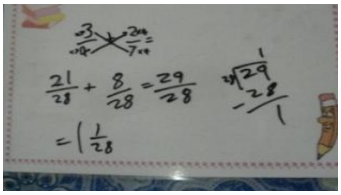

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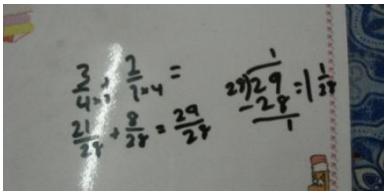

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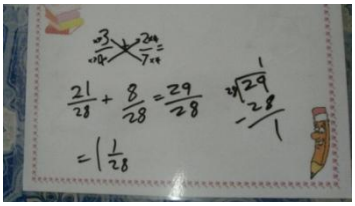
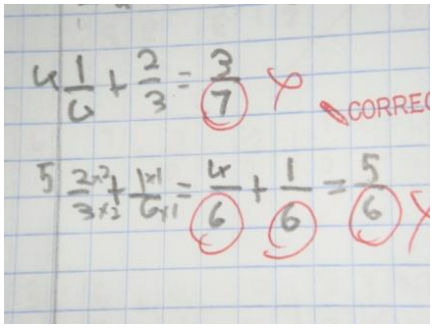


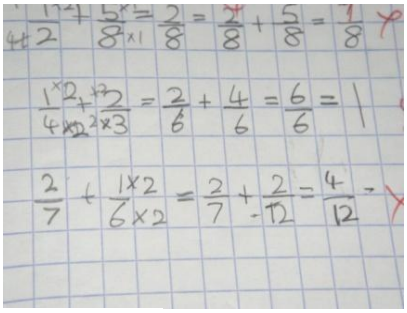
(P003)

Figure 1. Students' written responses.

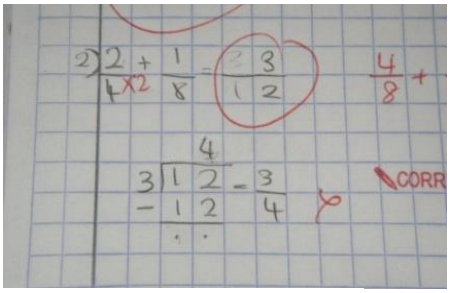
In students' exercise books, the teacher-researcher could also see students' weaknesses in the adding of fractions with different denominators (refer Figure 2). Nine respondents were not able to equate two different denominators. During classroom observation and through the analysis done by looking at students' written work in their exercise books, it was found that seven respondents faced difficulties in adding fraction of different denominators.



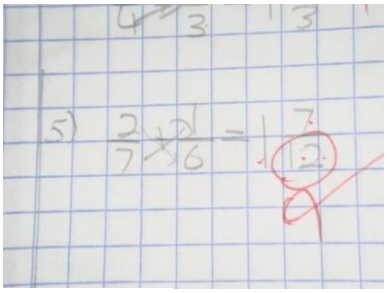
(L011)



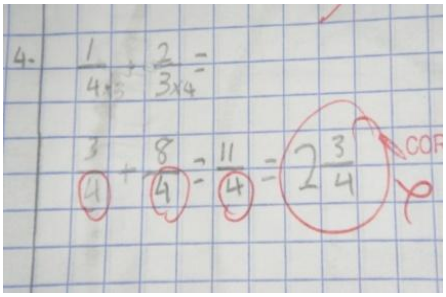
(L020)



(L018)



(L021)



(P007)

(L016)

Figure 2. Written solution of adding two fractions with different denominators.

Table 1
Respondents who were not able to add Two Fractions with Different Denominators.

Respondents (n=12)	Observation 1 (Classroom observation- performing computation)	Observation 2 (Analyzing exercise book - Performing computation)
P007	/	x
L009	x	/
L011	x	x
L012	/	/
L016	x	x
P017	x	/
P018	x	x
L019	/	x
L020	x	x
L021	/	x
P022	x	x
L023	x	x

Table 1 shows that respondents who were not able to perform addition of two fractions with different denominators in the classroom did not necessarily face the same problem while solving the questions in their exercise book. Therefore, the teacher-researcher decided to implement diagnostic tests to confirm whether the respondents were really facing problems when equating fractions with two different denominators.

Diagnostic testing is an instrument used to measure students' area of weaknesses (Norhaidi, 2009). The purpose of this diagnostic test was to determine respondents' actual ability in performing the addition of two proper fractions with different denominators. This test was meant to provide a guideline to help detect each respondent's difficulties in performing such computation. The test consists of ten questions and was conducted for 30 minutes.

Question 1 and Question 10 required the respondents to add two proper fractions with the same denominator, while Questions 2, 3, 6 and 7 required them to add two proper fractions with different denominators that needed them to only multiply the denominator with a certain coefficient to equate the denominator. Question 4, 5, 8 and 9 required them to add two proper fractions with different denominators which they needed them to multiply both denominators with a certain coefficient to equate the denominators. These questions were constructed to gather data about their strengths and weaknesses. All questions were open ended and the respondents were required to provide all the steps needed in solving the problem. In this diagnostic test, there were students who successfully answered all the 10 questions correctly. However 17 out of 23 of the respondents (n=17) were not able to get full marks.

Analysis of Preliminary Data Collection

During the initial stages, there were 23 respondents involved in this study. However after implementing the three stages of analysis: classroom observation on students performing computation, analysis of the students' exercise books and diagnostic tests, the actual number of respondents identified were still vague, we can see from the Table 1. Thus the second diagnostic test was implemented.

This second diagnostic test was administered to confirm the number of students facing difficulties in addition of fractions with different denominators. The second diagnostic test was also important to determine the reliability of the diagnostic test. Reliability of a convenient size means consistency of measures produced by the device. This was supported by Wainer and Braun (1988) in Ghazali pp 68 which consistency reliability of the test means the marks produced by the test.

After performing the diagnostic tests for the second time, the respondents' score for the first and second diagnostic tests were compared. Respondents' scores were relatively high which means 20 out of 23 of the respondents obtained the score of 7/10. Thus, only respondents who scored less than 50% were selected to take part in this study. There were three respondents who scored less than 50%. The other respondents managed to score more than 50%.

Thus, it can be concluded that a total of nine respondents were identified to face difficulties in adding two proper fractions with different denominators (refer Table 2). The selection of the nine respondents participated in this study was based on their performance from the three methods of data collection: classroom observation (during teaching and learning), documents analysis (students' exercise books) and scores obtained from the diagnostic tests.

Table 2
Data Obtained from Classroom Observation, Document Analysis and Diagnostic Test.

Respondents (n=24)	Classroom observation	Document analysis (exercise book)	Diagnostic test
L001	/	/	/
L002	/	/	/
P003	/	/	/
P004	/	/	/
P005	/	/	/
P006	/	/	/
P007	/	x	/
P008	/	/	/
L009	x	/	/
P010	/	/	/
L011	x	x	X
L012	/	/	/
L013	/	/	X
L014	/	/	/
L015	/	/	/
L016	x	x	X
P017	x	/	X
P018	x	x	X
L019	/	x	/
L020	x	x	X
L021	/	x	X
P022	x	x	X
L023	x	x	X

Objectives of the study

(1) To improve computation skills in performing addition of fractions with two different denominators.
(2) To improve students' ability to equate two different denominators by using 'caterpillar' technique.
(3) To evaluate the impact of using 'caterpillar' technique on students.

Research Questions

(1) What are the student's difficulties in performing addition of fractions with two different denominators?
(2) Does the 'caterpillar' technique improve student's ability to equate two different denominators?
(3) What are the students' views on the 'caterpillar' technique?

'Caterpillar' Technique

This technique is known as the 'caterpillar' technique due to the way the method was being carried out. The shape of this method is like a caterpillar. How do we use this technique? This technique is very easy to be applied. Figure 3 shows an example of the question and the use of the technique.

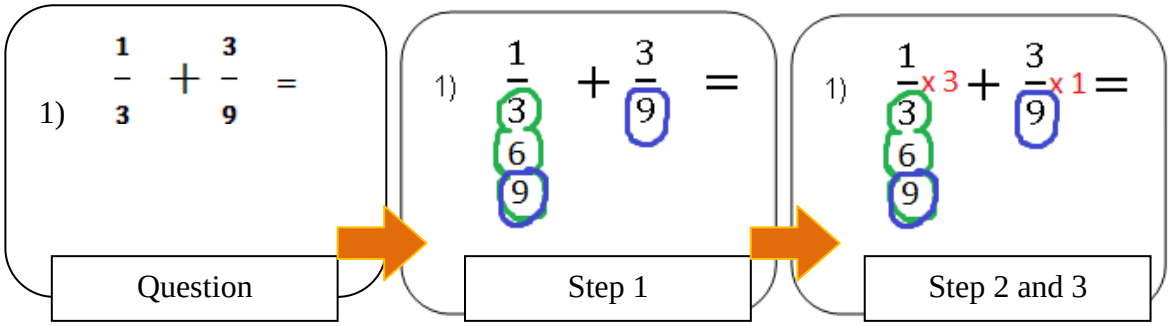


Figure 3. The steps of applying the 'caterpillar' technique.

Based on Figure 2, the steps and the shape of the 'caterpillar' technique are clearly shown. When respondents have a question with different denominators, they try to equate the denominators by applying the 'caterpillar' technique (Step 1). Respondents must compare between two denominators three and nine, the smallest number between two denominators should be listed first (green in colour). Then, they were required to compare the two numbers and circle the same numbers (blue in colour) (Step 2). Then, they would count the number that was rounded start at number three till number nine and multiply by three (step 3). Finally, they added both fractions to get the answer.

'Caterpillar Pairs' Technique

Figure 4 shows the continuation of the 'caterpillar' techniques which was described earlier.

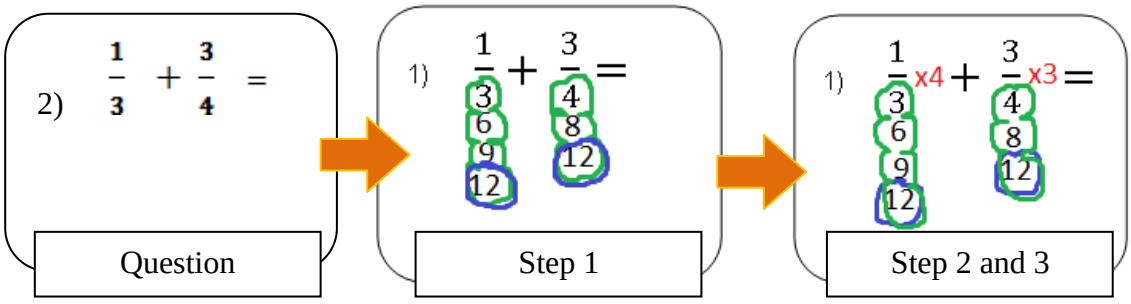
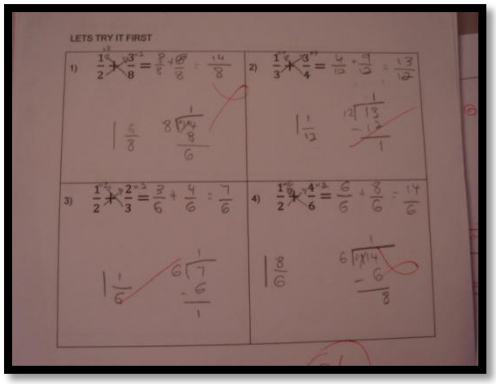


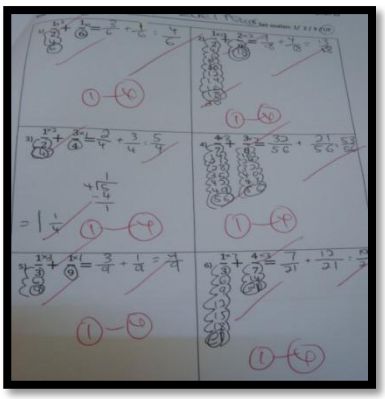
Figure 4. The steps to implement the techniques of 'caterpillar' pairs.

Steps to implement these techniques are as shown in Figure 4 above. Students can continue to evaluate their understanding of these techniques by trying to equate the two denominators. For the 'caterpillar pairs' technique, respondents should equate the two 'caterpillars' to determine the different denominators.

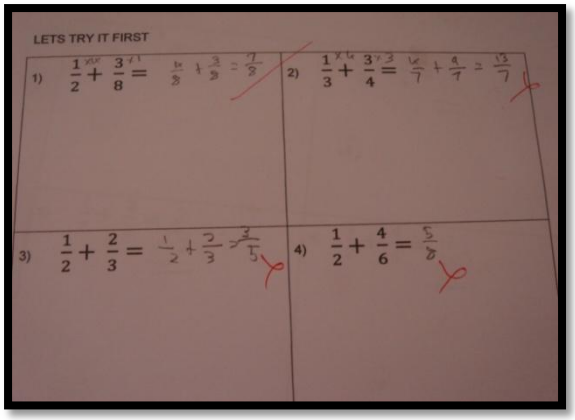
The teacher-researcher implemented these techniques for two weeks. These techniques are suitable for low and moderate achievers to help them find quickly the coefficient of fraction. Pupils who are unable to memorise multiplications are still able to use repeated addition in this technique. In addition, participants can also minimise the use of large numbers due to cross-products. The results obtained show significant changes in students' performance after they used the caterpillar technique. Students seemed to understand the caterpillar technique with minimum guidance.



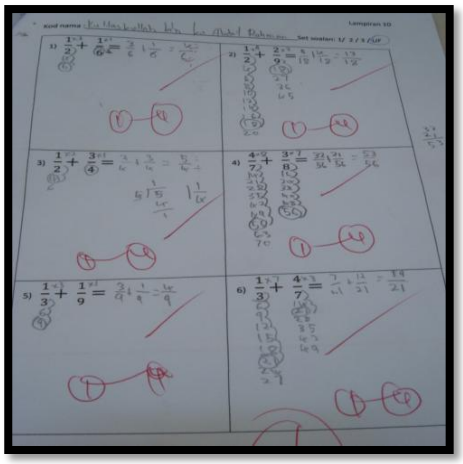
P018 (before using caterpillar technique)



P018 (after using caterpillar technique)



L011 (before using caterpillar technique)



L011 (after using caterpillar technique)

Figure 5. Written document analysis before and after using 'caterpillar' and 'caterpillar pairs' technique.

Figure 5 shows the written document of respondent L011. There is a difference between these two pictures. The respondent improved his skill after using the 'caterpillar' technique and 'caterpillar pair' technique.

These two techniques can be applied not only for proper fractions but also on mixed numbers, improper fractions with two different denominators. These techniques can be used on to equate two different denominators.

Findings

The teacher-researcher used three methods of data collection which were observation with the check list as an instrument, pre-test and formative tests and the last one was interview. Observation was carried out with three sets of question that consisted of six questions. Observation was done to all respondent with three steps calculations which were implemented in two weeks of teaching and learning. Observation was recorded in video clip. A mark was given to a correct step. The total marks obtained were changed into percentage in order to make it easier for the teacher-researcher to evaluate the respondent' ability. The teacher-researcher fixed that the respondents should obtain 70 percent as the minimum success rate. After calculating the percentages for all three sets of question, the teacher-researcher concluded that all respondents' were successful in obtaining the desired percent.

All the respondents managed to follow the three steps of the 'caterpillar' and 'caterpillar pairs' technique.

For the second method which was the pre-test and the formative test, the teacher-researcher recorded a total score that was obtained by both tests and changed them into percentage. The pre-test was conducted during the induction set session that consisted of four questions. While, the formative test was conducted after the respondent finished answering three sets of question and it was done at the school library. The teacher-researcher viewed the differences of the percentages in observing the performance. The results from Table 3 show that all respondents had minimum and maximum increase of 50 and 100 respectively.

The third method was interviews that were conducted informally but in order. The interviews were meant to get the respondents' comments as a user of the "caterpillar" technique. The data from the interview was analysed manually because there are only seven question. Results showed that all respondents could see the improvement of their skills based on their score in the formative test. Respondents agreed that the new method had helped them in fraction. In fact, respondents were eager to use this technique in equating two different denominators. "*Jemaah Nazir Sekolah Persekutuan (1996)* in Tengku Zawawi, Ramlee, Abdul Razak (2009) stated pupils' performance and interest in mathematics are still unsatisfied but teacher-researcher confident that pupils' performance and interest will increase after use the 'caterpillar' technique and 'caterpillar pairs' technique. Tengku Zawawi (2000) said "smart education" stress that pupils are able to learn if they are given the appropriate opportunity with suitable approach. Furthermore, these techniques will give the opportunity to the lower achievers to enhance their skills in equating two different denominators.

Table 3
Data Obtained from three method used in this research.

Num	Respondent	Method 1 (observation) target 70%	Method 2 (analysis document-%)	Method 3 (interview)
1	L021	98.15	+100	Quick, interesting, confidence
2	P022	100	+50	helpful, interesting, confidence
3	P018	77.78	+50	easy, interesting, confidence
4	L016	100	+100	easy, confidence
5	P017	100	+100	easy, confidence
6	L011	77.78	+75	easy, confidence
7	L013	77.78	+100	Helpful, quick, confidence
8	L020	100	+50	easy, confidence
9	L023	100	+100	Helpful, happy, confidence

In conclusion, from all the three methods, the results support the hypothesis proposed earlier about the benefits of the "caterpillar" technique. The first analysis showed that all respondents could follow the three calculation steps that were recommended. Meanwhile, the second method proved that the respondents' performance increased and the interviews reflect positive response from the respondents.

Reflection

At an early stage, this research was done for the purpose of fulfilling a course requirement as the teacher-researcher found that her students were having difficulties to equate two different denominators. As a result, they faced difficulties in adding fractions with different denominator. Nine out of 23 students were having these problems. In this study, the teacher-researcher discussed with the teachers in her school and also refered to the website and journal to help her complete this study. The teacher-researcher is keen in promoting this method as she felt it was appropriate to help students who are weak in mathematics. This is because Adnan (1986) in Norma (2004) stated that students do not like to study mathematics because the subject is difficult and boring. Due to this problem students tend to memorise in order to learn mathematics. Therefore, they lose interest in learning mathematics and produce unsatisfactory performance. The teacher-researcher also believes that the respondents can accelerate their computation skill via this method. Teachers at school also agreed with these techniques. So, the teacher-researcher hopes that these techniques can be adopted to benefit students. The teacher–researcher will like to recommend to all teachers to use this 'caterpillar' technique and 'caterpillar pairs' technique to help students improve their skill.

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