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Impact of videos and traditional teaching methods on fifth grade students' achievement in fractions

Nabil Kamal Al Farra [1*], Shashidhar Belbase [2], Hassan Tairab [3], Ahmad Qablan [3], Maxwell Peprah Opoku [4], Samir K. Safi [5]

[1] Department of Mathematics and Statistics, College of Engineering, Abu Dhabi University, Al Ain, Abu Dhabi, UAE
[2] Department of Mathematics, Troy University, Troy, Alabama, USA
[3] Department of Curriculum and Instruction, College of Education, United Arab Emirates University, Al Ain, Abu Dhabi, UAE
[4] Department of Special and Gifted Education, College of Education, United Arab Emirates University, Al Ain, Abu Dhabi, UAE
[5] Department of Statistics and Business Analytics, College of Business, United Arab Emirates University, Al Ain, Abu Dhabi, UAE

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Abstract

Mathematics teachers employ a diverse range of tools, resources, and materials to enhance the teaching and learning processes through various instructional strategies. In this quantitative study, the effectiveness of utilizing videos and traditional lecturing as distinct strategies for teaching fifth-grade students in fractions addition and subtraction was investigated. The researchers employed a quasi-experimental pre-test and post-test single group design, conducting the study in four schools with different curricula in Abu Dhabi over a two-week period. The same group of students underwent both pre- and post-tests after being exposed to lessons on fractions addition and subtraction through videos and lectures. The results indicated that using videos to teach fractions had a more positive impact on students' performance across different schools compared to traditional lecturing. This bears significant implications for enhancing students' proficiency in fractions through improved teaching strategies.

Keywords: fraction operations, mathematics teaching, quasi-experimental research, teaching with video, mathematics education, elementary school

INTRODUCTION

The concept of "fractions" holds crucial significance for students at the school level, as it intersects with various mathematical topics such as algebra, decimals, rational numbers, rates, and ratios (Aksoy & Yazlik, 2017; Aliustaoğlu et al., 2018). It is also integrated into students' daily lives (Kocaoglu, 2010). Despite its fundamental nature, numerous studies (e.g., Aliustaoğlu et al., 2018; Hansen et al., 2017; Obersteiner et al., 2019) have noted that students encounter difficulties in comprehending fractions, potentially attributed to ineffective teaching methods and a lack of conceptual understanding of fraction operations (Arcavi, 2003; Bentley & Bosse, 2018).

Misconceptions emerge after a misunderstanding of some statement. They can occur due to various factors, including a lack of clarity, preconceived notions, or cultural differences. It emerged from the notion of knowing something before and made it correct again after using reasoning, culture, tradition, and other factors (Wardat et al., 2021). Moreover, in mathematics, misconceptions arise in operations, as fractions are sometimes treated as integers without a grasp of the underlying concepts (Aliustaoğlu et al., 2018; Haser & Ubuz, 2002; Şiap & Duru, 2004). Understanding fractions is an introduction to learn rational numbers which are crucial to learn, as research indicates that understanding fractions can predict future mathematics achievement in school (Jarrah et al., 2022).

Understanding fractions poses challenges not only for students (Namkung & Fuchs, 2019) but also for teachers (DeWolf & Vosniadou, 2015; Lewis et al., 2015), rendering it a problematic area of study (Kor et al., 2018).

✉ nabil.a-adjunct@adu.ac.ae **(*Correspondence)** ✉ sbelbase@troy.edu ✉ tairab@uaeu.ac.ae ✉ qablan@uaeu.ac.ae
✉ maxwell.p@uaeu.ac.ae ✉ ssafi@uaeu.ac.ae

Contribution to the literature

- This study significantly contributes by highlighting how technology enhances the teaching of fractions, particularly at the elementary level.
- The study's exploration of video-based teaching as a strategy for improving students' understanding of fraction concepts adds valuable insights to the literature.
- Addressing the specific challenges faced by both students and teachers in teaching fractions within the context of the Arabian economy, especially the United Arab Emirates, is a noteworthy contribution.

For instance, Kara and Incikabi (2018) delved into the transitional skills of sixth-grade students concerning numerical models, number lines, and verbal representations in fractions addition and subtraction. The students demonstrated greater proficiency in numerical-numerical, model-model, model-numerical, and numerical-model transitions than in the addition and subtraction of fractions. Notably, during model formation, students frequently erred in determining denominators and numerators in addition operations. Similarly, errors were more prevalent in fractions subtraction, particularly in the execution of operations and the selection of numerators.

In a related study, Flores et al. (2018) investigated the impact of employing concrete representations and abstraction (CRA) in teaching fractions on the performance of 17 fifth-grade students. Using a pre-experimental design with pre- and post-tests, the researchers observed significant progress in students' learning of fractions and decimals through the 20-minute daily use of the CRA method. The material resources, such as fraction tiles created by cutting cards into equal parts, were easily prepared. The researchers recommended integrating 20-minute CRA fraction activities into the teaching of fractions and decimal units, emphasizing the ongoing exploration and development of effective interventions to help elementary students grasp rational number concepts and skills (Flores et al., 2018).

Prior research has advocated for the incorporation of multiple strategies in the teaching of fractions to students. The exploration of effective teaching methods has pinpointed videos as a suitable strategy to enhance students' understanding of fractions (Dapadap et al., 2021). The utilization of videos in the teaching and learning of mathematics may encompass various resources, such as models, tiles, whiteboards with colored markers, and posters, allowing students to represent fractions as quantities in terms of length or area (Izsák, 2008). The integration of videos into mathematics instruction has the potential to boost students' motivation, as well as improve both procedural and conceptual knowledge (Lalian, 2018). Employing video models for teaching fractions and their operations serves as an alternative approach (Hughes, 2019), offering benefits such as reducing student anxiety and promoting critical thinking (Lalian, 2018). The use of videos in teaching fractions addresses certain shortcomings of traditional methods, allowing students to replay the video multiple times and pause when encountering difficulties in comprehension (Rauf & Fauziah, 2021). Furthermore, incorporating videos can create learning scenarios that actively engage students, encouraging them to participate constructively in the learning process with heightened motivation (Hasan, 2017; Rachmavita, 2020).

Despite being widely used, the traditional lecturing approach remains in use, even though contemporary theories widely criticize it as an ineffective method (Noreen & Rana, 2019). Lecturing is characterized as a teacher-centered method, where the teacher possesses the information and serves as the transmitter, while students act as recipients. Mathematics teachers often resort to lecturing because it requires less effort, relying mainly on subject knowledge. However, perceptions of lecturing vary; some educators and teachers consider it more effective, while others deem it tedious, causing distractions and having a limited impact on students' progress in learning mathematics (Gunawan, 2018).

The challenge is apparent: students often struggle to grasp the concept of fractions, despite their widespread application in daily life (Fazio & Siegler, 2011). Relying solely on traditional teaching methods may not be sufficient and could potentially result in students developing a dislike for the concept (Wijaya et al., 2020). Therefore, it becomes imperative for teachers to diversify their teaching approaches, incorporating technology and modeling methods to actively engage all students. Tailoring activities to accommodate varying levels, cultural backgrounds, and interests is crucial in ensuring effective comprehension and retention of the subject matter.

Contextualization

In the PISA 2018 rankings, the United Arab Emirates (UAE) secured the 50th position among 78 countries in mathematics (OECD, 2018). Furthermore, in the TIMSS 2015 assessments, the UAE was positioned 39th out of 49 countries in grade-four mathematics and 23rd out of 39 countries in grade-eight mathematics (Mullis et al., 2016). When it comes to performance in fractions, UAE students exhibited an average score of 14, significantly lower than the international average of 18 (Mullis et al., 2020) (**Table 1**).

Table 1. The UAE grade 4 and 8 results in TIMSS

Year	UAE achievement in mathematics–Grade 4 TIMSS scale center point (500)	UAE achievement in mathematics–Grade 8 TIMSS scale center point (500)	The sources
2011	434 (2.0)	456 (2.1)	Government of Dubai (2012)
2015	452 (2.4)	465 (2.0)	Mullis et al. (2015)
2019	481 (1.7)	473 (1.9)	Mullis et al. (2020)

It's plausible that students in the UAE face challenges in learning fractions, and these difficulties might be linked to the teaching methods employed. There is a pressing need to explore and identify the most effective teaching approach for mathematics in the UAE. Unfortunately, there is a lack of studies on teaching fraction operations to determine which method best supports students' learning. This study posits that utilizing a video teaching approach could potentially enhance students' understanding of fractions and positively impact their performance. To assess the efficacy of different methods in teaching fractions, the video teaching method is compared to the traditional lecturing method, which is considered the conventional approach.

Purpose, Research Questions, and Hypotheses

The purpose of this study is to examine the impact of teaching fractions using video and traditional lecturing on fifth grade students' learning of fraction addition and subtraction. To achieve the purpose of this study, we answered the following research questions:

1. Are there differences in performance attributed to students' gender with regards to learning fractions with videos and traditional lecturing?
2. Is there a difference in students' performance in learning fractions by using videos and traditional lecturing strategy?

Based on our independent variable of teaching strategy (using videos versus traditional lecturing) and dependent variables (students' performance in learning fractions addition and subtraction using videos and traditional lecturing, our hypotheses are:

1. **H_0 #1 (Q2).** There is no statistically significant difference at $\alpha \leq 0.05$ between the performance of male and female students in learning the addition and subtraction of fractions when using videos as a teaching method.
2. **H_0 #2 (Q2).** There is no statistically significant difference at $\alpha \leq 0.05$ between the progress of male and female students in learning the addition and subtraction of fractions when using traditional lecturing as a teaching method.
3. **H_0 #3 (Q3).** There is no statistically significant difference of student achievement in fractions addition and subtraction at $\alpha \leq 0.05$ between learning by videos and traditional lecturing as a teaching method.

METHOD OF STUDY

Quasi-experimental research was implemented using the same dependent variables whose performance was measured at pre- and post-test (Ellington et al., 2020; Flannelly et al., 2018; Martin & Bridgmon, 2012). A pre-test and post-test design is a type of quasi-experimental research used to facilitate straightforward evaluation of an intervention administered to a group of study participants (Contreras, 2020). This permits for a comparison of the outcomes to determine the impact of the intervention. Unlike true experimental designs, this method does not involve random assignment of participants to control experimental groups, which can introduce some limitations in controlling for confounding variables. However, it remains a valuable tool for assessing changes over time within the same group of participants, making it a practical choice for various fields such as education, psychology, and healthcare (Shadish et al., 2002). In one-group experimental design, participants are assessed before implementation of a given intervention. In order to determine the impact of a given intervention, the performance of participants is assessed at post-test. The one-group pre-/post-test design was chosen because the intervention was implemented on a group of students at a given time and thus. Also, the sample size was not large in this study which made difficult to have separate experimental and control groups.

Sample of the Study

According to Abu Dhabi Department of Education and Knowledge (ADEK, 2023), there were 514 schools in Abu Dhabi in the Academic year 2022-2023, that include charter, private and nursery schools. Therefore, we conducted the study in 4 schools: one school at Al Ain city, one in Al Yahar city, and two in Bani Yas city. Three schools follow the UAE national curriculum, and the last one follows the American curriculum. These schools were selected based on two-fold reasons. First, the first author had a good relationship with the principals of these schools which made it easier and more convenient. The second reason was that those schools had different mathematics curricula and located in different locations in the Emirate of Abu Dhabi; Al Ain, Al Yahar, and Bani Yas, which made it a good sample to study the impact of the two mathematics teaching strategies. The study focused on fifth-grade students, comprising a total of 81 participants: 40 boys and 41 girls. These students came from various nationalities, reflecting the diverse

Table 2. Distribution of students in 4-schools

School	Curriculum	Number of students participated		Total
		Male	Female	
IKS	UAE MOE	7	4	11
DUF	UAE MOE	12	10	22
DUY	UAE MOE	13	21	34
UPSY	American	8	6	14
Total		40	41	81

population of the UAE, which includes people from numerous countries. The number of participants in the four schools is illustrated in **Table 2**.

Setting and Implementing the Study

According to both the UAE's grade five mathematics annual plan and the American curriculum, adding like fractions and subtracting unlike fractions are introduced in the second term of the academic year. Thus, students from both schools learned adding like fractions and subtracting unlike fractions at the same time. The time needed by students to grasp concepts is two periods. Students learned adding like fractions using different videos and learned subtracting unlike fractions using traditional lecturing. **Table 3** shows the order of the lesson and related standards. The video strategy was applied to explain adding like fractions for two periods. It was explained for all the mathematics teachers to follow the instructions and use the same videos in all schools.

Teaching fractions with videos

The researchers prepared four videos explaining the addition with like fractions in, Arabic and English, entitled: Adding like Fractions part 1 (Available at: https://www.youtube.com/watch?v=CYVBxJad0ig&t=6s), and we asked the mathematics teachers to use them in the class in addition to using other similar videos. Those videos save teacher's time because they had images, ready written questions and delivered in an organized way that fosters student engagement. Teachers had the flexibility to pause, repeat, or skip some parts of the videos to have discussions with their students and assess their understanding. Those videos were presented to the students in the classroom, and they were asked to solve some questions of fractions after watching the videos. For the other lessons, subtracting unlike fractions, mathematics teachers used the traditional lecturing to explain it.

It is important to note that researchers trained the participating mathematics teachers from all the schools on implementing the teaching strategy. The researchers helped the teachers in preparing their lesson plans and teaching resources. We provided participating teachers with the follow up they needed through attending their classes either virtually or physically and the researchers got daily feedback from the mathematics teachers.

Constructing the Tools, Pre- and Post-tests

The researchers prepared a 20-minute pre-test exam on adding like fractions and subtracting unlike fractions. The test contained 6 short answers questions and 2 problems solving with more than two steps of solution. The questions were chosen to cover the objectives of each lesson as per the MoE's guide. The pre-test was given to all students in the four schools. After implementing the lesson of learning adding like fractions using videos, the students sat for the post-test which has the same questions like the pre-test. Likewise, after the second lesson, subtracting unlike fractions using traditional lecturing, the students sat for the post-test that its questions were related to subtracting unlike fractions. The same (see **Table 4**). The purpose of the pre- and post-tests was to measure the students' achievement and analyze their progress to answer the research questions

Validity and Reliability

We addressed the validity of our study by examining the correlation of each part of the pre-test and post-test. Reliability is related to the consistency of a measure, and validity is about the accuracy of a measure. Reliable instruments remain consistent in different settings, produce generalizable results to other populations, and replications (Krishman & Idris, 2018). The reliability

Table 3. Curriculum of fraction addition and subtraction for grade-5 (UAE MOE-American curriculum)

5th-grade mathematics plan: Adding and subtracting fractions		
MOEUAE	Standard	Number of needed periods
Unit 8: Lesson 2: Adding like fractions Lesson 7: Subtracting unlike fractions	5.9.2.1	2
American: Chapter 6: L6.1 Addition with like denominators L6.6 subtraction with unlike denominators	CCSS 5.NF.1	2

Table 4. Types and number of items in pre- and post-tests

Strategy	Pre-test		Post-test	
	Short answer questions	Problem-solving	Short answer questions	Problem-solving
Video	3	1	3	1
Traditional lecturing	3	1	3	1
Total	8		8	

estimation aims to determine the consistency of scores from a measure and separate the various sources classified as errors (Seybert & Becker, 2019). For our study, we choose a pre-test and post-test at two different times for the same group.

Validating the tools

First, the researchers chose the questions for the pre- and post-tests from the UAE mathematics textbooks and the American books for grade five. Therefore, the questions were chosen based on the UAE MOE mathematics standards and the common core state standards (CCSS). Then, the mathematics teachers (experts in the field) from the participated schools checked the questions for the suitability and difficulty level. Later and based on their recommendations, the questions are modified.

The final version of the tests consisted of 8 questions and were written in English and Arabic languages. Both versions were then shared with ten mathematics teachers, expert, and educators in many countries: USA, UAE, Nepal, and Palestine for evaluation and validation. After taking their permission to validate the tools, they received an email with the tools. Experts were asked to check the questions based on four criteria; the language, the content, the diagrams, and the translation (for those who can speak English and Arabic languages). The feedback was very informative and helped to improve the tests. For example, the second question in the test "Show the sum of three fifths and two fifths by shading the figure and complete the addition sentence. Write the answer in the simplest form if needed. "One of the reviewers' comments was (make it 3/5 and 2/5 based on your picture. Why did you have fifth and fifths? Make it uniform. This is where you want them to write 3/5 and 2/5. Then tell them in sentence to use the box). His suggestion was considered when producing the final version of the tests. Finally, the test questions were modified according to teachers' recommendations and became ready to be used.

Pilot study and reliability of tools

After validating the test from the mathematics teachers, experts, and educators, we pilot tested the tool with 24 students from one non-participating American curriculum school in UAE. The aim of this stage was to ensure that the validity and reliability indices of the tools were at acceptable levels (Hamid & Kamarudin, 2021). Implementing the test and correcting it guided us to discover some mistakes or misleading phrases. Based on the students' results, questions 2 was rephrased to be more understandable for the students.

Cronbach's alpha is a measure of internal consistency, that is, how closely related a set of items as a group (Cronbach, 1951). It is considered to be a measure of scale reliability. A "high" value for alpha does not imply that the measure is unidimensional. The general rule of thumb is that a Cronbach's alpha of 0.70 and above is good, 0.80 and above is better, and 0.90 and above is best, (Norcini, 1999). In the current study, the Cronbach's alpha coefficient is used to measure the internal consistency of the tests' items and the correlation of each item to each other. The Cronbach's alpha was 0.865 for the test questions which indicated a high reliability of items in the tool.

Data Collection Procedure

In this quantitative quasi-experimental research, students from the fifth grade in the sample schools in the UAE have to study fractions addition and subtraction in the second term of the academic year based on the UAE MOE standards and American CCSS. At the beginning, students completed the pre-test exam in the four schools. The pre-test was administered by one of the researchers in both languages Arabic and English. The scores of the pre- and post-test were collected, analyzed, and compared to each other to investigate the impact, if any, of using both lecturing and videos on students' understanding of the addition and subtraction of the fractions. The researchers applied for the ethical approval from the Division of Research and Graduate Studies Ethics Approval System at a higher education institution in the UAE. The ethical approval was obtained from the Research Ethical Committee.

Data Analysis and Interpretation

In this quasi-experimental study, a non-random pre-test post-test model was used to measure the impact of video teaching strategy and traditional lecturing strategy on 5^{th}-grade students' understanding of fractions. The pre-test was used as a baseline measurement before conducting our study, and the post-test was given at the end of each teaching strategy to compare students' progress (Polit & Beck, 2013). Thus, all the participating students sat for the pre-test before starting the study to determine their levels in subtracting like fractions and adding unlike fractions. Then, the same students sat for the post-test. Data entered into a Microsoft Excel spreadsheet and then transferred to the statistical package for the social sciences (SPSS) version 28.0 for statistical analysis (Collins, 2020). Normality of the distribution of dependent variables (student achievements) was tested by Kolmogorov-Smirnov and Shapiro-Wilk tests. Then, non-parametric tests for group comparisons were performed with Mann-Whitney U-tests and Kruskal Wallis tests. Cohen's d was used to examine the effect size.

RESULTS

The test of normality was used to determine if a data set was normally distributed or not. The test is generally performed to verify whether the data involved in the

Table 5. Independent-samples Mann-Whitney U test summary for group comparison (gender-pre-RVideo): male:26 and female: 33

	Total N	Mann-Whitney U	Wilcoxon W	Test statistic	Standard error	Standardized test statistic	Male mean rank	Female mean rank	Asymptotic sig. (2-sided test)
Pre1	59	412.500	973.500	412.500	58.893	-0.280	30.63	29.50	0.779
Pre2	59	497.000	1058.000	497.000	53.951	1.260	27.38	32.06	0.208
Pre3	59	400.000	961.000	400.000	56.580	-0.513	31.12	29.12	0.608
Pre4	59	498.000	1059.000	498.000	53.885	1.281	27.35	32.09	0.200
PreRVAv	59	448.500	1009.500	448.500	62.468	0.312	29.25	30.59	0.755

research have a normal distribution or not (Ghasemi & Zahediasl, 2012). The well-known tests for normality are the Kolmogorov-Smirnov test and the Shapiro-Wilk test (Martin & Bridgmon, 2012). To test the normality of data in this study (parametric/nonparametric), first we found the average of the pre- and post-test scores and then used the SPSS software. The Kolmogorov-Smirnov and Shapiro-Wilk tests of normality for the pre-test and post-test and the results indicated that the data was not normally distributed ($p < 0.05$). Therefore, we have rejected the null hypothesis that assumes normal distribution of the data and have used the non-parametric tests, including the one-sample Wilcoxon signed rank test and Mann-Whitney U-test, to conduct our analysis.

Group Comparison (Mann-Whitney U Test) for the Pre- and Post-test

The Mann-Whitney U test is used to compare differences between two independent groups when the dependent variable is either ordinal or continuous, but not normally distributed (Martin & Bridgmon, 2012). The test was used to compare students' scores in the pre- and post-test based on gender.

Pre-test for video

Independent-samples Mann-Whitney U test was performed to examine if there was a significant difference between the male and female students on their responses to the pre-test related to learning fractions using videos. The results of this test have been presented in **Table 5**.

In the first question, "find the sum $\frac{3}{7} + \frac{1}{7}$," (male: mean rank = 30.63, N = 26; female: mean rank = 29.50, N = 33; U = 412.500, Z = -0.280, p = 0.779 > 0.05) (**Table 5**). Thus, there was no statistically significant difference between the male and female students' performance in the pre-test on the first question to add two like fractions with a common denominator. In the second question, "Show the sum of three fifths and two fifths by shading the figure and complete the addition sentence. Write the answer in the simplest form if needed", the result (male: mean rank = 27.38, N = 26; female: mean rank = 32.06, N = 33; U = 497.000, Z = 1.260, p = 0.208 > 0.05), showed that there was no statistically significant difference between the male and female students' performance in solving the problem. For the third question, "find the Sum of $\frac{3}{11} + \frac{1}{11} + \frac{2}{11}$," the result (male: mean rank = 31.12, N = 26; female: mean rank = 29.12, N = 33; U = 400.000, Z = -0.513, p = 0.608 > 0.05), showed that there was no statistically significant difference between male and female responses to the third question to add three like fractions with a common denominator.

Similarly, the fourth question, "Sara is making a key chain using the bead design as shown in the picture. What fraction of the beads in her design are colored," the result (male: mean rank = 27.35, N = 26; female: mean rank = 32.09, N = 33; U = 498.000, Z = 1.281, p = 0.200 > 0.05), indicated that there was no statistically significant difference between male and female responses to the question. The results of the average of the four questions related to learning fractions using video showed that there was no statistically significant difference between male and female students' performance (male: mean rank = 29.25, N = 26; female: mean rank = 30.59, N = 33; U = 448.500, Z = 0.312, p = 0.755 > 0.05) (**Table 5**).

Pre-test for traditional lecturing

Independent-samples Mann-Whitney U test was performed to examine if there was a statistically significant difference between the male and female students on their responses to the pre-test related to learning fractions using traditional lectures. The results of the test have been presented in **Table 6**.

In the first question, "find the difference $\frac{1}{2} - \frac{3}{8}$," the result (male: mean rank = 27.06, N = 26; female: mean rank = 32.32, N = 33; U = 505.500, Z = 1.669, p = 0.095 > 0.05), showed that the mean rank for female was greater than male, however, this difference was not statistically significant. In the second question, "find the difference between three fifths and one third", the result (male: mean rank = 26.50, N = 26; female: mean rank = 32.76, N = 33; U = 520.000, Z = 1.623, p = 0.10 > 0.05), showed there was no statistically significant difference between the male and female responses.

Likewise, for the third question, "find the difference of $\frac{5}{6} - \frac{1}{3} - \frac{1}{2}$," the result (male: mean rank = 29.87, N = 26; female: mean rank = 30.11, N = 33; U = 432.500, Z = 0.095, p = 0.924 > 0.05), showed that there was no statistically significant difference between male and female responses to the question. Similarly, the last question,

Table 6. Independent-samples Mann-Whitney U test summary for group comparison (gender-pre-test RLec)

	Total N	Mann-Whitney U	Wilcoxon W	Test statistic	Standard error	Standardized test statistic	Male mean rank	Female mean rank	Asymptotic sig. (2-sided test)
Pre5	59	505.500	1066.500	505.500	45.835	1.669	27.060	32.320	0.095
Pre6	59	520.000	1081.000	520.000	56.061	1.623	26.500	32.760	0.105
Pre7	59	432.500	993.500	432.500	36.762	0.095	29.870	30.110	0.924
Pre8	59	451.000	1012.000	451.000	34.343	0.641	29.150	30.670	0.522
PreRLAv	59	563.000	1124.000	563.000	59.882	2.238	24.850	30.060	0.025

Table 7. Independent-samples Mann-Whitney U test summary for group comparison (gender-post-test video)

	Total N	Mann-Whitney U	Wilcoxon W	Test statistic	Standard error	Standardized test statistic	Male mean rank	Female mean rank	Asymptotic sig. (2-sided test)
Post1	59	397.500	958.500	397.50	49.746	-0.633	31.21	29.050	0.527
Post2	59	302.000	863.000	302.00	55.925	-2.271	34.88	26.150	0.023
Post3	59	432.500	993.500	432.50	44.407	0.079	29.87	30.110	0.937
Post4	59	483.500	1044.50	483.50	58.585	0.930	27.90	31.650	0.352
PostVAv	59	356.000	917.000	356.00	63.789	-1.144	32.81	27.790	0.252

"Salem has a container that is filled with $\frac{9}{10}$ of a liter of water for a science experiment. If he pours $\frac{7}{8}$ of a liter of the water, how much water is left," the result (male: mean rank = 29.15, N = 26; female: mean rank = 30.67, N = 33; U = 451.500, Z = 0.641, p = 0.522 > 0.05), indicated there was no statistically significant difference between male and female responses to the question. The results of the average of the four questions related to learning fractions using traditional lectures showed that there was a statistically significant difference between male and female responses (male: mean rank = 24.85, N = 26; female: mean rank = 34.06, N = 33; U = 563.000, Z = 2.238, p = 0.025 < 0.05). Since the mean rank for female is greater than male, then female students seemed to perform better in answering correctly most of these questions compared to the male students (**Table 6**).

Post-test for video

Independent-samples Mann-Whitney U test was performed to examine if there was a significant difference between the male and female students on their responses to the post-test related to learning fractions using videos (**Table 7**). In the first question, "find the sum $\frac{3}{7}+\frac{1}{7}$," (male: mean rank = 31.210, N = 26; female: mean rank = 29.050, N = 33; U = 397.500, Z = -0.633, p = 0.527 > 0.05). Thus, there was no statistically significant difference between the male and female performance in the addition of adding like fraction with common denominator (**Table 7**).

In the second question, "show the sum of three fifths and two fifths by shading the figure and complete the addition sentence. Write the answer in the simplest form if needed", the result (male: mean rank = 34.880, N = 26; female: mean rank = 26.150, N = 33; U = 302.000, Z = -2.271, p = 0.023 < 0.05) (**Table 7**), showed statistically significant difference between the male and female students' responses. Since the mean rank for male is greater than female, then male students performed better in answering the question correctly compared to the female students. For the third question, "find the Sum of $\frac{3}{11}+\frac{1}{11}+\frac{2}{11}$," the result (male: mean rank = 29.870, N = 26; female: mean rank = 30.110, N = 33; U = 432.500, Z = 0.079, p = 0.937 > 0.05) showed that there was no statistically significant difference between male and female responses to the question.

Similarly, the fourth question, "Sara is making a key chain using the bead design as shown in the picture. What fraction of the beads in her design are colored," the result (male: mean rank = 27.900, N = 26; female: mean rank = 31.650, N = 33; U = 483.500, Z = 0.930, p = 0.352 > 0.05) showed that there was no statistically significant difference between male and female responses to the question. The results of the average of the four questions related to learning fractions using video showed that there was no statistically significant difference between male and female responses as a whole (male: mean rank = 32.810, N = 26; female: mean rank = 27.790, N = 33; U = 356.000, Z = -1.144, p = 0.252 > 0.05) (**Table 7**).

Post-test for traditional lecturing

Independent-samples Mann-Whitney U test was performed to examine if there was a significant difference between the male and female students on their responses to the post-test related to learning fractions using traditional lectures (**Table 8**). In the first question, "find the difference 1/2 - 3/8," the result (male: mean rank = 29.370, N = 26; female: mean rank = 30.500, N = 33; U = 445.500, Z = 0.281, p = 0.779) showed no statistically significant difference between the male and female responses.

In the second question, "find the difference between three fifths and one third", the result (male: mean rank = 26.250, N = 26; female: mean rank = 32.950, N = 33; U = 526.500, Z = 2.057, p = 0.040 < 0.05) showed statistically significant difference between the male and female responses. Since the mean rank for female is greater than

Table 8. Independent-samples Mann-Whitney U test summary for group comparison (gender-post-Lec)

	Total N	Mann-Whitney U	Wilcoxon W	Test statistic	Standard error	Standardized test statistic	Male mean rank	Female mean rank	Asymptotic sig. (2-sided test)
Post5	59	445.50	1006.50	445.50	58.667	0.281	29.37	30.50	0.779
Post6	59	526.50	1087.50	526.50	47.390	2.057	26.25	32.95	0.040
Post7	59	373.50	934.50	373.50	59.994	-0.925	32.13	28.32	0.355
Post8	59	410.50	971.50	410.50	59.160	-0.313	30.71	29.44	0.755
PostLAv	59	449.50	1010.50	449.50	64.727	0.317	29.21	30.62	0.751

Table 9. Cohen's *d* value and its effect size: Paired samples test

Paired samples test		Paired differences					t	df	Significance	Paired samples effect sizes
		Mean	Standard deviation	Standard error mean	95% confidence interval of difference				Two-sided p	Standardized Cohen's *d*
					Lower	Upper				
Pair 1	PostVAv-PreRV	0.85000	0.68000	0.09000	0.67000	1.03000	9.610	58.00	0.00	1.251
Pair 2	PostLecAv-PreRLAv	0.85000	0.54000	0.07000	0.71000	0.99000	12.020	58.00	0.00	1.565
Pair 3	PostVAv-PostLecAv	0.31780	0.53906	0.07018	0.17732	0.45828	4.528	58.00	0.00	0.590

male, then female students performed better than the male students in solving this question. For the third question, "find the difference of $\frac{5}{6}$ - $\frac{1}{3}$ - $\frac{1}{2}$," the result (male: mean rank = 32.130, N = 26; female: mean rank = 28.32, N = 33; U = 373.500, Z = -0.925, p = 0.355 > 0.05) showed that there was no statistically significant difference between male and female responses to the question.

Similarly, the last question, "Salem has a container that is filled with $\frac{9}{10}$ of a liter of water for a science experiment. If he pours $\frac{7}{8}$ of a liter of the water, how much water is left," the result (male: mean rank = 30.710, N = 26; female: mean rank = 29.440, N = 33; U = 410.500, Z = -0.313, p = 0.755 > 0.05) indicated that there was no statistically significant difference between male and female responses to the question. The results of the overall average of the four questions related to learning fractions using traditional lectures showed that there was no statistically significant difference between male and female students' performance (male: mean rank = 29.210, N = 26; female: mean rank = 30.620, N = 33; U = 449.5, Z = 0.317, p = 0.751 > 0.05) (**Table 8**).

Comparing Pre-/Post-Tests for Videos and Lecturing

Effect size is a quantitative measure of the magnitude of the experimental effect. The larger the effect size the stronger the relationship between two variables (Cohen, 1988). To calculate the effect size between two groups, subtract the mean of one group from the other and divide the result by the standard deviation of the population from which the groups were sampled:

$$d = \frac{M_1 - M_2}{SD}, \tag{1}$$

where d is the Cohen coefficient, M_1 is the mean of the first group, M_2 is the mean of the second group, and SD is the standard deviation (Goulet-Pelletier & Cousineau, 2018). It is agreed that if the difference between two groups' means is less than 0.2 standard deviations, the difference is negligible, even if it is statistically significant. If the d value is equal to or larger than 0.8, then the effect size is large which means that there is a big change between the two parameters.

The effect size with Cohen's d reflects a significant difference between the pre- and post-test scores (d = 1.251) for students who learned fractions through video, suggesting a considerable improvement in their performance (**Table 9**). Similar results were obtained for students who learned fractions through lecturing, with a large effect size (d = 1.565) observed. Comparing the post-test results of students who learned fractions through videos and lecturing, a smaller effect size (d = 0.595) was observed. The larger effect size for pre- and post-test lecturing than the pre- and post-test video could be due to students' ability to learn better from direct teacher explanations during lecturing than the explanations and demonstrations in the videos. While comparing the effect of videos in learning fractions compared to the lecturing, there is small effect size as the students might have learned a little better in video than in the direct lecturing.

DISCUSSION

The independent-samples Mann-Whitney U test showed no statistically significant difference between the boys' and girls' answers for the pre-test questions related to learning adding like denominator fractions using video. There was statistically significant difference between the male and female responses to the pre-test related to lecturing method on subtracting unlike denominator fractions. The results showed that female students performed better in answering correctly compared to the male students in question related to adding like fractions in lecturing method.

In the post-test, the independent-sample Mann-Whitney U test showed that the males were better in answering the second post-test question related learning fractions using video. However, females performed better than males in the second post-test question related to learning subtracting unlike denominator fractions in the lecture method. The superiority of females in the second post-test is in line with recent trends if gender gap in achievement where consistently girls in general started to outperform boys in mathematics (Alkhateeb, 2010).

Given that the students were exposed to learn fractions using videos and lectures, it was expected that their performance would improve. This can be understood as students' mastery of the subject matter increase after they have learned it. Overall, the success of the students in learning fractions through videos and lectures was clear in different levels, as supported by a wealth of research in the literature. For instance, several studies have found that learning fractions through video helps students achieve a deeper understanding of the subject (Lalian, 2018; Petocz & Wood, 2001; Rachmavita, 2020). Despite advancements in education and the availability of alternative teaching methods, lecturing is still the preferred approach of many teachers and remains the most commonly used method in education (Horgan, 2003; Ní Fhloinn & Fitzmaurice, 2021). The results are consistent with the behaviorism theory, which places a strong emphasis on the teacher as the primary driving force in the education process (Graham, 2019; Handal, 2003).

By computing Cohen's *d* to compare the effect size between the pre- and post-test, it was determined that there is a statistically significant difference between the pre- and post-test. It was observed that there was an improvement in students' performance when learning fractions using videos. Also, the results of the effect size revealed that leaning fractions using videos has better impact on students' progress than learning fractions by lecturing. The findings support the idea that using videos can assist young students in gaining a conceptual understanding of fractions addition and subtraction. This aligns with previous research which suggests that visual aids, such as pictorial representations, are beneficial in facilitating students' conceptual knowledge of mathematical concepts that may seem abstract or confusing (Miller & Hudson, 2007). The findings support the constructivist theory that students learn more when they use their senses in learning through doing and working in teams, develop their strategies, and correct their errors or misconceptions in fraction operations (Cherry, 2020; Kerslake, 1986; Klinger, 2009; Piaget, 1977). The theory of social constructivism further suggests that knowledge is formed through social interactions (Kalina & Powell, 2009). In accordance with these principles, constructivist teaching focuses on active learning experiences, allowing students to develop their understanding of concepts through hands-on experiences, personal engagement with the learning tasks, creating their own meanings, and engaging with ideas (Ernest, 2010).

The results of an independent-samples Mann-Whitney U Test indicated that there was no significant gender-based disparity between males and females in their responses to lecturing during the pre-test. However, for the pre-test on videos, there was a significant difference between the responses of males and females in question 1 and the average of the four questions. This indicates that prior to the experiment, there was no gender-based disparity with respect to lecturing. However, after the experiment, males outperformed females on one question regarding videos. But females performed better than males in the second post-test question related to learning subtracting unlike denominator fractions using lectures. The findings rejected hypothesis of gender that were not in accordance with the conclusion reached by Hallett et al. (2010), who found no gender difference in fraction learning. These results also contradict with the results of Geary et al. (2021), Hasemann (1981), and Mendiburo and Hasselbring (2014), who found that males outperformed females in fraction learning using lectures. Nevertheless, the findings are in line with those reported by AlKhateeb (2010) and Ross et al. (2012) who reported better performance of females using lectures has led to closing the traditional gap in favor of boys.

The current study emphasized the importance of varying in teaching methods in mathematics, mainly fractions because fractions is considered one of the most challenging topics for both students and teachers (Pantziara & Philippou, 2012). Lalian (2018) asserted teaching mathematics using videos improves students' motivation to learn and hence improves their attitudes toward learning mathematics. In general, using technology as a teaching method develops the innovation skills for the students (Kramarenko et al., 2019). Using educational technology, such as videos in the classroom, helps and benefits learning as recent meta-analyses support and construction of meaning with deeper interpretations (Golden, 2018; Kocaoglu 2010, Reinhold et al., 2020).

Implications

The findings of the current study highlight the significant role technology can play in the teaching and learning of mathematics. Specifically, the study demonstrated that incorporating videos as a teaching strategy for fractions can positively impact student achievement. Using videos allows for dynamic and engaging presentations of mathematical concepts, which can cater to diverse learning styles and needs. Visual and auditory elements in videos can help clarify abstract ideas, making them more accessible and easier to understand. Thus, the implications of this study enhance the use of teaching strategies, give the students the ability of self-study through using pause, replay, and review video, teachers may attend professional development in how effectively use videos in teaching and learning, educators can develop the curriculum to include videos as one resource for teaching mathematics, and using videos has positive impact on students' engagement in the learning process.

CONCLUSION, LIMITATIONS, AND RECOMMENDATIONS

The findings of this study indicate that utilizing videos as a teaching tool for fractions can have several benefits for students. One significant advantage is an improvement in their overall understanding and performance in fractions, which can lead to a positive shift in their attitudes toward learning not just fractions, but also mathematics in general. To optimize the effectiveness of educational videos, it is crucial for teachers to carefully select videos that align with their specific lesson objectives. These videos should be interactive and designed to encourage collaborative learning among students. Additionally, incorporating colorful and visually appealing illustrations such as figures, graphs, and tables can enhance student engagement. By meeting these criteria, videos can foster a more dynamic and engaging learning experience that goes beyond a simple lecture format and facilitates active communication between students and the educational content.

The study was limited to four schools in Abu Dhabi Emirate and may not be generalized to the other schools at the same Emirate and the rest of the Emirates. Other limitation was the number of the participants was 59 students from grade five which is considered a small sample that limited the generalization of the results (Singer & Strasser, 2017). A third limitation was there was only one school followed the American curriculum and the other three schools followed the Ministry of Education knowing that there were many schools in the UAE that followed different curricula such as British, Indian, Pakistani, Filipina, etc. Including these schools may enrich the study and give a clearer picture of students' achievement in learning fractions with different teaching methods, such as videos and traditional lecturing. A fourth limitation was the number of periods used for teaching students fraction addition and subtraction using videos and traditional lecturing was limited two periods for each method. The same groups pre- and post-test experimental design was used due to difficulty in creating equivalent control and experimental groups for the study.

Teaching fractions is considered one of the most challenging topics in mathematics and students forgot what they have learned about fractions once they finished the final exams. After conducting this study, we recommend some important points for teachers, educational leaders, and policy makers. First, it is essential for the teachers to have regular training to refresh, update, and gain new information about the subject knowledge, strategies of teaching, and the using of technology, such as videos, in teaching. As mentioned in many previous theories such as constructivism, sociocultural theory, and transformative learning theory, the role of the student in the learning process should be active; students have to lead their learning and the teacher should be innovative in choosing the best method of teaching to engage all the students. Teaching of fractions could be fun and enjoyable journey if the teachers didn't take it as a burden. The first step for teaching fractions is planning and planning starts from assessing the students' missed information that they can't understand fractions without mastering this information such as operations with whole numbers, place value, and comparing and ordering numbers. Future studies should be conducted with larger samples with separate control and experimental groups of students to examine the effects of different methods of teaching mathematics in general and fraction operations in particular as it is critical for learning all other mathematics contents.

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