A study on the basic Arithmetic ability of students studying Basic Math without using a Calculator

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Introduction

The purpose of the study is to investigate whether the students of Basic Math require intervention on basic arithmetic skills without using a calculator.

This investigation is inevitable due to the firm implementation of GFP guidelines.

A revised assessment rubrics issued by the GFP committee was implemented during the summer semester of the academic year 2017-18. The strict compliance of the GFP committee's instructions was also implemented along with the assessment rubrics. One of the instructions is denying the usage of the calculator in the basic math course.

The final result analysis of summer semester showed a significant increase in the failure rate. After inspection, it has been found that one of the reasons is due to the denial of the calculator. In schools, the students are allowed to use calculators from grade 8 until grade 12. After joining the technical college, the sudden denial of the calculator affects their performance in basic arithmetic. To quantify the number of students suffering from the understanding of basic arithmetic, it has been decided to conduct this action research.

This study has been conducted on the Foundation Level 2 students of Nizwa College of Technology. NCT is one of the premier technological institutions under the Ministry of Manpower in the Sultanate of Oman. It is a silver jubilee institution, producing more than 1000 employable graduates every year.

In NCT, there are approximately 4000 students studying in different specializations and different levels. Students in Foundation level will acquire skills in English, IT and Math. In Foundation there are four levels. In level 2, the students will study Basic Math and in Level 3 Applied Math or Pure Math as per their specialization. In any given semester approximately there are 1200 - 1500 students in Foundation level. There used to be approximately 400 – 600 students studying in Foundation Level 2. This study was conducted among those Level 2 students to test their basic arithmetic ability without using a calculator.

Review of the Literature

No research has been done on this context of this kind before. The students' academic performance data of the past two semesters in the Academic Year 2017-18 were taken for comparing with Semester 3 data. It has been found that the Semester 3 result was significantly declined compared to Semester 1 and Semester 2 results in which the students were allowed to use calculators. All the possible reasons were listed down for the cause of low results in Semester 3, where sudden denial of the calculator was one of the reasons.

Methodology

A detailed proposal has been submitted to the NCT research committee for approval and got approved. [Annexure – 0]

This study has been conducted in two phases. In both the phases, students were asked to answer a worksheet (without using a calculator) to test their ability in basic arithmetic.

-Integer Arithmetic

- Decimal Arithmetic

- Negative property

-Fraction addition and subtraction

Students answered the worksheet before intervention in phase I, whereas they answered the worksheet after intervention in phase II.

During phase I, an induction was given to the Basic Math teachers to get know the importance of this research. Feedback on the worksheet questions [Annexure-1] was obtained and the suggested modifications were made.

The marking rubrics, updated worksheet and schedule for Phase I study were disseminated to all the teachers of Basic Math course through official Email [Annexure – 2].

The phase I study was scheduled for the last 20 minutes of two hours lecture on a selected day. This was planned during week 3 of semester 1 AY 2018-19, before their regular course assessment (Test – 1).

As guided, the teachers explained the importance of this study to the students in the first 5 minutes and next 15 minutes the students were allowed to answer the worksheet. The evidence was photographed. [Annexure – 3 & 4]

The answers were evaluated according to the rubrics and marks entered in the excel sheet by the Basic Math course teachers. [Annexure – 5]

The answer scripts were collected and secured as evidence. [Annexure – 6]

Thorough analysis has been done on the data collected.

The Phase I results were shared to all teachers of Math section through a presentation.

It has been learned from the results of phase I, an interventional workshop is inevitable to conduct on basic arithmetic skills.

During Phase II, Marking rubrics for the worksheet questions, Lesson Plan for the workshop and updated worksheet questions were disseminated to the teachers through an official Email. [Annexure – 7(a), 7(b), 7(c)]

The interventional workshop was scheduled for a last 30 minutes of two hours lecture on a selected day. This was planned during week 7 of semester 1 AY 2018-19, before their regular course assessment (Final Exam).

As guided, the teachers explained the questions and answers given in the lesson plan. The students were given with the worksheet to answer after tutoring. The evidence was photographed.

[Annexure–8 & 9]The rest of the steps of Phase I were repeated until the analysis stage. [Annexure – 10 & 11]

Marks obtained after conducting the test among Basic Math students on basic arithmetic skills without using a calculator were listed in excel sheet group wise and question wise. As a first step, the Data Cleaning was done. The absence students and suspended students were removed from the list during phase I & II approaches. The cleaned data were classified into group wise, question wise and gender wise both in phase I and phase II.

Independently phase I and phase II data were analyzed and diagrammatically compared using a double bar graph.

To test the impact created by the intervention workshop on Basic Math Student's arithmetic ability without using a calculator paired t-test statistic was used.

Group-wise means performance before and after the intervention of all Basic Math groups (19) were taken as a sample for paired t-test.

The entire data collection on both the phases was performed with at most care and transparency.

This study was conducted on the entire population for maximum accuracy. (All students studying Basic Method)

This study was conducted during 12 weeks of semester 1 of Academic Year 2018-19.

Results and Conclusion

Results of the analysis are shown below:

No. of Students:366	Over All Students Answered Correctly			
Questions	Total		Female	Male
Q1.Integer Addition	285	77.87%	127	158
Q2.Integer Multiplication	200	54.64%	105	95
Q3.Negative Property	122	33.33%	67	55
Q4.Fraction Addition	207	56.56%	121	86
Q5.Decimal Addition	138	37.70%	65	73
Q6.Decimal Multiplication	149	40.71%	77	72
Q7.Negative Property	114	31.15%	64	50
Q8.Fraction Subtraction	189	51.64%	125	64
All Correct	18		11	7

Table 1: Phase I (Question wise Analysis)

No. of Students: 349	Over All Students Answered Correctly			
Questions	Total		Female	Male
Q1.Integer Addition	307	87.97%	144	163
Q2.Integer Multiplication	260	74.50%	133	127
Q3.Negative Property	257	73.64%	127	130
Q4.Fraction Addition	283	81.09%	146	137
Q5.Decimal Addition	242	69.34%	122	120
Q6.Decimal Multiplication	217	62.18%	113	104
Q7.Negative Property	263	75.36%	125	138
Q8.Fraction Subtraction	253	72.49%	137	116
All Correct	58	16.62%	50	8

Table 2: Phase II (Question wise Analysis)

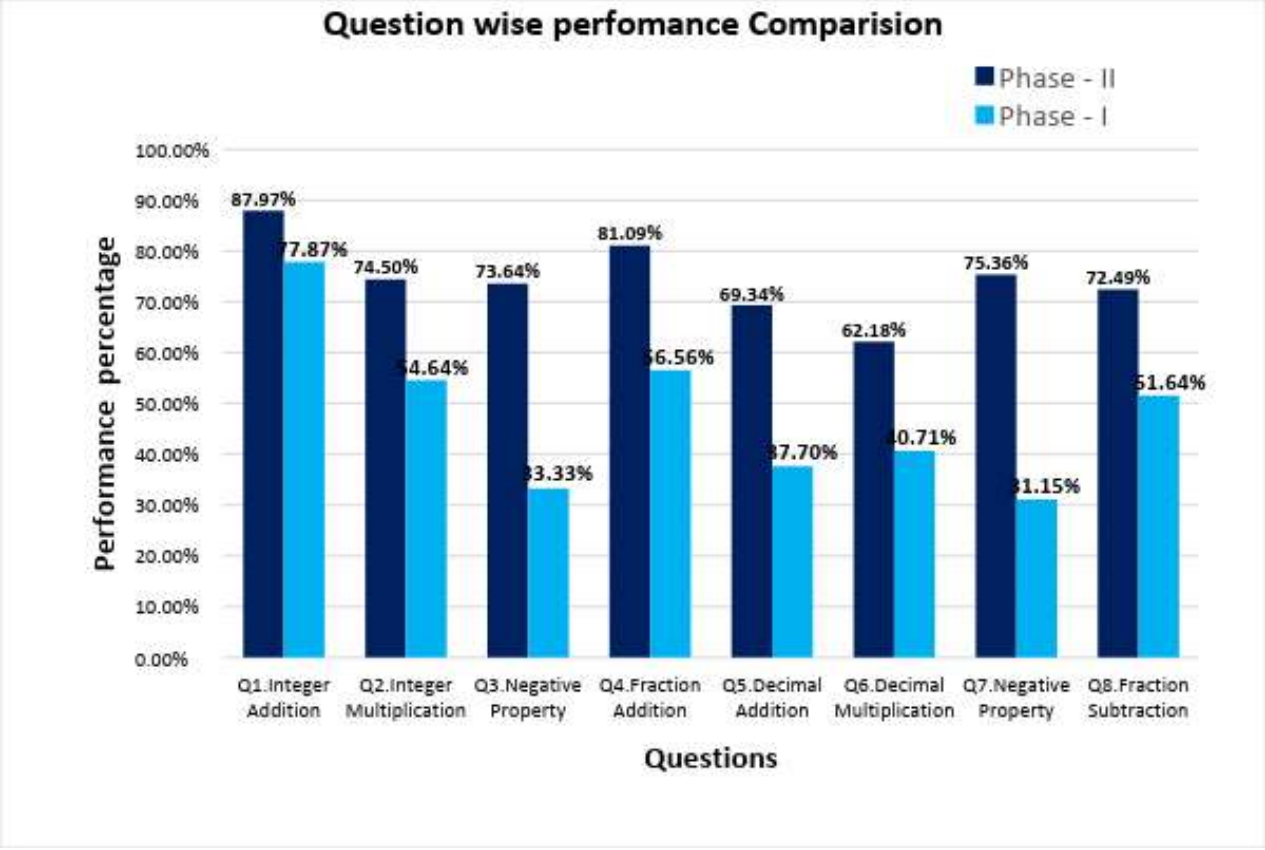

Fig.1 Question wise performance comparison analysis of phase I and phase II

It is obvious from the bar graph depicted in figure 1 that the performance after the interventional workshop helps the students to improve their basic arithmetic skills without using a calculator.

Groups	Group Average	Average (%)
E1	4.82	60.29%
E2	4.05	50.66%
E3	3.95	49.40%
E4	3.88	48.53%
E5	5.18	64.71%
E6	4.06	50.69%
E7	4.00	50.00%
E8	5.00	62.50%
E9	2.40	30.00%
E10	2.86	35.71%
E11	4.21	52.63%
I1	2.63	32.89%
I2	3.73	46.67%
I3	4.12	51.44%
I4	2.94	36.81%
I5	4.50	56.25%
I6	3.53	44.08%
I7	4.14	51.79%
I8	3.16	39.47%
Over All	3.84	48.05%

Table 3: Phase I (Group-wise Analysis)

Groups	Group Average	Average (%)
E1	6.38	79.69%
E2	5.53	69.08%
E3	6.57	82.14%
E4	6.62	82.74%
E5	6.00	75.00%
E6	6.33	79.17%
E7	6.36	79.46%
E8	6.37	79.61%
E9	5.67	70.83%
E10	6.39	79.86%
E11	5.95	74.34%
I1	5.72	71.53%
I2	4.78	59.72%
I3	5.63	70.31%
I4	6.18	77.21%
I5	6.05	75.63%
I6	5.82	72.79%
I7	5.67	70.83%
I8	5.39	67.36%
Over All	5.97	74.57%

Table 4: Phase II (Group-wise Analysis)

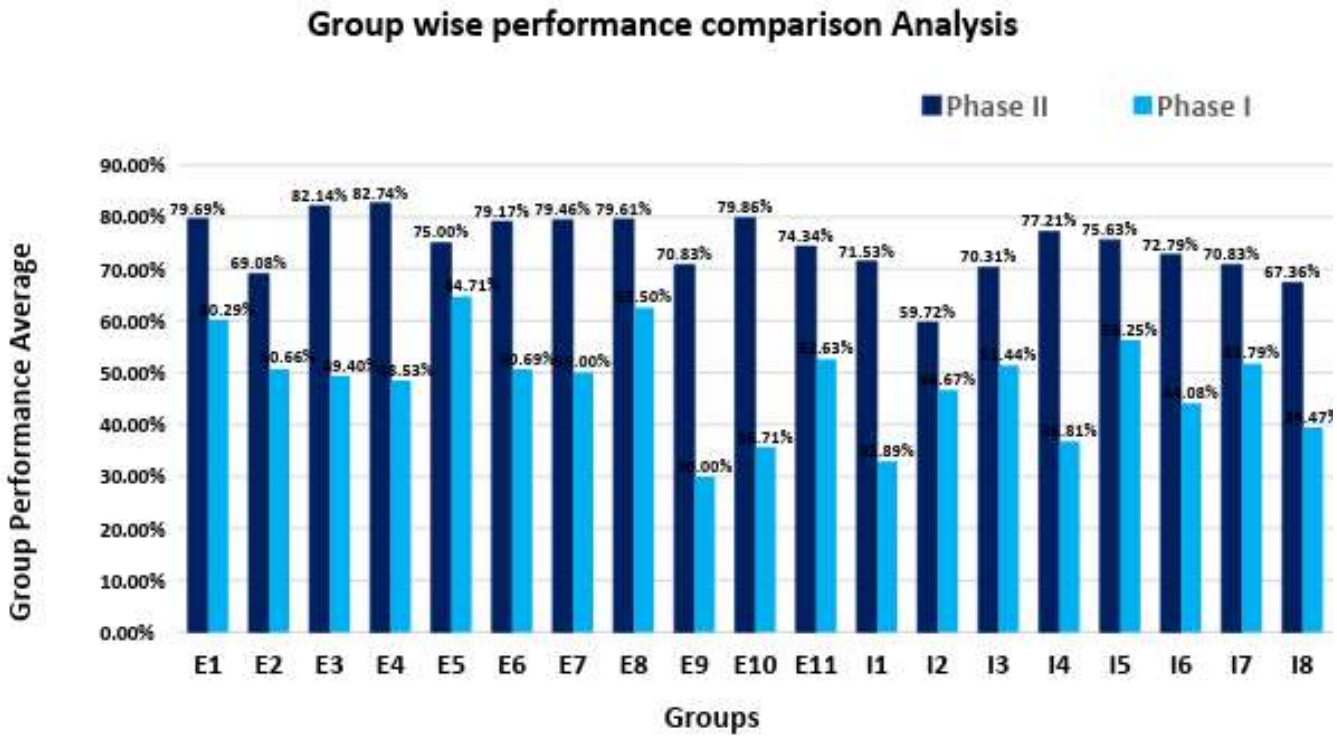

Fig.2: Group wise performance comparison analysis of phase I and phase II

It is obvious from the bar graph depicted in figure 2 that the performance after the interventional workshop helps the individual groups of students to improve their basic arithmetic skills without using a calculator.

As we want to determine whether the basic arithmetic skills without using a calculator before and after the interventional workshop are the same or different. In this approach, we have taken 19 groups of basic math students' basic arithmetic skills without using a calculator, before giving a review workshop, and then, the skill test results of the same set of students were recorded after the workshop and compared the results. Since the sampled groups were the same for before and after the workshop, paired T-test statistics has been chosen for the study.

Paired T-test confidence Interval: Before the intervention, After the intervention

Sample	N	Mean	StDev	SE Mean
Before Intervention	19	3.851	0.776	0.178
After Intervention	19	5.969	0.468	0.107

Estimation for Paired Difference

Mean	StDev	SE Mean	95% CI for μ_difference
-2.118	0.802	0.184	(-2.505, -1.732)

μ_difference: mean of (Before Intervention - After Intervention)

Test

Null hypothesis	H_0: μ_difference = 0
Alternative hypothesis	H_1: μ_difference ≠ 0

T-Value	P-Value
-11.52	0.000

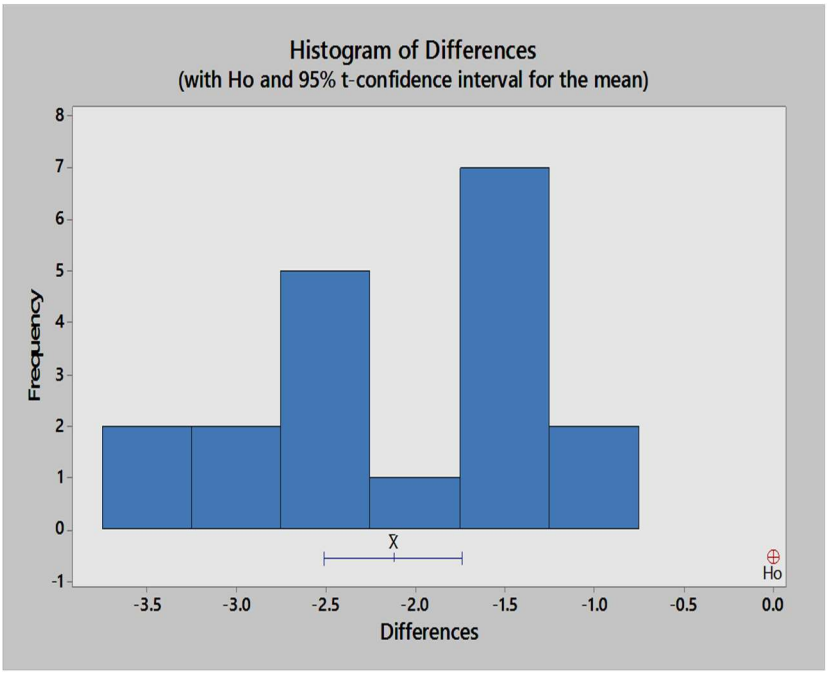

Fig.3: Histogram of differences

Fig.4: Deviation between the mean of means of Phase I and Phase II

From the paired T-test results, it is learned that the interventional workshop has created a significant impact on the Basic Arithmetic skills without using a calculator.

Implications and Recommendations

The phase I and phase II analysis brought out the following findings:

Phase I (Before Interventional Workshop)	**Phase II (After Interventional Workshop)**
Question wise analysis	
▪ Worst performed questions (<50% Students answered correctly) ▪ Q3, Q7-Negative property ▪ Q5-Decimal addition ▪ Q6-Decimal multiplication ▪ Questions with <60% ▪ All questions except Q1	All questions were answered correctly by more than 60% of the students
Group-wise analysis	
▪ Groups obtained >= 50% ▪ E1, E2, E5, E6, E7, E8, E11, I3, I5, I7 ▪ Groups obtained <50% ▪ E3, E4, E9, E10, I1, I4, I6, I8	▪ All Groups obtained >=60% ▪ Except 2 groups all groups scored more than 70%
Gender wise analysis	
▪ Female students performed better than male students in most of the questions. ▪ Overall Average is 3.8 out of 8	▪ Female students and Male students performed equally well in all the questions. ▪ Overall Average is 5.96 out of 8
Overall Results	
18 students obtained 8 from 8 points	58 students obtained 8 from 8 points

From this study, it has been concluded that the students of Basic Math course have to be given adequate review in the form of a workshop on "Basic Arithmetic Skills without using a calculator" at the first week of every semester. This will create a significant impact on their academic performance.