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A Study To Investigate The Effectiveness Of The Performance Lag Address Programme In Improving Students' Performance In Mathematics: A Case Study Of Students At Mutare Girls' High School In Zimbabwe

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Abstract: *In this study the effectiveness of the Performance Lag Address Programme which has been initially launched at Mutare Girls' High School in Zimbabwe is investigated. The period of study covered the practical teaching two terms from Term 3; 2012 to Term 1; 2013. Descriptive and inferential statistical methods were used to analyse the data. Performance Lag Address Programme level comparisons for the subgroups within each level were done as well as the combined effect for each level. The overall Performance Lag Address Programme was also analysed. It was found out that the programme is generally effective in enhancing pupils' understanding of the basic mathematical concepts. The research also revealed that the programme is mainly effective when dealing with the most challenged pupils.*

Keywords: *Performance Lag Address Programme, Pupils, Performance*

I. Introduction

Performance Lag Address Programme, PLAP, is a form of remediation since it seeks ways of improving students' performance. Remediation is defined as anything that serves to cure defects or improve conditions. Two differences between the normal remediation procedure and the PLAP exercise were noted. Firstly the usual remediation procedure works on the students' weakness within the students' level of study. As for PLAP students' weaknesses are believed to have cropped up from concepts missed at lower levels thus affecting their present performance. The teacher has to address these problems to ensure that the students build on them so as to catch up with their present level. Secondly, under the usual remediation, a one-to-one situation is expected between teacher and the student whereas for PLAP the students are handled as a class with commonly identified challenges. The aim of this study is to establish the extent to which the PLAP exercise, as a performance instrument, improves pupil's performance in mathematics.

The objectives of this study are:

1. To determine the trends of performance of students before and after PLAP lessons for each level.
2. To determine if there is any change in each level subgroups before and after PLAP lessons.
3. To determine the overall PLAP effectiveness for the combined PLAP levels.

In this study the null and alternative hypotheses are stated below:

H_0: PLAP lessons are not effective in improving students' performance in Mathematics, against

H_1: PLAP lessons are effective in improving students' performance in Mathematics.

The assumptions of the study are:

1. The students involved in the PLAP study are those who had continuous PLAP records for continuous assessment.
2. The students for each level attend all lessons.
3. Only students with low ability need to be remediated.
4. Poor performance in students' current levels is a result of achievement gaps experienced at lower levels and all other factors are held constant.

II. Literature Review

2.1 Remediation linked to the Performance Lag Address Programme

Effective Mathematics teaching and learning is characterised by continuous assessment of the students. The learning process is incomplete if the testing component is absent. It is from the results of these tests that the teacher then decides on the individual needs of his or her students. In summary, the teacher goes a step further in identifying the students' areas of weaknesses and find corrective measures so that those affected catch up with the rest of the class. This is now where remediation comes in. Several researchers have revealed controversy to a greater extent on the aspects of remediation at secondary level. With specific reference to the PLAP, this is a form of remediation where students are believed to have been affected at lower levels where they have

missed important concepts which affect their present performance. The research is therefore focusing on finding out if this form of remediation is effective in improving students' performance in Mathematics at secondary level.

Wheeler in [1] noted that the identification of the appropriate pupils for remediation is a difficult activity. He proceeded on to say that it depends on the physical condition in the classroom, the pupils' motivation to learn, the skill and insight of the teacher. This suggests that choice of remediating pupils mainly depends on the mathematical concept to be taught. This is where PLAP comes in as a form of remediation. Its basis is that any mathematical concept taught or developed at a higher level should have been soundly taught at the lower level and fully understood by the learner such that it will not give him or her application problems

2.2 Who should be remediated?

[2] says, "It is consistent with democratic philosophy that all children be given opportunity to learn whether they are average, bright, dull, retarded, blind, deaf, crippled, delinquent, emotionally disturbed or otherwise limited or deviant in other capacities to learn." It is however difficult to give all children the opportunity to learn like some authorities went on at length to define who needs extra assistance (the exceptional child) and the type of assistance which should be given. The arising question now will be who is the exceptional child? [3] defined an exceptional child as that child who deviates from the average child in mental characteristics, sensory abilities, neuromuscular or physical characteristics, social or emotional behaviour and communication to such an extent that a modification of school practice is needed in order to develop the child to his or her maximum capacity. The exceptional child may also be a child with exceptional talent. According to [2], 'An educational exceptional child makes it necessary to alter the educational programmes to meet his or her own needs. For purposes of clarity, there is a fine line between the exceptional child and those whose defects can be corrected by medical treatment or corrective devices. Children whose defects can be corrected through medical treatment or corrective devices are not regarded as exceptional since with corrective devices they are considered normal. Considering the above arguments, we can conclude that at the end of the day, those students with academic challenges are the ones who fall for remediation. This tallies well with the PLAP where all students are initially given the same pre-test and those who fail in accordance with their present form are the ones who are to be included into the programme. The students are taught lower level concepts as compared with their current form so as to create a sound background to build up on the mathematical concepts in their present level. In support of [2], [4] also says remedial education aims to help the pupil who is failing. [4] further says that, 'remedial', semantically suggests a type of teaching which rectifies some deficiency or puts things right. Such a corrective function of remedial teaching is clearly different from what the ordinary classroom aims at. This also supports the statement previously highlighted on the PLAP principles which focus on the foundation skills so as to understand the present concept. As a working strategy, under PLAP the students are grouped according to their capability levels as revealed by the marks for the pre-test. This will ensure that those who have common difficulties will be assisted together. [5] says that not all children who have fallen behind with their work need a special educational approach. Where the child remains willing and able to learn, systematic coaching may well meet the case. This reveals that for remediation to be effective, it both requires good interconnection between the remediator and the remediated. Giving a close look at the PLAP, students with commonly identified deficiencies regardless of their present level at secondary level are grouped together. This might bring about labelling especially to those in higher secondary levels hence become unwilling to be mixed with those in lower secondary levels. Though there will be a strong need to address their achievement gap, they might feel inferior, downgraded and become unwilling to cooperate within the group. At the end, the essence of the whole process will be defeated. Unless the student remains willing, the remediation process will not bear positive results. There is a saying which states that you can take a donkey to the river but you cannot force it to drink the water. This clarifies the scenario that the teachers will have done their task of identifying the students' academic challenges, make plans to help them and instead the student might lack interest in the exercise.

2.3 Diagnosis of Learning Difficulties in Pupils

[6] defined diagnosis as a process of identifying the causes of a particular unacceptable trend in pupils. Relating this to the PLAP, the instrument used is the common pre-test for all forms. It consists of different categories which start from the very basic concepts of simple addition and subtraction, for example 2 +7; 36 - 5. The concepts are gradually developed to include topics like factorisation, simultaneous equations and logarithms. This is taken as a way of trying to identify basic concepts missed at lower levels which will affect the pupils' current performance in their present form.

In line with this, [2] presented what he calls psycho-educational diagnostic procedures which can be employed by an educational practitioner in identifying difficulties in pupils. These are explained as follows:

Stage 1: This involves determining whether the child's learning problem is specific or generally serious for instance, carrying out an intelligence quotient test to determine the capacity expected to read.
Stage 2: Behaviour manifestation which is analysed as descriptive of the specific problem. It involves analysing how a child does in the subject, speed, faulty habits in computation and the type of concepts they confuse.
Stage 3: This involves discovering the physical environment and psychological correlates of the disability. In this context there are many reasons why a child may fail to master a concept. Amongst the causes may be poor attendance, unstable home background, cultural deprivation or brain damage.
Stage 4: This involves a diagnostic inference on the basis of the behavior manifestation and correlates. It involves specifying the relationship between the symptoms and the correlates that have been inhibiting a child's learning.
Stage 5: Challenges the investigator to organise a systematic remedial programme based on the diagnostic inferences (hypothesis) made. In addition [2] also highlights on some of the factors which cause learning difficulties within the child's environment. These were cited as physical factors which act as correlates. The physical correlates were explained as visual defects, confused spatial orientation and undernourishment. The environmental correlates are explained as traumatic experiences, conditional avoidance reaction, undue family pressure, sensory deprivation and lack of early school experience. The psychological factors were also given as poor auditory perception, slow understanding and interpretation of concepts, poor organising ability, inability to express concepts vocally or manually and defective short term memory.

Combining the two above authorities we can conclude that pupils' learning difficulties are a result of a combination of emotional, social, physiological and intellectual factors. However in slight contrast to the PLAP exercise, all the other factors are considered to be recessive and dominated by lack of untaught lower level concepts hence creating the achievement gaps in conjunction with the present level of operation. As a follow up to [2] diagnostic procedures under stage 1, instead of the intelligence quotient test in search for reading capacity, this idea is replaced by the pre-test used to detect the pupils' points of last success as once previously indicated. This is not on the surface reading capacity but the magnitude of the missed concepts. Focusing on Stage 3, among the causes has been expressed poor attendance. This explains well the basic motive behind the introduction of the PLAP. Poor attendance has arisen as a response of the teachers to the country's past economic hardships in the period 2006 to 2008. This cause was automatic in simple terms. Failure of teacher to be in class implied no learning for pupils, this indirectly lead to pupils not attending school. Marrying this with [2]'s prior argument, he also cited lack of early school experience under the environmental correlates. Pupils missed classes due to teacher absence leading them to lack the required basic experience in terms of the previous knowledge needed in order to develop a certain concept at higher level. This now provokes for a comprehensive analysis of the challenges the pupils and the teaching - learning process face and the potential of the pupils to the maximum extent possible.

Under stage 4, a hypothesis has to be made. Getting along with PLAP, it is believed that pupils' performance has been deeply affected by automatic promotion without actually considering how much they have understood in the previous grade or form. This is referred to as the pupil's last point of success, hence the mission for closing the achievement gap. This programme tries to focus on what exactly the pupil might have failed to come across in her previous educational encounter. For example, if a Form 3 pupil falls under PLAP Grade 7, thus Level 1, he or she will be entitled to have missed some Grade 7 concepts and this is what the PLAP teacher will have to focus on. As for the remedial programme under [2]'s stages, after identifying the achievement gap, the teacher is required to establish the level of performance of each child. According to the PLAP this exercise involves the grading approach as once highlighted. This determines the depth of a topic content which will be taught to the respective groups.

2.4 Effects of Remedial Education

[4] says, 'Remedial education aims to help the pupil who is failing. It is richly rewarding to the committed teacher but makes great demands on him'. In line with this, Williams in [4] also states that remedial treatment depends ultimately upon the ability to produce individual solutions to individual difficulties. He brings about different sorts of outcomes of remedial teaching as listed below: Progress of pupils performing below capacity is speeded up as a result of special attention that 'after one or two terms' they will be fit to join other pupils according to their expected capacity. This suits very well onto the PLAP strategies. It is believed that if the exercise is carried out effectively the pupils will be able to reveal their strength(s) within two school terms. Maturation plays a role in the performance improvement both during remedial teaching and during ordinary school teaching. Pupils make initial gains but do not maintain it if teachers do not take appropriate follow up action which is consistent. For an effective programme a time table is set which has to be consistently followed such that the pupils do not lose faith in it. This will also positively motivate them when they discover that the programme is fully monitored and is really meant for their progress.

III. Materials and Methods

3.1 Research design

Numerical data was collected from the three PLAP levels at Mutare Girls' High in Zimbabwe for the period 2012, Term 2 to 2013, Term 1. Both primary and secondary data were collected. Primary data involved the use of questionnaires which were distributed to mathematics teachers involved in the PLAP teaching Secondary data included lists of pupils in the PLAP collected from the prepared lists for each teacher. The data included also the pupils' end of term marks for Term 2; 2012 and Term 1; 2013. These marks were obtained from the end of term mark sheets.

3.2 Population and Sampling Procedures

The population for the study consisted of Mathematics teachers at Mutare Girls' High School. The population was so defined since these were in direct contact with the day to day teaching, learning and remediation of the pupils at the school. The sample for the study included mathematics teachers at the school and Forms 1, 2 and 3 pupils under PLAP. Working according to the PLAP expectations, all the Form Ones, Twos and Threes were given a common Mathematics pre-test given in Appendix 1. The marks obtained were then used to determine the PLAP grade in which the pupils would be classified into, as highlighted in Appendix 2. Those in the PLAP Grade7 and below constituted Level 1 if presently in any form. Grade 8 constituted Level 2 for those currently in Forms Two and Three and lastly Grade 9 being Level 3 for those currently in Form Three since they would be operating below their present form. Fifteen pupils were selected from each level using the systematic random sampling approach. By calculating the interval ratio, the first pupil to be selected from the list was chosen by randomly selecting any number between 0 and the obtained interval ratio to determine the first position. Using the interval ratio the next position was obtained by the taking the next interval position successively. A total of forty five students were used. Mathematics teachers directly conducting the PLAP lessons were automatically included in the study. The teacher sample involved only the three teachers since each level was attached to a single teacher for the period studied.

3.3 Research Instruments

In this research, documents from the school records were used. The PLAP pre-test results, Term 2 2012 midyear and end of Term 1 2013 marks were obtained from the documents. Questionnaires were used in the research. Information on knowledge on how PLAP lessons are conducted and their effectiveness on pupils' performance was obtained through the use of questionnaires.

3.4 Method

Paired tests

Paired tests are carried out on dependant paired samples. Two data samples are collected from the same source. This linked well with the researcher's procedures where the researcher obtained for each pupil in the sample, the mark before and after PLAP lessons. This approach discussed in [6] eliminates the effect of individuals included in the sample. [6] also says "we can greatly improve precision by making comparisons as within pairs or paired samples of experimental units." The statistical model is given as:

$$y_{ij} = \mu_i + \beta_j + e_{ij} \tag{1}$$

where y_{ij} is the response variable and β_j is the effect of the independent factor due to the j^{th} experimental units. μ_i is the true mean and e_{ij} is the random error with mean zero and variance σ^2 .

The paired differences' d ' are calculated as:

$$d = X_i - Y_i \tag{2}$$

where i =1, 2, 3...n, X_i is the mark before and Y_i is the mark after, which is treated as a single random sample. [6] defined the parameters as given below:

(i) $\mu_d = E[d]$ is the population mean

(ii) S_d is the standard deviation of the paired differences,

(iii) $\overline{d}$ is the mean of the paired differences

The hypotheses to be tested can be one of the following:

1. $H_0 : \mu_{\mathbf{d}} = 0$ *vs* $H_1 : \mu_d \neq 0$
2. $H_0 : \mu_{\mathbf{d}} = 0$ *vs* $H_1 : \mu_d > 0$
3. $H_0 : \mu_{\mathbf{d}} = 0$ *vs* $H_1 : \mu_d < 0$

The test statistic: $T_0 = \dfrac{\bar{d} - \mu_{\mathbf{d}}}{\dfrac{s_{\mathbf{d}}}{\sqrt{n}}}$ (3)

The paired t-tests rejection criteria for testing the hypotheses are as shown in Table 1 below:

Table 1: Rejection Criteria

Hypotheses to be tested	Reject Ho if :
$H_0 : \mu_d = 0$ vs. $H_1 : \mu_d = 0$	$\lvert T_0 \rvert > t_{n-1}^{\frac{\alpha}{2}}$
$H_0 : \mu_d = 0$ vs. $H_1 : \mu_d > 0$	$T_0 > t_{n-1}^{\alpha}$
$H_0 : \mu_d = 0$ vs. $H_1 : \mu_d < 0$	$T_0 < -t_{n-1}^{\alpha}$

The researchers are going to use the hypotheses as given in 3 and the related testing procedure. This is because the main aim of the research as stated in objective 1 is to determine the effectiveness of PLAP lessons in improving pupils' performance. This implies that if there is an improvement in the marks then in general we expect higher marks for results after the PLAP lessons; hence μ_1 for mean mark before should be less than μ_2 for mean mark after the PLAP lessons.

IV. Results

Microsoft Excel and SPSS statistical package were used to analyse the data.

4.1 PLAP Level

Table 4.1: 2012, Term 2 marks (X) and 2013, Term 1 marks (Y) for PLAP Level 1

Number	Marks Before (X)	Marks After (Y)
A1	8	6
A2	11	25
A3	17	25
A4	34	51
A5	10	23
A6	22	30
A7	19	34
A8	8	15
A9	25	18
A10	19	14
A11	25	25
A12	34	27
A13	28	42
A14	27	38
A15	26	35

Using the results from Table 4.1, a line graph was produced as shown in Figure 4.1.

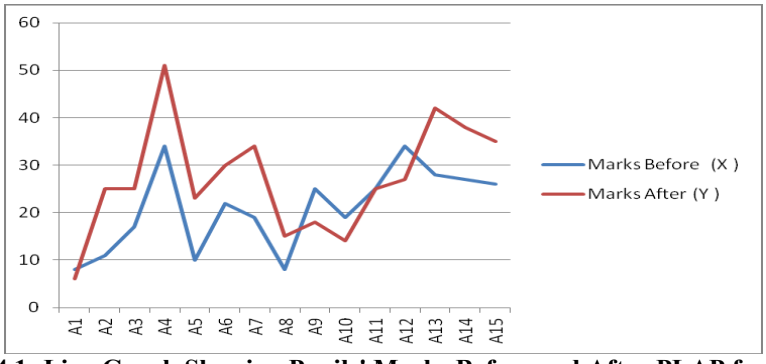

Figure 4.1: Line Graph Showing Pupils' Marks Before and After PLAP for Level 2

From Figure 4.1, it can be seen that for most pupils, the marks after floated above the marks before the programme. Basing on this, we can deduce that in general the pupils' marks increased after delivery of PLAP lessons.

From Table 4.1, the pupils' marks were subdivided into two subgroups using the mean mark of 20. 8667 for the marks before the PLAP exercise. The marks above and below the mean value were classified as subgroup 1 and subgroup 2 respectively. Table 4.2 shows the marks of pupils who obtained marks below the mean mark (Level 1, subgroup 1).

Table 4.2: Marks for Pupils in PLAP Level 1, Subgroup 1

Before PLAP (X)	After PLAP (Y)
8	6
11	25
17	31
10	23
19	34
8	15
19	14
Mean = 13.1429	mean = 21.1429

Comparing the means, 21.1429 is greater than 13.1429 suggesting a general increase in the marks. Using these marks the researchers performed a paired t-test. Table 4.3 gives a summary of the results produced.

Table 4.3: Paired Samples T - Test for PLAP Level 1, subgroup 1

difference	lower bound	upper bound	T	d.f
before- after	-15.70088	-0.29912	-2.542	6

A 95% confidence interval t - test on the following hypotheses was carried out:

$H_0 : \mu_1 - \mu_2 = 0$ (there is no improvement in pupils' performance) vs.

$H_1 : \mu_1 - \mu_2 < 0$ (there is improvement in pupils' performance)

In Table 4.3 the hypothesized value 0, does not lie within the confidence interval such that we reject the null hypothesis and make a generalisation that there were differences in the pupils' marks. Analysing further -2.542 is less than -1.94(critical value) we the reject the null hypothesis at 5% level of significance and hence conclude that there was improvement in pupils' performance after the programme for pupils in PLAP Level 1, subgroup 1.

Marks for pupils in level 1 subgroup 2 are as shown in Table 4.4:

Table 4.4: Marks for Pupils in PLAP Level 1, Subgroup 2

Before PLAP (X)	After PLAP (Y)
34	51
22	30
25	18
25	25
34	27
28	42
27	38
26	35
mean = 27.625	mean = 33.25

Table 4.4 shows an increase in the mean marks from 27.63 to 33.25. The paired t -test results are given in the Table 4.5:

Table 4.5: Paired Samples T - Test Results for PLAP Level 1, subgroup 2

difference	lower bound	upper bound	T	d.f
before- after	-13.33840	2.08840	- 1,724	7

From Table 4.5, 0 lies in the 95% confidence interval such that we fail to reject the null hypothesis and conclude that the pupils' marks before and after the PLAP lessons are not significantly different. The critical value of -1.89 is less than -1. 724 which support the above argument hence we can conclude that the pupils marks did not reflect any significant progress in pupils' performance for level 1 subgroup 2.

In assessing the general PLAP Level 1 effect the following are the 95% confidence interval paired t - test analysis summarised tables.

Table 4. 6 General statistics for PLAP Level 1.

Mark	**Mean**
Marks before	20.86667
Marks after	26.9333

From Table 4.6 the mean for marks after is greater than that for marks before, which indicates that there was an increase in the marks obtained by the pupils after the introduction of the PLAP exercise. Table 4.7 shows results for the paired t - test for PLAP Level 1:

Table 4.7: Paired Samples T - Test for PLAP Level 1

difference	lower bound	upper bound	T	d.f
before- after	-10.65464	-1.47869	-2.836	14

In Table 4.7, the hypothesized value 0 does not lie within the confidence interval hence we can simply conclude that there is a difference in the marks obtained before and after the programme. A further analysis shows that -2.836 is less than -1.76(critical value) hence we reject the null hypothesis at 5% level of significance and conclude that PLAP lessons are effective in improving pupils' performance in Mathematics. From the above reflections for PLAP Level 1, the general research findings have revealed that PLAP lessons are essential in improving pupils' performance though this does not really hold for the better pupils as obtained for subgroup 2.

4.2 PLAP Level 2

Table 4.8: 2012, Term 2 marks (X) and 2013, Term 1 marks (Y) for PLAP Level 2

Number	Marks Before (X)	Marks After(Y)
B1	25	34
B2	19	31
B3	11	28
B4	8	11
B5	29	22
B6	6	17
B7	29	36
B8	22	17
B9	24	25
B10	13	29
B11	12	25
B12	15	25
B13	17	28
B14	26	49
B15	35	24

Using the Table 4.8, a line graph was produced as shown in Figure 4. 2

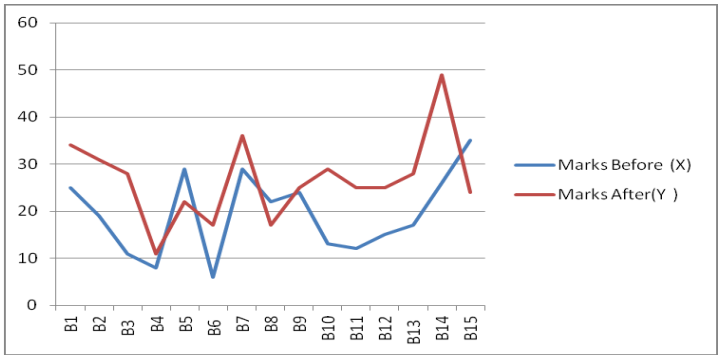

Figure 4.2: Line Graph for Pupils' Marks in PLAP Level 2

From Figure 4.2 the line graph, is can be seen that there seems to be an alternation of the two lines but where the line for marks after is above that for marks before, a greater range is reflected. We can use this argument to cater for a general increase of the marks after the lessons.

From Table 4.8 the mean mark for the marks before of 19.4000 was used to produce the subgroup tables.

Table 4.9: Marks for Pupils in PLAP Level 2, Subgroup 1

Number	Marks Before (X)	Marks After (Y)
B1	25	34
B2	19	31
B3	11	28
B4	8	11
B5	29	22
B6	6	17
B7	29	36
B8	22	17
B9	24	25
B10	13	29
B11	12	25
B12	15	25
B13	17	28
B14	26	49
B15	35	24

These results were analysed and produced summary results in Tables 4.10 and 4.11:

Table 4.10: Paired Samples Statistics for PLAP Level 2, Subgroup 1

Mark	Mean
Marks before	11.7143
Marks after	23.2857

From Table 4.10 the mean value for marks after is greater than that for marks before. This can literally mean that the performance improved.

Table 4.11: Paired Samples T-test Results for PLAP Level 2, Subgroup 2

difference	lower bound	upper bound	T	d.f
before- after	-15.83834	-7.30452	-6.636	7

Considering the paired t - test results in Table 4.11 we can see that 0 does not lie within the confidence interval hence the marks are significantly different. The test statistic -6.636 is less than -1.94(critical value) we reject the null hypothesis and conclude that there is enough evidence data at 5% level of significance that there is an improvement in pupils' performance.

The same analysis was done to subgroup 2 yielding the following results:

Table 4.12: Marks of Pupils for Pupils in PLAP Level 2, Subgroup 2

Before PLAP (X)	After PLAP (Y)
25	34
19	31
29	22
29	36
22	17
24	25
26	49
35	35
mean = 26.125	mean = 29.75

Table 4.12 shows an increase in the mean mark from 26.125 to 29.75. The following summarised paired t-test results were obtained:

Table 4.13: Paired Samples T-Test Results for PLAP Level 2, subgroup 2

difference	lower bound	upper bound	T	d.f
before- after	3.47953	-13.22779	-1.4374	7

From Table 4.13 we can see that 0 lies within the confidence interval implying that there was no significant difference in the marks in comparison. Also comparing the t values,-1.4374 is greater than -1.89 (the critical value) which leads to the rejection of the alternate hypothesis such that we conclude that there was no significant improvement in pupils' performance for subgroup 2.

Additional analysis was done for the whole PLAP Level 2 and the following summary table was obtained. Table 4.14 shows the general statistics for PLAP Level 2.

Table 4.14: Paired Samples Statistics for PLAP Level 2

mark	mean
marks before	19.4
marks after	26.7333

Comparing the means there was an improvement from 19.4 to 26.733 though this cannot be a valid argument on its own. Table 4.15 shows results for the paired t-test.

Table 4.15: Paired Samples T - Test Results for PLAP Level 2

difference	lower bound	upper bound	T	d.f
before- after	-12.5810	-2.08526	-2.997	14

From Table 4.15, the hypothesized value of 0 does not lie within the confidence interval. The implication of this result is that there are differences between the marks obtained by pupils before and after the PLAP exercise. To support this, the calculated t - value of -2.997 is less than the negative critical value of -1.76, hence we reject the null hypothesis at 5% level of significance and conclude that PLAP lessons are effective in improving pupils' performance in Mathematics. Linking this with the general behaviour of the line graph, in general we can conclude that PLAP lessons play a positive role in the pupils' academic achievement. However it has to be born

in mind that if we deal with special groups within the main group we are bound to have different conclusions as revealed for subgroup 2.

4.3 PLAP Level 3

The data collected from fifteen randomly selected pupils from PLAP Level 3 is as shown in Table 4.16.

Table 4.16: 2012, Term 2 marks (X) and 2013, Term 1 marks (Y) for PLAP Level 3

Number	Marks Before (X)	Marks After (Y)
C1	2	15
C2	21	19
C3	3	17
C4	11	14
C5	10	19
C6	22	17
C7	7	6
C8	31	29
C9	17	23
C10	3	22
C11	27	29
C12	34	41
C13	5	7
C14	24	35
C15	17	30

A line graph was plotted as shown in Figure 4:3.

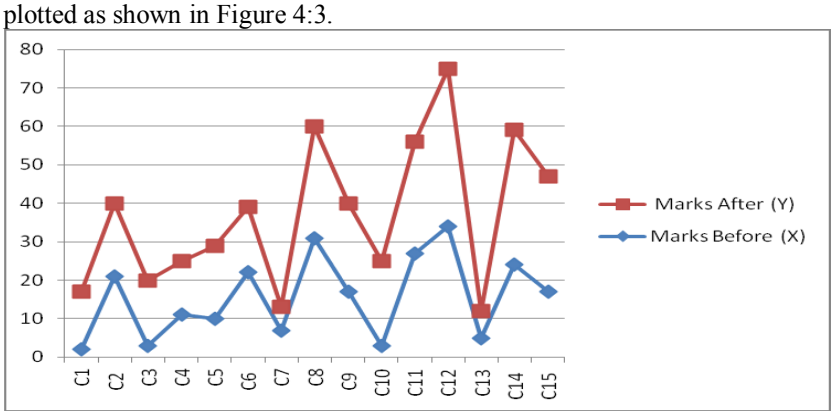

Figure 4.3: Marks of Pupils in PLAP Level 3

As reflected in the other groups in general marks after are superimposed above the marks below such that we can generalise on improvement of pupils' marks. From Table 4.16, two subgroups were also formed using the mean mark of 17.4667 for the marks before PLAP lessons. Table 4.17 shows the marks of those who got below the mean (Level 3, subgroup 1).

Table 4.17: Marks of Pupils PLAP Level 3, Subgroup 1

Before PLAP (X)	After PLAP(Y)
2	15
3	17
11	14
10	19
7	6
17	23
5	7
17	30
Mean = 9	Mean = 16.375

Basing on the means only it is clear that the mean mark has improved from 9 to 16.3750. However a further paired t-test was done and the results summarised as shown in Table 4.18.

Table 4.18 Paired Samples T - Test Results for PLAP Level 3, Subgroup 1

difference	lower bound	upper bound	t	d.f
before- after	-12.16587	-258413	-3.640	7

It can be clearly seen that 0 does not lie within the confidence interval such that we can conclude that the marks are significantly different. Comparing the t values, -3.640 is less than -1.89(critical value), we can match the two conclusions and say that there was an improvement in pupils' performance for level 3 subgroup 1.

The same procedure was done for subgroup 2 and the following summary results were obtained. Table 4.19 shows the pupils' marks who obtained marks above the mean mark (Level 3, subgroup 2).

Table 4.19: Marks of Pupils in PLAP Level 3, Subgroup 2

Before P.L.A.P. (X)	After P.L.A.P. (Y)
21	19
22	17
31	29
31	22
27	29
34	41
24	35
Mean = 27.1429	Mean = 27.429

An analysis of the mean marks shows a negligible difference between the two values. The paired t – test results are as shown in Table 4:20.

Table 4.20 Paired Samples T - Test Results for PLAP Level 3, subgroup 2

difference	lower bound	upper bound	t	d.f
before- after	-6.68687	6.11545	-0.109	6

Table 4.20 shows that 0 lies within the confidence level such that we can conclude that there is no significant difference between the marks before and after the PLAP lessons. To concretise this, we compare the t- values, -0.109 is greater than -1.94 therefore we fail to reject the null hypothesis and we conclude that there is no improvement in pupils' performance for level 3 subgroup 2 at 5% level of significance.

Analysis was also done for the whole PLAP Level 3 and the results produced are as shown in following tables.

Table 4.21: Paired Samples Statistics for PLAP Level 3

Mark	Mean
marks before	17.4667
marks after	21.5333

From Table 4.21, there is an increase in the mean, simply implying a general increase in the marks obtained by pupils after the PLAP lessons.

Table 4.22: Paired Samples T - Test Results for PLAP

difference	lower bound	upper bound	T	d.f
before- after	-7.99627	-1.3707	-2.220	14

Considering the paired t - test results in Table 4.22, the hypothesized value of 0 does not lie within the confidence interval. This reflects that there are differences between the marks before and the marks after the programme. A further analysis shows that -2.220 is less than -1.76(critical value) we therefore reject the null hypothesis at 95% confidence interval and hence conclude that PLAP lessons are effective in upgrading pupils' academic performance in Mathematics.

From the argument above we can therefore conclude that PLAP lessons are essential in improving pupils' academic performance in Mathematics. We have however obtained from subgroup 2 that it is also possible to get different conclusions if we critically analyse our data.

4.4 Overall PLAP Results

The researchers went on to combine all the marks for the forty five students for Levels 1, 2 and 3. The pupils were also subdivided into two subgroups using the initial mean of 19.244 following the same order of level of performance classification system. Subgroup 1 produced the following results as shown in Table 4.23.

Table 4.23: Paired Samples T - Test Results for the Overall PLAP Group

difference	lower bound	upper bound	t	d.f
before- after	-11.74238	-6.34458	-6.949	22

Considering the bounds, 0 lies within the confidence interval such that we can conclude that there was a general improvement in the pupils' marks. In support of this -6.949 is less than -1.72 (critical value) we reject the null hypothesis and conclude that there has been an improvement in pupils' performance in Mathematics.

The same procedure was carried out for subgroup 2 and yielded the following paired t-test results.

Table 4.24: Paired Samples T - Test Results for the Overall PLAP Group

difference	lower bound	upper bound	t	d.f
before- after	-5.67272	3.94545	-3.73	21

From Table 4.24, 0 lies within the confidence interval such that we cannot reject the null hypothesis and conclude that there are no significant differences in the pupils' marks before and after the lessons. Also -3.73 is greater than -4.72 which follows that the pupils' marks after the lessons were not significantly greater than the marks before. This means that for subgroup 2, no effect of PLAP was recognised.

Later the results were analysed for the overall programme using the forty five pupils. Using the matched pair t - test, the following 95% confidence interval paired t - test analysis summarised table results were obtained. Table 4.25 shows the general statistics of the overall group:

Table 4.25: Paired Samples Statistics for the Overall PLAP Group

Mark	Mean
marks before	19.2444
marks after	25.2889

From the 4.25 it can be seen that the mean for the marks after PLAP is greater than that for the marks before the programme. This reflects that in general, pupils achieved better marks as compared to their previous performance. Table 4.26 shows results the Paired Samples T - Test.

Table 4.26: Paired Samples T - Test

difference	lower bound	upper bound	t	d.f
before- after	-8.56046	-3.528	-4.842	44

Table 4.26 , it can also be clearly seen that the hypothesized value of 0, does not lie within the confidence interval implying that there exists a difference in the marks obtained before and after the PLAP lessons. Comparing t-values; -4.842 is less than -1.6449 (critical value) , we therefore reject the null hypothesis in favour of the alternative hypothesis at 5% level of significance and hence conclude that PLAP lessons proved to be effective in improving pupils' academic performance in Mathematics.

Considering all the results used for this research, for the PLAP levels separately or combined the researchers obtained that in general we can conclude that the PLAP exercise helps in boosting pupils' academic performance in Mathematics. For the three levels, findings for subgroups 2 have failed to support the alternative hypothesis. This shows that there is need for the teacher to identify these individual pupils and give them special attention.

4.5 Questionnaire Response Analysis

The three Mathematics teachers at the school were given the questionnaires and returned them completed. The responses from the questionnaires were analysed and the following analysis table was obtained.

Table 4.27: Questionnaire Response Analysis

	Frequency	Percent	Valid Percent	Cumulative Percent
valid,yes	3	100.0	100.0	100.0

Table 4.27 shows that PLAP was 100% effective in improving pupils' performance in Mathematics as obtained from teachers' questionnaire responses. The researchers also analysed the teachers' qualifications. This revealed that all are professionally qualified as shown in Table 4.28.

Table 4.28: Teachers' Professional Qualifications

Qualification	Frequency
Diploma in education	2
Certificate in education	1
Total	3

The fact that all the teachers are professionally experienced supports the fact that they managed to adjust fairly well to the PLAP exercise without much constraints bearing in mind that no proper training had been offered. However they managed to work effectively towards the programme as supported by the achievement displayed in Table 4.27.

4.6 Teacher Involvement in the PLAP exercise

In the questionnaires distributed three teachers indicated that they are involved in delivering the PLAP lessons. Two of the teachers indicated that they have not received any specific training on how to conduct the PLAP lessons. However the Head of Department had attended a workshop and gave feedback to the other teachers. From the questionnaires, it was revealed that it was the first time to introduce the programme. At first the exercise reflected to be challenging since it seemed an additional task but with time the teachers were able to

adjust to fit well into the programme. Analysing their responses the researchers found that regardless of this constraint, they have managed to pull through.

As once argued in the literature review that the PLAP exercise is not totally divorced from the remediation teachers study at their training colleges, they managed to make adjustments into the programme. Irrespective of this, however, two of them commented that there is need to actually hold training sessions with all the individual teachers who will be directly involved in the programme.

The questionnaire responses also revealed that some older pupils seemed ashamed when they are included in lower PLAP levels below their current level of learning, for example, a Form Three pupil getting into PLAP Level 1. At first they would not attend the lessons. A follow up on them was done as registers would be marked to ensure they capture all the records accurately. With the teachers' encouragement and explanations on the benefit of the programme on the part of the pupils themselves, they later regained their confidence and absorbed their pride. They later became active during the lessons.

V. Conclusion

The research has shown that the PLAP exercise, if managed properly will effectively help in improving pupils' academic performance in Mathematics. Teachers need to have a positive look at the programme so that they effectively implement it. However on the part of the teacher, not much seems strange as they had already been involved in pupil remediation.

In addition to teacher effort, the parents are expected to complement in a way. Parents are expected to be actively involved especially when dealing with those pupils who are truant. The parents are expected to sign in their pupil's books to acknowledge pupils' work and also confirm monitoring their children's work at home. This will reduce pressure on part of the teacher in managing the pupils.

The school administration needs also to be actively involved especially on time allocation towards the programme. It seems as if the programme is left independently to the Department which has to strive on its own to sort out the best strategy for running the programme.

VI. Recommendations

Based on the research findings the following recommendations are made:

1. In reference to the pupils in subgroup 2 who did not make significant improvement after PLAP lessons it implies a different need to be identified and addressed according to the group they fall into.
2. Ensure programme does not coincide with other activities, hence design a programme to accommodate all the pupils, even those who are in sports and other school activities to benefit.
3. The administration should exempt the teachers involved from other afternoon duties since they already have an additional task which demands their maximum participation weekly.
4. Teachers need to communicate often with the pupils' parents as a way of monitoring pupils both at home and at school. This could be done by frequently checking their children's PLAP exercise books and sign as way of confirming that they have seen the work.
5. Proper planning of the programme to be done especially on time allocation so that pupils get enough time for the programme. Lessons should also commence as soon as schools open. This is to the benefit of the pupils so they do not have to be disadvantaged.

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APPENDIX 1

WIDE RANGE ACHIEVEMENT TEST.REVISED LEVEL

Write as common fraction In lowest terms: .75 = ...

The complement of an angle of 30^0 = ...

.....

4^3 = ... If a=7, b=3: $\frac{1}{4}$% of 60 = Solve

.25 ÷ $1\frac{1}{5}$ =..... $a^2 + 3b$ =..... 66sq.ft. =.....sq. yd $\frac{7-(6+8)}{2}$ =.....

.....

Add: Factor: $\frac{r^2-5r-6}{r+1}$ Change to familiar numerals

-x – y -23 r^2+25-10r Ans. MDC X CI =.....

X –y +2 Ans:..... Find interest on $1,200 at 6% for 70 days. Ans.....

.....

3p –q =10 $\sqrt{2ax}$ =6 Find square root

2p – q = 7 x =..... $\sqrt{67081}$

P =.....

q =.....

$$\frac{7}{17} = \frac{6}{X}$$

X = ...

.....

$\log_{10}\left(\frac{1}{100}\right)$ $\log 5\sqrt{5}$ Reduce: $\frac{k^2+k}{k^2} \cdot \frac{3k-3}{k^2-1}$

Ans:..... Ans:..... Ans:.....

.....

2 +7 = ... 43 73 36 94 3x4=..... 512

8-4 =..... + 6 +9 -15 -64 18 ÷ 6 =..... x 3

.....

$4\frac{1}{3} + 3$ =..... $\frac{1}{2}$ of 18 =.....

$2\frac{1}{2} + 1\frac{1}{2}$ =..... $\frac{1}{6}$ of 30 =.....

\$4.95 726 229

X3 -349 5048

63

+ 1381

.....

2 - ..... = $\frac{1}{4}$ Add: $6\frac{1}{4}$ 809

$1\frac{1}{3}$ f .t =..... $1\frac{5}{8}$ x 47

$4\frac{1}{2}$

.....

Write as percent: Subtract: Multiply: 6.23 Find average

.42 = ...% $10\frac{1}{4}$ 12.7 34, 16,45,39,27

Write as decimal: Write as percent:

.42 =.....% $\frac{3}{8}$ = ...%

.....

Add 3 ft . 6 in M +2 =5

APPENDIX 2
PLAP CLASSIFICATION (OUT OF 66)

14 and below	*Below grade 3*
15 -17	*Grade 3*
18 -20	*Grade 4*
21-23	*Grade 5*
24-26	*Grade 6*
27-29	*Grade 7*
30-31	*Grade 8(form 1)*
32-33	*Grade 9(form 2)*
34-35	*Grade 10(form 3)*
36-37	*Grade 11(form 4)*
38-39	*Grade 12(form 5)*
40-66	*Above Grade 12(above form 5)*