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Using Peer Assisted Learning Strategy in Science

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### **1.0 – INTRODUCTION TO THE PROBLEM**

*What helps students to understand what is being taught in class?* It is generally acknowledged that this is one of the questions which has constantly been on the mind of every single teacher since they stepped into the classroom for the first time. Over the years of teaching, many answers to that question were found but it soon becomes clear that the list of answers is inexhaustible.

Factors such as the exponential increases in the school curriculum, difficulties finding resources to suit the diversity of learning styles or multiple intelligences of the students and not enough time to meet all of the student's instructional and emotional needs, in addition to keeping the students actively occupied, have all, to some extent, influenced how well the teacher is able to ensure that maximum student learning is achieved. Even so, in teaching one would quickly realise that the students themselves provide clues as to how a teacher may be able to support them in their understanding of what was taught in class.

Observing my current Second Form Integrated Science class during Term I of this year (2009-2010), my attention was drawn to the fact that some students seemed to understand some concepts better when they were engaged in one on one discussions, may it be with another student in class or the teacher. As is expected, they seemed more relaxed when they were in discussions with their peers and appeared more comfortable when given extra time to self analyse the material which was being taught. Also, when a student asked a question and it was redirected to other students, more often than not; small group discussions were started and usually the students seemed to gain more insight into the concept.

Anyone who has taught knows that the best way to learn something is to teach it to someone else and I wondered to what extent did peer teaching improve student learning because

here in this Science class, this was being randomly exhibited, albeit on a small scale.

Furthermore, according to Maheady (2001), children can serve as powerful instructional resources for one another, and systematically using peers to offer teaching assistance may greatly aid teachers and students in meeting the everyday challenges that are encountered in the classroom.

Consequently, the investigation into using *peer tutoring* also known as *Peer Mediated Intervention* or *Peer Assisted Learning Strategy (PALS)* as a method to improve student learning in this Science class was conceived.

**This research paper concentrates on determining the extent to which teaching science using the Peer Assisted Learning Strategy would improve student learning outcomes.**

**The following Research Questions will guide this investigation:**

(1) Would an improvement in academic achievement (cognition) be shown in both the High and Low achieving students when PALS is used?

(2) Is Reciprocal Peer Assisted Learning Strategy a teaching strategy that students would want to use continuously throughout the Science course and why?

(3) Would working in PALS pairs improve the student – student social relationships which exist in the class?

## **1.1. – REVIEW OF LITERATURE**

### ***1.1.1 What is Peer Assisted Learning Strategy (PALS)?***

Peer Assisted Learning Strategy is an alternative classroom arrangement in which students take an instructional role with classmates or other students, the students usually work in pairs. It is an organised educational programme where students tutor or teach their peers (Hall & Stegila, 2003). A person who has equal standing with another or others, as in rank, class, or age is a peer (Dictionary).

PALS was designed in 1989 by Dr. Lynn Fuchs and Dr. Doug Fuchs in conjunction with Dr. Deborah Simmons. The strategy was developed to enhance students' literacy development and beliefs about reading within a peer mediated framework. An organisation in the United States of America which looks at learning strategies, The Access Center (2008) further explains that PALS incorporates research-supported practices with individualised instruction which can be adapted to meet individual student needs. PALS combine peer tutoring with instructional principles and practices (Promising Practices Network [PPN], 2005).

One of the most important elements in PALS is the fact that students are likely to be more active or involved in their own learning (Foot & Howe, 1998).

### ***1.1.2 Application of Peer Assisted Learning Strategies to the classroom***

In this strategy, students are taught roles by their teacher and through these roles, systematically instruct other students (Hall & Stegila, 2003). The Access Center (n.d.) agrees by stating that students interact through “coach/ player” pairings in structured cooperative groups. During this process, the teacher monitors and facilitates pupils' progress (Hall & Stegila, 2003) while students support each other through frequent oral interaction, feedback and reinforcement (The Access Center, 2008). The Professional Instructional Center [PIC], (n.d.) agrees by

summarising that each member in the pair in Peer Assisted Learning Strategies shares the role of tutor and tutee, and the teacher trains them by giving each pair feedback and error correction procedures.

Furthermore, The Access Center (2008) writes that the pairing of higher and lower achieving students is intended so students gain knowledge from each other through practice and reinforcement. Most literature states that Peer Assisted Learning Strategies should be used two to four times a week for twenty-five to thirty-five minutes a session. (PIC (n.d.) & The Access Center, 2008).

### ***1.1.3 Peer Assisted Learning Strategies, academic achievement and social interactions between students***

The Peer Assisted Learning Strategy allows the teacher to circulate around the classroom and observe students, providing continuous feedback and remedial lesson where necessary (PPN, 2005). Bloomfield and Hoste (1975) believe that the most important aspect of assessment is that continuous feedback on teaching and learning are available to the teachers and students which are crucial in readjusting the teaching and learning accordingly. Wragg (2001) asserts that offering regular feedback may help to maximize concentration and attentiveness thus motivating the students.

In addition, Fulk & King (2001) declared that PALS keeps students actively on task and involved. Optimal use of the strategy includes “guided practice” activities that maximise students’ active engagement with the course content. However, Greenwood, Carta, & Hall (1988) persuasively argued that the most effective peer teaching methods are those that systematically train students in their teaching roles and then constantly monitor the effectiveness of their implementation. Unfortunately this would require additional time, a demand not present in teacher led instruction.

Peer tutoring has a low tutor to tutee ratio and allows for more individualisation (Cready, 2006). This corresponds well with Bloom's (1984) research into peer tutoring methods, in which one to one peer tutoring was more effective than both conventional for instance teachers' lecturing and mastery learning methods of teaching. Slavin (1980) strongly concurred with this by writing that one to one tutoring is the most effective form of teaching known.

One must be mindful when using PALS, that the tutors are properly trained because failure to prepare the peer adequately may place them at risk of receiving negative reactions or rejections from their classmates, classmate's parents and administrators (Greenwood et al., 1988). Cosden & Haring, (1992) purport that some educators and parents have argued that students do not come to school to be teachers and that undue reliance on peer teaching methods will somehow impede their children's opportunities to make sufficient progress on more relevant curricular activities.

The constant attention provided by the PALS leads to improved student motivation and increased time on task (Cready, 2006). More time on task, according to Greenwood et al. (1988), offers students greater opportunities to respond in addition to increasing the opportunity for immediate error correction. Ryan & Deci, (2000) concur. They suggest that the level of engagement with PALS influences student motivation to achieve classroom goals. Therefore the constant feedback, greater on time for task and improved student motivation all aid in enhancing academic achievement. Ryan, Reid & Epstein (2004) support this by stating the research is showing that schools may benefit by using peer mediated interventions which are consistently producing academic gains.

However, this has implications for the quantity of the syllabus which may be covered, especially in today's classroom where teachers are under pressure to complete all of the material

in a specific time frame (Maheady, 1998). With the use of PALS, peer learning dictates the instructional pace, so it may be difficult for some teacher to efficiently complete the syllabus.

Peer Assisted Learning Strategy has many advantages for implementation in the classroom these include: active learning, immediate tutor intervention, individualisation of learning, review and rehearsal of work, the simplification and clarification of work, stepwise prompting if needed, feedback opportunities, diagnosis and remediation of misconception (Maheady, 1998). All of these factors contribute to increase academic achievement.

However, another other major area of concern is accountability. In accountability, measures must be developed and implemented to ensure that none of the students are affected negatively. For example the lower skilled students should not always be the tutees and the higher achieving students should not be subjected to lower level academic material. (Greenwood et al., 1988).

PALS promote meaningful social interaction between peers (The Access Center, n.d.). Students engaged in peer tutoring increased their frequencies of positive social interaction (Maheady, 1998) while Miller and Miller (1995) stated Peer learning can benefit both tutor and tutee socially and educationally by motivating them to learn.

#### ***1.1.4 Summary of Major Research findings related to Peer Assisted Learning Strategies***

In a study by Fuchs, Fuchs and Kazden (1998), PALS was implemented in a high school remedial reading program. An overall improvement was shown in the reading and comprehension at the end of the sixteen week study. Students reported that they had enjoyed working in pairs and that they felt they had to work hard to improve their reading.

Mathes & Babyak, (2001) studied ten First-Grade PALS classes and ten control group classes and reported the following: Low-performing students in the PALS group experienced

significantly more improvements statistically in scores on the Test of Early Reading than the control students.

In summary, the literature has indicated that Peer Assisted Learning Strategies have many attributes which positively influence student academic achievement and social interactions. The aim of this study was to discover if the PALS techniques would improve student learning outcomes and social interactions in Science class.



## **2. – METHODOLOGY**

### 2.2.1 Sample *composition*:

This study took place in the second form Integrated Science class of a public secondary school. There were twenty-one (21) students; ten (10) males and eleven (11) females in this class. All the students were involved in the Peer Assisted Learning Strategy investigation which spanned five weeks.

Before the start of the investigation, the end of Term I marks were used to classify the students into two categories; the Alpha ( $\alpha$ ) or the A. If the student has received 71% or less in the end of term 1 mark they were classified as A, the others were classified as Alpha. 71% was used because it was the mean mark of the sample. Therefore, the class consisted of ten (10) A-students and eleven (11)  $\alpha$ -students. Refer to Table 1 at the end of this chapter.

In order to analyse the effects of the Peer Assisted Learning strategy on student learning, an Alpha student was paired with an A student. That is, in each pair there was a stronger and weaker science student. Refer to table 2 at the end of this chapter. The students were informed of these pairs one week before the strategy was implemented.

**TABLE 1: INITIALS, GENDER, DATE OF BIRTHS, END OF TERM 1 MARK AND GROUP CLASSIFICATION OF STUDENTS IN THE 2<sup>ND</sup> FORM INTEGRATED SCIENCE CLASS**

STUDENT'S INITIALS	DATE OF BIRTH	END OF TERM 1 SCIENCE MARK	CLASSIFICATION ALPHA OR A
<b>FEMALES</b>			
TB	20 <sup>th</sup> August 1997	81	$\alpha$
AB	28 <sup>th</sup> January, 1997	71	A
SB	16 <sup>th</sup> October, 1996	85	$\alpha$
IC	9 <sup>th</sup> October 1996	75	$\alpha$
AC	4 <sup>th</sup> May, 1997	58	A
CC	1 <sup>st</sup> February, 1997	88	$\alpha$
SD	7 <sup>th</sup> September, 1996	76	$\alpha$
KK	12 <sup>th</sup> June, 1997	77	$\alpha$
NK	28 <sup>th</sup> February, 1997	72	$\alpha$
JK	2 <sup>nd</sup> November, 1996	73	$\alpha$
AL	23 <sup>rd</sup> July, 1997	77	$\alpha$
<b>MALES</b>			
DH	23 <sup>rd</sup> July, 1997	60	A
SH	18 <sup>th</sup> May, 1997	58	A
RL	20 <sup>th</sup> December, 1996	69	A
KL	22 <sup>nd</sup> February, 1996	73	$\alpha$
BM	22 <sup>nd</sup> November, 1996	65	A
ZM	18 <sup>th</sup> November, 1996	71	A
SM	16 <sup>th</sup> June, 1996	58	A
SP	6 <sup>th</sup> November, 1996	69	A
CR	31 <sup>st</sup> January 1997	72	$\alpha$
SW	28 <sup>th</sup> June 1997	56	A

**TABLE 2: PEER ASSISTED LEARNING STRATEGY PAIR GROUPS AND DESIGNATED GROUP LETTER**

Group	Students in the Pair
A	TB, AL, SW*
B	AB, CR
C	SB, SH
D	CC, SM
E	KK, SP
F	NK, BM
G	JK, KL
H	IC, DH
I	SD, ZM
J	AC, RL

\* There are 21 students so one group would contain three students

**2.2.2 UNIT PLAN FOR THE ACTION RESEARCH TOPIC**

<b><u>INSTRUCTIONAL PLAN</u></b>	
DURATION: 5 WEEKS	NO. OF PERIODS: 20 PERIODS
FORM: SECOND (2 <sup>A2</sup> )	AGE RANGE: 12-13
SUBJECT: INTEGRATED SCIENCE	TOPIC: <b>ACID – BASE CHEMISTRY</b>
<p><b>RATIONALE:</b>            Life cannot exist without Chemical and Physical reactions occurring. Therefore all students should develop an understanding of what these reactions are and how they are used in their everyday routines. One such reaction, the acid–base chemical reaction is employed by students each day when they use items such as household cleaners, medicines and personal hygiene products.</p>	



TOPICS/ CONCEPTS	GENERAL OBJECTIVES	TEACHING METHODS	LEARNING ACTIVITIES	TECHNOLOGY / MATERIALS	ASSESSMENT PROCEDURES	FOLLOW-UP ACTIVITIES
Acids and Bases	Comprehend Acids and Bases	Lecture – Discussion (whole class)  Peer Assisted Learning Strategy –Tutor - Tutee	Listening to a presentation and sharing views on the properties of acids and bases based on previous experiences in class and at home.  Sharing information in pairs about acids and bases in order to complete worksheets	Multimedia projector, laptop, worksheets  Worksheets	Grading the answered questions  Assessing the completed worksheets	Read the relevant chapter of the text.

TOPICS/ CONCEPTS	GENERAL OBJECTIVES	TEACHING METHODS	LEARNING ACTIVITIES	TECHNOLOGY / MATERIALS	ASSESSMENT PROCEDURES	FOLLOW-UP ACTIVITIES
Acids & Bases	Comprehend Acids and Bases Cont'd	Cooperative Learning – Round table	Answering questions about acids and bases in turns by writing one answer on the paper, and then passing it a partner to answer the next question.	Blank coloured paper	Correcting the answer sheets.	
	Apply the use of pH	Experiment	Creating a pH scale reference flier to classify household substances as acidic, basic, and neutral via the use of universal indicator.	Universal indicator, household chemicals, relevant apparatus, multimedia projector, laptop, worksheets	Completed flier	

TOPICS/ CONCEPTS	GENERAL OBJECTIVES	TEACHING METHODS	LEARNING ACTIVITIES	TECHNOLOGY / MATERIALS	ASSESSMENT PROCEDURES	FOLLOW-UP ACTIVITIES
Acids & Bases	Apply the use of pH	Peer Assisted Learning Strategy –Tutor - Tutee	Participating in the completion of a worksheet on pH with the assistance of a peer.	Worksheets	Completed worksheet	Home-work: Describe the pH scale: – What does it show? - What do the numbers represent?
	Realise the importance of Neutralisation	Discovery – Guided	Testing an acid (HCl) with universal indicator, repeating process with a base (NaOH), mix the two substances together and testing the product with the indicator.	Reference books, Worksheets, Hydrochloric acid, Sodium hydroxide, universal indicator, test tubes	Completed lab write up	

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TOPICS/ CONCEPTS	GENERAL OBJECTIVES	TEACHING METHODS	LEARNING ACTIVITIES	TECHNOLOGY / MATERIALS	ASSESSMENT PROCEDURES	FOLLOW-UP ACTIVITIES
Acids & Bases	Realise the importance of Neutralisation Cont'd	Questioning - Orally  PALS – Tutor-Tutee  Cooperative Learning – Jig Saw	Answering questions based on what was observed in the discovery.  Sharing information in pairs about neutralisation in order to complete a puzzle.  Working in groups to solve an everyday problem with the use of neutralisation. The solutions will be presented orally.	Laptops, multimedia projector, puzzles, worksheets	Oral and/or written reports on the use of neutralisation along with the completed worksheets	Revise for Test

### 2.2.3 *The strategy:*

At the start of the unit the students were given a Pre-test. See appendix 5 for a copy. During the lesson before the implementation of the Peer Assisted Learning Strategy, the students and the teacher engaged in a discussion to determine the approach which will be used to investigate the strategy and to ensure that the students had consented to be a part of the research.

Each science lesson was usually for 80 minutes twice each week. The first 45 minutes of the lesson was used by the teacher to teach the objectives for that class. Along with the Peer Assisted Learning Strategy, a variety of teaching strategies was employed. These would include: Guided discovery, Inquiry, Discussion, Experimentation, Lecture, Questioning, Cooperative Learning, Brainstorming and Independent Study. Then for the next 20 minutes, the pairs engage in PALS. During the PALS session the pairs discussed the subject matter, asked and answered each other questions and generally ensure that they both understood what was taught.

After this time, the students were assessed independently to quantify the amount of learning which had taken place by the individual student. Assessments included the use of crosswords, clozed procedure, essay writing and quizzes. During the assessment time, the students were not allowed to confer with their pal, other students in the class, their notes or handouts to assist them in the answering of the questions. These assessments were then used to determine the amount of student learning and to provide feedback. At the end of the five weeks an overall summary test (Post test), which was identical to the Pre-test, was given.

#### *Peer Assisted Learning Strategy session 1:*

A special worksheet which contained a reading assignment and specific questions for the tutor to ask the tutee was created and supplied to five of the ten pairs (one of which was really was a trio because there were twenty-one students). The other five pairs also received reading sheets but these did not contain specially prepared questions. The tutor in the pair was

determined by the teacher. The teacher had observed the students in each pair during the 45 minute teaching session and had determined which of two had grasped the concepts better. That student was appointed the tutor for that session. After the twenty minute session where pairs were supposed to interact and question each other to ensure that they understood the subject matter which was taught, they were given an assessment sheet.

***Peer Assisted Learning Strategy sessions 2 – 10:***

These followed the same format as session 1, however all the pairs were supplied with specially created PALS questions and answer sheets and each person in the pair had specific questions to ask their PAL. So the class was now using a *Reciprocal Peer Assisted Learning Strategy*.

**4.2.3 THE LESSON PLANS FOR THE ACID-BASE TOPIC****LESSON PLAN - *The Pre -test***

<b>DATE:</b> Monday, Jan 11 <sup>th</sup> 2010	<b>TIME:</b> 9:00 – 10:15 am	<b>DURATION:</b> 75 minutes
<b>FORM:</b> Second (2A2)		<b>AGE RANGE:</b> 12-13 years
<b>SUBJECT:</b> Integrated Science		
<b>TOPIC: PHYSICAL &amp; CHEMICAL REACTIONS, ACIDS, BASES &amp; INDICATORS</b>		
<b>GENERALISATIONS:</b> Neutralisation reaction results when an acid and base chemically combine. This type of reaction is only one of the many reactions on which life depends.		
<b>CONCEPTS:</b> States of matter, processes involved in state changes, particle arrangement, physical and chemical properties, pH, neutralisation,		
<b>OBJECTIVES:</b> See Table of Specification		
<b>TEACHING STRATEGIES/METHODS:</b> Testing		
<b>TECHNOLOGY/ MATERIALS:</b> Test paper		
<b>SET INDUCTION:</b> Students will be told that this test is to determine how much they know about the material which will be taught to them this term before teaching begins. It will be explained that these results will be used to establish how much learning had taken place by the end of this unit. The students will be reminded that these marks would not contribute towards their mid-term or end of term marks.		
<b>LEARNING ACTIVITY/ EXPERIENCES:</b> Tell the students to try their best but do not become frustrated if they cannot answer all the questions. Then allow them to complete the test in the given time frame.		
<b>ASSESSMENT PROCEDURES:</b> Pre - Test		
<b>CLOSURE:</b> Collect the test material, thank the students and inform them that we will be studying the states of matter in the next class and that they should read ahead on this.		

**FOLLOW-UP ACTIVITY:**

**EVALUATION:**

As was expected the students complained, I emphasised that these marks would not be contributed to their mid or end or term marks. I even explained the reason why I was doing the test.

**SIGNATURE OF TEACHER:**

**LESSON PLAN # 1**

<b>DATE:</b> Thursday, 4 <sup>th</sup> Feb 2010	<b>TIME:</b> 10:20 -11:35 am	<b>DURATION:</b> 75 minutes
<b>FORM:</b> Second (2A2)		<b>AGE RANGE:</b> 12-13 years
<b>SUBJECT:</b> Integrated Science		
<b>TOPIC:</b> Acid and Bases		<b>SUB-TOPIC:</b> Indicators
<b>GENERALISATIONS:</b> <b>An Indicator is a substance which shows one colour in an acid and a different colour in the presence of a base.</b>		
<b>CONCEPTS:</b> Acid- Base chemical group, Indicators		
<b>OBJECTIVES:</b> <ol style="list-style-type: none"> <li>1. Identify if a substance was acidic or basic based on its colour changes with acid-base indicators.</li> <li>2. Define acid-base indicator.</li> <li>3. Conclude from the experiment that vinegar is an acid containing substance.</li> <li>4. Perform a series of experiments</li> <li>5. Handle all equipment and water carefully and responsibly</li> <li>6. Be attentive to his Tutor during PALS session by listening carefully to what is being asked/ discussed.</li> <li>7. Follow worksheet instructions to complete lab</li> </ol>		
<b>TEACHING STRATEGIES/METHODS:</b> Guided Inquiry, Peer –Assisted Learning Strategy, Discussion – Small group		
<b>TECHNOLOGY/ MATERIALS:</b>		
<b>SET INDUCTION:</b> Ask students what traffic lights, road signs and safety symbols all have in common. Hopefully one of them should say that they all tell or indicate when it is time to drive, to stop or if something is dangerous. Then the class will be informed that there is also a group of chemicals which perform a similar function and these will be investigated in today's class. Ask students what they think these substances are called. Hopefully they will say Indicators.		
<b>LEARNING ACTIVITY/ EXPERIENCES:</b> <ul style="list-style-type: none"> <li><input type="checkbox"/> Invite a student to share out the Laboratory worksheet.</li> <li><input type="checkbox"/> Ask one student to read Inquiry part 1 aloud while the other students follow on their worksheets.</li> <li><input type="checkbox"/> Discuss with students the procedure for completing the lab, any aspects they do not understand and once the difficulties are cleared up, tell the students to conduct their inquires.</li> </ul>		

- Remind to students to fill in their worksheets as they are completing the lab because what they have written on the sheets will be corrected, by the teacher as she monitors each group.
- After the first inquiry, the whole class will discuss their findings and to students will summarise what was learnt from that Inquiry.
- This procedure is repeated for Inquiry part 2.
- Once part 2 in completed, the students will receive their PALS handout (one to the Tutor and a different one to the Tutee).
- PALS will be given 10 -15 mins to read, discuss and question each other about the information which was provided.
- Students will use the information gathered at their PALS session, to complete an assessment worksheet.

#### **ASSESSMENT PROCEDURES:**

Grading of worksheet

#### **CLOSURE:**

Review the function of the Green, Red and amber colours of the traffic sign and ask students to state how Litmus, methyl orange and Phenolphthalein operated similarly, if they did.

#### **FOLLOW-UP ACTIVITY:**

#### **EVALUATION:**

The teaching strategies I had opted to use were that of experimentation, discussion – whole class and PALS. It was apparent that the students liked the students enjoyed the experiment aspect greatly and this was encouraging as I used this method to because I believed that the concept of indicators would be learnt more effectively through hands on and authentic learning than through discussion.

Since I am trying to develop deep thinkers, I asked the students to try to explain what they were realising from the experiment, if they noticed any patterns. I was concerned that students had difficulty making inferences from the results. After much prodding and asking leading questions the students started to grasp what the results were indicating. I will have to spend more time cultivating inductive and deductive skills in my students.

When it was time for the reading of the PALS handouts the students were less excited and wanted to continue experimenting. I encourage them to start to read the handouts and on reflection I decided that next time I will make the PALS handouts more colourful and use more student friendly fonts.

In this PALS class I had set up 10 pairs, I had decided to use 5 of these as control group – they did not receive any special questions on their handouts to ask their pal but they would have to make up questions on their own. This became a problem because some of the groups which were not given the special PALS paper wanted one, saying they did not know what to ask their pals. It was

at this point that I decided from next class all ten pairs would have Special PALS papers (with questions) and I would have to ensure that I give each pal in the pair a set of review questions to ask their pal buddy. In the long term however, it would be good though to get the students to the point where they were they could create their own questions after reading the handouts.

As the PALS strategy is my action research interest I will persevere with this strategy and see if it bears fruit in terms of improved student learning outcomes.

Apparently, the lesson objectives were met and the results of the students' worksheets indicated that over 75% of the class understood the concepts which were taught because they scored over 60% on the assessment.

As the students were well engaged during the conducting the experiment, the class discussion and PALS groupings there were no classroom management problems.

**SIGNATURE OF TEACHER:**



**LESSON PLAN# 2**

<b>DATE:</b> Monday, 8 <sup>th</sup> Feb 2010	<b>TIME:</b> 9:05 – 10:20am	<b>DURATION:</b> 75 minutes
<b>FORM:</b> Second (2A2)		<b>AGE RANGE:</b> 12-13 years
<b>SUBJECT:</b> Integrated Science		
<b>TOPIC:</b> Acid and Bases		<b>SUB-TOPIC:</b> Properties of Acid and Bases
<b>GENERALISATIONS:</b> Acids and Bases are chemical substance with pH less than 7 and greater than 7 respectively.		
<b>CONCEPTS:</b> Properties of Acids, Properties of Bases, pH,		
<b>OBJECTIVES:</b> <ol style="list-style-type: none"> <li>1. Transfer knowledge from last lesson to this one by answering specific questions about what was realised last class.</li> <li>2. Realise that acids have a pH less than 7 whereas bases have a pH greater than 7</li> <li>3. Conclude from the experiment that detergent is a base containing substance.</li> <li>4. State at least 4 properties of acids and 4 of bases</li> <li>5. Listen attentively to Pal during PALS session by being focused on partner and not engaging in talk with other PAL groups.</li> <li>6. Handle chemicals with due care and attention by not spilling or rushing about with the chemicals.</li> <li>7. Follow worksheet instructions to complete lab.</li> </ol>		
<b>TEACHING STRATEGIES/METHODS:</b> Guided Inquiry, Peer –Assisted Learning Strategy, Discussion – Whole Class, Experimentation		
<b>TECHNOLOGY/ MATERIALS:</b>		
<b>SET INDUCTION:</b> Ask students to identify Unknown solutions A and B by observing their colour changes with phenolphthalein and litmus indicators. Once this has been completed ask student the question ---WHAT ELSE DO YOU KNOW ABOUT ACIDS AND BASES? Jot what they say on the board. Let students know that today's class will focus on the properties of acids and bases.		
<b>LEARNING ACTIVITY/ EXPERIENCES:</b> <ul style="list-style-type: none"> <li><input type="checkbox"/> Students will discuss the activities of the last class with each other and answer questions from the teacher in order to fill out the first section of the Inquiry work sheet.</li> <li><input type="checkbox"/> Students will be invited to share answers aloud so that all the students would benefit.</li> <li><input type="checkbox"/> After section 1 of the Inquiry sheet is completed, ask the students to reassemble in their</li> </ul>		

PALS pair and read through the Inquiry –Experiment which they should begin to conduct their investigations once they have understood what they are to do.

- Remind students to fill in their worksheets as they are completing the lab.
- When finished, the whole class will discuss their findings and to students will summarise what was learnt from that Investigation.
- The students will receive their PALS handout.
- PALS will be given 10 -15 mins to read, discuss and question each other about the information which was provided.
- Students will use the information gathered at their PALS session, to complete an assessment crossword puzzle.

**ASSESSMENT PROCEDURES:**

Grading of crossword.

**CLOSURE:**

Ask each group (there are 5 whole groups) to list of 4 properties of acids and 4 properties of bases on a special sheet of paper which will then be posted in their class room.

**FOLLOW-UP ACTIVITY:**

Bring a sample of soil and household substances from home for next class.

**EVALUATION:**

The students were engaged and there no major classroom management problems. They participated well and they seem to like the PAL strategy. However, I had found it difficult to get most of the students to draw the correct conclusions from the results they have obtained. I had to use a low order questioning technique for them to build on first. This proved to me that I will have to continue to use Inquiry and Guided discovery in class in order to aid them in their development of their analytical abilities. The teaching was “just okay”.

The set objectives were met.

**SIGNATURE OF TEACHER:**

**LESSON PLAN # 3**

<b>DATE:</b> Monday, 15 <sup>th</sup> Feb 2010	<b>TIME:</b> 9:05 – 10:20am	<b>DURATION:</b> 75 minutes
<b>FORM:</b> Second (2A2)		<b>AGE RANGE:</b> 12-13 years
<b>SUBJECT:</b> Integrated Science		
<b>TOPIC:</b> Acid and Bases		<b>SUB-TOPIC:</b> pH scale
<b>GENERALISATIONS:</b> pH is a measure of how strong or weak an acid or base is.		
<b>CONCEPTS:</b> pH, neutralisation		
<b>OBJECTIVES:</b> <ol style="list-style-type: none"> <li>1. State what is pH.</li> <li>2. Realise that acid have pHs less than 7 and bases have pHs greater than 7</li> <li>3. Identify pH 7 as the neutral pH value</li> <li>4. Conduct an experiment to determine the pH of given substances.</li> <li>5. Create a coloured pH chart which reflects the pH of everyday substances.</li> <li>6. Work cooperatively with Pal during PALS session by answering the questions asked and reciprocating.</li> <li>7. Show respect for fellow lab mates by cleaning up workstation at the end of the experiment.</li> </ol>		
<b>TEACHING STRATEGIES/METHODS:</b> Peer –Assisted Learning Strategy, Discussion – Whole Class, Experimentation, Chart creation, Demonstration, Guided Inquiry		
<b>TECHNOLOGY/ MATERIALS:</b> PALS sheets - pH, acids and bases, universal indicator paper, relevant laboratory equipment, lap top, multimedia projector, Lysol, Purple Blaster, citrus fruits, vinegar, Clorox, milk, distilled water,		
<b>SET INDUCTION:</b> Show the students a large beaker of sodium hydroxide; add a few drops of universal indicator solution to the solution. Ask the students what they remember about bases. Inform the students that acid will be added to the beaker and they should observe what will happen. Ask the students what they realised about the indicator as the acid is being added. Let them know that today they will be investigating universal indicator and pH.		
<b>LEARNING ACTIVITY/ EXPERIENCES:</b> <ul style="list-style-type: none"> <li><input type="checkbox"/> Activity 1 – Experimentation: 15 – 20 mins: Pair will work to complete the experiment which is detailed on the attached sheet.</li> </ul>		

- Activity 2 – Students will reassemble for a general discussion of the results. In this session, students will be invited to share with their classmates what they have realised from the experiment and also complete the worksheet questions. The students will also be answering the teacher’s questions.
- Activity 3 – Students will reassemble in their Pal- pairs. They will read through the hand out and after they have tried to understand the material, they will ask and answers each other’s questions.
- Activity 4: Assessment – The students will be complete a clozed procedure essay on the function of pH. This will be collected and graded.

**ASSESSMENT PROCEDURES:**

Grading of essay

**CLOSURE:**

View a music video which succinctly describes the pH scale.

**FOLLOW-UP ACTIVITY:****EVALUATION:**

Teaching time was reduced to 30 mins because of an extended prayer session. As a result only objectives 4 to 7 were met. The closure was modified to a very short lecture. Next class, the remaining objectives will be emphasised. The students participated well in the Inquiry experiment and most groups cooperated nicely.

The teacher might have been a bit rushed because I wanted the students to complete the experiment part entirely. This is so that next class, a thorough discussion of the results could occur. A fair session only.

**SIGNATURE OF TEACHER**

**LESSON PLAN # 4**

<b>DATE:</b> Thursday, 18 <sup>th</sup> Feb 2010	<b>TIME:</b> 10:25 – 11:35 am	<b>DURATION:</b> 70 minutes
<b>FORM:</b> Second (2A2)		<b>AGE RANGE:</b> 12-13 years
<b>SUBJECT:</b> Integrated Science		
<b>TOPIC:</b> Acid and Bases		<b>SUB-TOPIC:</b> pH scale cont'd
<b>GENERALISATIONS:</b> pH is a measure of how strong or weak an acid or base is.		
<b>CONCEPTS:</b> pH, neutralisation		
<b>OBJECTIVES:</b> <ol style="list-style-type: none"> <li>1. Realise that acids have pHs less than 7 whereas bases have pHs which are greater than 7.</li> <li>2. Express that the larger the pH value the more basic the solution is.</li> <li>3. Name pH 7 as the neutral pH value</li> <li>4. Define what the word neutral means.</li> <li>5. Classify substances based on their pH</li> <li>6. Give full attention to Pal during PALS session by answering the questions asked and reciprocating.</li> <li>7. Show respect for fellow lab mates by not speaking when someone else is addressing the class during the class discussion.</li> </ol>		
<b>TEACHING STRATEGIES/METHODS:</b> Peer –Assisted Learning Strategy, Discussion – Whole Class, Questioning, Reading		
<b>TECHNOLOGY/ MATERIALS:</b> PALS sheets - pH, lap top, multimedia projector, blackboard,		
<b>SET INDUCTION:</b> Let the students know that because class was only one period on Monday we now have to continue the lesson. Ask the class if they remembered what they did on Monday. After which a video which shows a young boy performing similar tests will be shown. Invite one student to describe any differences they noticed between what they did or used and what he did or used.		
<b>LEARNING ACTIVITY/ EXPERIENCES:</b> <ul style="list-style-type: none"> <li><input type="checkbox"/> Ask a student to share out the work papers which were collected from the last class.</li> <li><input type="checkbox"/> Activity 1: Remind the students to reassemble in their groups to discuss and write down any patterns or observations that they made from the experiment.</li> </ul>		

- Activity 2: Students will reassemble for a general class discussion of the results. In this session, students will be invited to share with their classmates what they have realised from the experiment and also complete the worksheet questions. The students will also be answering the teacher's questions.
- Activity 3: Invite students to watch a video and view which summaries the important facts they had discovered about pH.
- Activity 4: Students will reassemble in their Pal- pairs. They will read through the hand out and after they have tried to understand the material, they will ask and answers each other's questions.
- Activity 5: Assessment – The students will then complete a clozed procedure essay on the function of pH. This will be collected and graded.

**ASSESSMENT PROCEDURES:**

Grading of essay

**CLOSURE:**

Power point presentation which summaries the pH scale.

**FOLLOW-UP ACTIVITY:****EVALUATION:**

From the results of the assessment all the students grasped the topic and its content very well. All of the set objectives were met and the biggest problem in the lesson was that some students still are not waiting their turns to share their ideas. Even though I am insisting that they raise their hand or wait until I call on them, they seem to get carried away with wanting to give their inputs. I will continue to work on this. The strategies were highly effective especially the PALS and the review PowerPoint as the closure.

**SIGNATURE OF TEACHER:**

**LESSON PLAN # 5**

<b>DATE:</b> Monday, 22 <sup>nd</sup> Feb 2010	<b>TIME:</b> 9:05 – 10:15 am	<b>DURATION:</b> 70 minutes
<b>FORM:</b> Second (2A2)		<b>AGE RANGE:</b> 12-13 years
<b>SUBJECT:</b> Integrated Science		
<b>TOPIC:</b> Acids + Bases Chemistry		<b>SUB-TOPIC:</b> Neutralisation
<b>GENERALISATIONS:</b> When acids and bases react a salt and water are produced		
<b>CONCEPTS:</b> Neutralisation, pH 7		
<b>OBJECTIVES:</b> <ol style="list-style-type: none"> <li>1. Describe how a sample of sodium chloride is prepared from hydrochloric acid and sodium hydroxide.</li> <li>2. State that the point of neutralisation is observe the colour change of the solution with an indicator e.g. phenolphthalein.</li> <li>3. Notice that the reaction between an acid and a base produces a salt and water.</li> <li>4. Define neutralisation</li> <li>5. Record their observations on the student worksheet</li> <li>6. Listen attentively while classmates are sharing their ideas, not talking when they are speaking.</li> </ol>		
<b>TEACHING STRATEGIES/METHODS:</b> Discussion – whole class, Questioning, Demonstration, Independent observation, Note making, Brainstorming, PALS		
<b>TECHNOLOGY/ MATERIALS:</b> Multimedia projector, laptop, worksheets,		
<b>SET INDUCTION:</b> Show the students a sample of salt but do not tell them what it is. Give them a few clues about the substance. Ask them –What they think it is? Where they believed it came from? How was it made? Show students a video clip. Then ask the questions again. Let them know that they could make salts in the lab using acids and bases in a process called neutralisation. Inform them that they will be studying this today.		
<b>LEARNING ACTIVITY/ EXPERIENCES:</b> <u>Demonstration and Note taking:</u> <ul style="list-style-type: none"> <li><input type="checkbox"/> Invite the students to watch a video entitled – Neutralisation.</li> <li><input type="checkbox"/> Ask students to make the sub-heading Preparation of An Acid- Base salt in their books and to write down what was happening in the video as it progresses under the sub-heading.</li> </ul>		

**Whole Class discussion and questioning**

- After the demonstration, ask the students to orally describe what they realised had occurred in the demonstration.
- Invite the students to answer the following questions:
  1. What was produced when the acid and base combined?
  2. If they had to name it what would they call it?
- Invite the students to participate in a brief interactive lecture lead by the teacher on Neutralisation and how to name the salts which are produced. During this lecture, they should make notes and ask questions to clarify any confusing areas.

**PALS activity and assessment**

- The students should assemble in their PALS pairs and read through the handout and ask each other the questions which are supplied.
- After the PALS have completed their peer coaching, they will individually complete the assessment activity – Write an essay of not less than ten lines which contains the following information:
  1. Describe the process of neutralisation. 4 marks
  2. Why is an indicator usually used during the neutralisation process? 1 marks
  3. How is the name of a salt determined? 2 marks
  4. Give the names of the salts which are formed from: a) sulphuric acid b) hydrochloric acid and c) nitric acids 3 marks
  5. Completion of equations: 5 marks

**ASSESSMENT PROCEDURES:**

The essay

**CLOSURE:**

Ask students to recap the salient points of the lesson.

**FOLLOW-UP ACTIVITY:****EVALUATION:**

My set induction was not effective at all. The students were able to identify the substance as salt but most of them did not seem to understand what was happening in the video clip. They complained that they could not understand what the child was saying. I have to be more aware of this when I am using these clips. Also, I lost valuable time when I was trying to locate the second video which I had wanted to show them. I had planned but these things do happen.

I was disappointed that when the second video of the salt production was played only a few students jotted down notes in their book. Clearly I have to develop this skill in them. Even after the video, they still had difficulty grasping the concepts involved in salt production. I will try to overcome this next class by letting them make the salts first hand.

**SIGNATURE OF TEACHER:**



**LESSON PLAN # 6**

<b>DATE:</b> Thursday, 25 <sup>th</sup> Feb 2010	<b>TIME:</b> 10:20 -11:35 am	<b>DURATION:</b> 75 minutes
<b>FORM:</b> Second (2A2)		<b>AGE RANGE:</b> 12-13 years
<b>SUBJECT:</b> Integrated Science		
<b>TOPIC:</b> Acids and Bases		<b>SUB-TOPIC:</b> Preparing a salt
<b>GENERALISATIONS:</b> When an acid and base react together a salt and water are produced		
<b>CONCEPTS:</b> Neutralisation, pH		
<b>OBJECTIVES:</b> <ol style="list-style-type: none"> <li>1. Produce a salt by reacting an acid with a base</li> <li>2. Indicate the point of neutralisation using indicator</li> <li>3. Explain the theory behind salt production</li> <li>4. Handle chemicals carefully so as to avoid spills</li> <li>5. Participate in the activity</li> <li>6. Take care when travelling with the apparatus so as to avoid breakage.</li> <li>7. Mix small amounts of acid to the base until the point of neutralisation is indicated.</li> </ol>		
<b>TEACHING STRATEGIES/METHODS:</b> Experiment, PALS, Discussion,		
<b>TECHNOLOGY/ MATERIALS:</b>		
<b>SET INDUCTION:</b> Give each pair a card which has a chemical formula of a salt on it. Ask the students what their different formula mean. After they figure out what their meant, let them know that that's the salt they will be making today.		
<b>LEARNING ACTIVITY/ EXPERIENCES:</b> <ul style="list-style-type: none"> <li><input type="checkbox"/> Students assemble in pairs.</li> <li><input type="checkbox"/> Collect worksheets and apparatus as needed.</li> <li><input type="checkbox"/> Follow instructions on the worksheet to create their salt.</li> <li><input type="checkbox"/> Complete discussion guide.</li> <li><input type="checkbox"/> Work in Pals groups to read attached hand out and answer the assessment questions which come after.</li> </ul>		
<b>ASSESSMENT PROCEDURES:</b> Worksheet with equations		

**CLOSURE:**

Invite a student to describe how their salt was created.

**FOLLOW-UP ACTIVITY:**

Review notes on Salt formation

**EVALUATION:**

Generally the objectives were met; however the students seemed more interested in making their salts than in discussing and answering the probing questions I was asking regarding the salt preparation process. So I decided to stop asking questions throughout the experiment and wait until they had finished. This seemed to work because the students completed the experiment faster and also they were more focused when I restarting the discussion segment.

My teaching could have been better, though it was good that I changed strategy when I want to discuss the results with the students, I still felt as if I needed to ask higher order thinking questions. I felt as if I needed to get the students to analyse their results and make conclusions on their own with little input from me.

I am impressed with the PAL strategy because students in their pairs were trying to understand the concepts. It is definitely beneficial to the learning process of the students. The students enjoyed the experiment and this was great because it enable d them to apply the theory first hand.

There were no Classroom management issues.

**SIGNATURE OF TEACHER:**

**LESSON PLAN #7**

<b>DATE:</b> Monday, 1 <sup>st</sup> March 2010	<b>TIME:</b> 9:05 – 10:15 am	<b>DURATION:</b> 70 minutes
<b>FORM:</b> Second (2A2)		<b>AGE RANGE:</b> 12-13 years
<b>SUBJECT:</b> Integrated Science		
<b>TOPIC:</b> Acid and Base Chemistry		<b>SUB-TOPIC:</b> Preparing Copper Sulphate
<b>GENERALISATIONS:</b> An insoluble <b>metal oxide</b> reacts with a <b>dilute acid</b> to form a <b>soluble salt</b> .		
<b>CONCEPTS:</b> <b>Salt formation, Dehydration</b>		
<b>OBJECTIVES:</b> <ol style="list-style-type: none"> <li>1. Describe how copper sulphate salt can be prepared</li> <li>2. Apply the reaction of neutralisation to solve real life problems</li> <li>3. Give reasons for the colour change which are observed when the copper oxide and sulphuric acid combine</li> <li>4. Prepare a sample of copper sulphate</li> <li>5. Measure liquid accurately using a measuring cylinder</li> <li>6. Heat mixture carefully on the tripod with a gentle blue flame.</li> <li>7. Attentive to the mixture especially while it is on the tripod so that it is not knocked over</li> <li>8. Complete acid-base reactions to give the correct salt</li> <li>9. Take care when adding the solid to the beaker, to avoid knocking the beaker over.</li> </ol>		
<b>TEACHING STRATEGIES/METHODS:</b> PALS, Lecture – Discussion, Experiment,		
<b>TECHNOLOGY/ MATERIALS:</b> relevant laboratory materials, laboratory sheets , PAL worksheets, Over Head Projector and transparencies		
<b>SET INDUCTION:</b> Tell the class that they will be preparing a special salt today. Show them a picture of the salt on the OHP and ask them if they know what it is? They really should not be able to tell me what the salt is. Inform them that by the end of the lesson they will be able to identify it in addition to describe how it is prepared.		
<b>LEARNING ACTIVITY/ EXPERIENCES:</b> <b>Activity 1 – Experiment to prepare copper sulphate crystals.</b> <ul style="list-style-type: none"> <li><input type="checkbox"/> Invite the students to read through the handout with instructions on the preparation of the salt and ask any question to clarify anything which may not be clear.</li> </ul>		

- Remind the students that they will be assessed using the following criteria:
  1. Lighting the Bunsen burner correctly
  2. Measuring the acid accurately
  3. Weighing out the prescribed amount of copper oxide.
  4. Mixing the reactant carefully
  5. Folding the filter paper correctly
- The students will start the experiment after they are sure they understand what they have to do.
- As the teacher circulates, individual groups will be asked to orally answer questions as they conduct the experiment

### **Activity 2 – Class discussion about what went on in the experiment.**

- After the experiment, the students will reassemble, discuss and share their findings with the whole group.
- In addition they will answer probing questions from the teacher in order to ensure that they understand the naming of salts, their preparation and the process of neutralisation. After this they will complete their worksheet.

### **Activity 3 – PALS**

- Students will work in their PALS pairs to question each other after they have read the attached handout on the uses of neutralisation.
- After the PALS are sure that they understand of today's concepts well, they will be assessed by completing a worksheet on neutralisation.

### **ASSESSMENT PROCEDURES:**

Completed worksheet.

### **CLOSURE:**

The teacher will give three scenarios which would be solved with the use of neutralisation. The problems are:

1. Shane has an upset stomach what should he do and why?
2. Adrielle's plants are not growing well; maybe the soil is too acidic. What can be done to solve this?
3. Kishmar was stung by a bee. How would you help him?

Three students will be selected to answer how neutralisation plays a part in solving these problems.

### **FOLLOW-UP ACTIVITY:**

Research two other uses of neutralisation for homework.

### **EVALUATION:**

Using the Over head projector in itself was a good set induction because the student wanted to

know what it was when I plugged it in, so the OHP was a good attention grabber. I quickly shifted their attention onto the real focus of the lesson – the salt. They did not know that salts came in different colours so they were amazed when I told them that the giant crystal which was being projected was the salt they were going to be making today.

The students were generally interested in reactions and the colour changes which were occurring. The set objectives were met and as I rotated amongst the students I was able to sort out any problems, which were few in number. The main problem was the long wait for the reagents since there was only one bottle of copper oxide. I felt the teaching went fairly good and the PALS was even better. I was concern about the quantity of glassware and hot substances the students had to handle but they were very responsible and focused. So there were no breakages or accidents.

**SIGNATURE OF TEACHER:**

**LESSON PLAN # 8**

<b>DATE:</b> Thursday, 4 <sup>th</sup> March 2010	<b>TIME:</b> 10:20 -11:35 am	<b>DURATION:</b> 75 minutes
<b>FORM:</b> Second (2A2)		<b>AGE RANGE:</b> 12-13 years
<b>SUBJECT:</b> Integrated Science		
<b>TOPIC:</b> Acid and Base Chemistry		<b>SUB-TOPIC:</b> Other Reactions involving Acids
<b>GENERALISATIONS:</b> Acids produce carbon dioxide gas with carbonates and hydrogen gas when reacted with metals.		
<b>CONCEPTS:</b> Acid-carbonate reactions, Acid-metal reactions		
<b>OBJECTIVES:</b> <ol style="list-style-type: none"> <li>1. Agree that acids release carbon dioxide when they react with carbonates</li> <li>2. State that acids react with metals to produce hydrogen gas</li> <li>3. Identify hydrogen gas using the lighted splint which pops test</li> <li>4. Identify carbon dioxide gas using bicarbonate indicator solution or limewater</li> <li>5. Determine the name of the salt which is produced when acid and carbonates react</li> <li>6. Identify the salt which is produced when an acid and metal react</li> <li>7. Complete equations to show what happens when an acid reacts with a carbonate or metal.</li> <li>8. Carefully handle laboratory equipment and reagents with care to avoid any accidents</li> <li>9. Follow the instructions which are on the worksheet</li> <li>10. Connect equipment as depicted on worksheet so that the presence of carbon dioxide may be tested.</li> </ol>		
<b>TEACHING STRATEGIES/METHODS:</b> PALS, Demonstration, Experiment, Discussion, Computer Assisted Learning		
<b>TECHNOLOGY/ MATERIALS:</b> relevant laboratory materials, multimedia projector, overhead projector, laboratory worksheets, pal sheets, assessment cards		
<b>SET INDUCTION:</b> Two Petri dishes containing dilute sulphuric acid will be placed on an OHP. A small piece of magnesium ribbon will be added to one dish and a small amount of copper (II) carbonate to the other dish. Then the students will be asked to describe what they see. Hopefully they would realise that a gas was produced in each case. See if any of them know what the name of the gases which were produced. Inform the students that today's lesson will be about the reactions of acids with carbonates and		

metals.

### **LEARNING ACTIVITY/ EXPERIENCES:**

#### **Activity 1 – Experiment with acids and carbonates**

- Invite the students to assemble in their pairs at their workstations after they had collected a lab sheet.
- Students should read through the worksheet, ask any questions that they may not be sure about and then collect apparatus which is needed.
- They then conduct the experiment and record all relevant observations on the lab sheets.

#### **Activity 2 – Class discussion of the results**

- After the experiment has been conducted, ask the students to refocus their attention to the front of the class (to the teacher) who will then lead a discussion of the results. Students should be invited to share their thought and views on what they observed in the experiment.
- The teacher should ask probing questions to ensure that the students understand that the products of acid and carbonate reactions are carbon dioxide, a salt and water.
- Once the students have grasped this first concept, they should be encouraged to write an equation which describes what transpired in the reaction.
- Then ask the students to start the next activity.

#### **Activity 3 – Experiment with the metals**

- Remind the students to** follow the remaining instructions on the lab sheet to determine the products of the reaction between acid and metals.
- They are to fill in the lab sheet as they go.
- After they have completed the lab work, ask them to reassemble for a discussion of the results. Like before, they will share their findings and draw conclusions.

#### **Activity 4 – Pals review and assessment**

- The students will pair up with their pals, read through the attached hand out and quiz each other on the information they had just read and the activities of the lesson.
- After they have completed their PALs activity and are sure that they understood today's concepts. The pairs will be given worksheets which contain statements about the reactions they had just studied and they are to classify the statements as true or false.
- The sheets are to be completed individually and the sheet will be collected for assessment.

### **ASSESSMENT PROCEDURES:**

Worksheets with sorted cards

### **CLOSURE:**

Students will view a short Computer generated lesson on the reaction of acids with metals and carbonates.

### **FOLLOW-UP ACTIVITY:**

### **EVALUATION:**

This was a great lesson. The set induction in the words of a student was 'cool'. All of the objectives

were met and I am seeing some improvement in the students' experimental techniques. The students were on task and the experiment aspect of the lesson was efficiently completed. Using the Computer assisted technology was an effective method to recap the salient points of the lesson.

**SIGNATURE OF TEACHER:**



**LESSON PLAN # 9**

<b>DATE:</b> Monday, 8 <sup>th</sup> March 2010	<b>TIME:</b> 9:05 – 10:15 am	<b>DURATION:</b> 70 minutes
<b>FORM:</b> Second (2A2)		<b>AGE RANGE:</b> 12-13 years
<b>SUBJECT:</b> Integrated Science		
<b>TOPIC:</b> Acid, Bases and Salts		<b>SUB-TOPIC:</b> Review 1
<b>GENERALISATIONS:</b> nil		
<b>CONCEPTS:</b> Acids, Bases, Neutralisation, Indicators, pH,		
<b>OBJECTIVES:</b> <ol style="list-style-type: none"> <li>1. Create a revision workbook</li> <li>2. Handle the photocopier with care by not slamming the door on the scanner glass</li> <li>3. Discuss with group members who will work on which aspect of the workbook and then inform the teacher of the decision.</li> <li>4. Share the glue and other materials, with members of the class without quarrelling over which group has what.</li> <li>5. State the properties of acids, bases and neutral substances</li> <li>6. Describe how indicators are used to identify acids, bases and salts.</li> <li>7. Define pH</li> <li>8. Give examples of the importance of neutralisation in everyday life</li> <li>9. List the products of reactions between acids and carbonates or metals.</li> </ol>		
<b>TEACHING STRATEGIES/METHODS:</b> Cooperative Learning – Group investigation, PALS, Science Booklet		
<b>TECHNOLOGY/ MATERIALS:</b> Textbook, construction paper, glue, crayons, markers		
<b>SET INDUCTION:</b> Inform the students that they have reached the end of the unit on Acids, Bases and salts and that in preparation for their test next week, today will be a review session. Tell them that they will in their PAL pairs create a Booklet with questions and answers to inform other Barbadian children about Acids, Bases and salts.		
<b>LEARNING ACTIVITY/ EXPERIENCES:</b> Activity 1- Booklet creation (30 mins) <ul style="list-style-type: none"> <li><input type="checkbox"/> Invite students to collect the materials they will need to create their revision booklets. Let them know that however they want to present the information is up to them but their booklet must include the following areas:</li> </ul>		

1. The differences in properties between acid and bases
2. How to identify acids and bases
3. pH and its use
4. Neutralisation and examples of its importance in everyday life
5. Acid reactions with metals and carbonates

Activity 2 – Photocopy workbook (10 mins)

- Invite the students to use the copier to make two copies of their workbook.

Activity 3 – PALS activity (15 mins)

- Invite groups to exchange their booklets with each other.
- The groups should use the booklets to question their Pals in an attempt to see how well the booklets work, if they are helpful in revision and give the booklet a score based on the attached rubric.

#### **ASSESSMENT PROCEDURES:**

The completed booklets

#### **CLOSURE:**

Invite students to recap what they need to revise for their test.

#### **FOLLOW-UP ACTIVITY:**

Review pages 23-38 of textbook and notes in preparation for test.

#### **EVALUATION:**

The students were really curious to see the work books which they did not work on. I asked them if they were really going to use the books to revise from and the majority of them answered yes. The strategies I used were quite effective.

None of the students were overwhelmed with the section they had to complete and when they collated their workbooks, one could see that they were very proud of their creations. They also like using the photocopier (my all in one HP from home). So a duplicate of each workbook was made and sent to the office so that each student could get a personal copy of one of the five booklets. When I assessed the booklets all of the students scored well on the exercise. I would use this again but not too often because it calls for a lot of resources.

#### **SIGNATURE OF TEACHER:**

**LESSON PLAN # 10**

<b>DATE:</b> Monday, 15 <sup>th</sup> March 2010	<b>TIME:</b> 9:05 – 10:15 am	<b>DURATION:</b> 70 minutes
<b>FORM:</b> Second (2A2)		<b>AGE RANGE:</b> 12-13 years
<b>SUBJECT:</b> Integrated Science		
<b>TOPIC:</b> Acids and Bases		<b>SUB-TOPIC:</b> Review
<b>GENERALISATIONS:</b> nil		
<b>CONCEPTS:</b> Acids, Bases, Neutralisation, Indicators, pH scale		
<b>OBJECTIVES:</b> <ol style="list-style-type: none"> <li>1. Define pH</li> <li>2. State the properties of acids, bases</li> <li>3. Describe neutralisation</li> <li>4. Give everyday uses of the neutralisation reaction</li> <li>5. Explain how indicators function</li> <li>6. <b>Write</b> equations for the reactions between acids and bases</li> <li>7. <b>Recall how the name of the salt is determined</b></li> <li>8. Participate in activities by answering or asking question</li> </ol>		
<b>TEACHING STRATEGIES/METHODS:</b> PALS, Class discussion, Game Show – Wheel of fortune		
<b>TECHNOLOGY/ MATERIALS:</b> Multimedia projector, workbooks which were created by students		
<b>SET INDUCTION:</b> Inform the students that their test is scheduled for Thursday this week. So today's session is a review of all that was covered under the area of acids, bases and salts.		
<b>LEARNING ACTIVITY/ EXPERIENCES:</b> <p>Activity 1: Working with PALs to answer questions in the workbook</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> Invite students to collate the workbooks.</li> <li><input type="checkbox"/> Then ask and answer questions to each other in their pal pairs.</li> </ul> <p>Activity 2: Discussing any weak areas</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> Allow the students to reform a whole class group</li> <li><input type="checkbox"/> Invite them to share any problems or difficulties they had encountered of points that they need clarification on.</li> </ul>		

**Activity 3: Wheel of fortune Game**

- Ask the students to form three large groups (of 7 students).
- Tell each student to choose a number between 1 and 7 and write a question on the index card with that number. They must supply the answer on the card as well.
- Spin the Wheel (on the multimedia); ask the 1<sup>st</sup> group to choose someone from the second group to answer the question which was identified.
- Then let the 2<sup>nd</sup> group ask the 3<sup>rd</sup> and the 3<sup>rd</sup> group the 1<sup>st</sup>.
- Every correct answer gives the group a point. Incorrect answers will be passed on and the points will be doubled.

**ASSESSMENT PROCEDURES:**

Judgement based on how students answered the questions in the game.

**CLOSURE:**

Allow students to recap what they have to revise for their test.

**FOLLOW-UP ACTIVITY:**

Revise of test.

**EVALUATION:**

The review session as good. The students approached the game very much like the television version. At times the students were a bit noisy but when they usually recognised when this happened and they quickly lowered their voices. This was a suitable lesson for the end of term when students were usually very tired.

**SIGNATURE OF TEACHER:**

**LESSON PLAN - The Test**

<b>DATE:</b> Mon, March 22nd 2010	<b>TIME:</b> 9:00 – 10:15 am	<b>DURATION:</b> 75 minutes
<b>FORM:</b> Second (2A2)		<b>AGE RANGE:</b> 12-13 years
<b>SUBJECT:</b> Integrated Science		
<b>TOPIC: ACIDS, BASES &amp; INDICATORS</b>		
<b>GENERALISATIONS:</b> Neutralisation reaction results when an acid and base chemically combine. This type of reaction is only one of the many reactions on which life depends.		
<b>CONCEPTS:</b> pH, neutralisation,		
<b>OBJECTIVES:</b> See Table of Specification		
<b>TEACHING STRATEGIES/METHODS:</b> Testing		
<b>TECHNOLOGY/ MATERIALS:</b> Test paper		
<b>SET INDUCTION:</b> Students will be told that this test is to determine how much they know about the topic acid, bases and salts. The students will be reminded that these marks would be contributed towards their end of term marks.		
<b>LEARNING ACTIVITY/ EXPERIENCES:</b> Tell the students to try their best but do not become frustrated if they cannot answer all the questions. Then allow them to complete the test in the given time frame.		
<b>ASSESSMENT PROCEDURES:</b> Test		
<b>CLOSURE:</b> Collect the test material, thank the students and inform them that we will be studying the states of matter in the next class and that they should read ahead on this.		
<b>FOLLOW-UP ACTIVITY:</b>		
<b>EVALUATION:</b> 95% of the students passed this test; however, the area which was the most poorly completed was		

the application part of question 3. This indicated that much work still has to be in the development of the analytical skills of my students.

**SIGNATURE OF TEACHER:**

### ***2.2.4 Assessment of the Strategy***

The effectiveness of the Peer Assisted Learning Strategy was determined using the Pre and Post Tests results of a topic taught without the use of PALS (Reactions) and the Topic taught with the use of PALS (Acids- Bases). Both topics were taught in the same term.

After the Acid-Base sub-unit was completed, the students were reassessed using the pencil paper test which was used for their Pre-test. The difference in percentage between the Post and Pre Tests was used to indicate how much learning for the topic has occurred. These results were compared to the difference of the Post and Pre tests percentage for the topic before the PALS was implemented.

At the end of the investigation, a questionnaire was developed to obtain feedback from the students regarding the pros and cons of the Peer Assisted Learning Strategy. Walonick (1993) recommends that the use of questionnaires is a convenient way of gathering information from a target population. Questionnaires are easy to analyze, and most statistical analysis software can easily process them. Questionnaires are familiar to most people nearly everyone has had some experience completing questionnaires.

The first two questions in the survey instrument elicited background information characteristics of the respondents. This information is shown in the description of the sample. The remaining items on the questionnaire consisted of eleven fixed response items and five opened question. The main reason for using fixed response questions was because they are quick to answer and they limited the response which could be given. Fixed response items consisted of a modified Likert rating scale with the options of YES AND NO.

Figure 1 shows the table of Specification indicating the allocation of survey items to research question is found below.

**TABLE 3 OF SPECIFICATION FOR RESEARCH QUESTIONS**

Research Question	Question #
(1) Would an improvement in academic achievement (cognition) be shown in both the High and Low achieving students who are present in the class with the use of the PALS?	3, 4, 5 and 19
(2) Is Reciprocal Peer Assisted Learning Strategy a teaching strategy that students would want to use continuous throughout the Science course?	6, 7, 10, 16, 17 and 18
(3) Would working in pairs improve the student – student social relationships which exist in the class?	8, 9, 11, 12, 13, 14 and 15

The responses were coded using the variables in the responses to determine the coding guide. The open-ended questions were coded and quantified.

### ***2.2.5 Data analysis***

The data which was provided by these questionnaires was organised using an Excel spread sheet and a basic statistical analysis of the percentages students responding yes and no were calculated for each fixed question. Graphs, where necessary, of these results were plotted to achieve easier visual comparison of the results.



### **3. - EVALUATION OF THE RESEARCH**

The first research question wanted to determine if there was an improvement in academic achievement (cognition) in both the High and Low achieving students when PALS was used. To investigate this, a comparison of the Pre and Post test results of the students for the Reaction end of topics test and the Acid-Base end of Topic test was used. Table 4 and Figures 1 indicate the results of these tests.

In addition, Questions 3, 4, 5 and 19 on the students' response questionnaire were used to obtain the students' perception of how much the Peer Assisted Learning Strategy had contributed to their academic achievement. Question 4 was a free response question. These results are shown in Figure 2 below.

#### **END OF TOPIC PENCIL AND PAPER TEST RESULTS**

From the results in Table 4, next page, most noticeable was the tremendous increase (45%) in the mean of the Post test scores of the Acid- Base (WITH PALS) topic when compared to the mean of the Pre-test score of the same topic. Whereas for the Reaction topic (WITHOUT PALS) there was only an 8% increase in the Mean Post Test scores over the Pre-Test scores.

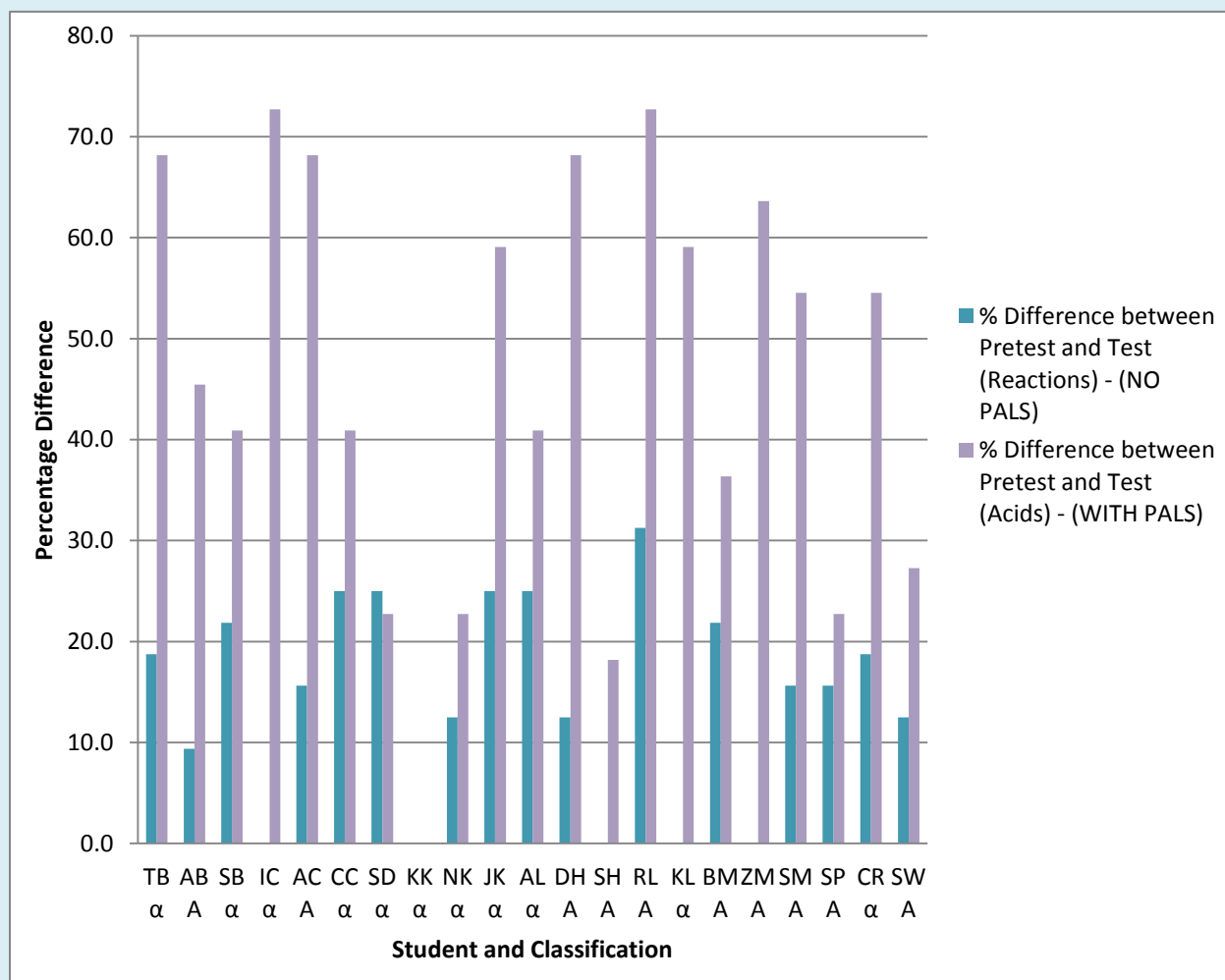
**FIGURE 2a: TABLE SHOWING THE RESULTS IN PERCENTAGE FOR THE PRE – TEST AND END OF TOPIC POST TEST: REACTIONS FOR THE STUDENTS IN THE SCIENCE GROUP**

<b>Student Initials and Classification</b>	<b>%Pre test Reaction</b>	<b>%Post Test Reaction (WITHOUT PALS)</b>	<b>% Differences between the Post and Pre Test for the Reaction</b>
TB $\alpha$	53.1	71.9	18.8
AB A	43.8	53.1	9.4
SB $\alpha$	43.8	65.6	21.9
IC $\alpha$	56.3	56.3	0.0
AC A	46.9	62.5	15.6
CC $\alpha$	53.1	78.1	25.0
SD $\alpha$	34.4	59.4	25.0
KK $\alpha$	43.8	0.0	0.0
NK $\alpha$	46.9	59.4	12.5
JK $\alpha$	50.0	75.0	25.0
AL $\alpha$	43.8	68.8	25.0
DH A	59.4	71.9	12.5
SH A	65.6	65.6	0.0
RL A	50.0	81.3	31.3
KL $\alpha$	50.0	0.0	0.0
BM A	43.8	65.6	21.9
ZM A	43.8	0.0	0.0
SM A	31.3	46.9	15.6
SP A	43.8	59.4	15.6
CR $\alpha$	46.9	65.6	18.8
SW A	46.9	59.4	12.5
Mean	47.5	55.5	14.6
STD	7.6	24.6	9.9
# of student who passed	8.0	17.0	0.0
# of students who failed	13	1	
		3 abs	18.8

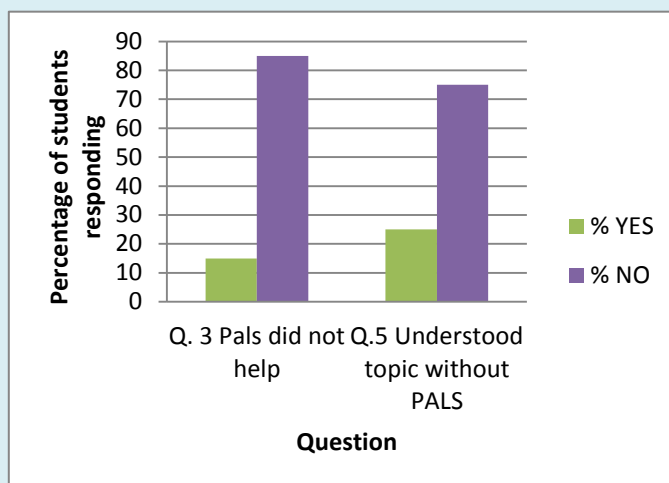
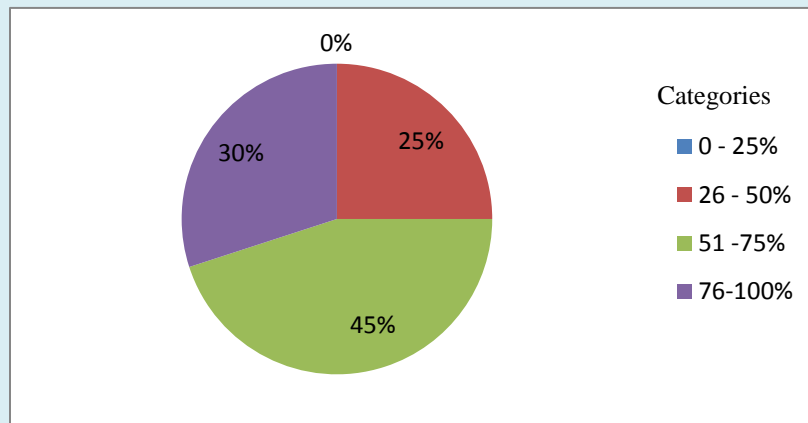
**FIGURE 2b: TABLE SHOWING THE RESULTS IN PERCENTAGE FOR THE PRE – TEST AND END OF TOPIC POST TEST; ACIDS & BASES, FOR THE STUDENTS IN THE SCIENCE GROUP**

<b>Student Initials and Classification</b>	<b>% Pre Test Acids</b>	<b>% Post Test Acids (WITH PALS)</b>	<b>% Differences between the Post and Pre Test for the Acid</b>
TB $\alpha$	18.2	86.4	68.2
AB A	13.6	59.1	45.5
SB $\alpha$	27.3	68.2	40.9
IC $\alpha$	4.5	77.3	72.7
AC A	4.5	72.7	68.2
CC $\alpha$	45.5	86.4	40.9
SD $\alpha$	27.3	50.0	22.7
KK $\alpha$	31.8	0.0	0.0
NK $\alpha$	27.3	50.0	22.7
JK $\alpha$	27.3	86.4	59.1
AL $\alpha$	18.2	59.1	40.9
DH A	9.1	77.3	68.2
SH A	22.7	40.9	18.2
RL A	0.0	72.7	72.7
KL $\alpha$	4.5	63.6	59.1
BM A	18.2	54.5	36.4
ZM A	18.2	81.8	63.6
SM A	4.5	59.1	54.5
SP A	31.8	54.5	22.7
CR $\alpha$	13.6	68.2	54.5
SW A	27.3	54.5	27.3
Mean	18.8	63.0	45.7
STD	11.7	19.6	20.9
# of student who passed	0.0	19.0	
# of students who failed	21	1	
		1 abs	

**FIGURE 3: BAR GRAPH SHOWING DIFFERENCE IN THE PERCENTAGE OBTAINED BETWEEN THE REACTION AND ACID – BASE TESTS FOR EACH STUDENT**



It was observed that all of the students showed improvement in the test results of both topics when compared to the pre-test results. However, in all but one case (SD), there was a significantly greater increase in the results the students had obtained in the topic area in which PALS was applied. All of the High and Low achieving ( $\alpha$  and A) students, except SD, registered a greater cognitive improvement with the PALS topic than without.

THE QUESTIONNAIRE**FIGURE 2: BAR GRAPH SHOWING THE PERCENTAGES OF STUDENTS ANSWERING YES OR NO FOR QUESTIONS 3 and 5 OF THE QUESTIONNAIRE****FIGURE 3: PIE CHART INDICATING THE PERCENTAGES OF STUDENTS SELECTING CATEGORIES TO INDICATE PERCENTAGEWISE HOW MUCH THE PEER ASSISTED LEARNING STRATEGY HELPED THEM FOR QUESTION 19 OF THE QUESTIONNAIRE**

The results expressed in Figures 2 and 3, provide further support as to the perceived importance of the use of the PAL strategy in promoting greater cognitive development. More than 70% of the students stated that PALS was beneficial in their understanding of the Acid-Base Topic. In addition, an overwhelming 75% of the students quantified that the technique aided them in understanding more than 50% of the topic content.

Reasons by given by the students to explain their answers to Question 3 included:

**Applewhaite (2010)**

*“The things I did not understand my pals understood” (4), “we shared answers, opinions, putting the pieces together” (5) and “we helped encourage each other to do the work” (4),*

**Please note that the number in brackets indicated the quantity of similar responses.**

These free responses indicated that most students like using the PALS because of the cooperative behaviour and individualise attention which is generated by the strategy. As indicated by Bloom (1984), Slavin (1980) and Greenwood et al. (1988) in the literature review.

The second research question focused on determining if Reciprocal Peer Assisted Learning Strategy was a teaching strategy which students would want to use continuously throughout the Science course and why. Questions 6, 7, 10, 16, 17 and 18 sought to investigate this question.

Question 6 and free response Question 7 explored if students would recommend that PALS be used more often in Science class. Question 10 wanted to determine if the PALS sheet helped the students to understand the topic while Question 16 asked students to choose, from a predetermined list, the ways in which the PALS helped them. The approach of being assessed each session was examined by Questions 17 and 18. Figure 5 below shows the results for these items. It must be noted that Questions 7 and 18 were open ended questions. So the results for these are summarised at the end.

**FIGURE 4: TABLE SHOWING THE PERCENTAGES OF STUDENTS ANSWERING YES OR NO FOR QUESTIONS 6, 10, 16, and 17 OF THE QUESTIONNAIRE**

Question	% Responding	
	Yes	No
Q.6 Recommend PALS be used more often in Science Class	85	15
Q.10 The reading sheets really helped	100	0
Q.16 I had someone my age explain what I did not know	65	35
b. I had more time to hang out with my pal	5	95
c. I found it easier to ask my pal a "silly" question than the teacher	55	45
d. I had more time to read and understand what was taught	80	20
e. I really had to know my work well in order to help my pal	65	35
f. I was comfortable with my pal	40	60
g. I had some "chill out" time with my pal	20	80
Q.17 I did not like getting an assessment at the end of each session	21	79

The results reflect that PAL Strategy is one that students would want to use continuously throughout the course. This was substantiated in the student’s free responses which were “*some people depend on their pals*” (1), “*I would not have understood the topic on my own, my pal helped me*” (9), “*it helped me to understand the topic better*” (3), “*it helps when a person your age explains it to you*” (1) and “*without the pal it would be hard to correct myself when I made a mistake*” (2). However, main reasons supplied by those students who did not want to continue the strategy were “*PALS is a distraction or is problematic*” (2). **Please note that the number in brackets indicated the quantity of similar responses.**

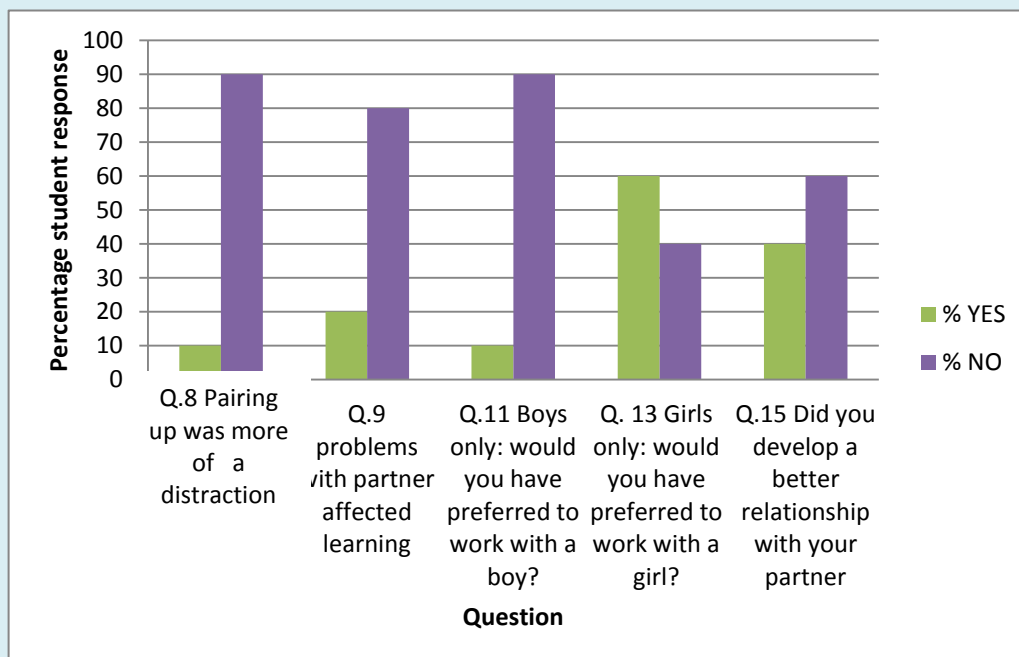
All of the students found the reading sheets helped. Whereas just over half of the students liked the strategy because they had a peer to explain the work to them and they realised that they had to know the work well in order to help their pal. On the other hand, two-thirds of

the students stated that they were not comfortable with their pal. This was surprising because the most of them had found it easy to ask their pal questions.

The majority of the students indicated that they liked getting an assessment at the end of every class. Reasons given for this included *“It showed me how much I had learnt”*, *“helped me to understand the work better”* which was expressed by more than half of the respondents but in contrast there were students, a small minority, who did not like getting an assessment each class and their reason for this included *“we always understood the work we did”* and *“I did not like getting assessment at the end because I like to go home and study first”*

The final research question sought to determine if working in pairs improve the student – student social relationships which exist in the class. Questions 8, 9, 11, 12, 13, 14 and 15 the student’s questionnaire tried to investigate this. Questions 12 and 14 were open ended questions so these are not indicated on the graph. The results for these questions are shown in Figure 7 below.

**FIGURE 7: BAR GRAPH SHOWING THE PERCENTAGES OF STUDENTS ANSWERING YES OR NO FOR QUESTIONS 8, 9 11, 13, and 15 OF THE QUESTIONNAIRE**





In general, the students did not allow any difficulties to prevent them from working together to ensure that they understood the work as is expressed by 80% responding No to Question 9 and 90% agreeing that they were not distracted by their pal. However, more than half of the girls would have preferred to work with another girl reasons given for this included *“Boys are easily distracted”*, *“Boys think differently to girls”* and *“girls work better together”*.

Lastly, three-fifths of the class reflected that better social relationships were not fostered with the use of the PAL Strategy. These results refuted the claim of Maheady (1998) and Miller & Miller (1995) in the Literature review that students engaged in peer tutoring increased their frequencies of positive social interaction.

In the Barbadian school system, most students remain in the same form with their classmate while in the junior school. Junior school lasts for three years. In addition, most of these children take all of their classes together so there is a great possibility that these students already had very strong social relationships and even deep friendships with each. This would have made the effect of the PALS on their relationships negligible. This is one plausible reason for the result of social relationships not being enhance via the use of PALS

## 4 – CONCLUSIONS AND RECOMMENDATIONS

### *4.1 Implications:*

During the monitoring of the PALS a few other advantages were observed these included:

- a. The students were always actively engaged in an activity.
- b. They were discussing points to a greater depth than before.
- a. They were using the feedback they receive from their pal.
- b. The feedback which was provided helped students to gain insight into how well they are progressing.
- c. The strategy allowed the incorporation of learning activities which develop all three domains of learning, thus improving the total development of the students.

However, the disadvantages of the Peer Assisted Learning Strategy observed include:

- a. The strategy may place a drain on resources for instance a large quantity of printing paper was use to create individual PALS tutor and tutee sheets, in addition to worksheets and then the assessment sheets for just one lesson.
- b. A bit of time was spent discussing with the students how the technique would be implemented and their roles in the strategy.
- c. Some students were not 100% comfortable with their pal.

### *4.2 The Major Limitation of this Research:*

It would have been ideal to have five PAL pairs which had the special tutor/tutee sheets and five non PAL pairs which did not have the special sheets for the Acid- Base topic. This would have allowed for only one manipulated variable in the experiment – the presence of the Peer Assisted Learning Strategy. However, when this was attempted in the first lesson of the research, the pairs who did not receive the special reading sheets were upset and therefore the

experiment had to be modified to ten PAL pairs. As a result, the performance of the students in two different topics had to be used. This in itself created another manipulated variable; topic content, in the experiment.

The assignment of the students in the pairs, although it served this investigation well, resulted in a few of the students not being comfortable with their partners.

### ***4.3 Conclusions***

The analyses of the results indicate that learning took place with and without the use of the Peer Assisted Learning Strategy. However, when the strategy was applied, learning of the topic content considerably increased for both the high and low achieving students of the class. Only one student failed the Post-test for the Topic in which the PALS was applied but when compared to his Pre-test score, it was very evident that learning still had taken place for this student.

There was an overwhelming positive response for the Reciprocal Peer Assisted Learning Strategy to be continued in the Science course. The main reason highlighted for this was without the use of the strategy students did not feel they would have understood the topic 'as well' on their own; they had a pal to help them.

Unfortunately, the students are not convinced that an improvement in the student – student social relationships which exist in the class would improve with the use of PALS.

***From the overall results, the Peer Assisted Learning Strategy is effective in increasing the student learning outcomes in Science.***

#### ***4.4 Recommendations***

The Peer Assisted Learning Strategy is another strategy which teachers should include in their collection of teaching strategies as a means to improve the learning outcomes of their students. However, further research needs to be conducted to investigate the effects PALS has on the social interactions between students. In addition, to allowing the students to have some input into the pairs which are created.

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## Appendix 1 - The Questionnaire

*EFFECTIVENESS OF PALS - STUDENT RESPONSES*

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Form 2A2,

**Applewhaite (2010)**



In Science class we have been using the Peer Assisted Learning Strategy for the last 6 weeks. In order to fully determine the effectiveness of this approach you feedback (ideas, inputs) are needed and this is the purpose of this questionnaire.

You do not have to identify yourself and nothing that you write will be held against you. Thank You for your co-operation.

### GIVE YOUR HONEST OPINONS

Tick the answers which best describe you and fill in the blank below.

1) Sex : Female  Male

2) Type of science student in general (in 1<sup>st</sup> form and 2<sup>nd</sup> form):

Very Strong has a very good grasp of the work (more than 75 %)

Strong, maybe a few of the concepts are difficult to grasp (60 – 75%)

Fair (50 -60%)

Weak (less than 50%)

For each question below, **circle** your answer; yes or no. **Only select one.**

3. Using PALS did not help me to understand the Acid, Base and Salt topic.	Yes	No
4. Give (a) reason(s) for your answer in 3 above:		
5. I would have understood the topic all on my own without the PALS	Yes	No
6. Would you recommend that PALS be used more often in Science Class	Yes	No
7. Give (a) reason(s) for your answer in 5 above:		
8. Being paired up was more of a distraction than a help	Yes	No
9. My partner and I did not get along and this affected how much I was learning	Yes	No
10. The reading sheets with the questions really helped me and my partner to understand the topic	Yes	No
11. <b>Boys only:</b> Would you have preferred to work with a boy instead of a girl?	Yes	No

12. Give reasons for your answer in 11 above		
13. <b>Girls only:</b> Would you have preferred to work with a girl instead of a boy?	Yes	No
14. Give reasons for your answer in 13 above		
15. Did you develop a better student to student relationship with your partner than you had before?	Yes	No
16. Tick all that apply: Using the PALS strategy helped me because: <ul style="list-style-type: none"> <li><input type="checkbox"/> I had someone my age to explain what I did not understand</li> <li><input type="checkbox"/> I had more time to hang out with my friend</li> <li><input type="checkbox"/> I found it easier to ask my PAL a “silly” question than the teacher</li> <li><input type="checkbox"/> I had more time to read and understand what was taught</li> <li><input type="checkbox"/> I really had to know my work well in order to help my PAL</li> <li><input type="checkbox"/> I was comfortable with my PAL</li> <li><input type="checkbox"/> I had some “chill out” time</li> </ul> <p>ADDITIONAL WAYS THE PALS HELPED:</p> <hr/>		
17. I did not like getting an assessment at the end of each PAL session	Yes	No
18. Give a reason for your answer in 17 above		
19. Percentagewise how much would you say the Peer Assisted Learning Strategy helped in your understanding the ACID, BASE and SALT area? <input type="checkbox"/> 0 – 25% <input type="checkbox"/> 26- 50% <input type="checkbox"/> 51 -75% <input type="checkbox"/> 76-100%		

ANYTHING ELSE YOU WANT TO ADD PUT IT HERE:

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## Appendix 2 – Raw Data for the questionnaire

Q.1 Sex		Q. 2 Type of science student	Q. 3 Pals did not help	Q.5 Understood topic without PALS			Q.6 Recommend PALS be used more often in Science Class			Q.8 Pair up was more of a distarction			Q.9 problems with partner affected learning			Q.10 The reading sheets really helped			Q.11 Boys only: would you have preferred to work with a boy?	Q. 13 Girls only: would you have preferred to work with a girl?	Q.15 Did you develop a better relationship with your partner			Q.16 I had someone my age explain what I did not know			b. I had more time to hang out with my pal			c. I found it easier to ask my pal a "silly" question than the teacher			d. I had more time to read and understand what was taught			e. I really had to know my work well in order to help my pall			f. I was comfortable with my pal			g. I had some "chill out" time with my pal			Q.17 I did not like getting an assessmnet at the end of each session			Q.19 Percentage wise how much did pal contribute		
M	STRONG	N	N	Y	N	N	Y	N	N	Y	N	Y	Y	N	Y	Y	N	N	N	N	Y	Y	N	N	N	N	N	N	N	Y	3																			
M	FAIR	N	N	Y	N	N	Y	N	N	Y	N	Y	Y	N	Y	Y	N	Y	Y	Y	Y	Y	N	Y	Y	N	N	N	N	N	2																			
F	STRONG VERY	N	N	Y	N	N	Y	N	N	Y	N	Y	Y	N	Y	Y	N	Y	Y	Y	Y	Y	N	Y	Y	N	N	N	N	N	4																			
F	STRONG VERY	N	N	Y	N	N	Y	N	N	Y	N	N	Y	N	Y	Y	N	Y	Y	Y	Y	Y	N	Y	Y	N	N	N	N	N	4																			
M	STRONG	N	Y	Y	N	N	Y	N	N	Y	N	N	N	N	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	N	4																				
M	STRONG	N	N	Y	N	N	Y	N	N	Y	N	Y	N	N	Y	N	N	Y	N	Y	Y	Y	Y	N	Y	Y	N	Y	N	3																				
M	STRONG VERY	N	N	Y	N	N	Y	N	N	Y	N	Y	Y	N	N	Y	N	Y	Y	Y	Y	Y	Y	Y	N	N	N	N	N	4																				
F	STRONG	N	N	Y	N	N	Y	N	N	Y	N	Y	N	N	Y	Y	N	Y	Y	Y	Y	Y	N	N	N	N	N	N	N	N	4																			
F	STRONG	N	N	Y	N	N	Y	N	N	Y	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	Y	N	3																				
F	STRONG VERY	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	N	N	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	2																			
M	STRONG	N	N	Y	N	N	Y	N	N	Y	N	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	N	N	N	N	3																				
F	FAIR	N	Y	Y	N	N	Y	N	N	Y	Y	Y	Y	N	Y	Y	N	Y	Y	N	N	N	Y	N	N	Y	N	N	N	2																				
M	FAIR	Y	Y	N	N	Y	Y	Y	N	Y	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	N	N	0	3																				
M	STRONG	N	N	N	N	N	Y	N	N	Y	N	N	Y	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	N	N	3																				
F	FAIR VERY	N	N	Y	N	N	Y	N	N	Y	Y	N	Y	N	N	Y	N	N	Y	Y	Y	N	N	N	N	N	Y	N	2																					
F	STRONG	N	N	Y	N	Y	Y	N	N	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	Y	N	N	4																					
F	STRONG	Y	Y	N	Y	N	Y	N	N	Y	Y	N	N	N	Y	Y	N	N	N	Y	N	N	N	Y	N	N	Y	N	N	2																				
M	FAIR	N	N	Y	N	N	Y	N	N	Y	N	N	Y	N	N	Y	Y	Y	Y	Y	Y	Y	N	N	N	N	N	N	3																					
F	FAIR	N	N	Y	N	Y	Y	N	N	Y	Y	N	Y	N	N	Y	Y	N	N	N	N	N	N	N	N	N	N	N	N	3																				
M	FAIR	N	N	Y	N	N	Y	N	N	Y	N	Y	N	N	Y	Y	Y	N	N	Y	Y	Y	N	N	N	N	N	N	3																					
#							1			2					1																																			
YES			3	5	7	2	4	0	1	6	8	3	1	1	6	3	8	4	4	4	4	4	4	4	4	4	4	4	4	4	0 -	25%	0	0																
#			1	1		1	1				1		1																																					
NO			7	5	3	8	6	0	9	4	2	7	9	9	4	7	2	6	15	15	15	15	15	15	15	15	15	15	15	15	50%	5	5																	
%							1																																											
YE			1	2	8	1	2	0	1	6	4	6			5	8	6	4	2	21	21	21	21	21	21	21	21	21	21	51 -			4																	
S			5	5	5	0	0	0	0	0	0	5	5	5	5	0	5	0	0	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	75%	9	5																
%																																																		
NO			8	7	1	9	8	0	9	4	6	3	9	4	2	3	6	8	78	78	78	78	78	78	78	78	78	78	78	78	100	3																		
			5	5	5	0	0	0	0	0	0	5	5	5	5	0	5	0	0	.9	.9	.9	.9	.9	.9	.9	.9	.9	.9	.9	.9	%	6	0																

