
UNIVERSITI PUTRA MALAYSIA

# EFFECTIVENESS OF PROBLEM-BASED LEARNING - TEACHING ALGEBRA AMONG FORM FOUR STUDENTS

KATHERINE KALAIVANI

FPP 2011 43

# EFFECTIVENESS OF PROBLEM-BASED LEARNING - TEACHING ALGEBRA AMONG FORM FOUR STUDENTS

**By**

**KATHERINE KALAIVANI**

**Thesis Submitted to School of Graduate Studies, Universiti Putra Malaysia, in Fulfilment of the Requirements for the Degree of Master of Science**

**September 2011**

Abstract of thesis presented to the Senate of University Putra Malaysia
In fulfilment of the requirement for degree of Master of Science

**EFFECTIVENESS OF PROBLEM-BASED LEARNING - TEACHING ALGEBRA AMONG FORM FOUR STUDENTS**

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**KATHERINE KALAIVANI**

**September 2011**

**Chairperson : Associate Professor Rohani Ahmad Tarmizi, PhD**

**Faculty : Educational Studies**

The purpose of this study is to examine the effectiveness of problem-based learning (PBL) in teaching algebra among Form Four students. The study consisted of 81 students from two classes of a government school, 4 Setia (n=41) as the experimental group and 4 Mulia (n=39) as the control group. Using the quasi-experiment of posttest-only control group design, 6 lessons of teaching using PBL and traditional approach was carried out with a total of 16 teaching period in each. The instruments used were the performance test, assessment exercises and student engagement survey. Data obtained from the performance test were analyzed using the non-parametric statistics (Mann-Whitney U Test) as the shape of the data distribution of population was not

normal. It is observed that the experimental group in which the PBL approach was applied performed better than the control groups to which traditional teaching approach was applied in the overall performance in algebra and performance in algebra higher-order thinking (HOT) questions. Mean and standard deviation was used to generalize the engagement of students toward learning algebra using the PBL approach. In general, the students were found to be positively engaged in learning algebra when taught using the PBL approach. Also, a non-parametric statistical analysis (Spearman's Rank Order Correlation) was used to understand the relationship between student engagement and the overall performance in algebra. There was a medium and positive correlation found between the two variables. In conclusion, the study shows that PBL is an effective instructional methodology tool in enhancing students' HOT skills and increasing engagement toward learning algebra.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan ijazah Master Sains.

**KEBERKESANAN PEMBELAJARAN BERASASKAN MASALAH - PENGAJARAN ALGEBRA DI KALANGAN PELAJAR TINGKATAN EMPAT**

Oleh

**KATHERINE KALAIVANI**

**September 2012**

**Pengerusi : Profesor Madya Rohani Ahmad Tarmizi, PhD**

**Fakulti : Pengajian Pendidikan**

Kajian ini bertujuan mengkaji keberkesanan pembelajaran berasaskan masalah dalam pengajaran algebra di kalangan pelajar Tingkatan Empat. Kajian ini telah dijalankan di sebuah sekolah karajaan melibatkan 81 orang pelajar dari dua kelas, 4 Setia (n=41) sebagai kumpulan eksperimen dan 4 Mulia (n=39) sebagai kumpulan kawalan. Dengan menggunakan eksperimen quasi ujian pasca sahaja, 6 sesi pembelajaran berasaskan masalah dan pembelajaran tradisional telah dijalankan dengan jumlah 16 masa pengajaran. Instrumen yang digunakan adalah ujian pencapaian, ujian latihan dan survei penglibatan pelajar. Data yang dikumpulkan melalui ujian pencapaian dianalisis menggunakan statistik bukan parametrik (Ujian U Mann-Whitney) kerana bentuk distribusi data populasi didapati tidak normal menggunakan ujian normaliti. Didapati bahawa kumpulan eksperimen yang menjalankan pembelajaran berasaskan masalah

menunjukkan tahap pencapaian yang lebih tinggi berbanding dengan kumpulan kawalan yang menjalankan pengajaran tradisional dalam pencapaian keseluruhan algebra dan pencapaian dalam soalan algebra berpemikiran tinggi. Min dan sisihan piawai digunakan untuk memahami penglibatan pelajar terhadap pembelajaran algebra menggunakan pembelajaran berasaskan masalah. Secara keseluruhan, didapati pelajar mempamerkan penglibatan positif terhadap pembelajaran algebra. Juga, analisis bukan parametrik (Ujian Korelasi Koefisien Spearman) digunakan untuk memahami hubungan antara penglibatan pelajar dan pencapaian keseluruhan dalam algebra. Korelasi yang positif dan sederhana didapati antara kedua-dua pembolehubah. Secara keseluruhannya, kajian menunjukkan bahawa pembelajaran berasaskan masalah merupakan metodologi pengajaran yang berkesan dalam menambahbaik kemahiran pelajar dalam menjawab soalan algebra berpemikiran tinggi dan meningkatkan penglibatan pelajar terhadap pembelajaran algebra.

## ACKNOWLEDGEMENTS

My sincere appreciation and thanks is dedicated to my supervisors, Associate Prof. Dr. Rohani Ahmad Tarmizi, Dr. Suhaida binti Abdul Kadir and Prof. Kamariah Abu Bakar for their understanding, constant support, encouragement, insights and guidance. The discussions with them and their ideas have been a great help in exploring the areas which otherwise would have been impossible.

My heartfelt thanks and love goes to my beloved family, especially my sisters, Helena and Linda whose continued support and understanding, time and effort, have made it possible for me to complete my graduate study.

Finally, I thank god for being kind to me for driving me through this journey.

I certify that a Thesis Examination Committee has met on 8 September 2011 to conduct the final examination of Katherine Kalaivani a/p James Jeyaselan on her thesis entitled "**Effectiveness of Problem-based Learning - Teaching Algebra among Form Four Students**" in accordance with the Universities and University Colleges Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U.(A) 106] 15 March 1998. The Committee recommends that the student be awarded the Master of Science.

Members of the Examination Committee were as follows:

**AIDA SURAYA MD. YUNUS, PhD**
Director
Centre for Academic Development
Universiti Putra Malaysia
(Chairperson)

**RAMLAH HAMZAH, PhD**
Deputy Dean (Academic)
Faculty of Educational Studies
Universiti Putra Malaysia
(Internal Examiner)

**ROSINI ABU, PhD**
Head
Department of Science and Technical Education
Faculty of Educational Studies
Universiti Putra Malaysia
(Internal Examiner)

_____

**SEOW HENG FONG, PhD**
Professor and Deputy Dean
School of Graduate Studies
Universiti Putra Malaysia

Date:

This thesis was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the degree of Master of Science. The members of the Supervisory Committee are as follows:

**Rohani Ahmad Tarmizi, PhD**
Associate Professor
Faculty of Educational Studies
Universiti Putra Malaysia
(Chairperson)

**Suhaida Binti Abdul Kadir, PhD**
Associate Professor
Faculty of Educational Studies
Universiti Putra Malaysia
(Member)

_____

**BUJANG BIN KIM HUAT, PhD**
Professor and Dean
School of Graduate Studies
Universiti Putra Malaysia

Date:

## DECLARATION

I declare that this thesis is my original work except for quotations and citations which have been duly acknowledged. I also declare that this thesis has not been previously and is not concurrently, submitted for any other degree of Master of Science at Universiti Putra Malaysia or other institution.

_____

**KATHERINE KALAIVANI**

Date: 8 September 2011

## TABLE OF CONTENTS

$y = x - 2$ — equation KD

$x - 2 = -2x + 31$

$3x = 31 + 2$

$\frac{3x}{3} = \frac{33}{3}$

$x = 11$ ✗

When $x = 11$

$y = 11 - 2$

$= 9$

$a = 11$ ✗

$b = 9$ ✗

**Assessment Exercises of Lesson 6**

1. Given that A is a fixed point (5, 0) and O is the origin. A point P moves such that OP: PA = 1: 4. Find the locus equation of P.

2. Find the locus equation of moving point P where its distance from fixed point M (2, 3) is 4 units.

# EXAMPLE ANSWERS OF

# ASSESSMENT 6

Marcus Chee 4Sc2

7/7

Assessment

1. Given that A is a fixed point (5, 0) and O is the origin. A point P moves such that OP: PA = 1: 4. Find the locus equation of P.

2. Find the locus equation of moving point P where its distance from fixed point M (2, 3) is 4 units.

1. A (5,0) — 3 — O — 1 — P

$\frac{OP}{PA} = \frac{1}{4}$

$4OP = PA$ (1)

$\left(4\sqrt{(x-0)^2+(y-0)^2}\right)^2 = \left(\sqrt{(x-5)^2+(y-0)^2}\right)^2$ (1)

$16[(x-0)^2+(y-0)^2] = (x-5)^2+(y-0)^2$

$16(x^2+y^2) = 25-10x+x^2+y^2$

$16x^2+16y^2 = 25-10x+x^2+y^2$

$15x^2+15y^2+10x-25=0$ (1)

$3x^2+3y^2+2x-5=0$ (2)

2. $P(x,y)$

$\left(\sqrt{(2-x)^2+(3-y)^2}\right)^2 = 4^2$ (1)

$(2-x)+(3-y) = 16$

$4-4x+x^2+9-6y+y^2 = 16$

$x^2+y^2-4x-6y-3=0$ (1)

Michelle Lee
4902

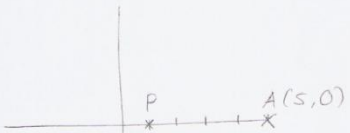
27/6/2022

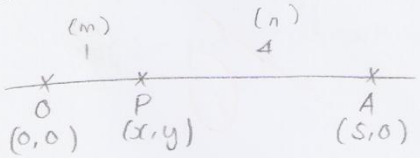
7/7

Assessment

1. Given that A is a fixed point (5, 0) and O is the origin. A point P moves such that OP: PA = 1: 4. Find the locus equation of P.

2. Find the locus equation of moving point P where its distance from fixed point M (2, 3) is 4 units.




$x = \frac{mx_2 + nx_1}{m+n}$, $y = \frac{my_2 + ny_1}{m+n}$

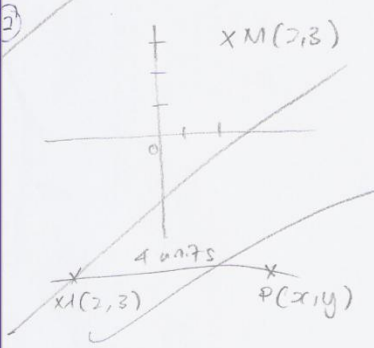
$\frac{1(5) + 4(0)}{1+4} = x$, $\frac{1(0) + 4(0)}{1+4} = y$

$\frac{5+0}{5} = x$, $\frac{0+0}{5} = y$

$\frac{5}{5} = x$, $\frac{0}{5} = y$

$x = 1$, $y = 0$

$P = (1, 0)$ //




$\frac{OP}{PA} = \frac{1}{4}$ (1)

$4OP = 1PA$

$[4(\sqrt{(x-0)^2 + (y-0)^2}]^2 = [(\sqrt{(x-5)^2 + (y-0)^2})]^2$ (1)

$16[(x-0)^2 + (y-0)^2] = (x-5)^2 + (y-0)^2$

$16(x^2 + y^2) = x^2 - 10x + 25 + y^2$

$16x^2 + 16y^2 = x^2 - 10x + 25 + y^2$

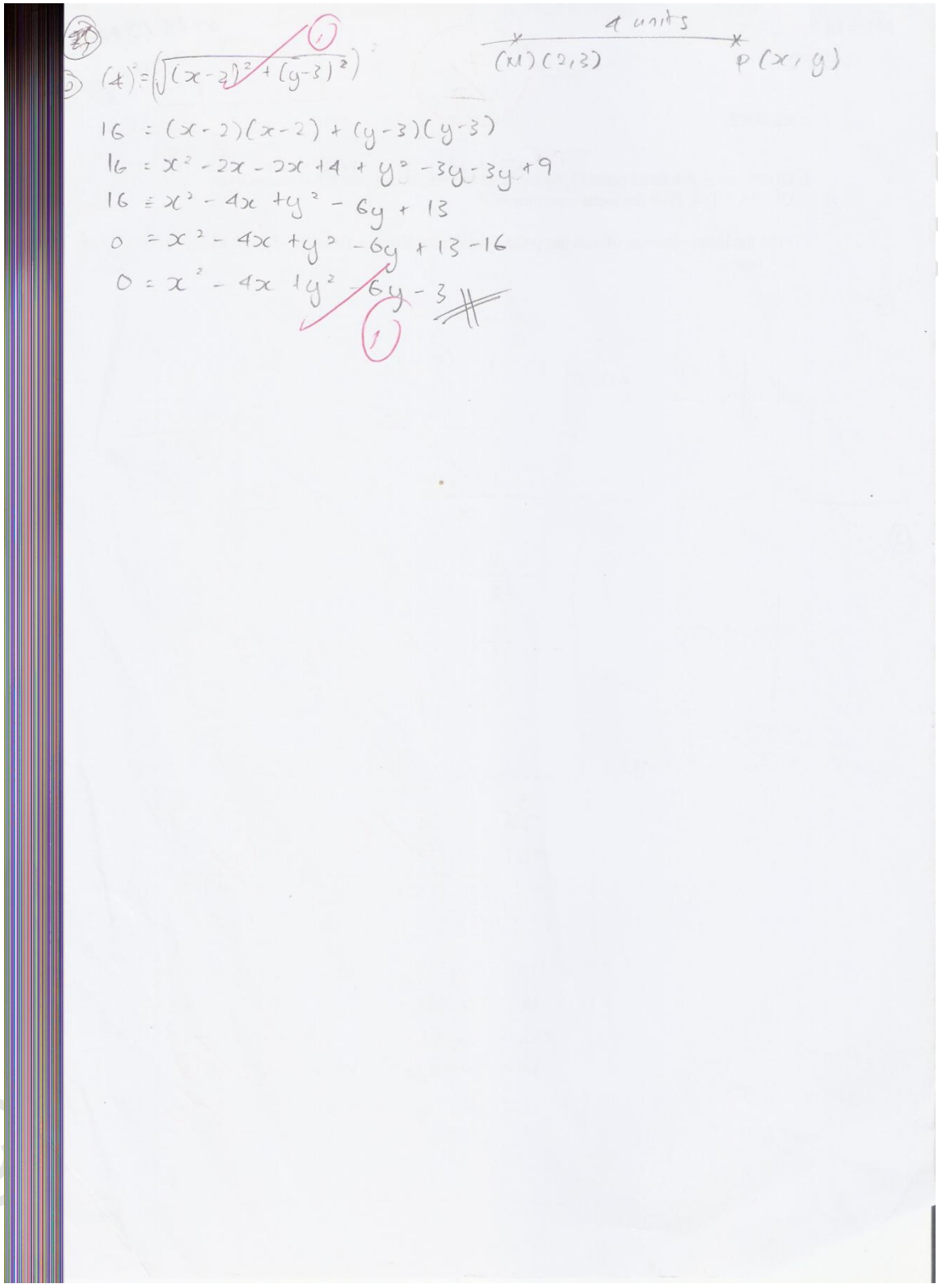
$16x^2 - x^2 + 16y^2 - y^2 + 10x - 25 = 0$

$15x^2 + 15y^2 + 10x - 25 = 0$ (1)

$3x^2 + 3y^2 + 2x - 5 = 0$ (1)

//

NO. (2) at the back page


4 units
(2,3)
P(x, y)
(4)² = (√((x-2)² + (y-3)²))²
16 = (x-2)(x-2) + (y-3)(y-3)
16 = x² - 2x - 2x + 4 + y² - 3y - 3y + 9
16 = x² - 4x + y² - 6y + 13
0 = x² - 4x + y² - 6y + 13 - 16
0 = x² - 4x + y² - 6y - 3

**SURVEY OF**
**STUDENTS' ENGAGEMENT**

**INSTITUTE FOR MATHEMATICAL RESEARCH (INSPEM)**
**UNIVERSITI PUTRA MALAYSIA**

# STUDENTS' ENGAGEMENT SURVEY
***SURVEI PEMBABITAN PELAJAR***

## SECTION I : DEMOGRAPHIC INFORMATION
***BAHAGIAN I: MAKLUMAT DEMOGRAFI***

**Please tick (√) to indicate your response.**
***Sila tandakan (√) untuk menunjukkan jawapan anda.***

---

**Name/ *Nama* :** _____

**Form/ *Tingkatan* :** _____

1. Gender/ *Jantina*
   - ◯ Male/ *Lelaki*
   - ◯ Female/ *Perempuan*

2. Your grades for the following subjects:
   *Gred anda untuk matapelajaran berikut:*

| **Examination/ *Peperiksaan*** | **Subject/ *Matapelajaran*** | **Grade/ *Gred*** |
|---|---|---|
| PMR | Mathematics | A / B / C / D / E |

**SECTION II – SURVEY ON STUDENT ENGAGEMENT**
***BAHAGIAN II – SURVEI ATAS PEMBABITAN PELAJAR***

**The following are items pertaining your engagement toward the Additional Mathematics lesson in the classroom. Please tick (√) or circle to indicate your level of agreement relating to the usage of problem-based learning for the teaching and learning session.**
***Berikut adalah perkara berkaitan dengan pembabitan anda tehadap pelajaran Matematik Tambahan di kelas. Sila tandakan (√) atau bulatkan untuk menunjukkan tahap pembabitan anda berkaitan dengan pembelajaran berdasarkan-masalah di sesi pembelajaran dan pengajaran.***

A. During your class, about how often have you done each of the following?
*Semasa kelas anda, sebanyak berapa kali telah anda melakukan yang berikut?*
**Scale: 6: very often/*selalu* 5: often/*sering* 4: occasionally/*kadang-kala* 3: rarely/*jarang* 2: very rarely/*sgt jarang* 1: never/*tdk pernah***

| No | Items/*Perkara* | Scale/*Skala* | | | | | |
|---|---|---|---|---|---|---|---|
| 1 | **Asked questions** during class and contributed to class discussion.<br>***Bertanya soalan*** *semasa kelas dan menyumbang kepada perbincangan kelas.* | **6** | **5** | **4** | **3** | **2** | **1** |
| 2 | **Worked with other students** on activities during class time.<br>***Bekerja dengan pelajar*** *lain dalam aktiviti pada masa kelas.* | **6** | **5** | **4** | **3** | **2** | **1** |
| 3 | **Worked with classmates outside** of class to complete class assignments.<br>***Bekerja dengan rakan sekelas di luar*** *kelas untuk menyiapkan tugasan kelas.* | **6** | **5** | **4** | **3** | **2** | **1** |
| 4 | **Tutored or taught** the class materials to other students in the class.<br>*Mentutor atau mengajar bahan kelas kepada kawan lain di kelas.* | **6** | **5** | **4** | **3** | **2** | **1** |
| 5 | Got **distracted** with activities other than class assignment.<br>*Telah terganggu dengan aktiviti lain selain tugasan kelas.* | **6** | **5** | **4** | **3** | **2** | **1** |

B. To what extend has this course emphasized the mental activities listed below?
*Setakat mana kursus ini telah menekankan aktiviti mental yang disenaraikan di bawah?*
**Scale: 6: very often/*selalu* 5: often/*sering* 4: occasionally/*kadang-kala* 3: rarely/*jarang* 2: very rarely/*sgt jarang* 1: never/*tdk pernah***

| No | Items/*Perkara* | Scale/*Skala* | | | | | |
|---|---|---|---|---|---|---|---|
| 6 | I find I have to concentrate on **memorizing** a good deal of what we have to learnt. *Saya terpaksa tumpukan perhatian dalam menghafal kebanyakan perkara yang telah dipelajari.* | **6** | **5** | **4** | **3** | **2** | **1** |
| 7 | I try to **analyze** questions by breaking them down to simplify matter in effort to formulate a plan to solve problems/ *Saya cuba **menganalisa** soalan dengan menceraikan untuk memudahkan perkara untuk merumuskan jalan kerja untuk menyelesaikan masalah.* | **6** | **5** | **4** | **3** | **2** | **1** |
| 8 | I try to **evaluate** how my friends gathered information and formulated solution pathways that led to accurate conclusion/ *Saya cuba **menilai** bagaiman kawan saya mengumpulkan maklumat dan merumuskan jalan penyelesaian yang meruju kepada kesimpulan yang tepat.* | **6** | **5** | **4** | **3** | **2** | **1** |
| 9 | I try to **relate ideas and application of algebra** to those in other topics, whenever possible. *Saya cuba **mengaitkan idea dan aplikasi algebra** kepada topic lain bila-bila mungkin.* | **6** | **5** | **4** | **3** | **2** | **1** |
| 10 | In reporting practical work, I like to **try to work out several alternative ways** of interpreting the findings/ *Dalam melaporkan kerja praktikal, saya suka **cuba kerjakan beberapa jalan alternative** dalam mentafsir dapatan.* | **6** | **5** | **4** | **3** | **2** | **1** |
| 11 | Although I generally remember facts and details, I find it difficult to **fit them together into an overall picture**/ *Walaupun pada umumnya saya ingat fakta dan butirannya, saya menghadapi kesusahan dalam **menyesuaikan mereka bersama untuk mendapat gambaran sepenuhnya**.* | **6** | **5** | **4** | **3** | **2** | **1** |

C. To what extend has this course contributed to your persistence of task?
*Setakat mana kursus ini telah menyumbang kepada ketabahan anda untuk meneruskan tugas?*
**Scale: 6: very often/*selalu* 5: often/*sering* 4: occasionally/*kadang-kala* 3: rarely/*jarang* 2: very rarely/*sgt jarang* 1: never/*tdk pernah***

| No | Items | Scale | | | | | |
|---|---|---|---|---|---|---|---|
| 12 | Learning effectively on my own**, by going back over things I didn't understand**.<br>*Belajar sendiri dengan berkesan, **dengan mengulangi perkara yang saya tidak faham.*** | **6** | **5** | **4** | **3** | **2** | **1** |
| 13 | When working with challenging questions, **I skipped the hard parts**.<br>*Bila mengerjakan soalan susah, **saya melangkau bahagian yang susah**.* | **6** | **5** | **4** | **3** | **2** | **1** |
| 14 | When working with difficult problems, **I know where to find the answers**.<br>*Bila mengerjakan soalan susah, **saya tahu dimana perlu dicari jawapannya.*** | **6** | **5** | **4** | **3** | **2** | **1** |
| 15 | I generally **put a lot of effort** into trying to understand things which initially seem difficult.<br>*Saya umunya **berusaha** untuk cuba memahami perkara yang asalnya nampak susah.* | **6** | **5** | **4** | **3** | **2** | **1** |

# APPENDIX C

# SCREENING OF DATA

## RELIABILITY OF PERFORMANCE TEST

## (Calculating Pearson Correlation Coeffiecient)

**Correlations**

| | | Total First Half Questions | Total Second Half Questions |
|---|---|---|---|
| Total First Half Questions | Pearson Correlation | 1 | .642** |
| | Sig. (2-tailed) | | .000 |
| | N | 81 | 81 |
| Total Second Half Questions | Pearson Correlation | .642** | 1 |
| | Sig. (2-tailed) | .000 | |
| | N | 81 | 81 |

**. Correlation is significant at the 0.01 level (2-tailed).

# RELIABILITY OF STUDENTS' ENGAGEMENT SURVEY

**Case Processing Summary**

| | | N | % |
|---|---|---|---|
| Cases | Valid | 42 | 91.3 |
| | Excluded[a] | 4 | 8.7 |
| | Total | 46 | 100.0 |

a. Listwise deletion based on all variables in the procedure.

**Reliability Statistics**

| Cronbach's Alpha | Cronbach's Alpha Based on Standardized Items | N of Items |
|---|---|---|
| .886 | .888 | 15 |

**Item Statistics**

| | Mean | Std. Deviation | N |
|---|---|---|---|
| Item 1 | 5.81 | .455 | 42 |
| Item 2 | 5.88 | .395 | 42 |
| Item 3 | 5.86 | .354 | 42 |
| Item 4 | 5.86 | .417 | 42 |
| Item 5 | 5.81 | .397 | 42 |
| Item 6 | 5.81 | .455 | 42 |
| Item 7 | 5.88 | .395 | 42 |
| Item 8 | 5.86 | .354 | 42 |
| Item 9 | 5.86 | .417 | 42 |
| Item 10 | 5.81 | .397 | 42 |
| Item 11 | 5.88 | .395 | 42 |
| Item 12 | 5.81 | .455 | 42 |
| Item 13 | 5.81 | .455 | 42 |
| Item 14 | 5.81 | .397 | 42 |
| Item 15 | 5.81 | .397 | 42 |

**Item-Total Statistics**

| | Scale Mean if Item Deleted | Scale Variance if Item Deleted | Corrected Item-Total Correlation | Squared Multiple Correlation | Cronbach's Alpha if Item Deleted |
|---|---|---|---|---|---|
| Item 1 | 81.74 | 12.588 | .558 | . | .878 |
| Item 2 | 81.67 | 12.959 | .520 | . | .880 |
| Item 3 | 81.69 | 12.999 | .576 | . | .878 |
| Item 4 | 81.69 | 12.902 | .507 | . | .881 |
| Item 5 | 81.74 | 12.832 | .564 | . | .878 |
| Item 6 | 81.74 | 12.588 | .558 | . | .878 |
| Item 7 | 81.67 | 12.959 | .520 | . | .880 |
| Item 8 | 81.69 | 12.999 | .576 | . | .878 |
| Item 9 | 81.69 | 12.902 | .507 | . | .881 |
| Item 10 | 81.74 | 12.832 | .564 | . | .878 |
| Item 11 | 81.67 | 12.862 | .556 | . | .878 |
| Item 12 | 81.74 | 12.588 | .558 | . | .878 |
| Item 13 | 81.74 | 12.588 | .558 | . | .878 |
| Item 14 | 81.74 | 12.832 | .564 | . | .878 |
| Item 15 | 81.74 | 12.832 | .564 | . | .878 |

**Scale Statistics**

| Mean | Variance | Std. Deviation | N of Items |
|---|---|---|---|
| 87.55 | 14.595 | 3.820 | 15 |

## RELIABILITY OF ITEMS PERTANING SOCIAL ASPECT

**Case Processing Summary**

| | | N | % |
|---|---|---|---|
| Cases | Valid | 42 | 91.3 |
| | Excluded[a] | 4 | 8.7 |
| | Total | 46 | 100.0 |

a. Listwise deletion based on all variables in the procedure.

**Reliability Statistics**

| Cronbach's Alpha | Cronbach's Alpha Based on Standardized Items | N of Items |
|---|---|---|
| .755 | .755 | 5 |

**Item Statistics**

| | Mean | Std. Deviation | N |
|---|---|---|---|
| Item 1 | 5.79 | .470 | 42 |
| Item 2 | 5.88 | .395 | 42 |
| Item 3 | 5.86 | .354 | 42 |
| Item 4 | 5.86 | .417 | 42 |
| Item 5 | 5.81 | .397 | 42 |

**Inter-Item Correlation Matrix**

| | Item 1 | Item 2 | Item 3 | Item 4 | Item 5 |
|---|---|---|---|---|---|
| Item 1 | 1.000 | .647 | .397 | .586 | .168 |
| Item 2 | .647 | 1.000 | .573 | .634 | .007 |
| Item 3 | .397 | .573 | 1.000 | .354 | .322 |
| Item 4 | .586 | .634 | .354 | 1.000 | .126 |
| Item 5 | .168 | .007 | .322 | .126 | 1.000 |

**Item-Total Statistics**

| | Scale Mean if Item Deleted | Scale Variance if Item Deleted | Corrected Item-Total Correlation | Squared Multiple Correlation | Cronbach's Alpha if Item Deleted |
|---|---|---|---|---|---|
| Item 1 | 23.40 | 1.222 | .640 | .487 | .664 |
| Item 2 | 23.31 | 1.341 | .669 | .647 | .658 |
| Item 3 | 23.33 | 1.496 | .563 | .433 | .701 |
| Item 4 | 23.33 | 1.350 | .604 | .463 | .680 |
| Item 5 | 23.38 | 1.754 | .188 | .201 | .819 |

**Scale Statistics**

| Mean | Variance | Std. Deviation | N of Items |
|---|---|---|---|
| 29.19 | 2.109 | 1.452 | 5 |

## RELIABILITY OF ITEMS PERTANING COGNITIVE ASPECT

**Case Processing Summary**

| | | N | % |
|---|---|---|---|
| Cases | Valid | 42 | 91.3 |
| | Excluded[a] | 4 | 8.7 |
| | Total | 46 | 100.0 |

a. Listwise deletion based on all variables in the procedure.

**Reliability Statistics**

| Cronbach's Alpha | Cronbach's Alpha Based on Standardized Items | N of Items |
|---|---|---|
| .727 | .739 | 6 |

**Item Statistics**

| | Mean | Std. Deviation | N |
|---|---|---|---|
| Item 6 | 5.81 | .455 | 42 |
| Item 7 | 5.88 | .395 | 42 |
| Item 8 | 5.86 | .354 | 42 |
| Item 9 | 5.86 | .417 | 42 |
| Item 10 | 5.81 | .397 | 42 |
| Item 11 | 5.88 | .395 | 42 |

**Inter-Item Correlation Matrix**

| | Item 6 | Item 7 | Item 8 | Item 9 | Item 10 | Item 11 |
|---|---|---|---|---|---|---|
| Item 6 | 1.000 | .142 | .130 | .110 | .199 | .006 |
| Item 7 | .142 | 1.000 | .573 | .634 | .007 | .688 |
| Item 8 | .130 | .573 | 1.000 | .354 | .322 | .573 |
| Item 9 | .110 | .634 | .354 | 1.000 | .126 | .634 |
| Item 10 | .199 | .007 | .322 | .126 | 1.000 | .318 |
| Item 11 | .006 | .688 | .573 | .634 | .318 | 1.000 |

**Item-Total Statistics**

| | Scale Mean if Item Deleted | Scale Variance if Item Deleted | Corrected Item-Total Correlation | Squared Multiple Correlation | Cronbach's Alpha if Item Deleted |
|---|---|---|---|---|---|
| Item 6 | 29.29 | 2.063 | .160 | .121 | .783 |
| Item 7 | 29.21 | 1.685 | .621 | .660 | .641 |
| Item 8 | 29.24 | 1.796 | .587 | .455 | .657 |
| Item 9 | 29.24 | 1.698 | .557 | .490 | .659 |
| Item 10 | 29.29 | 2.014 | .272 | .312 | .742 |
| Item 11 | 29.21 | 1.636 | .679 | .654 | .623 |

**Scale Statistics**

| Mean | Variance | Std. Deviation | N of Items |
|---|---|---|---|
| 35.10 | 2.479 | 1.574 | 6 |

## RELIABILITY OF ITEMS PERTANING BEHAVIORAL ASPECT

**Case Processing Summary**

| | | N | % |
|---|---|---|---|
| Cases | Valid | 42 | 91.3 |
| | Excluded[a] | 4 | 8.7 |
| | Total | 46 | 100.0 |

a. Listwise deletion based on all variables in the procedure.

**Reliability Statistics**

| Cronbach's Alpha | Cronbach's Alpha Based on Standardized Items | N of Items |
|---|---|---|
| .777 | .777 | 4 |

**Item Statistics**

| | Mean | Std. Deviation | N |
|---|---|---|---|
| Item 12 | 5.81 | .455 | 42 |
| Item 13 | 5.81 | .455 | 42 |
| Item 14 | 5.81 | .397 | 42 |
| Item 15 | 5.81 | .397 | 42 |

**Inter-Item Correlation Matrix**

| | Item 12 | Item 13 | Item 14 | Item 15 |
|---|---|---|---|---|
| Item 12 | 1.000 | 1.000 | .199 | .199 |
| Item 13 | 1.000 | 1.000 | .199 | .199 |
| Item 14 | .199 | .199 | 1.000 | 1.000 |
| Item 15 | .199 | .199 | 1.000 | 1.000 |

**Item-Total Statistics**

| | Scale Mean if Item Deleted | Scale Variance if Item Deleted | Corrected Item-Total Correlation | Squared Multiple Correlation | Cronbach's Alpha if Item Deleted |
|---|---|---|---|---|---|
| Item 12 | 17.43 | .983 | .618 | . | .702 |
| Item 13 | 17.43 | .983 | .618 | . | .702 |
| Item 14 | 17.43 | 1.129 | .545 | . | .741 |
| Item 15 | 17.43 | 1.129 | .545 | . | .741 |

**Scale Statistics**

| Mean | Variance | Std. Deviation | N of Items |
|---|---|---|---|
| 23.24 | 1.747 | 1.322 | 4 |

# NORMALITY ASSESSMENT OF PERFORMANCE TEST

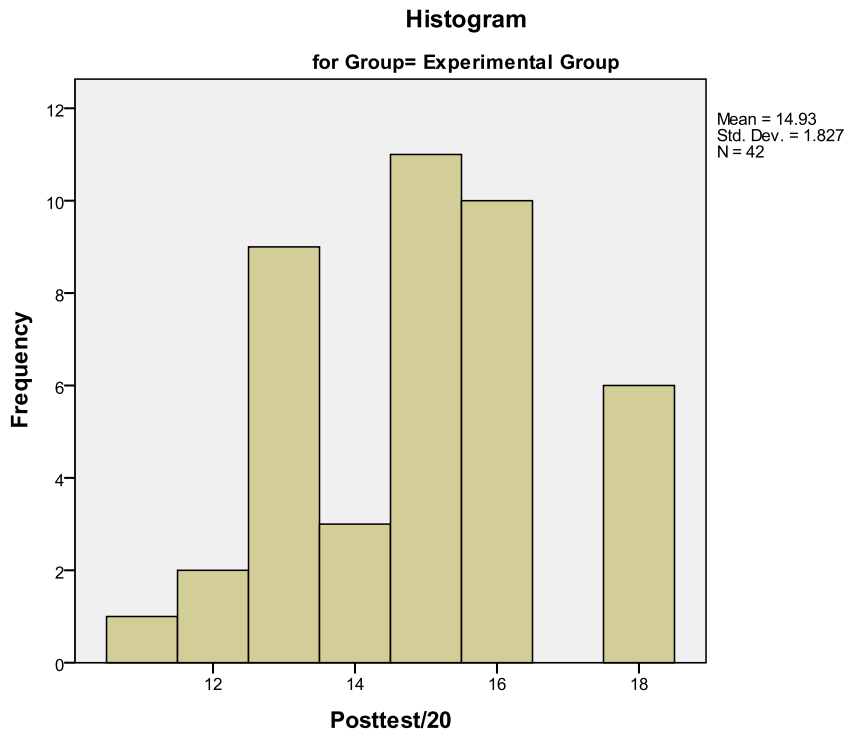
**Descriptives**

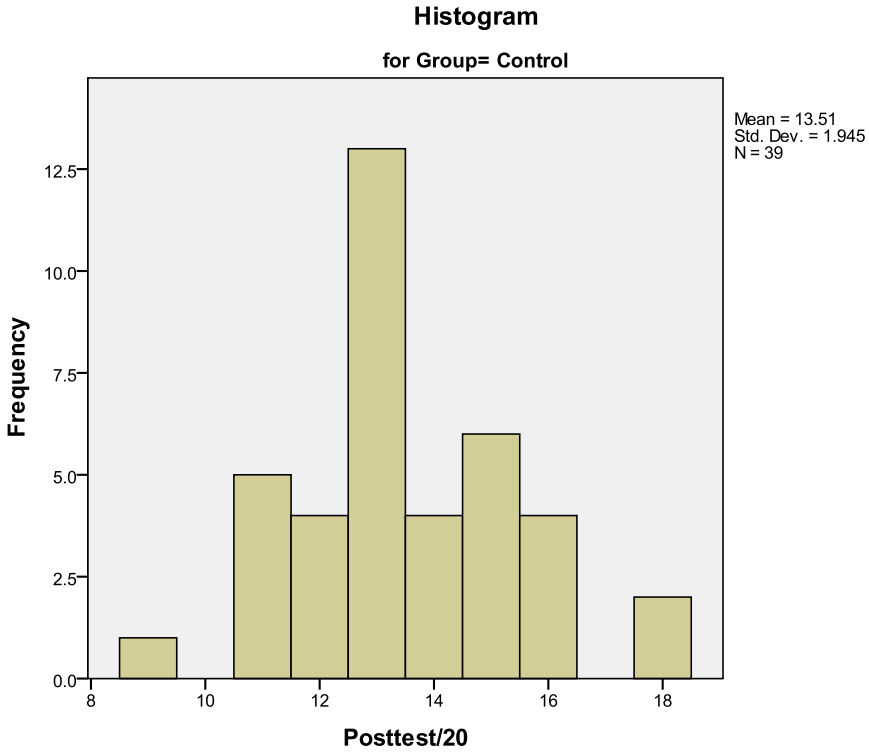
| | Group | | | Statistic | Std. Error |
|---|---|---|---|---|---|
| Posttest/20 | Experimental Group | Mean | | 14.93 | .282 |
| | | 95% Confidence Interval for Mean | Lower Bound | 14.36 | |
| | | | Upper Bound | 15.50 | |
| | | 5% Trimmed Mean | | 14.95 | |
| | | Median | | 15.00 | |
| | | Variance | | 3.336 | |
| | | Std. Deviation | | 1.827 | |
| | | Minimum | | 11 | |
| | | Maximum | | 18 | |
| | | Range | | 7 | |
| | | Interquartile Range | | 3 | |
| | | Skewness | | .035 | .365 |
| | | Kurtosis | | -.546 | .717 |
| | Control | Mean | | 13.51 | .311 |
| | | 95% Confidence Interval for Mean | Lower Bound | 12.88 | |
| | | | Upper Bound | 14.14 | |
| | | 5% Trimmed Mean | | 13.46 | |
| | | Median | | 13.00 | |
| | | Variance | | 3.783 | |
| | | Std. Deviation | | 1.945 | |
| | | Minimum | | 9 | |
| | | Maximum | | 18 | |
| | | Range | | 9 | |
| | | Interquartile Range | | 3 | |
| | | Skewness | | .285 | .378 |
| | | Kurtosis | | .257 | .741 |

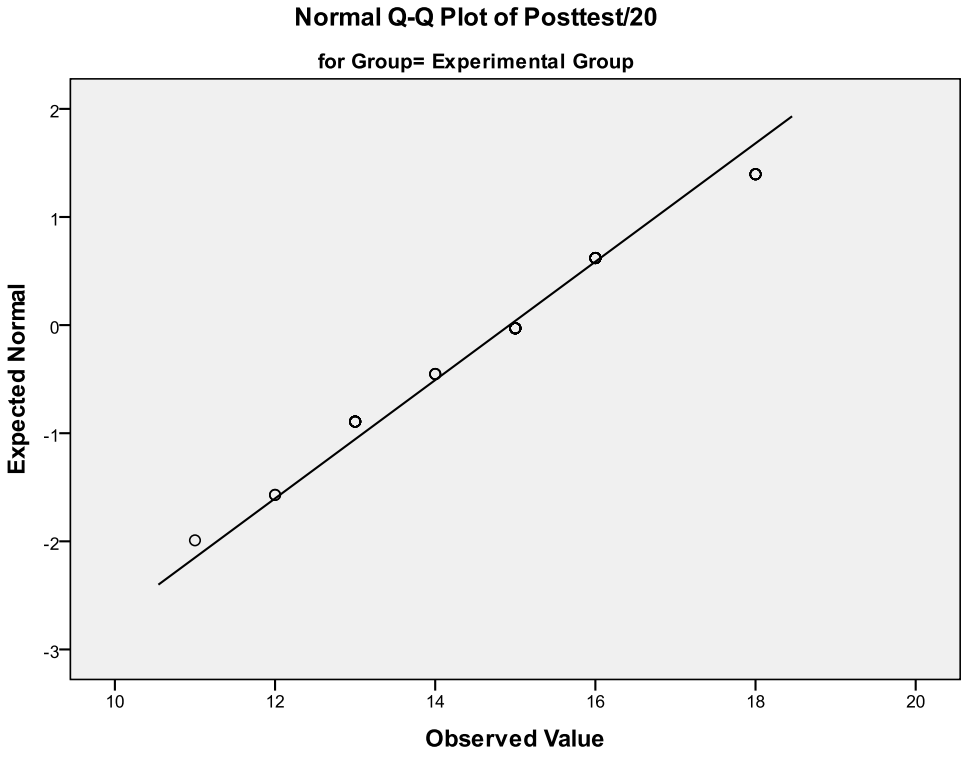
**Tests of Normality**

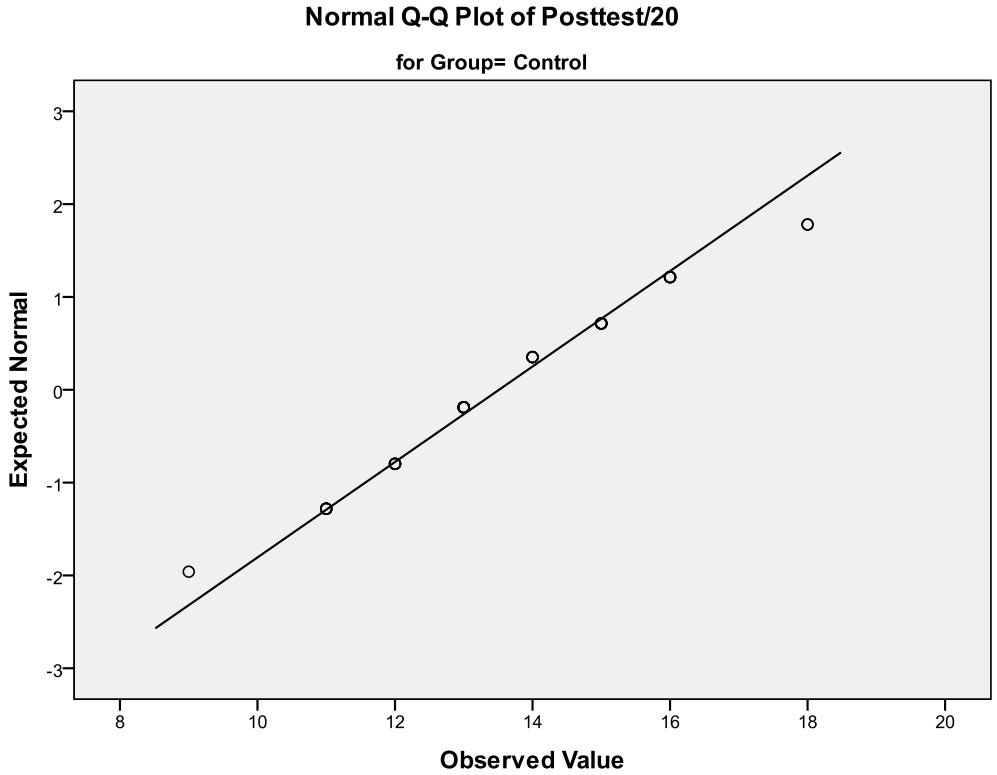
| | Group | Kolmogorov-Smirnov[a] | | | Shapiro-Wilk | | |
|---|---|---|---|---|---|---|---|
| | | Statistic | df | Sig. | Statistic | df | Sig. |
| Posttest/20 | Experimental Group | .158 | 42 | .010 | .931 | 42 | .014 |
| | Control | .194 | 39 | .001 | .952 | 39 | .100 |

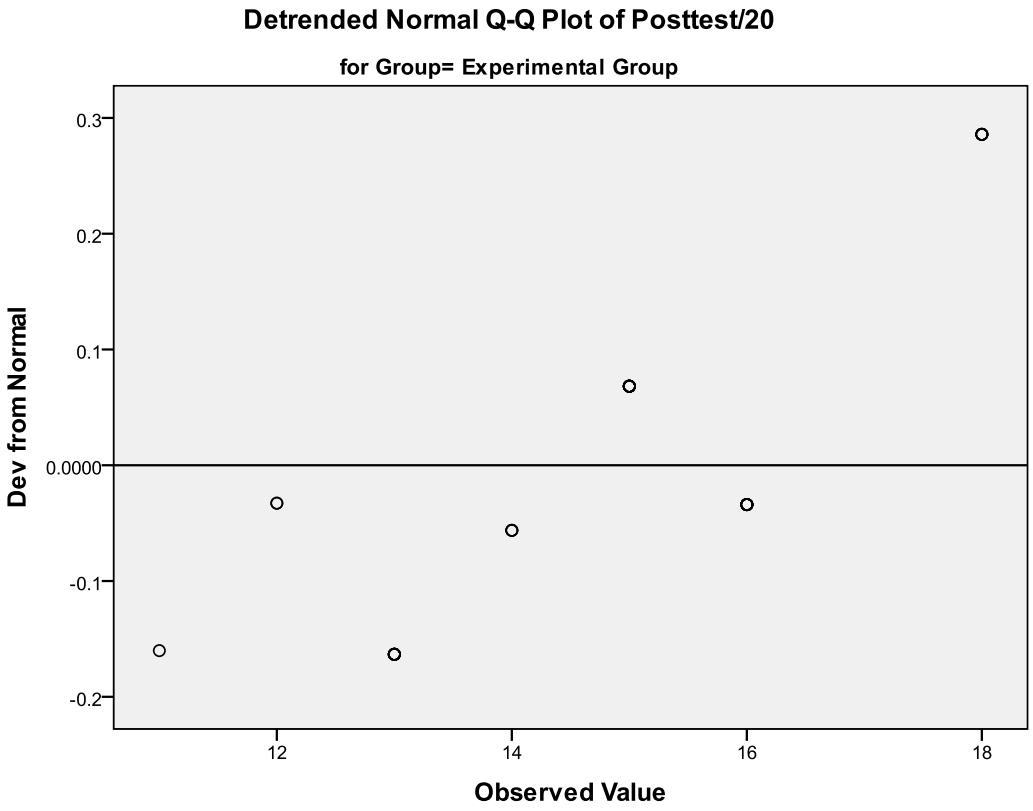
a. Lilliefors Significance Correction

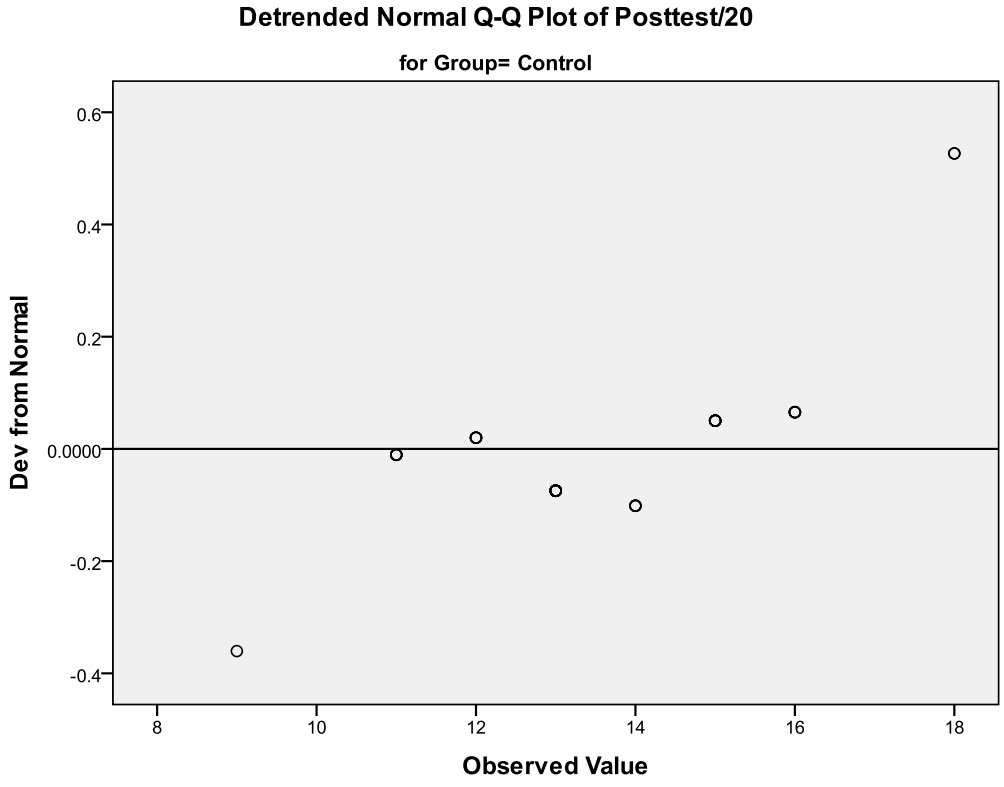

Histogram
for Group= Experimental Group
Mean = 14.93
Std. Dev. = 1.827
N = 42
Frequency
Posttest/20

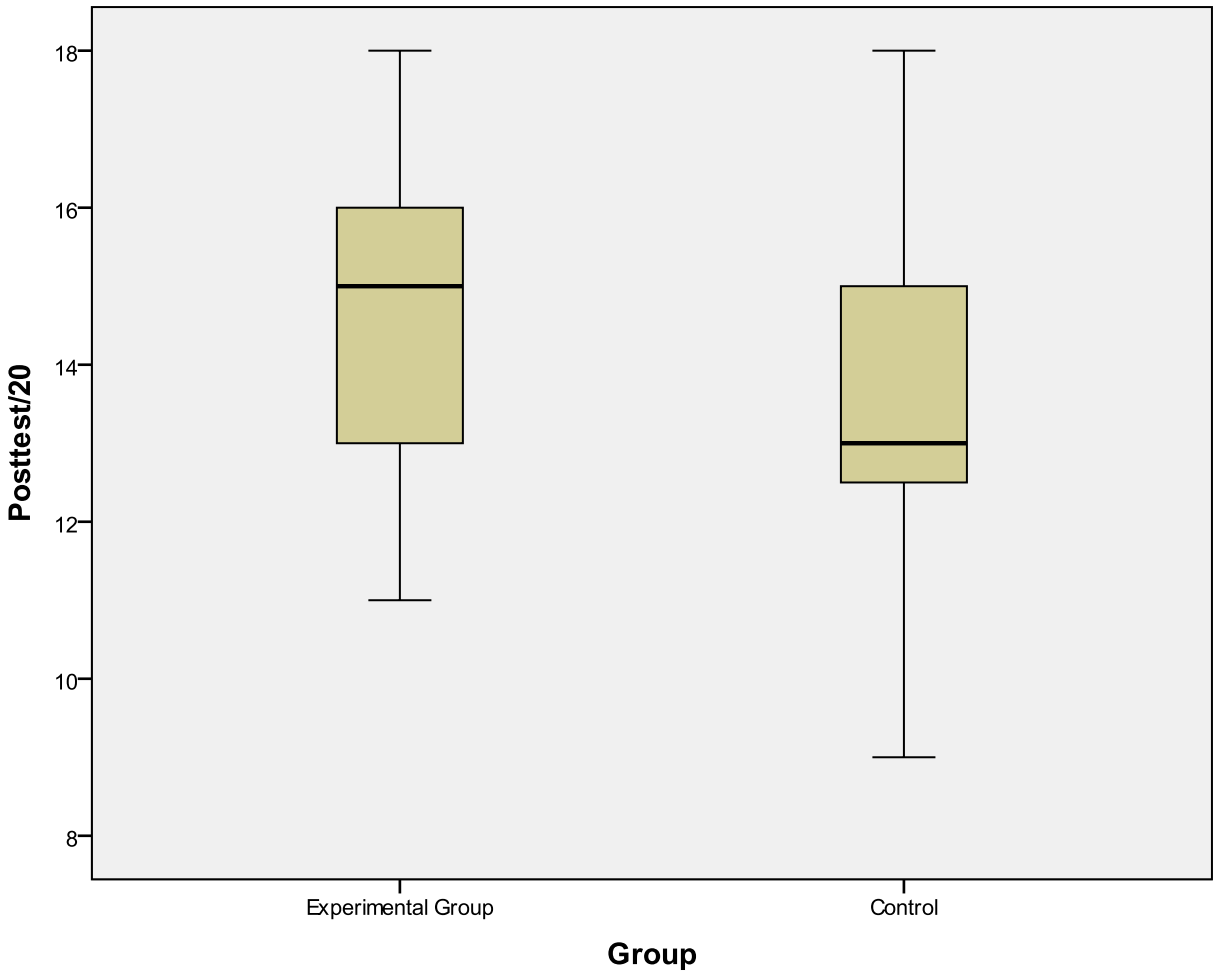

Histogram
for Group= Control
Mean = 13.51
Std. Dev. = 1.945
N = 39
Frequency
Posttest/20


Normal Q-Q Plot of Posttest/20
for Group= Experimental Group
Expected Normal
Observed Value
2
1
0
-1
-2
-3
10
12
14
16
18
20


Normal Q-Q Plot of Posttest/20
for Group= Control
Expected Normal
Observed Value
3
2
1
0
-1
-2
-3
8
10
12
14
16
18
20


Detrended Normal Q-Q Plot of Posttest/20
for Group= Experimental Group
Dev from Normal
0.3
0.2
0.1
0.0000
-0.1
-0.2
12
14
16
18
Observed Value


Detrended Normal Q-Q Plot of Posttest/20
for Group= Control
Dev from Normal
0.6
0.4
0.2
0.0000
-0.2
-0.4
8
10
12
14
16
18
Observed Value


Posttest/20
18
16
14
12
10
8
Experimental Group
Control
Group

# MANN WHITNEY U-TEST FOR OVERALL PERFORMANCE

**Ranks**

| | Group | N | Mean Rank | Sum of Ranks |
|---|---|---|---|---|
| Posttest/20 | Experimental Group | 42 | 48.90 | 2054.00 |
| | Control | 39 | 32.49 | 1267.00 |
| | Total | 81 | | |

**Test Statistics[a]**

| | Posttest/20 |
|---|---|
| Mann-Whitney U | 487.000 |
| Wilcoxon W | 1267.000 |
| Z | -3.197 |
| Asymp. Sig. (2-tailed) | .001 |

a. Grouping Variable: Group

# MANN WHITNEY U-TEST FOR PERFORMANCE IN ALGEBRA LOT QUESTIONS

**Ranks**

| | Group | N | Mean Rank | Sum of Ranks |
|---|---|---|---|---|
| LOT/10 | Experimental Group | 42 | 45.89 | 1927.50 |
| | Control | 39 | 35.73 | 1393.50 |
| | Total | 81 | | |

**Test Statistics[a]**

| | LOT/10 |
|---|---|
| Mann-Whitney U | 613.500 |
| Wilcoxon W | 1393.500 |
| Z | -2.354 |
| Asymp. Sig. (2-tailed) | .019 |

a. Grouping Variable: Group

# MANN WHITNEY U-TEST FOR PERFORMANCE IN ALGEBRA HOT QUESTIONS

**Ranks**

| | Group | N | Mean Rank | Sum of Ranks |
|---|---|---|---|---|
| HOT/10 | Experimental Group | 42 | 46.17 | 1939.00 |
| | Control | 39 | 35.44 | 1382.00 |
| | Total | 81 | | |

**Test Statistics[a]**

| | HOT/10 |
|---|---|
| Mann-Whitney U | 602.000 |
| Wilcoxon W | 1382.000 |
| Z | -2.110 |
| Asymp. Sig. (2-tailed) | .035 |

a. Grouping Variable: Group

# NORMALITY TEST OF ASSESSMENT EXERCISES

**Descriptives**

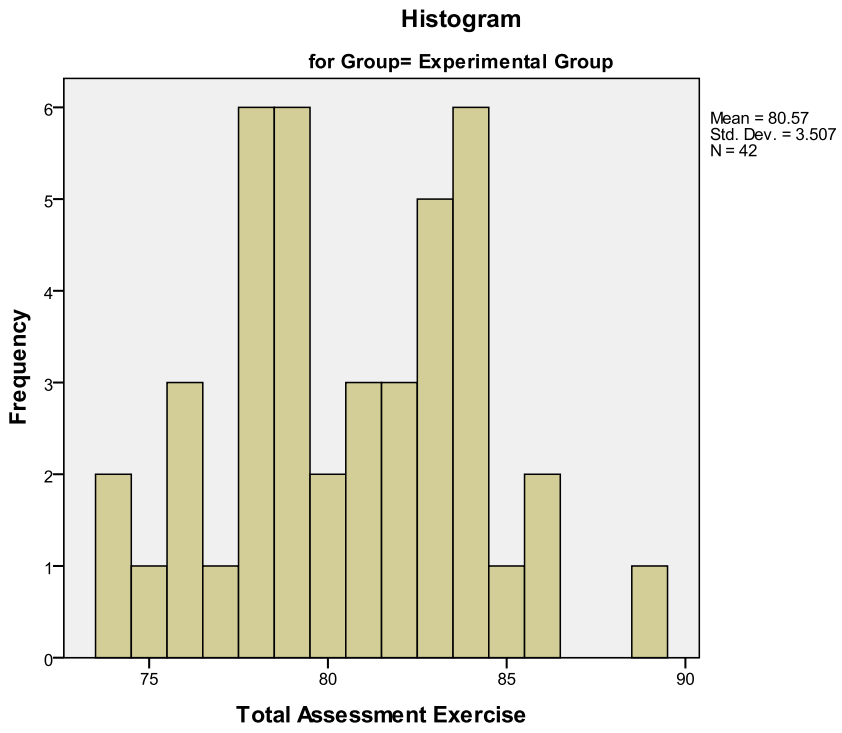
| | Group | | | Statistic | Std. Error |
|---|---|---|---|---|---|
| Total Assessment Exercise | Experimental Group | Mean | | 80.57 | .541 |
| | | 95% Confidence Interval for Mean | Lower Bound | 79.48 | |
| | | | Upper Bound | 81.66 | |
| | | 5% Trimmed Mean | | 80.55 | |
| | | Median | | 80.50 | |
| | | Variance | | 12.300 | |
| | | Std. Deviation | | 3.507 | |
| | | Minimum | | 74 | |
| | | Maximum | | 89 | |
| | | Range | | 15 | |
| | | Interquartile Range | | 5 | |
| | | Skewness | | .077 | .365 |
| | | Kurtosis | | -.498 | .717 |
| | Control | Mean | | 75.74 | .805 |
| | | 95% Confidence Interval for Mean | Lower Bound | 74.11 | |
| | | | Upper Bound | 77.37 | |
| | | 5% Trimmed Mean | | 75.52 | |
| | | Median | | 76.00 | |
| | | Variance | | 25.248 | |
| | | Std. Deviation | | 5.025 | |
| | | Minimum | | 68 | |
| | | Maximum | | 89 | |
| | | Range | | 21 | |
| | | Interquartile Range | | 8 | |
| | | Skewness | | .503 | .378 |
| | | Kurtosis | | -.110 | .741 |

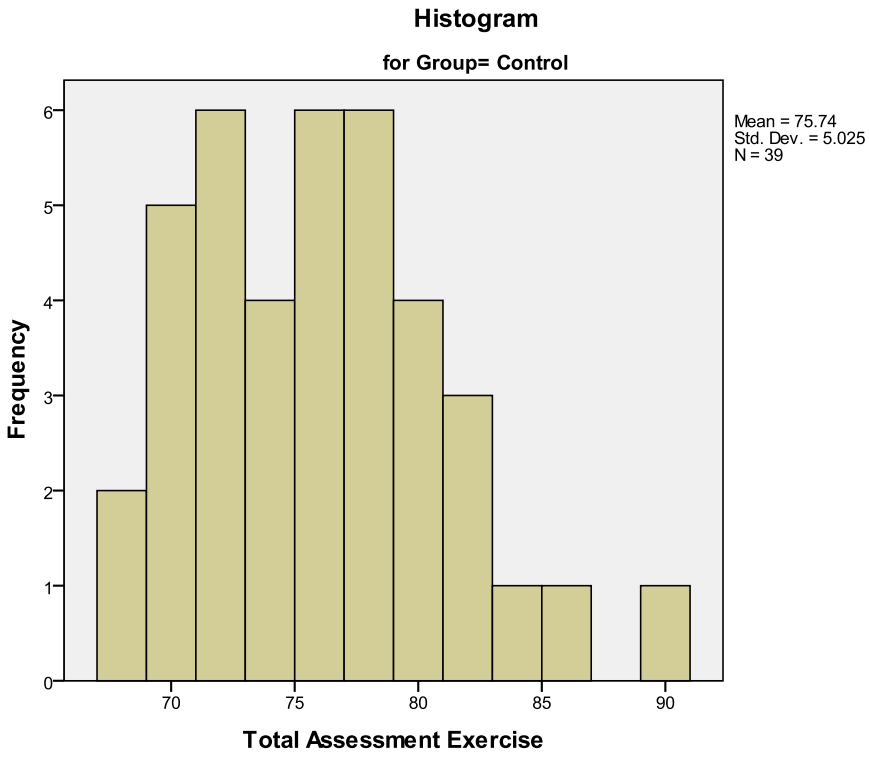
**Tests of Normality**

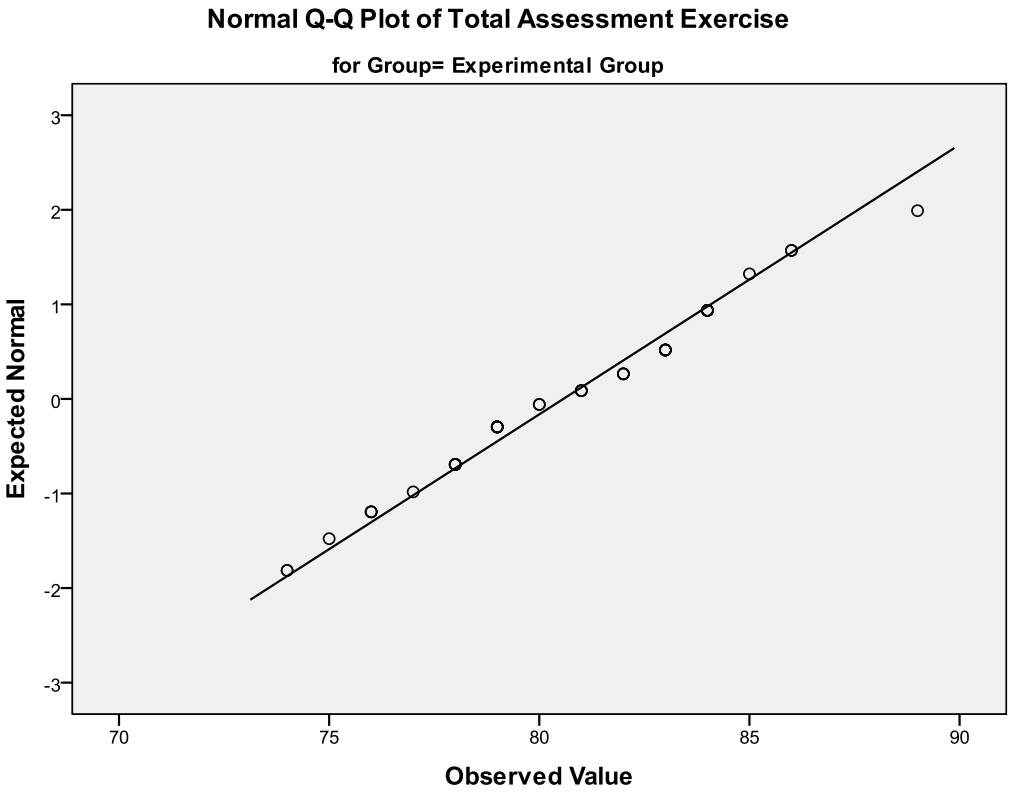
| | Group | Kolmogorov-Smirnov[a] | | | Shapiro-Wilk | | |
|---|---|---|---|---|---|---|---|
| | | Statistic | df | Sig. | Statistic | df | Sig. |
| Total Assessment Exercise | Experimental Group | .125 | 42 | .095 | .973 | 42 | .401 |
| | Control | .109 | 39 | .200* | .955 | 39 | .126 |

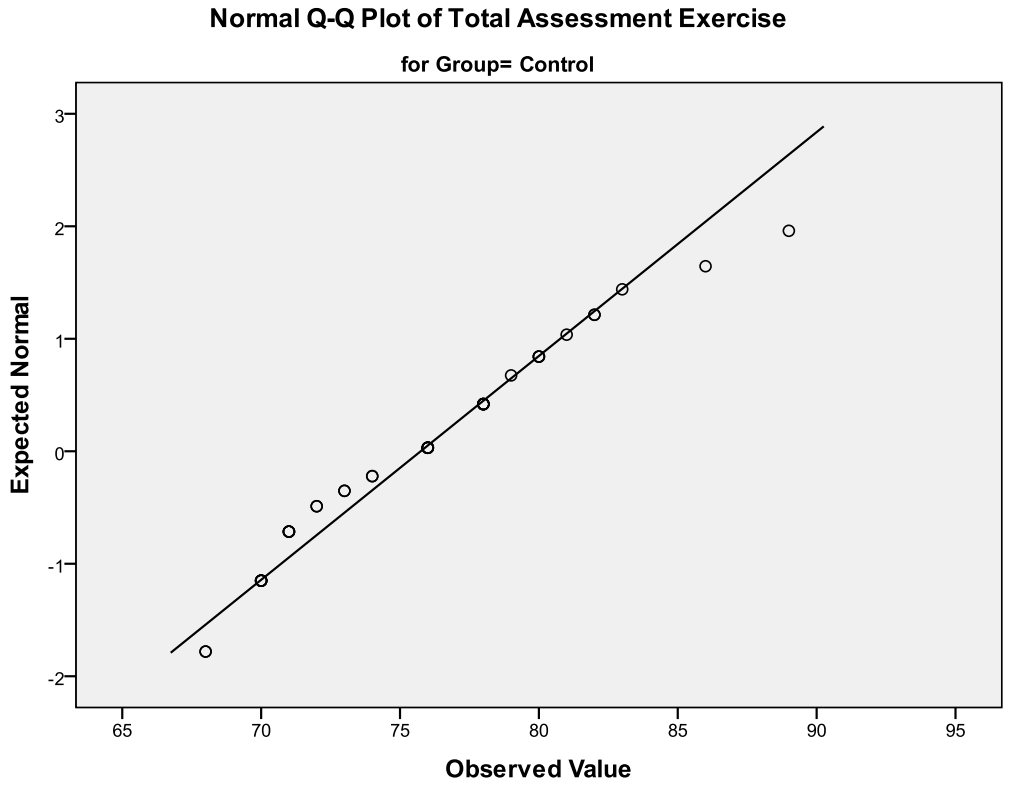
a. Lilliefors Significance Correction

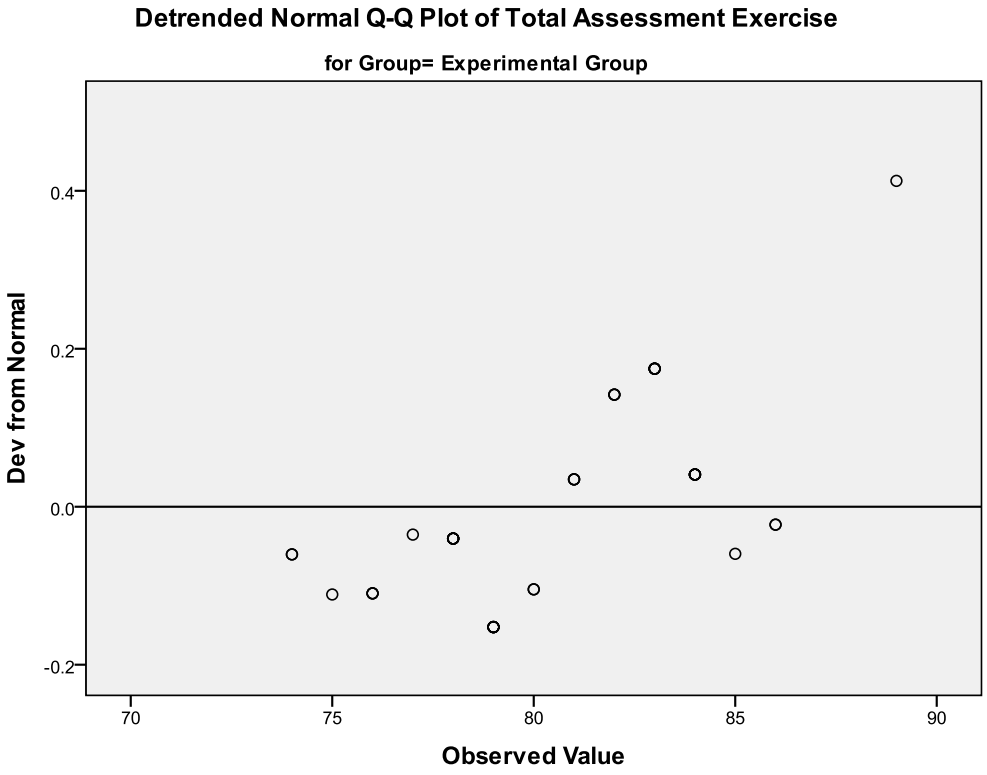
*. This is a lower bound of the true significance.

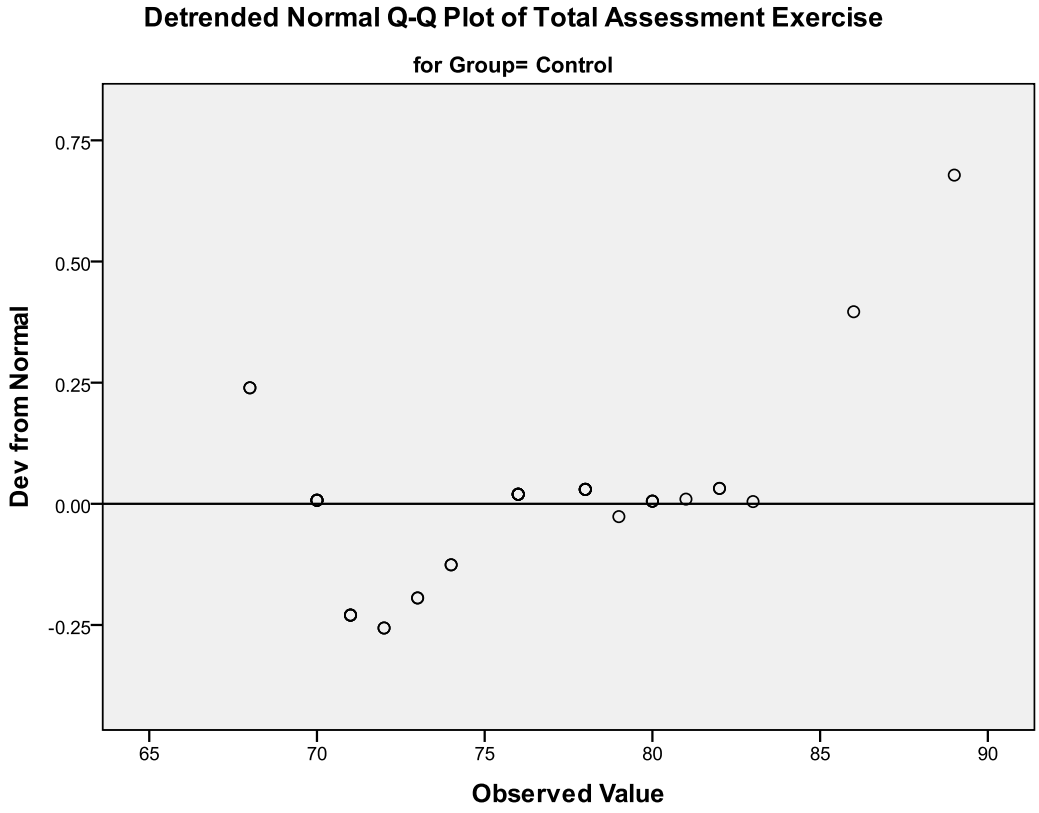

Histogram
for Group= Experimental Group
Mean = 80.57
Std. Dev. = 3.507
N = 42
Frequency
Total Assessment Exercise

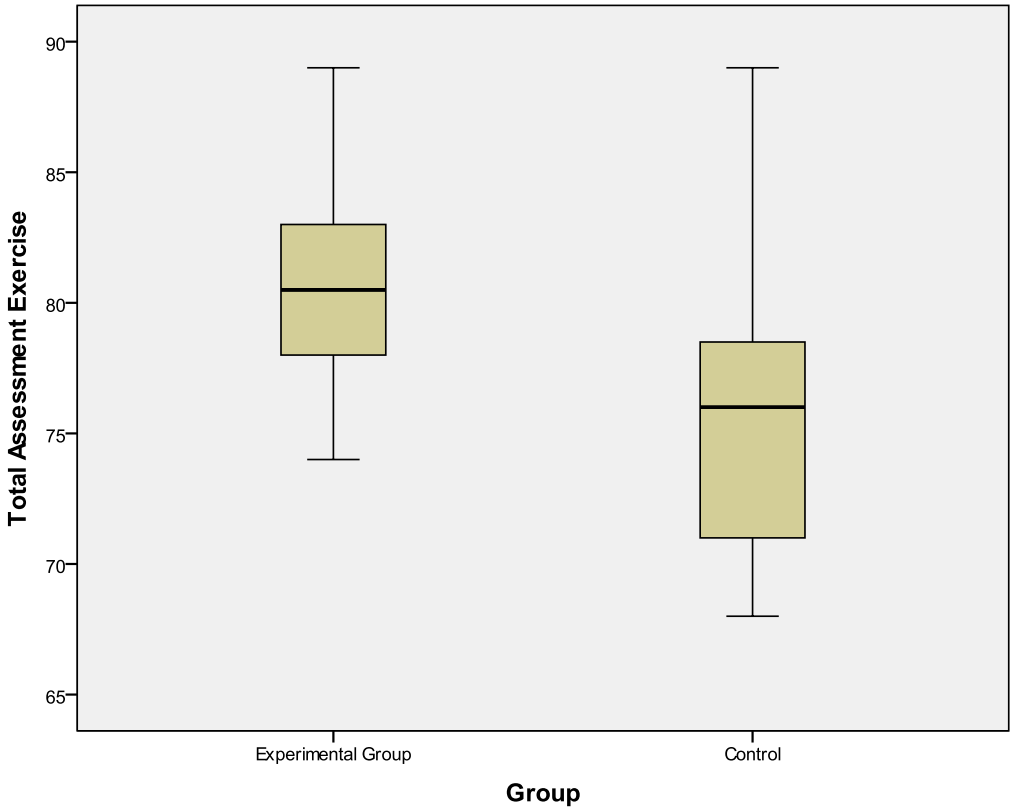

Histogram
for Group= Control
Mean = 75.74
Std. Dev. = 5.025
N = 39
Frequency
Total Assessment Exercise


Normal Q-Q Plot of Total Assessment Exercise
for Group= Experimental Group
Expected Normal
Observed Value
3
2
1
0
-1
-2
-3
70
75
80
85
90


Normal Q-Q Plot of Total Assessment Exercise
for Group= Control
Expected Normal
Observed Value
3
2
1
0
-1
-2
65
70
75
80
85
90
95


Detrended Normal Q-Q Plot of Total Assessment Exercise
for Group= Experimental Group
Dev from Normal
0.4
0.2
0.0
-0.2
70
75
80
85
90
Observed Value


Detrended Normal Q-Q Plot of Total Assessment Exercise
for Group= Control
Dev from Normal
0.75
0.50
0.25
0.00
-0.25
65
70
75
80
85
90
Observed Value



# MEAN AND STANDARD DEVIATIONOF STUDENTS' ENGAGEMENT SURVEY

**Descriptive Statistics**

| | N | Mean | Std. Deviation |
|---|---|---|---|
| Item1 | 42 | 5.95 | .216 |
| Item2 | 42 | 5.88 | .328 |
| Item3 | 42 | 6.00 | .000 |
| Item4 | 42 | 5.98 | .154 |
| Item5 | 42 | 1.10 | .297 |
| Item6 | 42 | 1.12 | .328 |
| Item7 | 42 | 5.93 | .261 |
| Item8 | 42 | 5.83 | .437 |
| Item9 | 42 | 5.90 | .297 |
| Item10 | 42 | 5.81 | .397 |
| Item11 | 42 | 1.10 | .370 |
| Item12 | 42 | 5.83 | .437 |
| Item13 | 42 | 1.17 | .377 |
| Item14 | 42 | 5.93 | .261 |
| Item15 | 42 | 5.88 | .328 |
| Valid N (listwise) | 42 | | |

# CORRELATION OF OVERALL PERFORMANCE AND STUDENTS' ENGAGEMENT SURVEY

**Correlations**

| | | | Posttest/20 | Total Students' Engagement |
|---|---|---|---|---|
| Spearman's rho | Posttest/20 | Correlation Coefficient | 1.000 | .452** |
| | | Sig. (2-tailed) | . | .003 |
| | | N | 81 | 42 |
| | Total Students' Engagement | Correlation Coefficient | .452** | 1.000 |
| | | Sig. (2-tailed) | .003 | . |
| | | N | 42 | 42 |

**. Correlation is significant at the 0.01 level (2-tailed).

## BIODATA OF STUDENT

Katherine Kalaivani James Jeyaselan started her primary education at Sekolah Rendah Convent, Teluk Intan, Perak in 1989 and continued secondary education at Sekolah Menengah Kebangsaan Convent from 1995 to 1999. From 2000 to 2001, she completed higher education at Sekolah Menengah St. Anthony, Teluk Intan, Perak. She pursued her tertiary education at Universiti Putra Malaysia, Serdang, Selangor following the program on forestry science from 2002 to 2005 and was awarded Bachelors of Science in Forestry Science. While pursuing her Bachelor Degree, she was tutoring students of secondary school on a self-employment basis, and then continued doing it full-time upon completion of her tertiary education. She worked as a temporary teacher at Sekolah Menengah Kebangsaan Sri Serdang from January 2006 to March 2006 and at Sri Garden Private and International School from January 2008 to November 2009 teaching Additional Mathematics and Modern Mathematics for students of Form 4 and Form 5 sitting for Sijil Pelajaran Malaysia (SPM). From there, she decided to pursue to do her Masters Degree in the field of education.