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Appendix A

This appendix includes copies of the letters of consent for the study undertaken as well as for the use of students' data and comprises:

The consent of the Faculty Committee for Research Ethics and Integrity of the Faculty of Engineering, Built Environment and Information Technology.

The consent of the Faculty Committee for Research Ethics of the Faculty of Natural and Agricultural Sciences.

UNIVERSITEIT VAN PRETORIA
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3 April 2002

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Faculty of Engineering,
Built Environment and
Information Technology

Dear Ms Steyn

FACULTY COMMITTEE FOR RESEARCH ETHICS AND INTEGRITY

Your application refers

1 I hereby wish to inform you that your research project titled *A learning facilitation strategy for mathematics in a support course for first year engineering students at the University of Pretoria* has been approved by the Committee.

2 This approval does not imply that the researcher, student or lecturer is relieved of any accountability in terms of the Codes of Research Ethics of the University of Pretoria, if action is taken beyond the approved proposal.

3 According to the regulations, any relevant problem arising from the study or research methodology as well as any amendments or changes, must be brought to the attention of any member of the Faculty Committee who will deal with the matter.

4 The Committee must be notified on completion of the project.

The Committee wishes you every success with your research project.

I. du Plessis
Dr Ina du Plessis
Chair: Faculty Committee for Research Ethics and Integrity.

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8 April 2002

Prof R M Crewe
Dean: Faculty of Natural and Agricultural Sciences
University of Pretoria
Pretoria.

Dear Prof Crewe,

Mrs TM Steyn: Aplication for inclusion of students' data in PhD thesis.

I am aware of mrs. Steyn's research. She started to collect data while being a staff member of the Gold Fields Computer Centre. She later moved to the Faculty of Engineering where she continued this research. I confirm that, while at the Gold Fields Computer Centre, the conditions under which the data was collected, were as stated in her application.

I am also familiar with the HBDI thinking styles assessment system. It is a non-contentious system providing valuable insights to individuals. If the results are used anonymously, as mrs Steyn intends to do, no harm, in my opinion, could be done to any individual or group.

I therefore find no grounds, ethical or otherwise, to deny mrs Steyn permission to use the data collected here, as part of her PhD.

Yours sincerely

Johan van Staden
Director: Discovery Centre @ Tuks

June 12, 2002
Prof J van Staden
Discovery Centre@Tuks
UNIVERSITY OF PRETORIA

University of Pretoria
Ethics Committee
Faculty of Natural and Agricultural Sciences
E-mail: ethics@postino.up.ac.za

Dear Prof van Staden

Project: **Inclusion of student data in PhD thesis (EC020604-010)**

The project conforms to the requirements of the Ethics Committee.

Yours sincerely,

Prof NH Casey

Chairman: Ethics Committee
Faculty of Natural and Agricultural Sciences

Appendix B

This appendix includes an example of a worksheet and accompanying answer sheet from:

Greybe, W., Steyn, T. & Carr, A.1998. *Fundamentals of 2-D function graphing – a practical workbook for precalculus and introductory calculus.* Cape Town: Oxford University Press.

An adapted version of one of the exercises is also included.

Solving Inequalities and Piecewise Defined Functions

6

In this worksheet you will

- extend your knowledge of *Master Grapher for Windows*
- solve inequalities graphically
- explore a piecewise defined function

Hints for solving inequalities with the *Grapher:*

hints for solving **inequalities** with *Master Grapher for Windows*

- Plot the function and use one or more fixed lines to partially define the area of the graph window which contains the solutions.
- Use a vertical moving line and a right mouse button click to define the area of the graph window which contains the solutions.
- **Remember that explorations with a graphing tool are always done from left to right.**
- If you are in doubt as to the choice of the dimensions of the graph window, start with the default graph window: [-10, 10] x [-10, 10]
- Use **zoom** if applicable.

Solutions must be determined graphically and answers given to two decimal places.

1 Use a suitable graph window and draw a complete graph of function f where $f(x) = -0.41x^2 + 3.9x + 2.8$

1.1 Write down the dimensions of the graph window that you use.

1.2 Solve for x: $-0.41x^2 + 3.9x + 2.8 > 0$
Give the dimensions of the graph window that you use.

1.3 Solve for x: $-0.41x^2 + 3.9x + 2.8 \leq -7.8$
Give the dimensions of the graph window that you use.

1.4 Solve for x: $-0.41x^2 + 3.9x + 2.8 > 5.2$
Give the dimensions of the graph window that you use.

2 Use applicable graphs to solve for x: $-\frac{3}{4} < \frac{3-x}{2} \leq 8$
Give the dimensions of the graph window that you use.

3.1 Use applicable graphs to solve for x: $|3.2x - 2.7| > 0.9$
Give the dimensions of the graph window that you use.

3.2 If $a \leq |3.2x - 2.7| \leq b$, determine the values of a and b given that $-0.34 \leq x \leq 2.5$
Give the dimensions of the graph window that you use.

4.1 Use the default graph window and draw a complete graph of f where $f(x) = \frac{2.2x + 3.4}{|x - 1.7|}$
Observe what the graph looks like.

4.2 Change the dimensions of the graph window to [-5, 10] x [-5, 20].
You can compare the graph in the two different graph windows as follows:
Click on **View**.
Click on **Previous Graph**.

The graph is displayed in the [-10, 10] x [-10, 10] graph window.

Click on **View** again.
Click on **Previous Graph**.

The graph is displayed in the [-5, 10] x [-5, 20] graph window.

4.3 Determine the intersection with the Y-axis.
Give the dimensions of the graph window that you use.

4.4 Solve for x: $\dfrac{2.2x+3.4}{|x-1.7|}=0$
Give the dimensions of the graph window that you use.

4.5 Solve for x: $\dfrac{2.2x+3.4}{|x-1.7|}>0$ and give the dimensions of the graph window that you use.

4.6 Redraw the graph of f in a graph window with dimensions [-5, 10] x [-5, 50]
What seems to happen with the function values $f(x)$ as x gets nearer and nearer to the value 1.7 ?

4.7 Is $x=1.7$ part of the solution to question **4.4** ?
Motivate your answer algebraically.

5.1 Use the default graph window and draw the graphs of f_1, f_2 and f_3 defined by
$f_1(x)=-|1.4x-3.6|+5$, $f_2(x)=x^2+3.5x-5.64$ and $f_3(x)=1.86$ on the same set of axes.

5.2 Write down the domain and range of f_1

5.3 Write down the domain and range of f_2

5.4 Write down the domain and range of f_3

5.5 Draw fixed vertical lines at $x=-5$ and at $x=1$

5.6 Use the graphs of f_1, f_2 and f_3 in question **5.1** and the lines drawn in question **5.5** as guidelines to draw a freehand sketch of the function g defined by:

$$g(x)=\begin{cases}1.86 & x\le -5\\ x^2+3.5x-5.64 & -5<x<1\\ 2 & x=1\\ -|1.4x-3.6|+5 & x>1\end{cases}$$

Hint: Use the graphs given on the answer sheet to compile g by tracing the appropriate section with colour.

Your sketch must clearly indicate:

- the intersection with the axes
- the domain of g
- the range of g
- the zeros of g

5.7 Write down the domain and range of the function g

5.8 For which values of x is $g(x) > 0$?

5.9 Determine the values of x given that $-1 < g(x) < 1$

6 Two scuba divers explored a reef close to the shore. They swam out for 50m on the surface and then dived towards the reef at a trajectory described by the function $f(x) = 0.002x^2 - 0.574x + 23.746$ The divers then ascended to a depth of 15m below the surface to explore the reef at this depth for a further 50m still heading offshore. Finally they ascended to the surface at a trajectory described by the function $g(x) = 0.09x - 35.61$

Note The distance from the shore is represented on the X-axis and the depth below the surface on the Y-axis.

6.1 Use a graph window with suitable dimensions to display the graphs representing the dive.

6.2 Draw a freehand sketch representing the dive.

6.3 Define a function p to describe this dive. Let x represent the distance from the shore and $p(x)$ the depth below the surface.

6.4 What was the maximum depth of this dive ?

6.5 How deep were the divers when they were 80m offshore ?

6.6 The most interesting part of the reef occurred at a depth of 15m. How far offshore was it ?

6.7 How far offshore did the divers start their final ascent ?

6.8 At what distance from the shore did they reach the surface again ?

6.9 Calculate the distance that the divers swam in the final ascent to the surface.

Answer Sheet 6 **qualities and Piecewise Defined Functions**

Name: _____ Student no: _____ Date: _____

Note: The **dimensions of the graph window** required for the answers in this worksheet must **not** be that of the zoomed window but the window displaying a complete graph of the function.

Dimension of graph window	Solution(s)
1.1	
1.2	
1.3	
1.4	
2	
3.1	
3.2	
4.3	
4.4	
4.5	
4.6	
4.7	

Name: _____ Student no: _____ Date: _____

5.2 Domain of f_1 = Range of f_1 =	**5.6**
5.3 Domain of f_2 = Range of f_2 =	
5.4 Domain of f_3 = Range of f_3 =	
5.7 Domain of g = Range of g =	

5.8
5.9

6.1 Dimensions of the graph window:
6.2

Answer Sheet 6 **qualities and Piecewise Defined Functions**

Name: _____ Student no: _____ Date: _____

6.3	
6.4	**6.5**
6.6	**6.7**
6.8	
6.9	

An adaptation of Question 6 of Worksheet 6[§]

Two scuba divers explored a reef close to the shore. They swam out for 50m on the surface and then dived towards the reef at a trajectory described by the function $f(x) = 0.002x^2 - 0.574x + 23.746$. The divers then ascended to a depth of 15m below the surface to explore the reef at this depth for a further 50m still heading offshore. Finally they ascended to the surface at a trajectory described by the function $g(x) = 0.09x - 35.61$

Note The distance from the shore is represented on the X-axis and the depth below the surface on the Y-axis.

Use a graphing utility and a graph window with suitable dimensions to display the graphs representing the dive.

1 Draw a freehand sketch to represent the dive.

2 Define a function p to describe this dive. Let x represent the distance from the shore and $p(x)$ the depth below the surface.

2 What was the maximum depth of this dive?

4 How deep were the divers when they were 80m offshore?

5 The most interesting part of the reef occurred at a depth of 15m. How far offshore was it?

6 How far offshore did the divers start their final ascent?

7 At what distance from the shore did they reach the surface again?

8 Calculate the distance that the divers swam in the final ascent to the surface.

[§] In this adaptation the pictures were added to orientate those students who do not have a frame of reference regarding scuba diving. Although it is not part of the research reported in this thesis, it can be mentioned that this example was preceded in 2002 by course activities in skills training on accessing information through a traditional library (books) as well as an internet search. In addition students were shown a short video on a scuba dive.

Answer sheet

1		
2		
3	4	5
6	7	
8		

Appendix C

This appendix includes examples of questions in the final version of the Study Orientation Questionnaire in Mathematics Tertiary (SOMT) as it was used in this study. The final version of the SOMT resulted from various editing, done in this research study, to the original Study Orientation Questionnaire in Mathematics (SOM) published in 1996:

Maree, J.G. 1996. *Study orientation: maths questionnaire.* Pretoria: Human Sciences Research Council.

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YUNIBESITHI YA PRETORIA

Name: ..... **Date:** .....

This questionnaire is a survey regarding various aspects concerning your study orientation towards **mathematics at university**. Your answers will be treated confidentially.

Consider each of the questions below and then rate yourself according to one of the five possible options that are explained below. You are asked to rate yourself not as you think you should do or feel, or as you think others rate you, but as **you yourself** are in the **habit of doing or feeling**.

For every question, make an ✓ in the box to the left of the category that best describes your feeling about the statement **with reference to your university mathematics** to date.

Please note that there are no right or wrong answers.

Make sure that you do not omit any question.

Rarely means	0-15% of the time
Sometimes means	16-35% of the time
Frequently means	36-65% of the time
Generally means	66-85% of the time
Almost always means	86-100% of the time

1. I enjoy solving Maths problems.

	Rarely		Sometimes		Frequently		Generally		Almost always

2. While answering tests or exams in Maths, I panic

	Rarely		Sometimes		Frequently		Generally		Almost always

3. I catch up missed work in Maths.

	Rarely		Sometimes		Frequently		Generally		Almost always

4. I explain Maths to my fellow students.

	Rarely		Sometimes		Frequently		Generally		Almost always

5. My lecturer uses words that I do not know and that confuse me.

	Rarely		Sometimes		Frequently		Generally		Almost always

Appendix D

This appendix includes examples of questions in the Herrmann Brain Dominance Instrument (HBDI) (Herrmann, 1995:66-67; 1996:321-323) as well as an example of a full-sized profile from the database of the author of this thesis.

Herrmann, N. 1995. *The creative brain* (2nd ed.). Kingsport: Quebecor Printing Group.
Herrmann, N. 1996. *The whole brain business book*. New York: McGraw-Hill.

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BIOGRAPHICAL INFORMATION

Please complete **every** question according to the directions given. Each response, including your answers to questions 2, 3 and 4, provide important data. When directions are not followed or data is incomplete we are unable to process your survey, and must return it to you.

1. Name _____ 2. Sex: M ☐ F ☐

3. Educational focus or major _____

4. Occupation or job title _____

Describe your work (please be as specific as possible) _____

_____

HANDEDNESS

5. Which picture most closely resembles the way you hold a pencil?

A ☐  B ☐  C ☐  D ☐ 

6. What is the strength and direction of your handedness?

A ☐ Primary left B ☐ Primary left, some right C ☐ Both hands equal D ☐ Primary right, some left E ☐ Primary right

SCHOOL SUBJECTS

Think back to your performance in the elementary and/or secondary school subjects identified below. Rank order all three subjects on the basis of how well you did: **1** = best; **2** = second best; **3** = third best.

7. _____ Math 8. _____ Foreign language 9. _____ Native language or mother tongue

Please check that no number is duplicated: The numbers **1**, **2**, and **3** **must be used once** and **only once**. Correct if necessary.

WORK ELEMENTS

Rate each of the work elements below according to your strength in that activity, using the following scale: **5** = work I do best; **4** = work I do well; **3** = neutral; **2** = work I do less well; **1** = work I do least well. Enter the appropriate number next to each element. **Do not use any number more than four times.**

10. _____ Analytical
11. _____ Administrative
12. _____ Conceptualizing
13. _____ Expressing Ideas
14. _____ Integration
15. _____ Writing
16. _____ Technical Aspects
17. _____ Implementation
18. _____ Planning
19. _____ Interpersonal Aspects
20. _____ Problem Solving
21. _____ Innovating
22. _____ Teaching/Training
23. _____ Organization
24. _____ Creative Aspects
25. _____ Financial Aspects

Please tally: Number of 5's_____, 4's_____, 3's_____, 2's_____, 1's_____. If there are more than **four** for any category, please redistribute.

KEY DESCRIPTORS

Select **eight adjectives** which best describe the way you see yourself. Enter a **2** next to each of your **eight** selections. Then change one **2** to a **3** for the adjective which **best** describes you.

26. _____ Logical
27. _____ Creative
28. _____ Musical
29. _____ Sequential
30. _____ Synthesizer
31. _____ Verbal
32. _____ Conservative
33. _____ Analytical
34. _____ Detailed
35. _____ Emotional
36. _____ Spatial
37. _____ Critical
38. _____ Artistic
39. _____ Spiritual
40. _____ Rational
41. _____ Controlled
42. _____ Mathematical
43. _____ Symbolic
44. _____ Dominant
45. _____ Holistic
46. _____ Intuitive
47. _____ Quantitative
48. _____ Reader
49. _____ Simultaneous
50. _____ Factual

Please count: seven 2's and one 3? Correct if necessary.

HBDI™

Profile
Overlay

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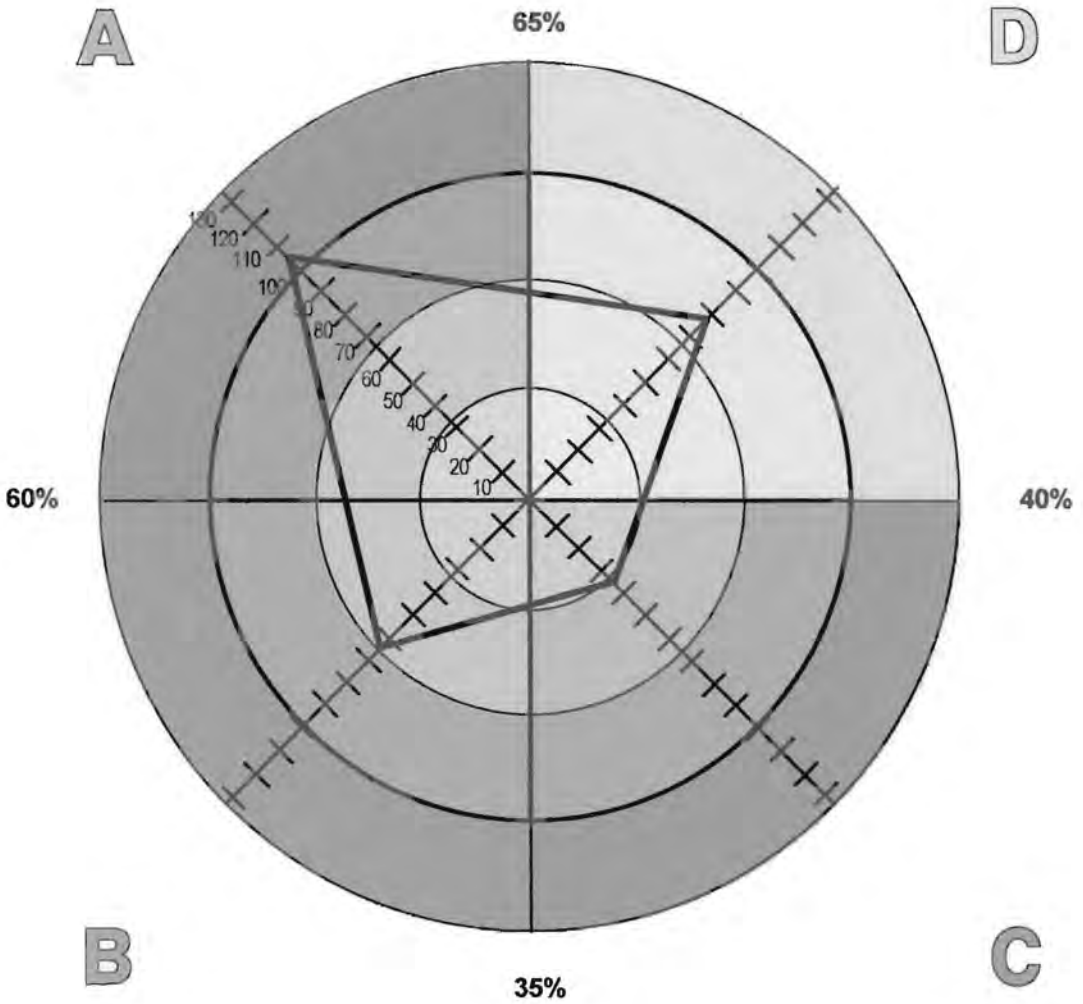
YUNIBESITHI YA PRETORIA

[redacted]

Quadrant:	A	B	C	D
Preference Code:	1	2	2	1
Adjective Pairs:	7	6	1	10
Profile Score:	105	65	35	77



Appendix E

This appendix includes a copy of the Lumsdaine and Lumsdaine Learning Activity Survey (LAS) that was used in this research study. This survey was adapted from Lumsdaine and Lumsdaine (1995:83, 86, 89,93).

Lumsdaine, E. & Lumsdaine, M. 1995. *Creative problem solving – thinking skills for a changing world.* Singapore: McGraw-Hill.

Name: _____ UNIVERSITEIT VAN PRETORIA UNIVERSITY OF PRETORIA YUNIBESITHI YA PRETORIA Date: _____

Survey on learning activity preferences of First Year Engineering Students

About the survey:

Please note that it is not a test and it is not compulsory. It is merely a survey to get an indication of the activities that you find easy and like doing. So, why do you have to complete it and how will you be able to use the results? By completing the survey honestly, you will hopefully get an indication of your thinking style preferences and you will also become aware of those activities that you do not like. Developing skills to utilise activities, associated with your lesser preferences, may contribute to success in your academic career and in your communication with other people.

What to do:

In Sections 1 – 4 below, circle the dots of those items that are *easy* for you **and** that you *enjoy* doing.

Section 1

- Looking for data and information
- Organising information logically in a framework (but not down to the last detail)
- Listening to informational lectures.
- Reading textbooks.
- Studying example problems and solutions.
- Thinking through ideas in a rational and critical manner.
- Doing library searches.
- Doing research using principles associated with scientific methods.
- Making up a hypothesis (tentative assumption), then testing it to find if it is true.
- Judging ideas that are based on facts and logical reasoning.
- Reading (studying) technical information.
- Knowing how much things cost; studying financial information.
- Knowing how computers work; using them for information processing.
- Dealing with things, rather than with people.
- Dealing with reality and the present, rather than with future possibilities.

Section 2

- Following directions (guidelines) carefully instead if trying to do something your own way.
- Doing detailed homework problems neatly and conscientiously.
- Testing theories and procedures to find flaws and shortcomings.
- Doing lab work step by step.
- Writing a sequential report on the results of lab experiments.
- When using computers there must be detailed guidelines and tutoring.
- Finding practical uses for knowledge learned – theory is not enough.
- Planning projects; doing schedules and then executing them according to plan.
- Listening to detailed lectures.
- Taking detailed, comprehensive notes.
- Studying according to a fixed schedule in an orderly environment.
- Making up a detailed budget to manage your money.
- Practising new skills through frequent repetition.
- Taking a field trip (gaining on-site knowledge) to learn about organisations and procedures.
- Writing a "how-to" manual (keeping detailed instructional notes) about a project.

Section 3

- Listening to others and sharing ideas and intuitions.
- Motivating yourself by asking "why" and by looking for personal meaning.
- Learning through sensory input – moving, feeling, smelling, tasting, listening.
- Hands-on learning by touching, feeling and using a tool or object.
- Using group-study opportunities and group discussions.
- Keeping a journal to record feelings and spiritual values, not details.
- Doing dramatics: the physical acting out of emotions is important, not imagination.
- Taking people oriented field trips.
- Gaining knowledge of other cultures to find out about the people and how they live.
- Studying with classical background music, or making up rap songs as a memory aid.
- Reading (studying) people oriented case studies.
- Respecting others' rights and views; people are important, not things.
- Learning by teaching others.
- Preferring visual to audio information to make use of body language clues.
- Reading the preface of a book to get clues on the author's purpose.

Section 4

- Looking for the big picture and context, not the details, of a new topic.
- Taking the initiative in getting actively involved to make learning more interesting.
- Doing simulations and asking "what-if" questions.
- Making use of the visual aids in lectures. Preferring pictures to words when learning.
- Doing open-ended problems and finding several possible solutions.
- Appreciating the beauty in a problem and the elegance of the solution.
- Leading a brain storming session – wild ideas, not the team, are important.
- Experimenting and playing with ideas and possibilities.
- Like to have physical adventures and explore new places.
- Thinking about trends.
- Thinking about the future.
- Relying on intuition to find solutions, not on facts or logic.
- Synthesising (combining) ideas and information to come up with something new.
- Using future-oriented case discussions.
- Trying a different way (not the general procedure) of doing something.

Learning activity preference distribution

To determine your preferred mode(s) of learning activities, do the following analysis:

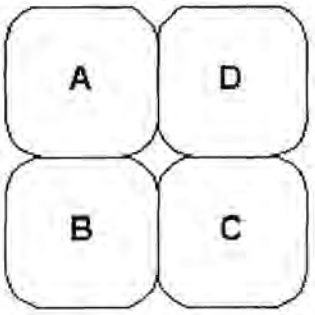
- Count the total number of circled dots in each of the sections above and write it down in the 2nd column of Table 1 below.
- Add up the total for all the responses (Section 1-4) and write it down.
- Calculate the average number of circled dots for the responses in each of Sections 1-4: divide total § by 4.

Table 1

	Number of circled dots	
Section 1		Quadrant A
Section 2		Quadrant B
Section 3		Quadrant C
Section 4		Quadrant D
Total:Sections 1-4	§	

Average number of circled dots (Divide total § by 4):

Figure 1



How to interpret Figure 1:

The quadrant with the highest score is likely the quadrant representing your strongest preferences for learning activities, especially if the score is much higher than your average.

Here are two examples to illustrate the above interpretation:

Example 1:

Number of circled dots: Section 1=12; Section 2 =3 Section 3=7 Section 4=8
Total Sections 1-4: 30
Average/quarter: 7.5 circled dots
From these results, it can be said that this student prefers learning activities in the A-quadrant, which is learning activities associated with those listed in Section 1.

Example 2:

Number of circled dots: Section 1=3; Section 2 =1 Section 3=3 Section 4=2
Total Sections 1-4: 9. Average/quarter: 2 circled dots.
No valid conclusion on preferred learning activities could be drawn due to insufficient data points.

Appendix F

This appendix includes:

Examples of questions in the printed version of the Felder Soloman Index of Learning Styles (ILS).

Examples of questions answered in the online version of the ILS as well as a printout of the results obtained from completing the online version.

A handout on *Learning Styles and Strategies* that is recommended reading for anyone who does the ILS.

All the above documents accessible from links at: *www.ncsu.edu/effective_teaching/*

INDEX OF LEARNING STYLES*

Barbara A. Soloman
First-Year College
North Carolina State University
Raleigh, North Carolina 27695

Richard M. Felder
Department of Chemical Engineering
North Carolina State University
Raleigh, NC 27695-7905

DIRECTIONS

Circle "a" or "b" to indicate your answer to every question. Please choose only one answer for each question.

If both "a" and "b" seem to apply to you, choose the one that applies more frequently.

1. I understand something better after I
   (a) try it out.
   (b) think it through.
2. I would rather be considered
   (a) realistic.
   (b) innovative.
3. When I think about what I did yesterday, I am most likely to get
   (a) a picture.
   (b) words.
4. I tend to
   (a) understand details of a subject but may be fuzzy about its overall structure.
   (b) understand the overall structure but may be fuzzy about details.
5. When I am learning something new, it helps me to
   (a) talk about it.
   (b) think about it.
6. If I were a teacher, I would rather teach a course
   (a) that deals with facts and real life situations.
   (b) that deals with ideas and theories.
7. I prefer to get new information in
   (a) pictures, diagrams, graphs, or maps.
   (b) written directions or verbal information.
8. Once I understand
   (a) all the parts, I understand the whole thing.
   (b) the whole thing, I see how the parts fit.
9. In a study group working on difficult material, I am more likely to
   (a) jump in and contribute ideas.
   (b) sit back and listen.
10. I find it easier
    (a) to learn facts.
    (b) to learn concepts.
11. In a book with lots of pictures and charts, I am likely to
    (a) look over the pictures and charts carefully.
    (b) focus on the written text.
12. When I solve math problems
    (a) I usually work my way to the solutions one step at a time.

Index of Learning Styles Questionnaire

Barbara A. Soloman
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North Carolina State University
Raleigh, North Carolina 27695

Richard M. Felder
Department of Chemical Engineering
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Raleigh, NC 27695-7905

Directions

Please provide us with your full name. Your name will be printed on the information that is returned to you.

Full Name
Student

For each of the 44 questions below select either "a" or "b" to indicate your answer. Please choose only one answer for each question. If both "a" and "b" seem to apply to you, choose the one that applies more frequently. When you are finished selecting answers to each question please select the submit button at the end of the form.

1. I understand something better after I
   - ○ **(a)** try it out.
   - ◉ **(b)** think it through.

2. I would rather be considered
   - ○ **(a)** realistic.
   - ◉ **(b)** innovative.

3. When I think about what I did yesterday, I am most likely to get
   - ◉ **(a)** a picture.
   - ○ **(b)** words.

4. I tend to
   - ○ **(a)** understand details of a subject but may be fuzzy about its overall structure.
   - ◉ **(b)** understand the overall structure but may be fuzzy about details.

39. For entertainment, I would rather
    - (●) **(a)** watch television.
    - ( ) **(b)** read a book.

40. Some teachers start their lectures with an outline of what they will cover. Such outlines are
    - ( ) **(a)** somewhat helpful to me.
    - (●) **(b)** very helpful to me.

41. The idea of doing homework in groups, with one grade for the entire group,
    - ( ) **(a)** appeals to me.
    - (●) **(b)** does not appeal to me.

42. When I am doing long calculations,
    - ( ) **(a)** I tend to repeat all my steps and check my work carefully.
    - (●) **(b)** I find checking my work tiresome and have to force myself to do it.

43. I tend to picture places I have been
    - (●) **(a)** easily and fairly accurately.
    - ( ) **(b)** with difficulty and without much detail.

44. When solving problems in a group, I would be more likely to
    - ( ) **(a)** think of the steps in the solution process.
    - (●) **(b)** think of possible consequences or applications of the solution in a wide range of areas.

When you have completed filling out the above form please click on the Submit button below. Your results will be returned to you. If you are not satisified with your answers above please click on Reset to clear the form.

Submit | Reset

Last Updated: June 29, 1999 :bh
Dr. Richard Felder, felder@eos.ncsu.edu

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YUNIBESITHI YA PRETORIA

NC STATE UNIVERSITY

Learning Styles Results

Results for: Student

```
ACT                                                   X                 REF
     11   9    7    5    3    1    1    3    5    7    9    11
                               <--  -->

SEN                                  X                                  INT
     11   9    7    5    3    1    1    3    5    7    9    11
                               <--  -->

VIS  X                                                                  VRB
     11   9    7    5    3    1    1    3    5    7    9    11
                               <--  -->

SEQ                                                        X            GLO
     11   9    7    5    3    1    1    3    5    7    9    11
                               <--  -->
```

- If your score on a scale is 1-3, you are fairly well balanced on the two dimensions of that scale.
- If your score on a scale is 5-7, you have a moderate preference for one dimension of the scale and will learn more easily in a teaching environment which favors that dimension.
- If your score on a scale is 9-11, you have a very strong preference for one dimension of the scale. You may have real difficulty learning in an environment which does not support that preference.

We suggest you print this page, so that when you look at the explanations of the different scales you will have a record of your individual preferences.

For explanations of the scales and the implications of your preferences, click on Learning Style Descriptions.

For more information about learning styles or to take the test again, click on Learning Style Page.

LEARNING STYLES AND STRATEGIES

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Hoechst Celanese Professor of Chemical Engineering
North Carolina State University

Barbara A. Soloman
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North Carolina State University

ACTIVE AND REFLECTIVE LEARNERS

- Active learners tend to retain and understand information best by doing something active with it--discussing or applying it or explaining it to others. Reflective learners prefer to think about it quietly first.
- "Let's try it out and see how it works" is an active learner's phrase; "Let's think it through first" is the reflective learner's response.
- Active learners tend to like group work more than reflective learners, who prefer working alone.
- Sitting through lectures without getting to do anything physical but take notes is hard for both learning types, but particularly hard for active learners.

Everybody is active sometimes and reflective sometimes. Your preference for one category or the other may be strong, moderate, or mild. A balance of the two is desirable. If you always act before reflecting you can jump into things prematurely and get into trouble, while if you spend too much time reflecting you may never get anything done.

How can active learners help themselves?

If you are an active learner in a class that allows little or no class time for discussion or problem-solving activities, you should try to compensate for these lacks when you study. Study in a group in which the members take turns explaining different topics to each other. Work with others to guess what you will be asked on the next test and figure out how you will answer. You will always retain information better if you find ways to do something with it.

How can reflective learners help themselves?

If you are a reflective learner in a class that allows little or not class time for thinking about new information, you should try to compensate for this lack when you study. Don't simply read or memorize the material; stop periodically to review what you have read and to think of possible questions or applications. You might find it helpful to write short summaries of readings or class notes in your own words. Doing so may take extra time but will enable you to retain the material more effectively.

SENSING AND INTUITIVE LEARNERS

- Sensing learners tend to like learning facts, intuitive learners often prefer discovering possibilities and relationships.
- Sensors often like solving problems by well-established methods and dislike complications and surprises; intuitors like innovation and dislike repetition. Sensors are more likely than intuitors to resent being tested on material that has not been explicitly covered in class.
- Sensors tend to be patient with details and good at memorizing facts and doing hands-on (laboratory) work; intuitors may be better at grasping new concepts and are often more comfortable than sensors with abstractions and mathematical formulations.

- Sensors tend to be more practical and careful than intuitors; intuitors tend to work faster and to be more innovative than sensors.
- Sensors don't like courses that have no apparent connection to the real world; intuitors don't like "plug-and-chug" courses that involve a lot of memorization and routine calculations.

Everybody is sensing sometimes and intuitive sometimes. Your preference for one or the other may be strong, moderate, or mild. To be effective as a learner and problem solver, you need to be able to function both ways. If you overemphasize intuition, you may miss important details or make careless mistakes in calculations or hands-on work; if you overemphasize sensing, you may rely too much on memorization and familiar methods and not concentrate enough on understanding and innovative thinking.

How can sensing learners help themselves?

Sensors remember and understand information best if they can see how it connects to the real world. If you are in a class where most of the material is abstract and theoretical, you may have difficulty. Ask your instructor for specific examples of concepts and procedures, and find out how the concepts apply in practice. If the teacher does not provide enough specifics, try to find some in your course text or other references or by brainstorming with friends or classmates.

How can intuitive learners help themselves?

Many college lecture classes are aimed at intuitors. However, if you are an intuitor and you happen to be in a class that deals primarily with memorization and rote substitution in formulas, you may have trouble with boredom. Ask your instructor for interpretations or theories that link the facts, or try to find the connections yourself. You may also be prone to careless mistakes on test because you are impatient with details and don't like repetition (as in checking your completed solutions). Take time to read the entire question before you start answering and be sure to check your results

VISUAL AND VERBAL LEARNERS

Visual learners remember best what they see--pictures, diagrams, flow charts, time lines, films, and demonstrations. Verbal learners get more out of words--written and spoken explanations. Everyone learns more when information is presented both visually and verbally.

In most college classes very little visual information is presented: students mainly listen to lectures and read material written on chalkboards and in textbooks and handouts. Unfortunately, most people are visual learners, which means that most students do not get nearly as much as they would if more visual presentation were used in class. Good learners are capable of processing information presented either visually or verbally.

How can visual learners help themselves?

If you are a visual learner, try to find diagrams, sketches, schematics, photographs, flow charts, or any other visual representation of course material that is predominantly verbal. Ask your instructor, consult reference books, and see if any videotapes or CD-ROM displays of the course material are available. Prepare a concept map by listing key points, enclosing them in boxes or circles, and drawing lines with arrows between concepts to show connections. Color-code your notes with a highlighter so that everything relating to one topic is the same color.

How can verbal learners help themselves?

Write summaries or outlines of course material in your own words. Working in groups can be particularly effective: you gain understanding of material by hearing classmates' explanations and

you learn even more when you do the explaining.

SEQUENTIAL AND GLOBAL LEARNERS

- Sequential learners tend to gain understanding in linear steps, with each step following logically from the previous one. Global learners tend to learn in large jumps, absorbing material almost randomly without seeing connections, and then suddenly "getting it."
- Sequential learners tend to follow logical stepwise paths in finding solutions; global learners may be able to solve complex problems quickly or put things together in novel ways once they have grasped the big picture, but they may have difficulty explaining how they did it.

Many people who read this description may conclude incorrectly that they are global, since everyone has experienced bewilderment followed by a sudden flash of understanding. What makes you global or not is what happens before the light bulb goes on. Sequential learners may not fully understand the material but they can nevertheless do something with it (like solve the homework problems or pass the test) since the pieces they have absorbed are logically connected. Strongly global learners who lack good sequential thinking abilities, on the other hand, may have serious difficulties until they have the big picture. Even after they have it, they may be fuzzy about the details of the subject, while sequential learners may know a lot about specific aspects of a subject but may have trouble relating them to different aspects of the same subject or to different subjects.

How can sequential learners help themselves?

Most college courses are taught in a sequential manner. However, if you are a sequential learner and you have an instructor who jumps around from topic to topic or skips steps, you may have difficulty following and remembering. Ask the instructor to fill in the skipped steps, or fill them in yourself by consulting references. When you are studying, take the time to outline the lecture material for yourself in logical order. In the long run doing so will save you time. You might also try to strengthen your global thinking skills by relating each new topic you study to things you already know. The more you can do so, the deeper your understanding of the topic is likely to be.

How can global learners help themselves?

If you are a global learner, it can be helpful for you to realize that you need the big picture of a subject before you can master details. If your instructor plunges directly into new topics without bothering to explain how they relate to what you already know, it can cause problems for you. Fortunately, there are steps you can take that may help you get the big picture more rapidly. Before you begin to study the first section of a chapter in a text, skim through the entire chapter to get an overview. Doing so may be time-consuming initially but it may save you from going over and over individual parts later. Instead of spending a short time on every subject every night, you might find it more productive to immerse yourself in individual subjects for large blocks. Try to relate the subject to things you already know, either by asking the instructor to help you see connections or by consulting references. Above all, don't lose faith in yourself; you will eventually understand the new material, and once you do your understanding of how it connects to other topics and disciplines may enable you to apply it in ways that most sequential thinkers would never dream of.

- Click on tell me more for more information about the learning styles model and implications of learning styles for instructors and students.
- Click here to return to Richard Felder's home page.

Appendix G

This appendix includes examples showing the format of the feedback sheets that were used during the research reported in this thesis.

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Individual student's photo

My preferences as in May 2001

1. Felder Soloman Index of learning style

Use the inventory that you received back and indicate preferences as *mild*; *moderate* or *strong*.

For processing information:	Reflective	Active
For perceiving information:	Sensing (logical, factual)	Intuitive
For the way in which information is presented:	Verbal	Visual
For progressing to understand information:	Sequential	Global

2. Survey for First Year Engineering students of preferred learning/thinking activities:

Enter percentage of your preferences as compiled on the survey form in each of the quadrants.

Logical Factual Critical Deductive Analyse Technical Sequential	Experiential Conceptual Intuititive Inductive Synthesise Imaginative Global
Structured Organised, planned Detail Evaluative Individual	Experiential Emotional Feeling Cooperative

Student: .....

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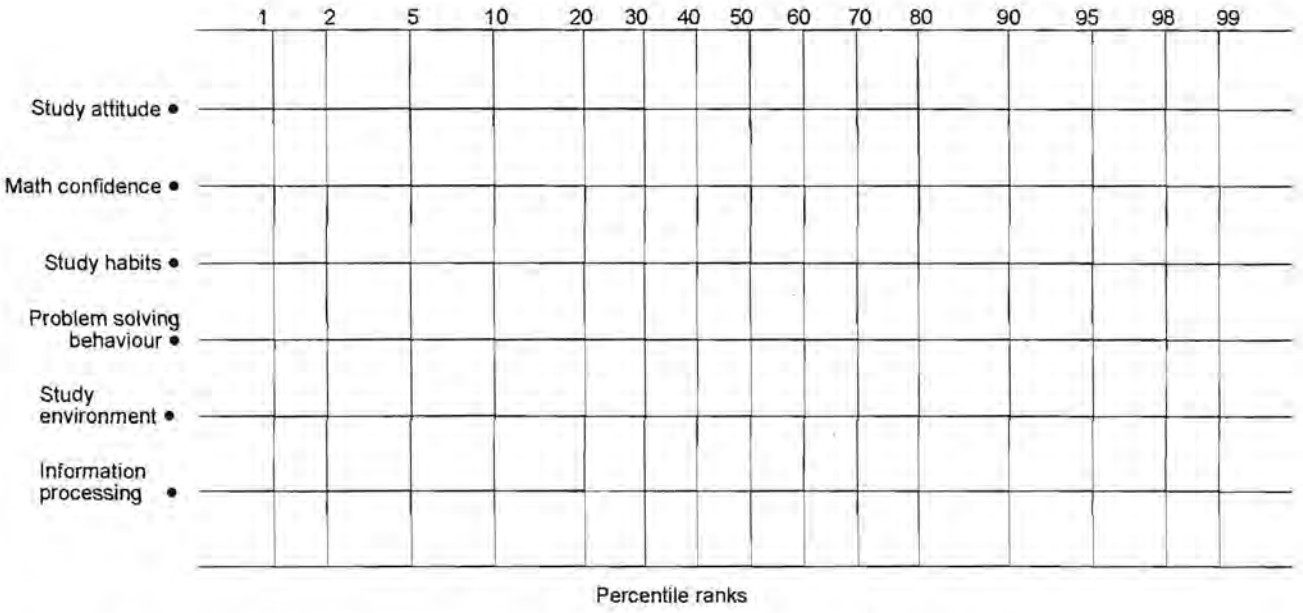
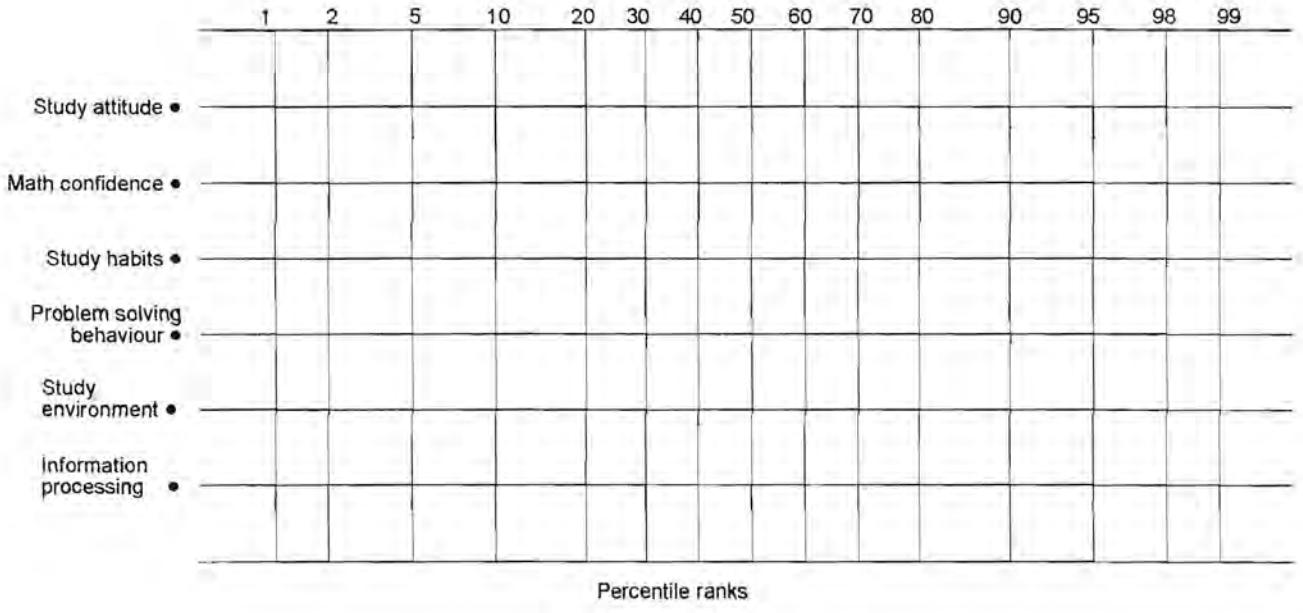
Your Profile of the SOM as in March 2001



Average (Study attitude + Math confidence + Study habits + Problem solving behaviour + study milieu):

Your Profile of the SOTM as in September 2001



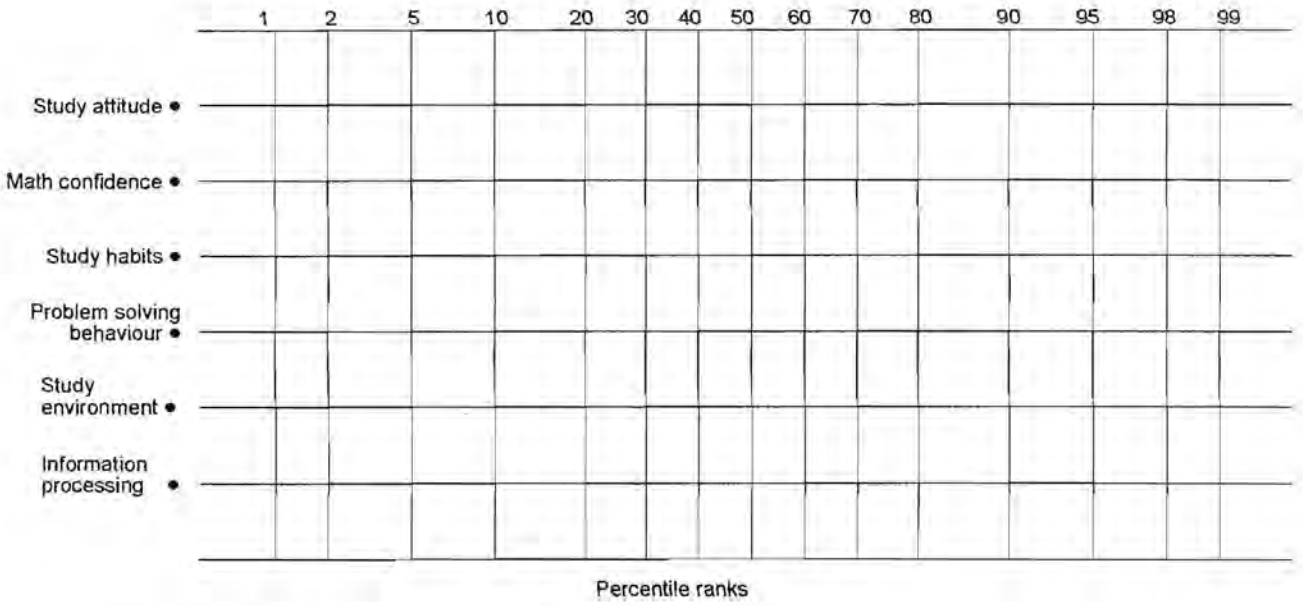
Average (Study attitude + Math confidence + Study habits + Problem solving behaviour + Study environment):

March 2002					
SA	MC	SH	PSB	SE	IP

August 2002					
SA	MC	SH	PSB	SE	IP

Use the data above to draw your study orientation profiles on the grid below. Use two different colours representing each profile as in March and August 2002.

My study orientation in mathematics as in 2002



For each of the fields:
A score of 0-39% indicates an unfavourable study orientation
A score of 40-69% indicates a neutral study orientation
A score of 70-100% indicates a favourable study orientation

Explanation of the fields of the study orientation questionnaire:

Study attitude (SA) deals with feelings (subjective but also objective experiences) and attitudes towards mathematics that are manifested consistently and which affect your motivation, expectation and interest with regard to mathematics.

Mathematics confidence (MC) concerns an overall feeling of 'comfort' toward mathematics. An 'uncomfortable' feeling, on the contrary, can be associated with anxiety which manifests itself in insignificant behaviour (like excessive sweating, scrapping of correct answers and an inability to formulate mathematics concepts).

Study habits (SH) refers to the displaying of acquired, consistent and effective study methods.

Problem solving behaviour (PSB) in mathematics includes the strategies that you use in mathematics.

Study environment (SE) includes factors relating to the social, physical and perceived environment.

Information processing (IP) reflects on general and specific learning, summarising and reading strategies, critical thinking and understanding strategies such as optimal use of sketches, tables and diagrams.

Assignment: Analysis of my study orientation in mathematics as in 2002

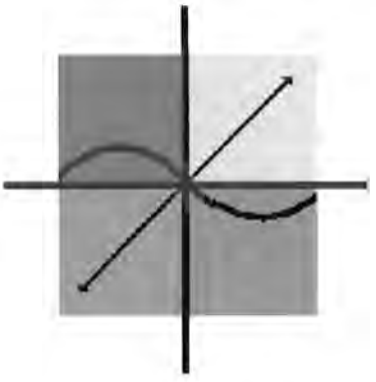
For this assignment you have to do an analysis of your profile concerning your study orientation in mathematics. Do the analysis according to the guidelines given below and as they apply to your profiles. Off course, like always, you must adhere to the guidelines for writing assignments in JPO 120

Submission: This analysis and your profiles must be stapled together and be submitted no later than **Friday 23 August 9:00**.

1. The fields in which I have improved from March to August 2002 are:
2. The fields in which I have not improved from March to August 2002 are:
3. The fields in which my study orientation remained more or less the same from March to August 2002 are:
4. Possible reasons for my improvement in .....are the following:
5. Possible reasons why I did not improve in .....are the following:
6. Concerning the field(s) in which my study orientation remained more or less the same, I think .....
7. Overall, the study orientation profiles give a good/fair/ etc. indication of my study orientation in mathematics. Motivate your statement.

Appendix H

Colour code of the whole brain model



According to Herrmann (1999), the creator of the whole brain metaphor, the colour designations for each quadrant has the following meaning:

- The upper left A-quadrant typifies **cerebral** processing and therefore the colour chosen to represent this quadrant is **cerulean** blue.
- The lower left B-quadrant indicates strong structure and is colour coded by **green** because green suggests **groundedness**.
- The lower right C-quadrant, because of its **emotional**, feeling and interpersonal orientation, is colour coded by **red** because of the **emotional passion** implied by this colour.
- The upper left D-quadrant signifies **imaginative** qualities and is represented by **yellow** which indicates **vibrancy**.

The author of this thesis used the original idea of the four quadrant whole brain metaphor of Ned Herrmann to compile the figure above. This figure depicts a whole brain approach to the exploration of 2-D functions and their graphs.

Herrmann, N. 1999. Information given to TM Steyn during personal communication.

Treat people as if they were what they ought to be and you help them become what they are capable of being.

Johann W von Goethe