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Tobia Steyn has been involved in academic support programs at the University of Pretoria since 1991. Based on this experience she co-developed computer graphing software; co-authors and updates a mathematics workbook for use with the graphing software. She is co-author of a South African edition of a textbook on studying engineering. These educational aids as well as her research focus are aimed at developing first year students' mathematical and non-mathematical skills necessary for success in engineering study.

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Skills development using Logo – experiences with first year engineering students on an extended study program

Abstract

Since 2003, Logo has been used in a developmental course, Professional Orientation, presented to first year students enrolled for an extended study program in engineering. Ongoing action research at the University of Pretoria has identified a lack of competence in mathematics and mathematical thinking skills as well as shortcomings in communication skills in the background of freshmen engineering students. The use of Logo is purposefully structured with little emphasis on programming per se as a minimum of Logo programming commands are used. The accent is on the development of logical and procedural thinking skills, observational skills, as well as analysis and synthesis. IT and communication skills, including reading, writing and comprehension skills, are also fostered. The Logo course content relies on basic knowledge of a 2-D set of axes, elementary concepts from trigonometry and Euclidian geometry as well as algebra. The underlying pedagogical approach is based on the principles of whole brain thinking and learning and with emphasis on assisting the students in making the transition from an empirical-inductive thinking pattern to a hypothetical-deductive thinking pattern. Qualitative analysis of students' feedback shows that the experiences with Logo, when used in an innovative pedagogical approach, with content and a learning environment that is new to students, contribute to intellectual growth and a sense of achievement.

Introduction: Logo

Logo was originally developed by Seymour Papert at the Massachusetts Institute of Technology in the mid-1960s. It is a programming language that enables the creation of programs of varying levels of sophistication, depending on the skill of the programmer. Since it first appeared, numerous variations of the Logo interface have been developed. These are available commercially and as freeware. Freeware versions include UCB Logo and MSW Logo (which has an MS Windows interface, but uses the UCB Logo core). Terrapin Logo is a commercial version which is used in the activities reported in this paper. It was chosen as its level of interface sophistication fits our educational aims. Logo is traditionally viewed as an educational tool to explore mathematics in the realm of elementary school curricula and its use with children to develop better thinking skills has been widely researched and reported. However, Logo has also been used extensively in undergraduate computer courses at the University of California at Berkeley. During the 1980s and 1990s much was written on Logo and its (potential) educational uses, but this enthusiasm for Logo seems to have diminished. In the United States, Terrapin Software is still actively involved in promoting Logo as a tool for learning. In all the interface variations, the Logo philosophy and the basics of the Logo language have remained the same, namely, that Logo offers a participatory, hands-on environment and promotes self directed learning. We are of opinion that Logo is still a very effective tool for learning but its decline in popularity is probably due to lack of insight into its capabilities by educators. In high schools it is often seen as a programming language, rather than an aid to developing logical thinking skills.
Background: Students on an extended study program in engineering

In 1994, we started using Logo with students on a bridging program in the Faculty of Science at the University of Pretoria. Based on these experiences, Logo was implemented as a tool for skills training and development in a course, Professional Orientation in 2003. The course is presented to first year engineering students on an extended study program in engineering. This program comprises five years of full time study and is offered in addition to the standard four year university engineering program, which is regulated by the Engineering Council of South Africa (ECSA). The purpose of the extended study program is to create opportunities for students who have the potential to become engineers, but who do not meet the entrance requirements to enroll for the standard four year program and/or who are academically at risk of not coping with the high demands of engineering study. The extended study program is structured in such a way that the courses of the first two years of the standard four year program are spread over the first three years of the extended program. Students on both programs attend the same classes, have the same lectures, use the same textbooks and write the same tests and examination papers. Students on the extended study program receive additional tutoring support in their first year modules.

Our ongoing action research confirms that two consistent problem areas exist in the background knowledge of freshmen engineering students, namely, a lack of fundamental mathematical skills and a lack of competence in communication skills, especially technical (including mathematical) communication skills. Similar observations were noted in the United States where a survey revealed that an increasing number of incoming students need remedial courses in mathematics and English. To address these shortcomings, we embarked on a proactive approach to promote the academic development of students on the extended study program. Some of these students enroll for a developmental course, Professional Orientation, during the first year of study.

The Professional Orientation course

The course comprises two credit-bearing semester modules with, on average, seven hours contact time per week. The learning content is integrated with the learning process and with skills development combining mathematical skills; academic skills; personal skills; communication skills and IT skills. In this way learning content and learning processes are fused into the conceptual and psychological framework of the learner. New knowledge is constructed from existing knowledge and the learning process is fostered when a learner constructs meaning by making associations within his/her own range of learning experiences. Our experiences with students on the extended study programme indicate that they often find it difficult to construct meaning and rely on rote-learning without understanding. It is therefore necessary to devise teaching strategies to aid students in developing thinking skills.

The main aim of the Professional Orientation course is the development of each student's academic potential in order for him or her to pursue engineering studies successfully. The instructional approach is illustrated in Figure 1. Broadly speaking, this approach is based on the Herrmann four quadrant whole brain model, the Felder Silverman model of learning styles, and the Lumsdaine & Lumsdaine's modes of student learning. This instructional approach thus underpins the principles of these models:
there are different ways of learning;
students arrive at tertiary institutions with established ways of thinking and doing; and
students should acquire the ability to be able to function in different learning (thinking) style modes.

Figure 1 Instructional approach in the Professional Orientation course

The following strategies are viewed as core pedagogical principles:
• active learning;
• face to face interaction;
• cooperative learning;
• continual assessment; and
• extensive feedback.

Active learning involves activities that engage students in doing something, instead of only observing what can or should be done. Students are made aware of their own learning actions and that they must consciously plan, implement, monitor and evaluate these actions. The significance of this principle is in accordance with research results which show that active learning has the strongest positive influence on academic improvement. Face to face interaction is the main mode of communication between facilitators (lecturer and tutors) and the students, but is not in a traditional lecture style format. The course is presented in a computer laboratory where facilitator-student and student-student interaction are mostly one-on-one or in informal small groups. Class activities are purposefully structured to foster cooperative learning. An approach of continual (formative) assessment and extensive feedback on performance is followed. A strong emphasis is placed on a high standard of work.

During the first semester the main focus is on fundamental mathematical concepts. The aim is to give students a thorough understanding of 2-D functions and their graphs. Our research affirms that freshmen engineering students are in dire need of gaining competence in, and mastering of these concepts to ensure a solid basis for their calculus study. In the second semester the focus is less on mathematics as such and more on skills development including thinking skills, communication skills and IT skills. Logo is incorporated into the course as part of this strategy.
Logo curriculum

When we started with Logo in 1994, we used the text *A first course in programming*, but very soon realised that the focus of that curriculum was not in accordance with our aims. The text was, in a sense, too sophisticated with too strong a focus on programming skills. In fact, the content of most of the texts available at that time (see Appendix A for a list of some Logo resources) did not comply with what we wanted to achieve. We then developed a curriculum to suit our aims and thus the current curriculum evolved.

The Logo curriculum in the Professional Orientation course is structured with little emphasis on programming per se and a minimum of Logo programming commands (approximately 20) are used. In addition to the development of thinking skills (procedural, logical, analysis and synthesis), Logo tasks and the results of the Logo programming are also used to foster comprehension as well as skills in observation and communication. The formal exposure to Logo is purposefully spread over six weeks, with one class per week, so that students have time to explore Logo and to progress in the development of thinking skills at an individual pace. Most of the students usually need more time than one class period to finish a Logo tutorial. Students, who do finish in time, usually continue with their own experimentation in Logo. The Logo component of the course culminates with a project. The time allocated to this project is approximately one month. Table 1 gives a summary of the topics and tasks in each tutorial.

<table>
<thead>
<tr>
<th>Tutorial</th>
<th>Topic</th>
<th>Tasks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tutorial 1</td>
<td>Introduction</td>
<td>Explore the Logo environment.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Explore Logo commands for drawing basic shapes: square, rectangle; triangle</td>
</tr>
<tr>
<td>Tutorial 2</td>
<td>Regular polygons</td>
<td>Explore: Relative and absolute orientation and movement of the turtle.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Deduce mathematical relationship between the number of sides, size of interior angle and the number of turtle turns to draw a regular polygon.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Generalize the relationship between the number of sides, size of interior angle and sides of any regular polygon.</td>
</tr>
<tr>
<td>Tutorial 3</td>
<td>Using the repeat command</td>
<td>Formalize multiple executions of the same command with 'repeat'.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Apply to the basic shapes.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Adapt the commands for a regular polygon to draw a circle.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Determine the radius of circle approximated by an n-sided regular polygon using three possible mathematical scenarios.</td>
</tr>
<tr>
<td>Tutorial 4</td>
<td>Rotating and repeating regular figures.</td>
<td>Analyze a given composite diagram to determine a basic figure.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Compile the commands to draw the basic figure.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Compile nested repeat commands to draw the composite figure.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>See the example in Figure 2(b).</td>
</tr>
</tbody>
</table>
Tutorial 5 Procedures

- Compile procedure as a building block in programming.
- Apply to the basic shapes.
- Combine a group of procedures linked by a main procedure as an example of a program.
- Examples with mathematical relationships from Euclidian geometry.
- Plan the structure of program to draw an uncomplicated picture.
- Write a program to draw the picture.
- Elaborate a program by adding detail (e.g. color).

Tutorial 6 Parameters

- Draw the basic shapes (square, rectangle, triangle, and circle) in any size.
- Use mathematical relationships to draw diagrams that 'grow' or 'shrink'.
- See the example in Figure 2(c).

Project Draw a church

Activity 1: Freehand design on paper. Then do the design in Visio.
Activity 2: Compile planning report in MSWord.
Activity 3: Write a Logo program to draw the designed church.
Activity 4: Demonstrate (and explain) the Logo church program to an audience.

Table 1 Summary of the Logo curriculum

The composition of the Logo curriculum is structured to promote the development of students' thinking skills and assist in transition from an empirical-inductive thinking pattern to a hypothetical-deductive pattern. Empirical-inductive thinking patterns enable one to order accurately and describe perceptible objects, events and situations. Hypothetical-deductive patterns allow one to go beyond descriptions and create and test hypothetical (non-observable) explanations.

All the tutorials require that students apply, at varying levels, observational and procedural skills, analysis and synthesis as well as some form of communication. Table 2 summarizes the progress in the development of these skills.
Empirical inductive thinking pattern

<table>
<thead>
<tr>
<th>THINKING SKILLS</th>
<th>Observe</th>
<th>Procedural</th>
<th>Analysis</th>
<th>Logical</th>
<th>Synthesis</th>
<th>Write/Speak</th>
</tr>
</thead>
<tbody>
<tr>
<td>Look /Read</td>
<td>&quot;Use recipe&quot;</td>
<td>&quot;What now?&quot;</td>
<td>&quot;How to&quot;</td>
<td>&quot;Make recipe&quot;</td>
<td>Write/Speak</td>
<td></td>
</tr>
</tbody>
</table>

### COMPREHENSION

| Tutorial 1 | ✔ ✔ | ✔ ✔ ✔ | ✔ | ✔ | ✔ |
| Tutorial 2 | ✔ | ✔ | ✔ ✔ | ✔ | ✔ | ✔ |
| Tutorial 3 | ✔ | ✔ | ✔ ✔ | ✔ ✔ ✔ | ✔ ✔ | ✔ |
| Tutorial 4 | ✔ ✔ | ✔ | ✔ ✔ | ✔ ✔ | ✔ | ✔ |
| Tutorial 5 | ✔ ✔ | ✔ | ✔ ✔ | ✔ ✔ | ✔ ✔ | ✔ |
| Tutorial 6 | ✔ ✔ | ✔ | ✔ ✔ | ✔ ✔ | ✔ | ✔ |
| Project | ✔ ✔ | ✔ | ✔ ✔ | ✔ ✔ | ✔ | ✔ | ✔ |

### COMMUNICATION

| Tutorial 1 | ✔ ✔ | ✔ ✔ | ✔ | ✔ | ✔ |
| Tutorial 2 | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ |
| Tutorial 3 | ✔ | ✔ | ✔ ✔ | ✔ ✔ | ✔ | ✔ |
| Tutorial 4 | ✔ ✔ | ✔ | ✔ ✔ | ✔ ✔ | ✔ | ✔ |
| Tutorial 5 | ✔ ✔ | ✔ | ✔ ✔ | ✔ ✔ | ✔ | ✔ |
| Tutorial 6 | ✔ ✔ | ✔ | ✔ ✔ | ✔ ✔ | ✔ | ✔ |
| Project | ✔ ✔ | ✔ | ✔ ✔ | ✔ ✔ | ✔ | ✔ | ✔ |

### INTELLECTUAL DEVELOPMENT

#### ABDUCTABLE KNOWLEDGE

Table 2  Progress in the development of skills using Logo as a tool

The explorations with a pentagon (a specific regular polygon) illustrate, for example, the progress in procedural thinking from 'use a recipe' (follow instructions) to 'make a recipe' (create instructions). The diagrams in Figure 2 illustrate the progress in complexity from the first encounter with drawing a pentagon in Tutorial 2 (see Figure 2 (a)) to the composite diagram in Tutorial 6 (see Figure 2 (c)). Simultaneously, there is also progress in analytical ('what to do') and logical ('how to do it') thinking skills.

![Simple pentagon](image1.png)
![Rotation of a pentagon](image2.png)
![Using parameters and procedures](image3.png)

(a) Simple pentagon in Tutorials 2 and 3  (b) Rotation of a pentagon in Tutorial 4  (c) Using parameters and procedures in Tutorials 5 and 6

Figure 2  Progress in complexity

Although the diagrams in Figure 2 may seem easy once the basic figure has been recognized, higher order thinking skills are needed to complete them. For instance, in Figure 2 (c), it is necessary to move from the center of the small figure to the centre of the large figure. This may seem simple, but requires sophisticated mathematical reasoning which involves the sine rule.
In order to move from the center of the small diagram in Figure 2(c) to its edge, it is necessary to calculate the distance $a + b$ shown in Figure 3. Analysis of a pentagon will yield the data shown in Figure 3. So, for a pentagon with side length $x$, $a + b = \frac{x \sin 54}{\sin 72} + \frac{x \sin 54}{2 \sin 36}$ from applications of the sine rule for determining both $a$ and $b$. Thus it can be seen, that in order to solve the problem shown in Figure 2(c), the processes of analysis, logical thinking and synthesis must be used in order to achieve the solution.

**Logo as a tool for ITC skills**

The explorations in Logo are also used in the training of IT and communication skills. From easy Logo exercises, students are expected to use MS Visio and MS Paint to compile a technical report. For example, the tutorial given in Appendix B requires that an isosceles triangle, with labels, be constructed in Visio and then programmed in Logo. A screen capture from Logo is used to import the triangle into MS Paint. This triangle is then cropped from the screen capture and then exported to the report in MS Word. In doing this, the students gain experience in using multiple computer applications to achieve a single goal. Furthermore, this exercise requires a student to compile a technical document which includes labeling of the diagrams and writing of sensible accompanying text, with references to the diagrams.

Appendix C shows an example of the expected outcome of these exercises. Training in technical writing skills is extended further in the report of the Logo project. Logo content thus offers a suitable spin off for training in technical writing skills.

**Logo project**

The Logo curriculum concludes with a project. The project requires that the students display hypothetical-deductive thinking patterns in designing and programming a church in Logo. Table 2 shows how the intended progress from an empirical-inductive thinking pattern to a hypothetical-deductive pattern culminates in the project. Considering that abduction is the process of creating a generalized statement (hypothesis) from results and theories in another context in order to explain the current context, abductable knowledge (see Table 2) is then the knowledge which can be used in this process. Knowledge and skills gained in the Logo tutorials can now be used in creating the necessary foundations for the church project. Hopefully these
knowledge skills will be carried through and also used in the students' further studies. Feedback from senior students shows that this indeed does happen.

**Logo project: a whole brain creative process**

The Logo church project serves as an example of the application of the instructional approach in and the pedagogical principles of the Professional Orientation course. The diagrams in Figure 4 illustrate how the principles of whole brain thinking and the modes of student learning (Figure 1) are applied in the project. These serve as elements in the creative process. When introducing the project, students are made explicitly aware of the steps involved in the thinking processes shown in Figure 4(a). In this way the development of students' metacognition is encouraged and hopefully enhanced. Activities in the Logo project reaffirms McKeachie's view that *at least four elements of teaching seem to make a difference in student gains in thinking*, namely,

- student writing and discussion;
- explicit emphasis on problem solving procedures and methods;
- verbalization of methods and strategies to encouragement development of metacognition; and
- time to think and reflect.

![Figure 4(a)](image1)
![Figure 4(b)](image2)
![Figure 4(c)](image3)
![Figure 4(d)](image4)

Figure 4 Whole brain creative process in the Logo project
Logo project detail

Our decision to choose a church as object to design and program is based on the premise that all students have some idea of the concept 'church'. The level of sophistication that students can put into their designs depends not only on their own concept of a church but also on their creativity.

The information outlining the requirements for the Logo project is given in Appendix D. The instructions for and the outcomes of the project are explicitly communicated. The aim of the first two activities is to expose the students to project planning. They have to create a diagram of their intended design and compile a technical report on their proposed design, before they start the programming in Logo. An additional objective of the report is to introduce students to the writing of a technical proposal. Assessment of the project comprises grading of the written report; evaluation of the Logo program and an oral presentation. The oral presentations are conducted as a training session for public speaking skills.

Students are required to attend class to work on their project and facilitator-student interaction continues on a level of assisting where necessary. The scale of the project is such that students can finish the tasks in the scheduled class periods. However, most of them spend more time on the project, as they get so involved that they keep on modifying and refining their creations. Figure 5 shows two churches, the one being an example of a more realistic construct and the other a more imaginative construct. Due to the open-ended nature of the project, each student's design is unique. Completion of the project contributes to intellectual growth and a sense of achievement which are noted in students' feedback.

According to Felder and Brent, the goal of engineering education should be to bring students to a point where they start to think like engineers. Schooling should promote intellectual growth and independent, critical and creative thinking. They also remark that intellectual growth is complex and influenced by aspects of classroom instruction. These aspects include the types of tasks assigned, the clarity with which expectations are communicated to students and the degree to which the classroom environment supports the students. On a micro scale, the Logo
curriculum, discussed in this paper, attempts to encourage intellectual growth, in addition to the development of skills.

Assessment

The developmental nature of the students' experience with Logo necessitates that continual formative assessment be used in all the Logo activities. This mostly entails one-on-one interaction and assessing whether a student has progressed in acquiring the supposed thinking skills listed in Table 2. Summative assessment is applied to the Logo project. The rubrics in Appendix E were used in 2007 and indicate the scope and focus of this assessment. It should be pointed out that, as the aim with the Logo experience is not programming skills per se, 50% of the marks are allocated to technical communication skills and the compilation of a written report. An external examiner oversees the process of assessment of the project.

Students' feedback

At the time of writing, none of the students who had enrolled for the Professional Orientation course had had any prior exposure to Logo. Students' feedback at the end of the course indicated that most of them seemed to have had some form of apprehension when they were initially introduced to Logo. However, all the students commented positively on some form of personal development and appreciation for the Logo experience, at the end of the course. The following comments, given verbatim, serve as examples of this:

When I reminisce about the first Logo tutorial, feelings of uncertainty, inexperience and reluctance come to mind. Upon receiving Logo Tutorial 1, I was baffled, when thinking of ways of how I was going to approach this new section of work. With the right guidance and much practice, I was able to gain knowledge and experience, which I now apply with utmost confidence when I am given a Logo project. Looking at the church that I have designed using Logo, I now feel more confident and experienced in order to be able to excel in any given project.

...well let me tell you about my first encounter with logo. I didn't have a good history with computers. when we started programming I actually remember saying "oh my now what am I going to do I am computer illiterate". The logo programming was scary . . . then came the church project. It was a challenge and I though I was going to drown until the end, but everything went smoothly. I enjoy logo now and I want to add more and more things to my church. truly Professional Orientation has taught me so much and given me the confidence that there's nothing I cannot do, especially after logo

When I first saw LOGO program I thought it was just a program that was useless and time consuming. ... but along the way I started to enjoy working with this program. During the church project I really found LOGO interesting having to draw a beautiful church using the programs was fantastic and really it was a mind-blowing experience.
Two succinct comments by different students summarize their Logo experience as follows:

*I have learned a lot in a short period of time.
Logo really teaches you to think.*

Conclusion

We are faced with the challenge that it is difficult to measure intellectual development and intrinsic academic gain as a result of a specific educational strategy. Furthermore, the effects of interventions (such as thinking skills development using Logo) may not be immediate and direct but delayed and diffusive. It is, however, academic success in the long term that also points back to successful educational intervention in the first year. In this regard, we feel confident that the Logo curriculum, as implemented in the Professional Orientation course, contributes positively to aid in the academic and intellectual development of the freshmen engineering students.

References

Appendix A: Some Logo resources


Appendix B: Example of a tutorial on skills training incorporating Logo

IT Tutorial 8: Using multiple applications

On completion of this tutorial, you will be able to:
Compile a technical document in MS Word using different MS Office applications and editing features.

Compile a one-page document as your reference for using multiple application programs in scientific writing.
The topic of the document concerns the planning, commands and outcome of a diagram to be created in LOGO, namely, an isosceles triangle that displays the following features:
The base of the triangle (longest side) is on the invisible X-axis.
Red borderlines in pen width three, filled with blue on a yellow background.
Turtle must start and end at (0, 0) and face up.
The triangle may not be equilateral, the angles may not be 45° and you must not use HOME to complete the triangle.

30 July Task 1: Pen & paper planning of LOGO diagram
31 July Task 2: Convert pen & paper diagram to electronic version
2 Aug Complete Task 2
   Task 3: LOGO commands
3 Aug Task 4: Compile the document

Task 1: Pen & paper planning (to be completed for the next class)

Use the space below to plan your triangle. Make a diagram (with labels), do the calculations and write down the details of the mathematical procedures you use. Remember: you will use the diagram to compile the LOGO commands, thus the turtle's movements and the magnitudes thereof must be also be indicated.
Appendix C: Expected outcome using Logo in training to write technical reports

IT Tutorial 8: Using multiple applications in a report

The diagram in Figure 1 illustrates a triangle that can be drawn in LOGO. The diagram was compiled in the MS Office program Visio. It is an isosceles triangle ABC, with sides \( b = c = 75 \) and equal angles 50°. The sine rule can be used to calculate the length of the third side as follows:

\[
\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}
\]

\[
a = \frac{b \sin A}{\sin B} = \frac{75 \sin 80}{\sin 50} = 96.4
\]

![Figure 1](image1)

The LOGO commands to draw the triangle in Figure 1 are as follows:

```logo
draw
rt 40 setpc "red setw 3 fd 75 rt 100 fd 75 rt 130 fd 96.4
rt 150
pu fd 30 pd setpc "blue fill
setbg "yellow
ht
```

The figure that results from these LOGO commands is illustrated in Figure 2. MS Paint was used to edit the LOGO drawing. In LOGO the base of the triangle is on the invisible X-axis and the left bottom corner of the triangle (B in Figure 1) is at the origin of the LOGO coordinate system. The red border lines of the triangle have a pen width of three.

![Figure 2](image2)
Appendix D: Logo project 2007

LOGO Tutorial 7: Project

Time schedule

Thursday 13 September: Activity 1.
Friday 14 September: Complete Activity 1 and start Activity 2.
Monday 17 September: Church planning report completed and Buddy checked.
Tuesday 18 September: Finalize Activity 2 and continue with Activity 3.
Wed 19 September @ 8h30: Church planning report to be submitted via email to jpotutor@tuks.co.za
Buddy assessed hard copy submitted to Dr Steyn or Ms Venter.
Thursday 20 September: Activity 3.
Friday 21 September: Activity 3.

Wed 17 October @ 12h00: Logo Church program must be completed and submitted via email to jpotutor@tuks.co.za

Thursday 18 October: You will demonstrate your Church program to the class, the external examiner and to invited guests.

Activity 1: Design
The aim of Activity 1 is a thorough planning before you start programming. You must:

Do a freehand design of your church on paper.

Draw your paper version of the church in Visio. Establish relative scaling in your design and determine the scaling you will use for the programming in LOGO. Include color in your design. Adhere to additional instructions and suggestions given in class.

Activity 2: Project planning report
Compile a report in WORD. Write in the third person. Your report must contain the following:

1. EBIT individual cover page.
3. Content page. Include a list of figures and a list of tables on the same page.
4. The body of the report must have the following headings and content:

   1. **Introduction**
      Explain the LOGO Church project.

   2. **Design**
      Write a 'linking' sentence.
      A picture of the church you designed in Visio.
      Refer to the diagram.
      Refer to the scaling factor you will use in your LOGO program.
      Describe the main components of your design.
      With each item, also name the LOGO procedure(s) that you will create in LOGO to compile your program.
      Do NOT give basic LOGO commands.

   3. **Outline of Logo program**
      Make a list giving an outline of your intended church program.

   4. **Schedule**
      Give details of the time schedule you will follow to complete the project. Use a table for the data.
5. An appendix containing the pen and paper freehand design with which you started off your project.

6. Save your project planning report in your Logo folder as **studentnumberChurch.doc** where **studentnumber** must be your own student number.

**Activity 3: Programming**

Write a LOGO program to generate the church that you designed. The following instructions for the program apply:

- Your program must be saved as **studentnumberChurch.lgo**
- Your program must have a main procedure, named CHURCH.
- The church must be drawn in a frame.
- Your program must have sub procedures to draw the frame and the different components of the church.
- Your program must make use of the basic LOGO procedures **with variables** that were used in the LOGO tutorials, e.g. the procedure for a square to draw squares of different sizes as required in your design.
- You may use absolute positioning to draw the frame (e.g. setx m sety n) and to start drawing the church.
- You must then use relative positioning to position the turtle for drawing the components of the church.
- If necessary, you may use seth n to orientate the turtle although turtle movement for orientation is preferred.

Save your LOGO church program in your Logo folder as **studentnumberChurch.lgo** where **studentnumber** must be your own student number.

**Assessment**

Project planning report: 50%
LOGO program and demonstration: 50%.
The LOGO church project contributes 25% to your continual assessment mark.
Appendix E: Logo project assessment rubrics

Assignment 12 2007: LOGO Proposed design for church

<table>
<thead>
<tr>
<th>Mark as Buddy:</th>
<th>out of 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mark for skills:</td>
<td>out of 16</td>
</tr>
<tr>
<td>Mark for communication:</td>
<td>out of 28</td>
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<td>out of 48</td>
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</tbody>
</table>

<table>
<thead>
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<th>2</th>
<th>3/4</th>
<th>Marks</th>
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<td>Meet expectations</td>
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<td>As Buddy</td>
<td>Too many mistakes not noted</td>
<td>Some mistakes not noted</td>
<td>Most mistakes noted; format and grammar checked; good feedback given</td>
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</table>

Technical Layout
- Correct format, fonts, spacing and page numbers.

TOC: List of Fig/Tables: appendix
- Correct format; complete.

Figures and Tables
- Captions; in text references to figures/tables as applicable.

1. Introduction
- Background information; aim and purpose of project given.

2. Design
- Design sufficiently explained to the reader.

3. Outline of LOGO program
- Concise and clear account of intended program.

4. Schedule
- Detail given in appropriate format.

References
- Correct format. Complete.

<table>
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<th>3/4</th>
<th>5/6</th>
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<td>Grammar</td>
<td>Minor grammar, punctuation or spelling mistakes. Good writing comprehension.</td>
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<td>Comprehension</td>
<td>Good writing comprehension; clear and concise (not vague and &quot;fluffy&quot;)</td>
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Name: ____________________________

LOGO Church program demonstration

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Total /25 |