

Student Teachers and Microsoft Word's Equation Editor

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Abstract

Mathematics teachers need an uncomplicated yet effective programme that they can use to type documents that contain mathematical symbols and notation. Many such programmes exist on the market, but are costly and in most cases, difficult to use. Microsoft Word's Equation Editor provides a solution to this problem in that it is easy to use and readily available in the Microsoft package. An investigation into how third-year education students respond to the presentation and use of this programme was made. The research was executed in the form of a case study, as only third-year mathematics students from the School of Teacher Education at the Central University of Technology, Free State, participated. It was found that these students grasped the concepts needed to use the Equation Editor quite easily, although the level of application by the academically stronger group of students was much higher than the level reached by the weaker academic group.

1. INTRODUCTION

I have been teaching Mathematics and Subject Didactics: Mathematics to second-, third- and fourth-year education students in the School of Teacher Education at the Central University of Technology, Free State for eight years. In Subject Didactics: Mathematics students are expected to complete various assignments and projects in preparation of becoming competent mathematics teachers. Thorough training in the setting of tests and examination papers is one critical aspect that is addressed throughout their study.

From the second year level onwards, it is expected that students hand in typed versions of their work. This implies that the tests and examination papers that they compile for their imaginary learners, and which contain mathematical symbols and notation, have to be typed. I noticed, however, that the questions they typed, and which contained simple mathematical text in the form of statements and equations, were ambiguous. Their lack of knowledge regarding software that can be used to type mathematical text resulted in the students using What-You-See-Is-What-You-Get keyboard options to type mathematical content. As a result an equation such as

$y = \sin \frac{2x^2 - 4}{3x}$ was typed incorrectly as $y = \sin (2x^2 - 4/3x)$. The second equation can then be interpreted by a learner as $y = \sin 2x^2 - \frac{4}{3x}$. I realised that to assist

students with the typing of mathematical content, an introduction to Microsoft Word's Equation Editor was an important aspect that I had to address urgently.

This paper addresses the approach that I took to introduce the students to Microsoft Word's Equation Editor and highlights some interesting observations in general with respect to working with third-year education students on different competency levels.

2. METHODOLOGY

Various software applications such as *MathType*, *Scientific Workplace* and *PCTEX*, do exist and offer much greater possibilities than Word's Equation Editor. The reality of the matter, however, is that the students studying in the School of Teacher Education will, in most cases, be employed at senior secondary schools with restricted budgets, where the possibility of obtaining any programme other than the Microsoft package is very small. I thus decided to work with an application that they would have access to once they were employed.

As mentioned in the abstract, the methodology of the study is qualitative in nature (Mouton, 2001); in essence a case study of two groups of Education students whom I taught mathematics and didactics to, during the 2005 academic year. The first group (Group A) consisted of 17 third-year students completing a National Diploma in Education. They were the very last group that registered for the National Diploma in the School of Teacher Education in 2003, before it was phased out in 2004 and replaced by the Bachelor of Education programme. However, they were a strong group of students who performed well in Mathematics III and in Subject Didactics: Mathematics III.

The second group of students who participated in the study (Group B) was a group of seven third-year students who failed Subject Didactics: Mathematics II in 2004 and were therefore repeating the subject in 2005. They formed part of the abovementioned group of students who registered for the National Diploma in the School of Teacher Education in 2003, but made up the weaker part of that group. The bigger part of Group B also failed Mathematics II in 2004 and repeated the subject in 2005.

Initially, the main aim of introducing my students to the Equation Editor was the fact that I knew they would need it once they were teaching their own learners. Gradually, however, I realised that I could not introduce these two different groups to the Equation Editor in a similar way. Students from the two groups were on different levels of academic development and had different cognitive abilities. Gillham (2000) supports this notion and states that human behaviour, and therefore ability, is determined by context. People should be approached in their context and in the way that they operate. I therefore decided to introduce the Editor to the two groups individually and to use a slightly different approach in each case.

3. AN APPROACH TO TEACHING MICROSOFT WORD'S EQUATION EDITOR

I determined that to teach these two groups of students how to successfully use the Equation Editor, I had to do it in three steps. A complete description of the approach and its results constitute the greater part of the rest of the paper.

3.1 Description of step 1

The first step involved an exercise that all the students completed and which provided me with information regarding their knowledge of the most common mathematical signs and symbols that are available in the Editor. Symbols that they encountered as senior secondary school learners, as well as new mathematical symbols that were introduced to them during their studies, were chosen. In the exercise they had to identify and name each mathematical symbol or object and then provide an example of how it could be used in a mathematical context. For example, the symbol \perp means "perpendicular to" and could be used as $AB \perp DC$, to show that line segment AB is perpendicular to line segment DC. The complete exercise is attached as Appendix 1.

On average the academically weaker group (Group B) obtained only 57% while the academically stronger group (Group A) obtained 79% for the exact same exercise. This result gave me an indication of the gap that exists between the two groups with respect to their current knowledge on mathematical symbols and notation. Observations that I made after administering the exercise to the two groups on separate occasions, include the following:

3.1.1 Results after administering the exercise: Group B (n = 7)

- None of the students could identify the symbols \subset (the inclusion sign used in set notation) or \int (the integral sign).
- Only 56% of the students in Group B recognised \sum as a summation sign which can be used to write a sum in sigma notation.
- The students had difficulty naming the different types of brackets, namely $()$ (round/open brackets), $[\]$ (square/closed brackets) and $\{ \}$ (curly brackets, used to indicate a set). The last type of bracket, indicating set notation, was spelled “kelly” brackets instead of “curly” brackets by the majority of the group. This was probably the result of a school teacher pronouncing the word incorrectly and never writing it on the board so that the learners could see the correct spelling of the word.
- The theta sign, θ , was described as “theter” by 50% of the class. Other descriptions included “thiter”, “fita” or “theater”.

The last two observations with respect to students’ knowledge regarding mathematical signs and symbols show that in addition to not being able to identify the abovementioned symbols, or otherwise stated: students simply do not know what the symbols represent, these students also struggle to describe the symbol by means of a word if they do know what the mathematical symbol represents. Language proficiency in English can therefore be described as a stumbling block for these students who are being trained to become our mathematics teachers of tomorrow.

3.1.2 Results after administering the exercise: Group A (n = 17)

- 88% of the group could not identify \int as an integral sign. This was expected as integration is only done during the second semester of the third year, while this exercise was administered during the first semester. Of the two students who did identify it correctly, one was a repeater and the other was the brightest student in the class, who probably paged through his new textbook out of curiosity with the learning guide at hand providing references to page numbers.
- Only 12% of Group A identified \subset as the symbol indicating a proper subset. Some confused it with \cup ; the symbol indicating the union of two or more subsets, while 31% of the class didn’t name the symbol at all.
- Unlike Group B, nearly the whole of Group A demonstrated a clear understanding of the different types of brackets, namely $()$, $[\]$ and $\{ \}$.

3.2 Description of step 2

The second step involved booking a computer laboratory and introducing the students to the Equation Editor. Because of the difference in ability between the two groups, I purposefully kept them separate to ensure that a different approach to the Editor was possible for each group.

Group B (the weaker group) was introduced to the Editor first and I had to show them how to make the Equation Editor icon available on a toolbar. I had to describe the steps one-by-one and had to ensure that each student followed my every command precisely before I could proceed to the next step. It did seem, however, as if the students did not experience any difficulties performing this exercise. Thereafter each student activated the Editor on their computer and simply looked at the icons that were presented. I then gave a brief introduction as to possible uses of each of the icons.

Following this, the students had to do some work by themselves and I instructed them to type a few expressions and equations that I provided to them on a worksheet. The main difficulties that the students in Group B encountered were the following:

- They tried to type more than one expression or equation per activated Equation Editor box. This resulted in a string of equations that could not be separated or numbered.
- They numbered the equations or expressions within the Editor, rather than completing the mathematical text in the Editor and then numbering the questions by using Word's "Format – Bullets and numbering" commands.
- They tried to insert spaces between symbols, whilst the Editor does it automatically.
- They combined the Editor with the symbols on the keyboard in typing a single expression or equation. This meant that instead of typing $y = \sin \frac{2x^2 - 4}{3x}$ by only using the Editor, they would type the first part, $y \sin$, on the keyboard and the fraction by using the Editor. The equation would then look like this:

$$y \sin \frac{2x^2 - 4}{3x}$$

My approach to teaching Group A was different in the sense that I was stricter with respect to the outputs that they had to deliver. I also explained to them how to get the Equation Editor icon onto the toolbar, but did it at a much greater pace and hardly repeated any steps as I did with Group B. I once again let them activate the Equation Editor and briefly introduced each of the mathematical symbols. They then had to type some expressions and equations by themselves and encountered very much the same problems and difficulties as Group B, the weaker group, had. My intervention in all that they did was very limited, however, and I tried to encourage them to help each other instead of asking me for direction.

3.3 Description of step 3

The third step involved the students typing a test with mathematical text in it, by using the Equation Editor. I marked the students' work and Group B obtained an 89% average for the test. It should be said however, that I did not formally mark and allocate a percentage to the students' first attempts, but instead only made recommendations on their first attempts and asked them to redo it, giving a mark only to the second versions of their work. The test is attached as Appendix 2.

Incorrect observations and consequent misrepresentations of the questions were the most common mistakes that were made in their first attempts. Most of these mistakes, however, were corrected in the students' second attempts. They would for instance

type $\log_2\left(\frac{1}{8}\right)$ when the question asked to type $\log_2\left(\frac{1}{8}\right)$, or they would use upper

case letters instead of lower case letters, as indicated in the question. These mistakes indicated to me that the students did understand what they were asked to type, but that they expressed it differently when using the Equation Editor.

Group A spent a whole period just getting accustomed to the Equation Editor without me testing them in any way. The next period was the testing period with their results contributing toward their final year mark. The test was the exact same one that I administered to Group A, as I wanted to compare the marks obtained between the two groups. As anticipated Group A performed very well and obtained a class average of 96% on their first attempt. It seemed as if Group A had a better ability to interpret the questions that I asked and to reproduce them more accurately by using the Equation Editor, than Group B were able to do.

4. CONCLUSION

This informal study was not only performed to compare the outputs and abilities of two groups, one weak and another stronger, but served the greater purpose of teaching the students how to successfully use an electronic device in their future working environment. The students reported that working with the Editor was a very positive experience and that the knowledge that they now have, will surely be used in the years to come when they have mathematics classes of their own which have to be taught and for which mathematics tests and examinations have to be set.

5. REFERENCES

Gillham, B. 2000. *Case study research methods* (1st Ed.). Cornwall: TJ International Ltd.

Mouton, J. 2001. *How to succeed in your Master's & Doctoral Studies: a South African guide and resource book*. Pretoria: Van Schaik Publishers.

Appendix 1

Student Name:

Student number:

Do the following exercise to the best of your ability. For each object given, provide a name for the object in the first column and an example of how it can be used in mathematics in the second column.

Object	Name	Use in mathematics
Example: \leq	Smaller or equal than ...	$x \leq 8$
\pm		
\rightarrow		
\therefore		
\notin		
\subset		
Σ		
\perp		
Δ		
$()$		
$[]$		
$\{\}$		
$ $		
$\sqrt[3]{}$		
\equiv		
\neq		
\approx		
\div		
π		
θ		
\int		

Appendix 2

Student Name:

Student number:

Do the following exercise to the best of your ability. Type the following questions by using the Equation Editor on your computer and print it out when you have finished.

1. $y = \frac{-2}{x}$

2. $\log_2\left(\frac{1}{8}\right) = -3$

3. $2\left(i + \frac{3}{2}j\right) - \frac{1}{2}(6j)$

4. $\sum_{k=1}^9 (2j - k^2)$

5. $\cos ec^2 x dx$