ICT in the Mathematics classroom: A teacher’s perspective

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Changing teaching pedagogies to suit verbal and visual learning styles

As recently as the early 2000s, armed only with my mathematical knowledge, a textbook and chalk, I confidently, and what I believed at the time, successfully, taught high school mathematics. Those learners who performed poorly at assessments opted for Standard Grade Mathematics or chose Business Studies instead of Mathematics, thereby relieving some pressure from the Higher Grade mathematics teacher in terms of teaching high level mathematics to learners who struggled with grasping certain mathematical concepts. I accepted that some learners did not have the ability to perform high level calculations and solve problems of a complicated nature. I was also aware of other factors such as mathematics anxiety and dyscalculia which influenced performance in the subject. There were, however, in every one of my mathematics classes, learners who were not achieving to their full potential. I wondered if this was as a result of a lack of commitment on the learners’ part or even possible shortfalls in my teaching methods.

Research in learning styles indicated that there were five ways in which individuals learn: Verbal, Visual, Tactile, Kinesthetic and Aural. Most individuals are a combination but may be dominant in a specific style. Traditionally, in South African Schools, most emphasis was placed on verbal methods of teaching, and research which showed that a large number of individuals learnt best through visual means encouraged me to explore other teaching pedagogies.

Technological hardware

New technological devices have added a new dimension to teaching. The interactive whiteboard which was set up in my classroom was not without its complications. I had to source effective software, plan lessons which would enhance learning, and develop resources which were conducive to my new teaching techniques. Fortunately, there are now many software programs and support websites available to facilitate the use of technology in the classroom.

I believe that technological hardware devices such as interactive whiteboards, Bluetooth tablets (which allows for the teacher or learner to work from any vantage point and project work onto the whiteboard) and Classroom Performance Systems (CPS discussed further below) have enhanced visual presentations in the classroom, improved learner focus and concentration, increased enjoyment of lessons and more importantly have improved learning in my classroom. Teaching of topics such as Functions, Data Handling, Analytical Geometry, Calculus, Transformation Geometry and Trigonometry have been made easier with software programs like Geometer’s Sketchpad, Autograph, Fathom and GeoGebra. Teaching time traditionally required to complete a section like Functions has been reduced by half. In the words of a Grade 9 learner in 2009:

“Technological change has struck a revolution with teaching. The smartboard and projector keeps me much more focused and interested. I would even go as far as to say that it makes me feel properly involved and it makes lessons much more fun and something to look forward to. It’s much better than someone standing at the front and droning on in a monotone voice while furiously scribbling away on the board.”

The availability of a computer scanner in the classroom has also proven to be very beneficial in terms of scanning and projecting diagrams, notes or solutions to problems. The interactive whiteboard allows me to write on a scanned diagram and save notes made during the course of instruction. Manipulation of graphs drawn on the interactive board and demonstrations of transformations prove to be an invaluable teaching aid in terms of eliciting conceptual understanding.

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The Classroom Performance System (CPS) is an excellent way for the teacher to assess learners’ knowledge quickly and efficiently. The system includes the learners’ response pad or clicker and a receiver which connects to the computer’s USB port. The hand-held clicker enables learners to respond immediately to questions asked verbally, on screen or on paper, and the results are captured on computer so that instant feedback is available to the teacher and learner. This form of assessment is beneficial since it immediately provides data on the learners’ understanding of specific concepts taught, it ensures that all learners respond to questions thereby providing opportunity for the introverted learner to also participate and it seems to promote greater focus and concentration especially with verbal questioning.

“The CPS device enabled us to identify problem areas for the whole class far more easily…”
(Grade 10 learner, Oct 2009)

Technological software
The use of interactive software programs, interactive worksheets and mathematics tutor software are valuable if made available to learners for additional mathematics support. Learners may in their own time work on these programs in the library or at the computer laboratories. Interactive worksheets also serve the purpose of providing immediate solutions and assessment results.

Another benefit of software programs like Geometer’s Sketchpad and Autograph is that they allow for the creation of professionally presented worksheets and assessment tasks since diagrams are easily drawn. This has been an enormous help for resource development.

The use of software programs in teaching
To illuminate the use of software programs I provide an example of a teaching activity which I used with my Grade 10 class.

The section on functions included sketching, interpretation, graph shifts and finding equations of straight lines, parabolas, hyperbolas, exponential functions, sine graph, cosine graph and the tan graph. Learners were given a worksheet with functions to sketch and questions pertaining to graph interpretation. The learners were required to sketch the graphs in the first section using a table and substitution. The second section involved the use of the table function in the calculator (Casio fx-82ES). The aim was for learners to be given the opportunity to use Autograph in the computer laboratory to sketch the graphs electronically, to see the effects of changing values of the variables and the transformations of the graphs, and to correct any discrepancies with their written sketches.

The results: I noticed a definite improvement in learners’ understanding of functions in comparison to previous years when the section was taught without the use of technology. I was able to teach the topic in about half the time that was required in the past, with better results.

An example of a dynamic geometry investigation task
Learners work in pairs, have access to a computer loaded with GSP and are familiar with the program and its functions.
Task 1
Investigation 1.1
i. Construct any triangle using GSP.
ii. Label the triangle.
iii. Construct perpendicular bisectors on two of the three sides of the triangle.
iv. What do you notice about the two perpendicular bisectors in terms of intersections?
v. Label the point of intersection ‘U’. Measure the distance between U and each vertex.
   Show the measurement on your diagram page. What do you notice?
vi. Drag one of the vertices and investigate what changes and what remains the same.
   Explain your answer.
vii. There exists a relationship between the point of intersection of the perpendicular
    bisectors of the triangle and its vertices. What geometric figure can be related to this?

Task 2
Investigation 1.2
i. Draw a circle using GSP. Label the centre ‘O’. Draw any chord and label it AB.
ii. Draw a line from the centre that intersects the chord. Label the line OC.
iii. Mark the point of intersection between the chord AB and the line OC and label it
    point D.
iv. Measure angle $\angle BDO$ and $\angle ADO$ and show on diagram sheet.
v. Measure lengths/distance BD and DA and show on diagram sheet.
vi. Drag point ‘C’ to at least 10 different positions and record the changes to angles
    and lengths previously measured.
vii. Make a conjecture about the line drawn from the centre of a circle that is
    perpendicular to a chord.
viii. Prove this conjecture.

Task 3
Discuss any links or connections between investigation 1.1 and investigation 1.2.

Conclusion
The inclusion of technology in teaching has added a whole new dimension to learning and experiencing
mathematics in the classroom. Teachers, however, need to guard against using technology ‘when it does
not fit’. It is therefore important that lessons are well planned and only where appropriate are
 technological aids used. Depending on whether the intention of using technology for a specific lesson is
for visual teaching, demonstrative activities, investigations, assessment, efficient use of instruction time, or
to add variety and enjoyment to a lesson, one must not neglect the importance of the interaction between
learner and teacher.

“Technology in Mathematics is vital, but it must be like a partner to other basic learning methods”
(Grade 9 learner, Oct 2009)

I strongly believe that there is still room for the use of textbooks, chalkboards and verbal transmission of
knowledge, but the benefits of integrating information and communication technology in the teaching of
mathematics is vast and cannot be ignored.