Errors and Common Misconceptions in the Classroom KS3 & KS4

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Errors & Misconceptions

• Today’s talk is about trying to categorise errors – with the aim that giving supportive feedback we can encourage a deeper understanding of Mathematics

• and a more secure pathway in Learning Mathematics – towards Mastery!
Errors & Misconceptions

• When we look at learners’ work we try to see if the solution are efficient, methodical, clear, accurate, based on sound mathematics. ......And of course (mostly) correct!

(....it’s not the answer but the journey!)

• Learners’ solutions do not always bear this hallmark!

• As teachers we want to locate errors in learners’ work – Why? to understand what’s going wrong in their thinking/understanding. We all make small errors, often showing a lack of accuracy. This is not in itself a major problem, of course it needs to be addressed.

• But errors could contain or display misconceptions or indicate that the topic has not been grasped or understood at all.
Errors could be...

- calculation, or wrong values have been taken – or miscopied
- mis-applied a piece of theory, wrong operation applied (eg KS2/3 dividing when they should be multiplying)
- Muddled topics- wrong theory has been used – eg use Pythagoras but there’s no right-angle.
- The strategy adopted leads nowhere. (A different strategy was needed) - Circular arguments
  - Reasoning has gone wrong (wrong deductions made during the question) eg in GCSE A* questions when two-stage problems are used such as the sine and cosine rules, and the logic has gone astray during these stages.
As teachers what can we do to address this? – why should we? - and how will it help?

• **WHAT?** : Adopt teaching strategies to address any substantive errors
• Use examples, question their thinking, address logical issues, address lack of knowledge or mis-learnt knowledge, or gaps in knowledge (it may take time to unravel where the thinking has gone wrong). Eg Paige – year 9 student. **Any others?**

• **WHY?** : It’s one of the principles of effective teaching “Exposure and discuss common misconceptions.” (Swan, cf ILIM PD1).

• **Research shows**: (a) **Teacher Orientation towards Student Performance** has some influence on improving learning & also overall school improvement. (cf Honingh & Hooge & others, 2014).

(b) **Errors are essential** when developing understanding (Ingram, Baldry, Pitt, ATM Magazine, May 2014)
How will it help?

• **How will it help?** New learning will not be embedded properly - In our TASK – will develop your thinking on this.

• If a learner has gaps in their knowledge this needs to be addressed.

• Mathematical learning develops as links in a chain.

• Topics are inter-connected. When we learn a new topics this needs to be build on a solid foundation, or it will not be absorbed /retained (or learnt!)

• **Psychology of learners** – be mindful of this – learners don’t want their errors exposed for their peers to see, they may become defensive – and learning stops.

* Use Errors as a discussion point (Ingram, Baldry & Pitt, ibidem)
How will it help?

- What sort of feedback helps?

• Feedback needs to be corrective in nature; tell students how they did in relation to specific levels of knowledge. Rubrics are a great way to do this.
• Aim to give feedback in a timely fashion and be specific.
• Encourage students to lead feedback sessions.
• These strategies are from “Classroom Instruction That Works” by Robert Marzano, Debra Pickering, and Jane Pollock. (2001)
• Let’s look at a couple of video clips

Feedback – Ego Vs Task

https://www.youtube.com/watch?v=MzDuiqaGqAY
Listening – individual feedback -Peer support

https://youtu.be/4hy-tClLdy8
Accelerating students learning- what's the impact of various approaches? Effect Sizes here have been converted to months of school progress.

Ref: [http://educationendowmentfoundation.org.uk/toolkit/about-the-toolkit/](http://educationendowmentfoundation.org.uk/toolkit/about-the-toolkit/) research funded by The Sutton Trust

<table>
<thead>
<tr>
<th>Approach</th>
<th>Average Impact in months</th>
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<tbody>
<tr>
<td>Behaviour interventions</td>
<td>4</td>
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<tr>
<td>Collaborative Learning</td>
<td>5</td>
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<tr>
<td>Digital technology</td>
<td>4</td>
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<td><strong>Feedback to students</strong></td>
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<td>Homework (secondary)</td>
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<td>one-to-one tuition</td>
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<td>Meta-cognition and self-regulation</td>
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<td>oral language interventions</td>
<td>5</td>
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<tr>
<td>Peer Tutoring</td>
<td>6</td>
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This is an extract from a workshop we did for the DfE – the report is in public domain.
Examples of what examiners say about errors

**GCSE F**

- Arithmetic often poor, algebraic manipulation below the standard required. Area and perimeter confused. Computations with fractions are difficult. Muddling acute and obtuse angles. Negative numbers pose a problem. Finding 42% of a value problematic.

**GCSE H**

- Standard of arithmetic overall was poor, lack techniques of 4 basic rules. Presentation of answers was good, written communication clearly taught.
- Fractions, expanding brackets, confusion over time calculations, km-miles conversion all display problems. In the calculator paper – rounding prematurely. Tree diagrams – most could do – but weaker students couldn’t use them. Lack of confidence working with vectors. Use of random number tables. Standard form questions with no workings – and outside acceptable range.

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Case Studies
The room is arranged into Key Stages

• TASK

• In groups of 3 or 4 look at the solutions you’ve been given for this range of problems

• Problems are from KS3, KS4 (IGCSE & GCSE)
**TASK CTD**

On the flip chart paper – draw 3 columns with these headings

<table>
<thead>
<tr>
<th>Student Topic</th>
<th>Identify the error – and what type – is it a serious error?</th>
<th>Feedback you would give to improve the work and progress in learning.</th>
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For each topic add a Post-it Note saying what teaching strategies would you adopt to overcome these difficulties
Conclusions

• Myriad of errors and we use a wide variety of teaching strategies to help.

• Above all, Maths teachers are very much needed!!!
References


http://educationendowmentfoundation.org.uk/toolkit/about-the-toolkit/

https://www.youtube.com/watch?v=MzDuiqaGqAY

PD1 & PD2 National Stem Centre e-documents, Standards Units – Improving Learning in Mathematics
Key Stage 4  IGCSE  Errors or Misconceptions
(Use of a Calculator is available for all questions)

Example 1

The length of an Airbus A300 aeroplane is 54 m. The ratio of the length of this aeroplane to its wingspan is 6 : 5. Work out the wingspan of the aeroplane.

\[
\frac{L}{W} = \frac{54}{?}
\]

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Aiyo’s Solution

\[
\frac{6}{5} \times 54 = 99 \text{ m}
\]

Example 2

Tickets for a show are priced at £12.50 for an adult and £7.20 for a child ticket. Find the total cost, in £, for 5 adults and 4 child tickets.

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Harry’s Solution

\[
12.50 + 7.20 = 19.70 \times 5 = £48.5
\]
Example 3

In the diagram AQB is parallel to CRD and PQRS is a straight line. Find the value of x.

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Nikhat’s solution

\[ R = 2x - 40 \quad \text{\(Z\) shaped angles} \]

\[ 3x + 10 + R = 180 \degree \quad \text{angles on a line} \]

Harij’s solution

\[ 2x - 40 = 3x + 10 \]

\[ -40 = x + 10 \]

\[ -50 = x \]
Example 4

ABCD is a rectangle.

Leaving all your construction lines in, construct the locus of all points inside the rectangle which are

a) equidistant from D and C,

b) equidistant from the lines AD and DC.

The region R consists of all the points inside the rectangle which are closer to C than D and closer to AD than DC.

c) Show by shading the region R. Label the region R.

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Rosalind’s solution is on the diagram above.