SELF AND PEER ASSESSMENT OF MATHEMATICAL PROCESSES

Alice Onion and Elnaz Javaheri explore using Bowland Mathematics as part of a scheme of work.

Elnaz Javaheri is in her second of teaching at Heartlands Academy, a National Challenge school (former categorisation) in a deprived area of Birmingham. 65 percent of the students in the school are entitled to free school meals and 72 percent have English as an additional language. Elnaz is currently studying for a Masters in Teaching and Learning. She began to use Bowland assessment tasks as an alternative to her department’s normal scheme of work. This article tells the story of Elnaz’s innovative work with a lower set Year 8 – set 4 out of 6 – over the course of just over a term.

Like almost all mathematics departments, the scheme of work at Heartlands Academy is organised around content. With her Year 8 set, Elnaz began to use Bowland assessment tasks and Nuffield AMP activities, which she matched to content areas as far as possible, as an alternative to the scheme of work, so the direct teaching of content in a conventional way no longer took place. Students had been used to working individually from textbooks, so their learning had been mainly procedural. They learnt methods and techniques but there was little opportunity for deep mathematical thinking, or for reflection.

The new way of working marked a significant change for students in their mathematics lessons. The Bowland tasks and Nuffield AMP activities are designed to develop students’ mathematical thinking; they are focused on key processes. So unfamiliar demands were being made on the students; they were being challenged to think about their own approaches to solving problems. Furthermore students were no longer working individually; Elnaz organised the group into pairs and they were encouraged to discuss their approaches with one another. Over time, mathematical talk among students became an important feature of mathematics lessons.

These changes were further built on by the systematic use of peer assessment. After a period of time working on a task or activity, pairs of students gave their work to other pairs for comment. Comments were written on post-it notes and attached to the work. In the following lesson students’ work was returned to them and they were given time to reflect on their peers’ comments, and to improve their work. Here are some samples of student comments on each others’ work:

“The way you explained it is clear and it is really easy to understand.”
“You could add more assumptions / more work explained.”
“The titles are fine. The layout is fine. The border is random. I can’t really understand how you worked it out.”
“There’s good pictures to show what’s going on.”

Elnaz was not working alone on this; she was working in close cooperation with a teacher, Shane Walsh, at a very different type of school. Together they decided to extend peer assessment by swapping students’ work between the two schools. The comments above are from both schools.

Both the Bowland assessment tasks and Nuffield AMP activities provide progression grids in the teachers’ notes. These show typical progress.
though key processes within the context of the particular task or activity. These grids are written in teacher language; although, they have been used by some teachers without modification, to aid self and peer assessment, Shane and Elnaz decided to modify the grids in two ways. Firstly they simplified the language used to make it more student friendly. Secondly, they added space at the bottom of the grid, for students to write comments for their peers. At the end of this article you can see the adapted progression grid and the student stimulus for a Bowland assessment task called Z factor. The original grid is on the Bowland website.

After completing three tasks/activities in this way, Elnaz asked students to reflect on their experiences. Students were given a table to complete to show how they worked on each of the three problems. Below you can see an example of a completed table. You can see how the student’s description involves more use of peer assessment on Speedy Santa than on Text Messaging, illustrating the development that has taken place in the time between the first and third tasks/activities.

It might help to make sense of this if you know something of the tasks/activities themselves. The Text messaging activity was a draft version of a Nuffield AMP activity – see the Nuffield website for the final version. In the draft version pupils were asked the following questions:
1. How many text messages are sent if four people all send messages to each other?
2. How many text messages are sent with different numbers of people?
3. Approximately how many text messages would travel in cyberspace if everyone in your school took part?
4. Can you think of other situations that would give rise to the same mathematical relationship?

The Pupil stimulus for Speedy Santa, which is two PowerPoint slides, is reproduced on the next page.

### Development of the Year 8 students

At the start of the project students were reluctant to talk with each other about their maths; they had few skills of working in pairs. For example, some boys would not sit with girls. They believed that there was a unique answer to a question and they knew only one way to tackle a problem. Students had little desire to think. After just over a term of working in the new way Elnaz noted that students:

- Are ready to discuss their mathematics
- Feel more autonomous in the class
- Are willing to challenge their learning and ideas
- Have more productive comments about their own work
- Have increased confidence
- Appreciate feedback from students, especially from the other school and have asked for more challenging feedback

Elnaz asked students to write about mathematics lessons now, as opposed to mathematics lessons earlier, and here are some of their comments:

“*I think maths is a fun lesson when we learn. I started this school in Year 7 and I thought maths was boring because all we had to do is get a textbook and copy out the questions in our book and then answer them. That was really boring for me. When I moved up to set 4 it was more fun because I get to work with my classmates and also learn while we have fun activities. I like it better when we work together and learn functional skills.*”

“I like the activities because when we were working together we were learning from each other.”

“I learned new vocabularies like assumption, substantial.”

“When I first started secondary I thought that maths was the worst lesson ever invented but now I think that maths is not boring and no-way near the worst.”

<table>
<thead>
<tr>
<th>Completed self assessment sheet</th>
<th>What did you do before you began to solve the problem?</th>
<th>What did you do as you solved the problem?</th>
<th>What did you do to improve your work in the second lesson?</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Text messaging</strong></td>
<td>I analysed and took out the key bits from the information given</td>
<td>I used all the mathematical signs and used them to work out the answer</td>
<td>I added key information and polished my work</td>
</tr>
<tr>
<td><strong>Z factor</strong></td>
<td>I specially picked out the key information and discussed it with my peers</td>
<td>I took my own prediction and went around the class discussing it</td>
<td>I made my work look very attractive and corrected my calculations</td>
</tr>
<tr>
<td><strong>Speedy Santa</strong></td>
<td>I discussed the calculations and the amount of people / santas and children there were</td>
<td>I used methods and a lot of advice on mathematical terms with my peers and was given the assessment grid</td>
<td>I improved by checking key mathematical terms with my peers and was given the assessment grid</td>
</tr>
</tbody>
</table>
The activities we have been doing are more fun and better than usual lesson that we do, because in our usual lessons we sit there quietly and just raise our hands if we have got the answer, but now we work in groups we communicate better in lessons. We get some answers and we combine it together and come to an agreement together and decide who is right or wrong with our evidence. I think the best part is when we get to look at the work from the other school and assess their work and pass it to them!

So we are seeing vast improvements in the way students view mathematics and in their behaviour and learning in class. But what of outcomes as measured by tests? Many teachers are fearful of these innovative ways of working because they believe that there will be fewer gains in tests than if they stick with direct teaching of content. However, Elnaz’s experience is the opposite. Her Year 8 set were tested in September 2010 and in February 2011 on standard content items. Students actually made better progress than expected in that time, and better progress than other classes, who were not working in this way. There was an average of about half a level improvement per student in just over one term. As a result ten of these students have now moved up a set. Elnaz has now been asked by her head of department to work the same magic with the Year 8 set 6.

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