Using problem solving grids to improve independent problem solving

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Context

New Forest Academy is a smaller than the average-sized secondary school. This is partly because the number of secondary age students in the local area has been declining for several years. The school was judged as being Inadequate in 2013. A new Prinicpal, Karen Godshall was appointed and she had a clear vision for the school, highlighting teaching and learning as the key focus alongside raising the aspirations and learning skills of the students hence the involvement in the Thinking like an Engineer project as a vehicle by which to ensure rapid and sustained progress and the embedding of life-long learning skills. Over the past year there have been three positive monitoring visits by their attached HMI inspector and the school has been judged as making reasonable progress towards the removal of special measures. The most recent report stated that 'faster and more secure learning is evident in a range of subjects now, including in science and languages.'

A group of 28 higher attaining students, based on KS2 performance, were selected to take part in the project.

The issue

Students often commented they 'did not get' science and lacked confidence, especially when expected work together to discuss and apply scientific ideas to unfamiliar situations. Their written work was often vague and lacked specific scientific terms and the precise use of language. My premise was, that if students were to become more engaged with STEM subjects, they first had to gain insight and become skilled at 'sounding like a scientist'. By providing them with a simple grid template students were able to independently 'decode' the steps needed to elevate the quality of their discussions and written work. This would then lead to increased confidence and a greater willingness to take creative risks within science lessons.

Review of current literature

Jane E. Pollock (2012) stated in her article: *Feedback for Learning-How Feedback Leads to Engagement* that*:*

> 'The most disengaged students in class are often the ones who receive the least feedback and direction.'

She then went on to suggest three techniques that improved student feedback, including the use of goal template grids. It suggested that this simple technique encouraged tuned-out students to seek feedback about their own understandings and their own learning and also enabled them to understand where they were, in terms of their own learning.

In her article she refers to using templates as a method 'of 'neuronal courtesy' that enables learners to ease into the lesson. She then goes on to state that: 'teachers are often pleasantly surprised by how quickly students get used to the routine of scoring themselves and how much more focused they become.'

Hattie (2009) has suggested that if a teacher allows students to form and give their own feedback, it will be more powerful and effective.

It was on this basis that I decided to use a simple template to encourage students to be able to 'decode' the stages of learning and be able to identify areas of strength and weakness and feel more in control of the stages of learning in the lesson.

The EHoM skills are seen as by New Forest Academy as central in enabling teachers to plan effective lessons and also provide a clear platform by which students can understand how to gain the life-long learning skills they will need.

My research question

'If provided with a simple problem solving grid, will students become more independent in problem solving and in generating their own feedback?'

The project

A template was devised to encourage students to be able to 'decode' the stages of learning and be able to identify areas of strength and weakness and feel more in control of the stages of learning in the lesson – see appendix 1

Initially I decided to include four elements into the grid: key words, links, explanation, and application. Students were expected to draw a table at the side of their work each lesson and tick each one as they achieved it during the lesson. As a teacher I directed them to the grid to ensure they had used the key terms in the lesson, that they were able to define and explain them, and could link the ideas and apply them to new situations.

This gave a familiar structure to each lesson that consisted of the following elements:

- research to define terms

- discussion to link and improve student's ability to communicate and explain their ideas and
- An 'Art Gallery' – a series of unfamiliar applications or questions that encouraged the students to discuss the scientific ideas they had acquired with each other in order to explain how or why a particular machine, system or idea behaved or reacted in a particular manner.

After six lessons, as students were clearly more confident, the gird was altered to include keywords, links, application and asking a creative question.

This element was included as I judged that the majority of students were more confident in being able to access the lessons at a higher level and more confident in discussing ideas i wanted to ask them to take risks and ask a creative question about what they had learned that lesson.

Students were encouraged to use the grid at the start and end of each lesson to focus their progress in lessons and be able to work out what was the 'next step' or the 'missing element' in their mastery of the topic.

To complement and further raise students aspirations and expectations of STEM careers, students were involved in a whole year group STEM careers event; a problem solving activity based on running an oil refinery run in conjunction with the attached STEM ambassador from EXXON. The girls also went to a Women in Science STEM day at the Winchester Science Centre.

Findings

1. *From comparison of student responses to the questionnaire issued at the start and end of the project.*

Areas of improvement as judged by, the strength of response, to the question at the start and end of the project - see appendix 3

- 'I enjoy working on improving what I have done.
- ' I am honest with how I am doing'
- 'My brain comes up with lots of creative ideas'

However there was a decline in strength of response to 'I love asking questions and coming up with my own point of view'

2. *From test data and overall level of students during the project*
    - 0.5 on average grade improvement per students in test score on previous module – see appendix 4

3. *From student interview and responses to improved test scores*
    - ' I understand how science language works'

- ‘ I know how to link ideas and have a go and know when it sounds wrong’
- I link sentences more confidently’
- ‘I am not scared by science questions anymore’

4. *From teacher observations:*
    - By lesson 3 I did not have to ask students to add grid to books they did it automatically
    - By lesson 5 some students were referring to the grid during the lessons ‘have you got the key words’ ‘how do I link them’ comments overheard.
    - Each lesson student have to complete an extended writing task ,by lesson 6 students were starting the writing task more quickly and were on task for longer before looking around class
    - By third week students were holding ‘on task’ conversations for longer time periods and discussions on Art Gallery clearly used and referred to key terms and ideas – students began to self- correct when I caught eye contact and upgrade their word with correct language more quickly.
    - Initially on including the ‘creative question’ element two boys each lesson and one regularly after the lesson asked ‘what if and ‘how would’ style questions to extend the learning to general knowledge and observations they had seen or observed outside the classroom. In the last week two girls regularly and a few occasionally would pose extended questions where they had not before.

Overall summary regarding my initial question

That if provided with a simple problem solving grid, students will become more independent in problem solving and generating their own feedback.

It is evident that providing a clear structure for students to refer to in lessons has led to greater independence observed during the lesson and a quantitative improvement in test scores.

The students have expressed views that have led to a qualitative conclusion that their ability to ‘seeing themselves as scientists’ being able ‘to do’ science has improved.

My own observations have led to the qualitative conclusion that the ‘grid template’ method has led to students working better independently and collaboratively showing greater confidence and ability to be able to discuss ideas and self – correct, upgrading the quality of their discussions and writing.

Lesson learned

By providing and modelling the use of grid templates consistently over time, students' habits and attitudes change over time. This model can be adapted to introduce a range of skills and I will be looking to utilise this method with other areas over time.

References

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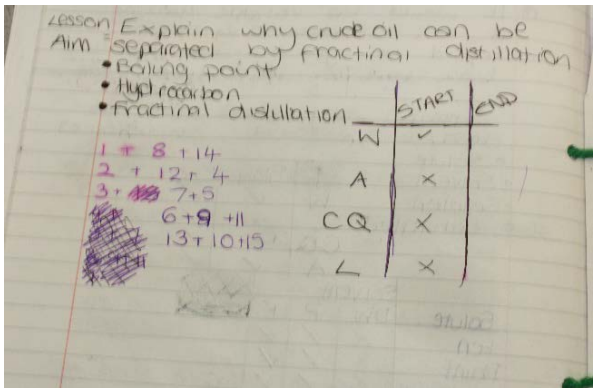
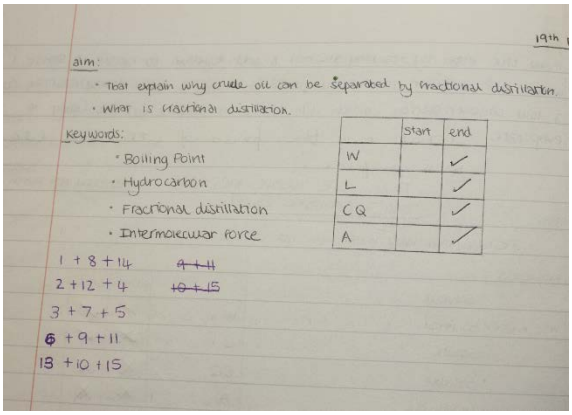
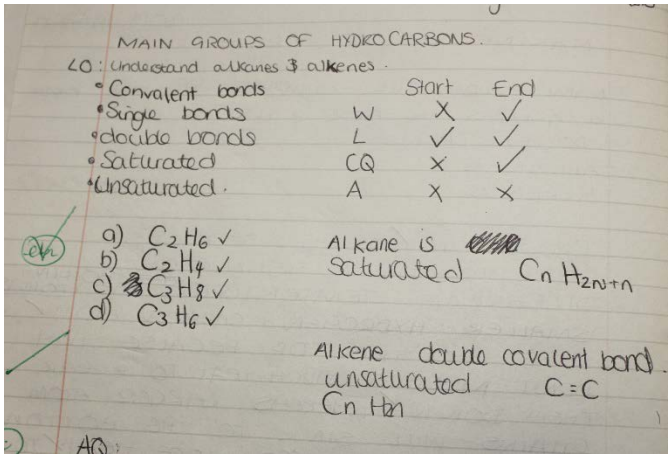
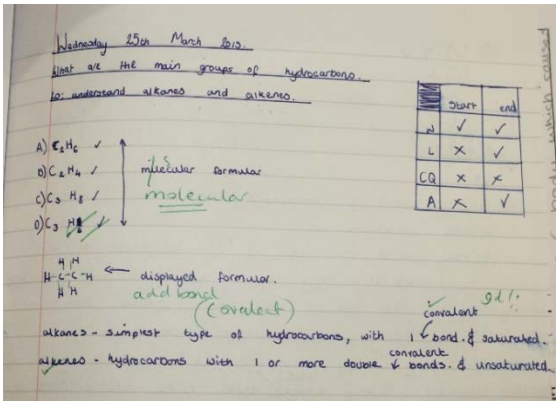
(accessed May 2015)

Appendix 1 Examples of grids in students' books









Appendix 2 Overall scores of questionnaires

Question posed	Start of TLAE project					End of TLAE project				
	1	2	3	4	tot	1	2	3	4	tot
1. I like making links between things in my head	1	6	11	0	18	0	11	8	2	21
2. I enjoy combining things together to make something new	1	6	8	3	18	1	7	9	4	21
3. I'll check and check again until satisfied	2	11	5	0	18	2	8	9	2	21
4. I love asking questions and coming up with my own point of view	0	8	6	4	18	5	9	6	1	21
5. I enjoy thinking out loud as I imagine what things look like	3	5	5	5	18	3	5	8	5	21
6. I like making models to demonstrate my ideas	3	6	5	4	18	1	5	10	4	21
7. I enjoy working on improving what I have done	2	5	10	1	18	2	8	10	1	21
8. I am honest with myself about how I am doing	2	2	10	4	18	3	4	8	6	21
9. My brain comes up with lots of creative ideas	2	5	5	6	18	1	8	12	0	21
10. I like working in a group even when I don't know people well	3	5	5	5	18	2	5	8	6	21
11. I'm happy to stick up for what I think in a discussion	2	7	3	6	18	1	7	7	6	21
12. I'm ready to put in hard work and practise, even when it is tricky	0	6	8	4	18	0	3	13	5	21

Appendix 3 Student Test Scores – average difference = 13/26 = 0/5

Previous grade	Test grade	Difference	Previous grade	Test grade	Difference
B	B	0	B	A	1
B	B	0	A	*	1
C	B	1	B	B	0
*	*	0	A	A	0
B	B	0	B	A	1
C	B	1	C	B	1
*	*	0	B	B	0
D	B	2	A	A	0
C	B	1	C	C	0
B	A	1	B	B	0
A	*	1	B	B	0
A	A	0	B	A	1
B	B	0	C	B	1