

## How can we promote creative problem solving using the engineering habits of mind?

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### Context

Our school is a single form entry school located in West Sussex. The intake is roughly 200 pupils, coming from backgrounds that usually meet or exceed the national average. Most children are well supported at home and have access to additional learning experiences on a regular basis. All parents have a good understanding of numeracy and literacy allowing the children support early into their learning journey.

In most year groups our pupil premium is too small to make comparisons to national levels. The school meets the government attainment and progress levels for reading, writing and maths, and has recently become a teaching school.

For the purpose of this study a year 2 class have been chosen. There are 30 children in total with an equal weighting of girls and boys 15:15. All children are working at level 2 to 3 for all subjects. Observations were made by a selection of staff and volunteer helpers including the teacher, teaching assistant, volunteer readers and parent helpers.

### The 'problem' or issue I have addressed

Throughout the school emphasis is placed on 'learning to learn', encouraging the children to develop their own learning styles. This strategy is effective across the year groups however there continue to be confidence issues which inhibit the younger students from generating their own ideas and developing approaches to problem solving via critical thinking.

As year two teacher I have observed that many children enter the year with little ability or confidence to generate their own ideas- 'thinking outside the box'. Given an open ended task many children develop a block in thinking, sometimes inhibiting them from being able to start the task without extra help. This is understandable due to the age of the children and the limited access to life experiences that they will have had. However, after talking to other members of staff in the school it is true to say that none have actively taught children how to generate ideas.

When undertaking creative writing many children required structured ideas to help them begin to write, often unable to even come up with basic ideas. It was also evident that although the detail of writing was different for most stories, the overall ideas were shared within the class, resulting in a narrow breadth of ideas being developed. This was also seen in maths, where children showed a good ability to answer closed questions, however many struggled with open ended investigation. This was not due to lack of exposure to this type of learning, more that some children were not able

to think in that way and had not practised the skills to do so. Children in the school are regularly exposed to higher order thinking and open questions through problem solving, but all teachers admit that there are still children within classes who become stuck if scaffolding is not provided. This is true throughout the school.

Many of the children who struggled with this area also had a lower confidence level when it came to producing work of this nature. As a consequence, this was also creating a barrier to their learning, even if the ideas were generated, they were reluctant to express them.

By teaching the children strategies of how to come up with ideas, and allowing them the open approach of 'nothing is wrong', we are encouraging children to use their imagination with confidence, so reducing any negative preconceptions they may have. This also allows for a larger variation in ideas generated by the class as a whole, so developing independence in their own work, from not only teacher-led learning, but also from that of their peers.

Although the aim of this research project was to encourage children to generate their own ideas, many other factors are encompassed under that umbrella such as: building confidence, critical thinking, overall teaching styles, resilience, positive reinforcement, role models and brain development.

### **Review of current practice and literature**

Most research into creative thinking suggests it is vital within the classroom. Carol McGuinness (1999) investigated the way in which creative thinking can be promoted within the learning environment. She suggested that 'interventions can be directed towards enhancing general thinking skills through structured programmes which are additional to the normal curriculum'. The concept of teaching children how to think creatively is also supported by numerous researchers, namely Robert L. DeHaan (2011), Crane (1983) and Swartz.R.J et al. (1994), to name a few.

Robert L. DeHaan (2011) suggested that to be successful at innovative thinking children must start with creativity skills. This emphasises the links between creative and critical thinking that we found within the research we undertook. Crane (1983), Paul et al. (2008) and Scriven (1976) among multiple others, also found there were strong links between creative thinking and critical thinking.

Discussions with other researchers undertaking the 'Think like an Engineer' project show similar findings. Researchers felt they needed longer to see the effects of the project, concluding that habits of mind will take longer to change than one year, a viewpoint which we all agreed on. However researchers also found that the children were engaged and keen to take part in their learning.

### **My research question**

*If I actively teach my year 2 children how to have ideas, will they get better at generating their own?*

## **The project**

Our school aims to promote a love of learning, to develop children to be happy, successful learners, confident individuals and responsible citizens who are fully prepared to meet the challenges of an ever changing world. We do this through an active and enriched curriculum, exposing each child to as many real world learning opportunities as possible and encouraging calculated risk taking, where learning from our mistakes equips us for challenges later in life. This ethos is embraced throughout the school from reception, where child-led learning encourages children to investigate the world and their own interests up to year six, where many children are preparing to undergo one of the biggest transitions of their lives so far.

When discussing the research project within staff meetings, it was agreed that much of our practice already followed the Engineering Habits of Mind, however teachers across key stages were keen to understand how these could be further embedded into our school ethos and teaching. Teachers of all classes regularly allow children access to open ended investigation questions, encouraging children to use their own imagination to resolve problems. However it was also the case than not many teaching in the school were actively teaching the children strategies to develop these ideas if they were struggling. This was an area that was thought to be important from the time children first attend school, in order to build up these skills as they progress through the years, resulting in more children able to access the higher order of thinking as they leave the school in year six.

At the start of the project children within the year 2 class filled out a questionnaire (in total only 27 filled out both questionnaires due to absences), using a scale of one to four to assess their own ability at a variety of engineering habits of mind. This questionnaire was repeated shortly before compiling this report (see appendix 7). A focus group of 6 children, three girls and three boys was also selected for individual observations to be made by the teacher. A further six children (three girls and three boys) were selected for the teaching assistant to observe. Individual adult questionnaires about these children were also completed before and after the project period (see appendix 8 and 9). These children were chosen as they represented the children in the class for whom generating ideas appeared most difficult. Work that the children produced, which exhibited their imagination and critical thinking, was collected during the project. Individual comments and questions by focus children were also captured, helping to develop a picture of their thought processes and their understanding about the learning they were completing.

All children were then taught a selection of techniques to help them generate their own ideas along with a critical thinking approach to teaching as a whole. These were:

- Talking partners- children shared an idea with others around them, working together to build on an idea, making sure they can explain their thinking as they go. These ideas were then put on the board so the whole class could add to them, resulting in a large number of different ideas from everyone in the class. Children would often be asked to say their friend's idea with the aim of reducing any apprehension.

- Talk to the hand - children who struggled with developing ideas could tell their ideas to their hand, capture it and then put those ideas into action. This strategy worked well for children who were able to generate ideas, but were less confident to speak out.
- Thunks- Questions were placed on the board for the beginning of the day, children would write their answers and opinions on the board or on individual white boards, explaining their answers as best they can. This promoted individual thinking as no answers were wrong, therefore building confidence to have their own voice within the class. All questions were higher order/ open ended questions.
- Critical thinking tasks- Children were set tasks that encouraged them to generate ideas to help solve a problem. These were linked to writing, maths, PSHCE and other topics. Children would vary from working individually to working as a team.

Before these techniques and activities were put into place, we discussed some rules to help us. The children had input into these to ensure they felt comfortable and understood how we would use them to help us. These were:

- There would be no wrong answers
- Try to explain your answer
- No one says anything negative, but anyone may add to ideas in a positive way if they would like
- Try and develop your idea further by asking questions such as how, why and what if?

Within class teaching an EYFS approach was adopted, encouraging children to find out for themselves, ask questions and be curious. Investigations were set out to allow children to discover the answers for themselves, allowing children to ask questions to further their understanding and promote interest in the topic covered. To begin with, some activities were scaffolded to help those who were struggling, however this was reduced once it was deemed that children understood and felt confident with the different approaches to learning.

Finally the focus children were interviewed to obtain their views on their own development and if they felt the work had been useful to them in their own learning journey.

## **Findings**

The projects aimed to teach and support children to allow them to generate their own ideas, building confidence within the class to use their imagination and approach problems with an open mind. Four out of the 12 focus children felt they had improved at coming up with lots of good and new ideas. Five children felt they had stayed the same and two children felt they had got worse. When looking at these results I feel that many of the children gave themselves an overly high score for the first questionnaire, maybe due to lack of understanding, over confidence and the young age of the children.

When looking at the data for the whole class 10 out of 27 of children say they have got better at coming up with lots of good and new ideas, 11 out of 27 have not noticed any change and 6 out of 27 say they have got worse. It is important to note when looking at this data that all children in the

class have a better understanding of their learning towards the end of the year, which may explain why some children have given themselves a lower score than when they first did the survey. More girls (6) than boys(4) said they had got better, however equal numbers of boys and girls said they had got worse at generating ideas, three of each. Seven boys said they had stayed the same compared to 4 girls.

When looking at the teacher assessment of the focus children, all children except one have made progress within the generating ideas category. When observing the focus children, the boys have made greater progress than the girls, this may be due to the tasks that were set being more appealing to them and the willingness of the learners. Data collected and assessed by the teaching assistant shows some children made progress with their creative thinking, however this was only two out of 6 children.

Both the teacher and teaching assistant felt that overall the children's ability to generate ideas and 'think outside the box' had improved. Children were better able to approach a task without having to ask for help, and the ideas that they were coming up with were more exciting, complex and individual. Many children in the class who would have previously remained silent during carpet time were independently offering answers and opinions to questions asked, in addition to this the answers given were at an overall higher level. Children were able to explain their ideas using suitable words and logic to the rest of the class with confidence.

The introduction of regular 'thinking outside the box' tasks that allowed children to practise their thinking skills appeared to instil confidence in the children, even if they were unsure of an answer. Children realised that they would always receive a positive reaction, and would, if required, be helped by other members of the class to build on the ideas they had started with. This meant that confidence levels for individuals who previously struggled began to rise, and in turn had a positive effect on the way they used their imagination. However the extent that this can be credited to the change in practice rather than normal child development must also be considered, and should be a subject for further study.

The children enjoyed the tasks which allowed them to air their own opinion and really get to grips with their own ideas. It was also beneficial to the teaching staff as it showed a side of many children that we did not know about. It was also used to help tailor learning to specific needs and interests that had become evident from the open ended tasks. Although the tasks took a relatively substantial amount of time to incorporate into school days the benefits that have been seen in all children greatly outweigh any additional time that has been spent on them, making the process wholly worthwhile.

### **Lessons learnt and next steps**

Actively teaching children to generate their own ideas has had positive effects on the learning of the children within year 2. All parties involved have identified increased confidence within the class and a willingness to offer ideas and explanations through all topics studied. I feel that allowing children the space and time to develop their creative thinking skills is outweighed by the benefits gained

from the children on a range of different levels. However after completing the project I feel there are still discrepancies which require further investigation, these are:

1. Children develop a huge amount during year 2 and the progress the focus children have made could be due to natural development of the child as opposed to the taught skills.
2. There is no control to compare the current year 2 to previous years or those also in year two in other schools.
3. Further investigation between year groups could be undertaken to provide comparisons.

In light of the above issues I have a number of next steps that I feel would be beneficial to enhance the learning of children at our school. Firstly, I would like to develop a set of creative thinking tasks that can be used during the year to build confidence for children in the class. I would like other teachers in the school to begin using similar strategies covered in the project to develop these skills with children in their classes. Finally I feel the benefits from this project can be enhanced further by encouraging children from the start of their learning journey in reception throughout their stay in our school.

**References:**

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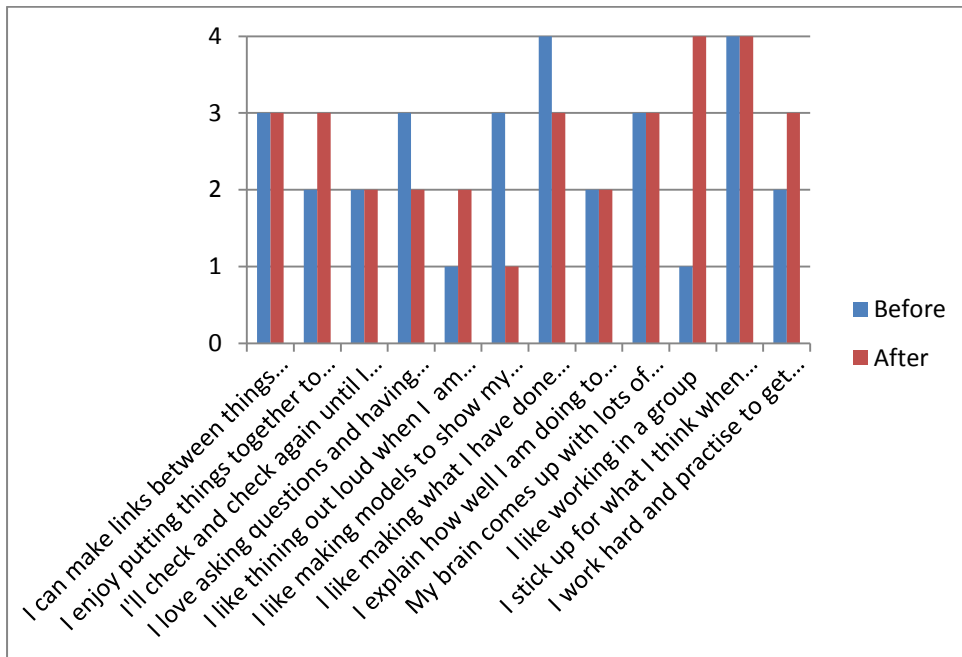
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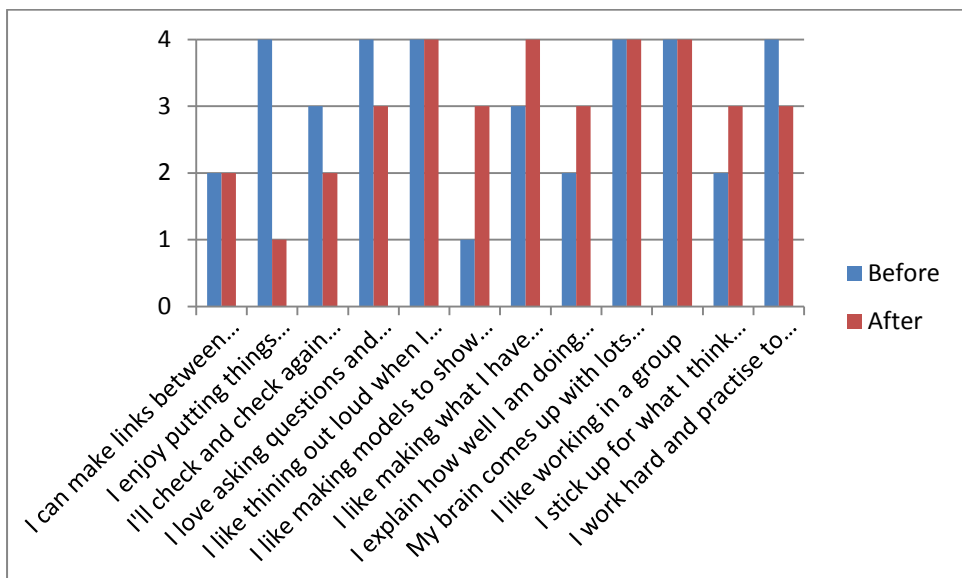
## Appendix 1

### Child 1 self-evaluation:



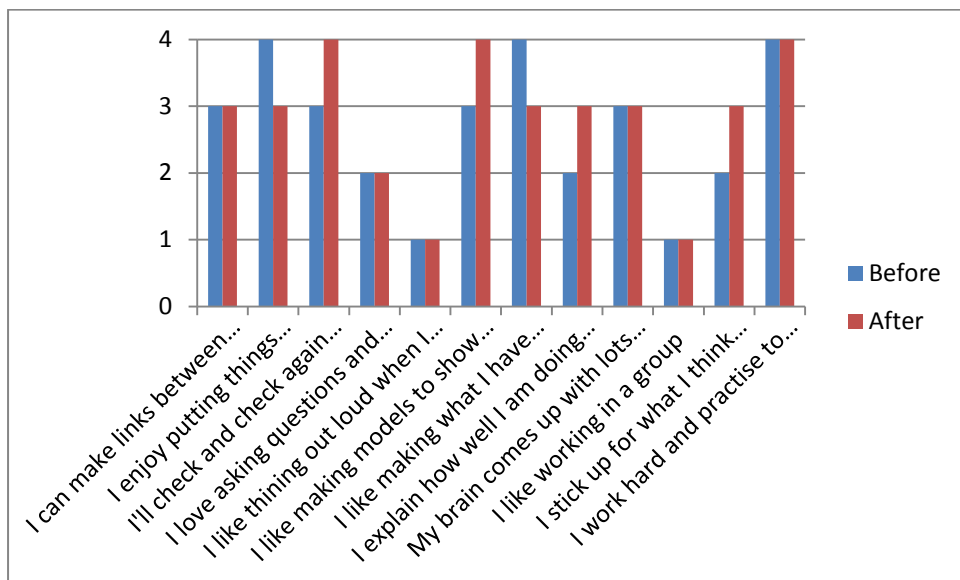
## Appendix 2

### Child 2 self-evaluation:



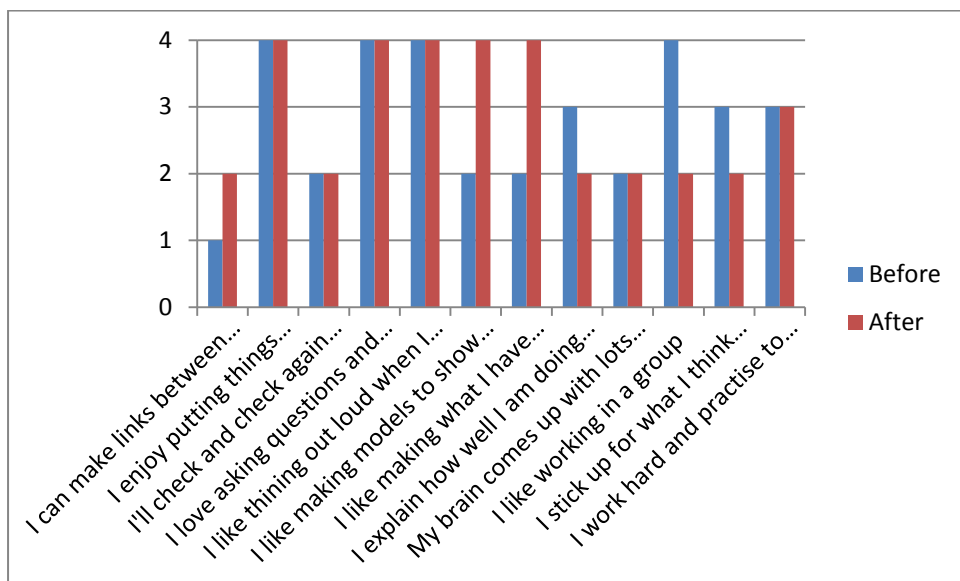
**Appendix 3**

**Child 3 self-evaluation:**



**Appendix 4**

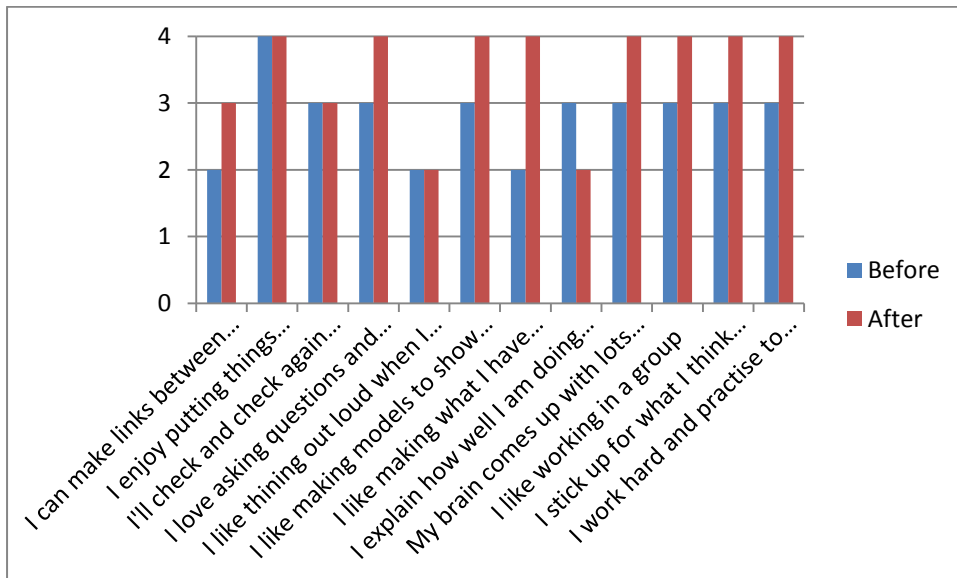
**Child 4 self-evaluation:**





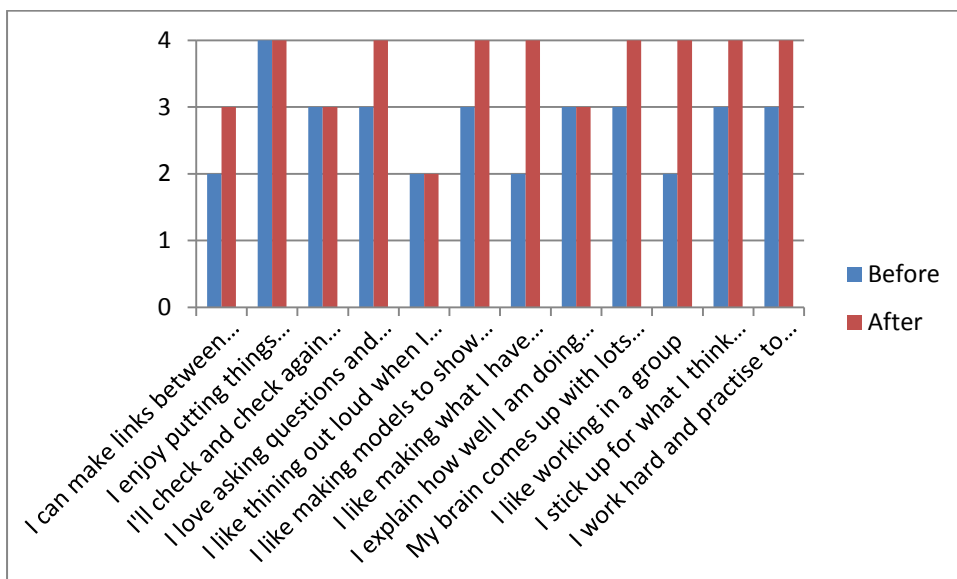
## Appendix 5

### Child 5 self-evaluation:



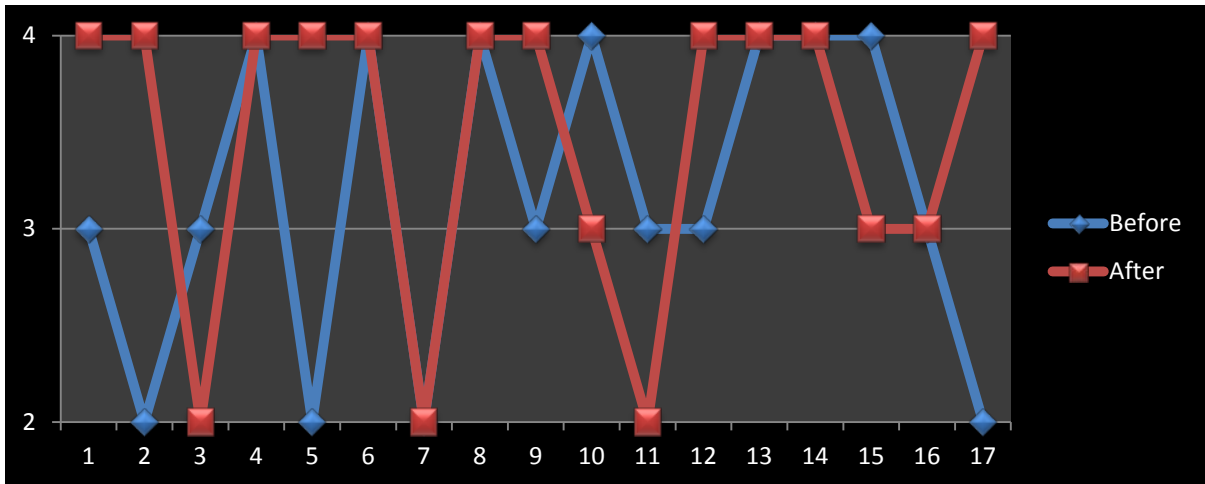
## Appendix 6

### Child 6 self-evaluation:



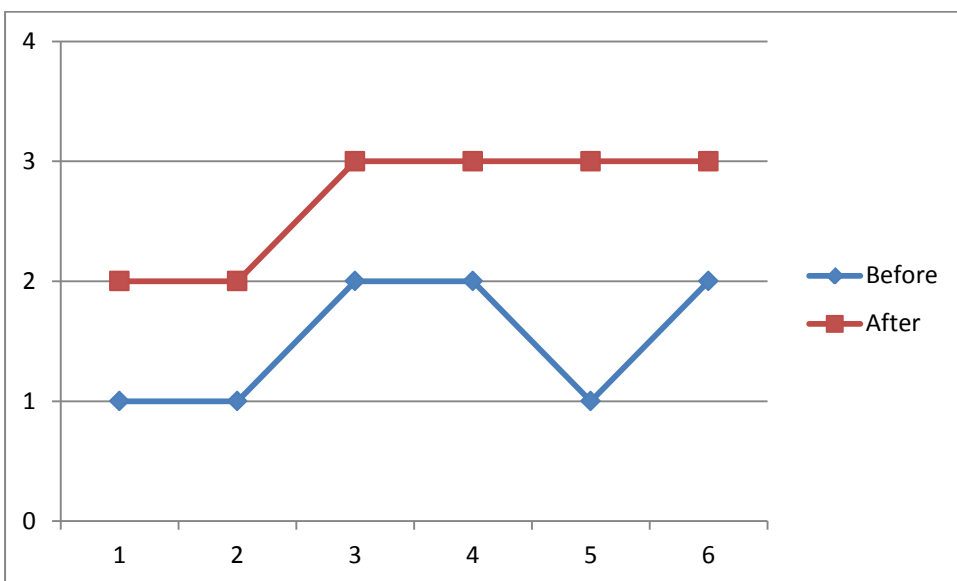
### Appendix 7

Graph showing non focus children's responses before and after the project for the statement: My brain comes up with lots of good and new ideas.



### Appendix 8

Graph showing Teacher assessment before and after for 6 target children:



**Appendix 9**

**Graph showing teaching assistant assessment before and after for 6 target children:**

