HANDS-ON DATA ACTIVITIES IN THE CLASSROOM - ENTHUSING TEACHERS AND STUDENTS

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ABSTRACT

Hands-on data activities in the classroom are often avoided by teachers of KS3 and KS4 mathematics in the UK. In many cases where data handling skills are taught in the classroom, the activities used involve data which is safe, predictable and the outcomes are limited to ensure the task of marking and assessment is made easier. Such an approach reduces the opportunities to engage students to think for themselves, including key decisions about the choice of data, data collection methods, and the process of analysis and interpretation.

In developing hands-on data activities for Crea8te Maths (A Government funded project for Yorkshire and Humberside to improve numeracy), we acknowledged activities that had a student led element generally have more interesting outcomes, promote ownership, engagement, motivation within the class, and encourage lateral thinking. Anecdotal evidence of the benefits of our developed activities including 'Stretchiness' and 'Classroom Olympics' are presented. Based on our experiences in activity development and teaching in the classroom we explore the opportunities for hands-on activities in the new Y12 curriculum involving solving real problems using data and mathematics.

INTRODUCTION

Rather than being a scientific paper analysing research and findings in the area of hands-on data activities in the classroom the conference presenter, Bradley Payne, will provide an account of the presentation delivered in Macao, 2013, covering key points and experiences. The activities discussed throughout this paper originated from the Cre8ate Maths project that I worked on as a resource developer between 2007 and 2010.

During 2011, at the time of running data investigation workshops in schools, I was fortunate enough to be invited to have dinner with the UK Prime Minister, the Rt Hon David Cameron. In a room of 50 or so guests I managed to grab a few minutes with the charismatic prime minister. I explained that I develop data activities for school children and that the students would be extremely enthused and excited if they saw that a statistician had met the prim minister. David kindly agreed to have his picture taken with me.

During subsequent school workshops I presented the picture to students between the ages of 8 and 12. The rather disappointing responses from students included "Who is that?", "That is the prime minister … Gordon". I fortunately had another picture to hand capturing the moment I met Jeremy Clarkson who is the

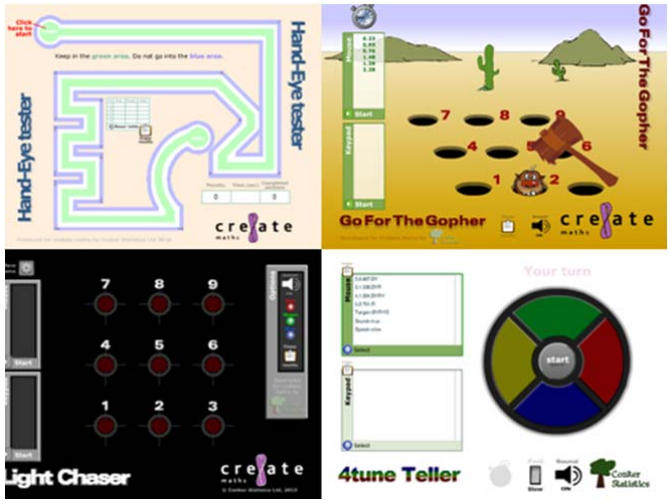
presenter of the British television show about motor vehicles called Top Gear. Not only was the students' interest overwhelming. ?", "Wow – you met Jeremy!", I was inundated with questions: "What car was he driving?", "Was the Stig there?"

The message from this experience, which although is rather convoluted is often over looked when developing data or statistical activities for the classroom.

"Activities that we as educators think will enthuse and engage students may not necessarily be the case."

Unfortunately many of classroom data activities are taught by teachers who lack confidence, the skills and enthusiasm to engage students in the classroom. As a result both students and teachers are unmotivated and the subject of statistics suffers.

To overcome the stigma often associated with statistics it is essential to engage both teachers and students in data related activities. Conker Statistics were commissioned to develop games and challenges that tackled some of the issues associated with engagement and fun. Initially web-based data games were developed including Hand Eye Tester, Go For The Gopher, Light Chaser and 4Tune Teller. These were more than just games as allowed experimentation with sound, speed and different colours. Furthermore, the Hand Eye tester was developed from a template used by NASA to train astronauts in hand-eye coordination. The GoForTheGopher game is also referenced in the book, "Statistics & Probability in the Australian Curriculum" by Helen MacGillivray et al. The key messages learned from these data activities include:



"Web based games provide a quick means to obtain a data set in a fun and engaging environment."

"The activities can be undertaken, the data analysed and interpreted by students working individually or in small groups."

"A competitive element can be introduced to motivate the analysis and interpretation of the data."

As these activities worked well, further hands-on data activities were developed with a competitive element in mind. These resources were developed using a process that evolved over a two year period whilst working with teachers, students, and evaluation experts. The teacher workshops held at weekends included a Continuous Professional Development (CPD) element that complemented the resource development activities.

Specifically at the CPD events the following was performed:

1. All teachers took part in an established hands-on data activity, from data collection to analysis and interpretation.
2. Working in groups a partially finished data resource was provided to the groups to critique and provide suggestions on how to finish the resource.
3. Develop a new idea for a data investigation.

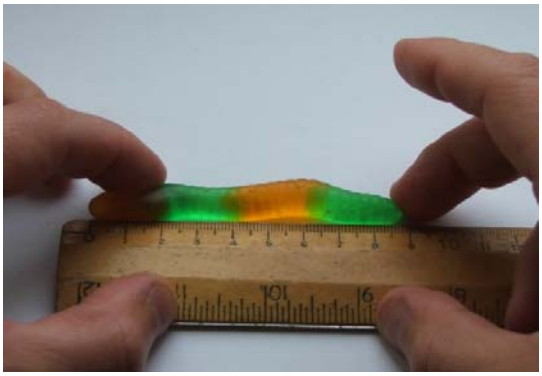
Feedback from the teachers indicated that ownership of the activities through input would result in teachers being more enthused and confident in using such materials in the classroom. This inevitably would tackle the problem of teachers avoiding open-ended data activities and sticking to hand written activities that were safe, predictable and the outcomes limited to aid making and assessment. The activities that were developed were referred to as "Wow Activities" to help motivate and engage students and teachers in data related investigations.

"Nappy Changing Challenge" was one of the first Wow-Activities that was launched at a special Maths day for 300 school children aged 11 to 13. As an ice breaker a baby doll, filled with sand to an approximate weight of a new born baby, is carefully passed around the group of 10 or so students with the objective of estimating the weight of the baby in grams. For reference a sack of potatoes and a tin of beans with known weight are also passed around. The second part of the activity involved students following instructions to prepare a terry towelling nappy to perform a timed nappy change in the third part. A measure of carefulness is also recorded. Students record their estimates and results on a pre-prepared form where they also answer questions about their views on looking after children and the roles of mothers and fathers. Students were enthused, engaged, and more importantly we observed that students were highly motivated in performing the analysis. This motivation was a result of the competitive element. Groups of boys and girls used their knowledge of statistics and data analysis to promote their case for being the best. Interesting discussions and critical thinking followed on how the key messages from the data investigations varied based on what criteria was being investigated.

This activity has also been used at CPD for teachers where the Stig character from the famous UK TV show Top Gear set target times for the investigation.

During 2010/2011 when there was a huge interest in the forthcoming 2012 London Olympics a set of competitive classroom Olympic activities were developed. These included various activities such as the standing-start triple jump and Cotton-wool shot put. The activities were launched at the English Institute of Sport in the UK with over 400 students taking part. A pre-prepared form was used to also collect information about the participant together with their opinions on which sports they love/hate and which sports they would like to perform more of/less of at school.

More recently we have added Sprint to the set of Olympic activities. Once again the competitive element drives the investigations. The activity appeals to all abilities as the race distance can be set anywhere between 1m and 5m. Reaction time out of the starting blocks and race time are recorded using our specially designed timing gates.



Further successful hands-on data activities include Stretchiness which employs an open-ended problem based approach. This activity was the result of a conversation with Helen MacGillivray during 2008. Equipped with rulers, pen, paper and jelly sweets students or teachers work in groups to come up with a measure of stretchiness and how to test and measure it.

The appeal of many of these activities for teachers is that in addition to being fun and engaging they can be easily implemented and modified. They are not designed to replace conventional teaching but for complementing and promoting data related learning.

Many teachers that were involved in the CPD workshops have subsequently enhanced the existing material or developed new resources. One such teacher is Terry Dawson who now works for the MEI (Mathematics in Education and Industry) in developing a post 16 curriculum aimed at 250,000 students who obtain a General Certificate of Secondary Education (GCSE) maths grade C or better but do not wish to study maths at the Advanced level. Problem solving is at the heart of the activities, but unlike the CPD workshops mentioned earlier resources are developed by committees and advisory groups. The proposed PBL approach is for the students to work in a group to answer a specific question. The teacher directs students to think more deeply by asking questions at appropriate times which ultimately leads to an understanding and appreciation of the mathematics and statistics involved. Assessment, as always, for PBL is difficult but methods are evolving and being tested for such a curriculum. A key idea is that students need to state their assumptions whenever providing evidence and interpreting the results.

CONSIDERATIONS & EXPERIENCES

The lessons learned from our experiences are as follows:

> "A competitive element may help to provide engagement and drive the data investigation."

> "Many of the 'safe' practitioners need encouragement to try hands-on data activities."

> "It is important not to get carried away with the context of the activity. Many of the activities are merely games or fun activities if the teacher does not complement the activity by re-confirming the important learning."

> "Through practice the right balance between fun and learning can be achieved."

> "Hands-on data activities and PBL require teachers to think on their feet."

> "Hands-on data activities do not replace traditional methods, but can complement them."

REFERENCES

All the data activities mentioned can be found at either:

http://www.nationalstemcentre.org.uk/elibrary
www.conkerstatstics.co.uk
www.cre8atemaths.org.uk