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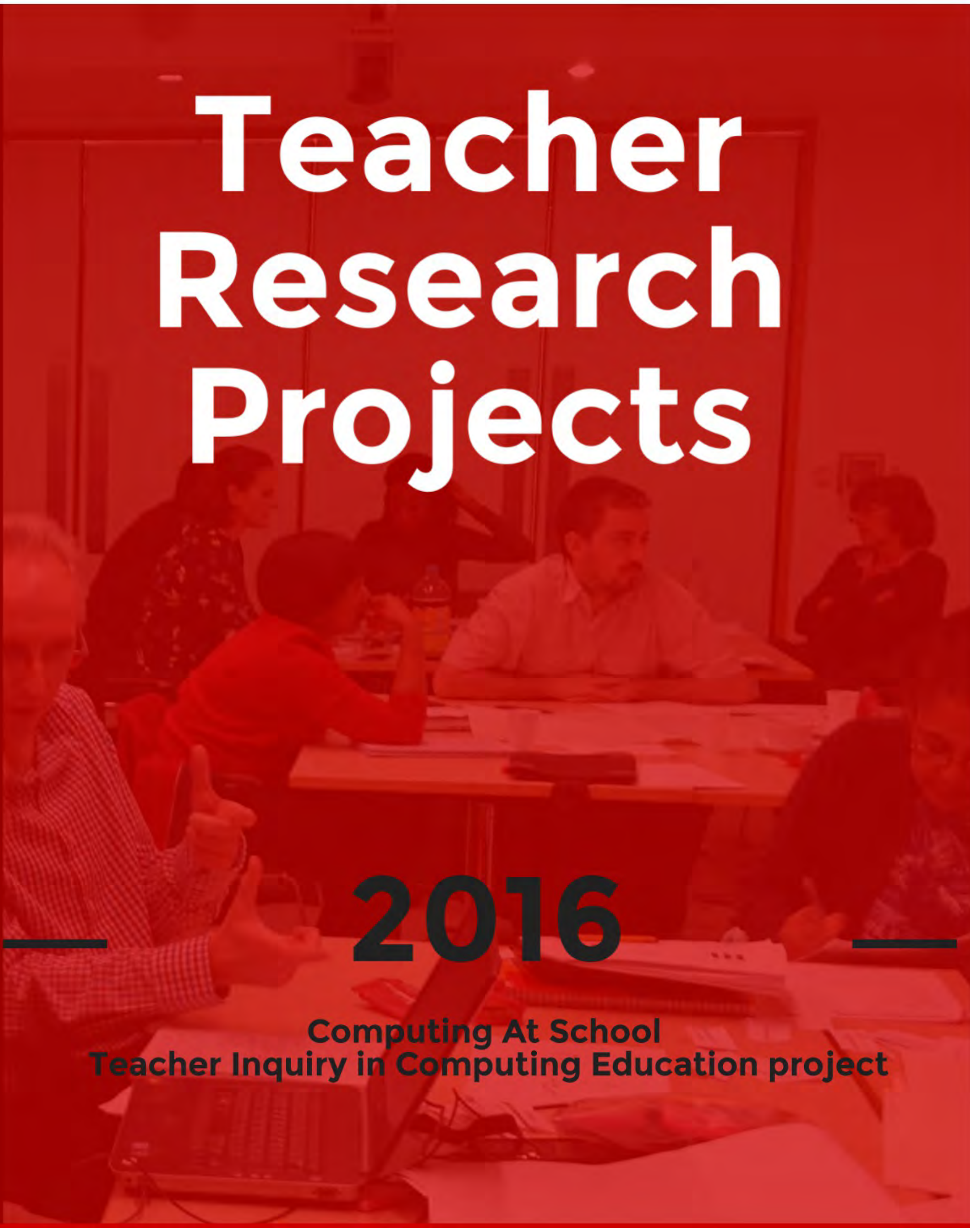

Teacher Research Projects

2016

Computing At School
Teacher Inquiry in Computing Education project

CONTENTS

Other teachers participating: Graeme George, Iwan Jones, Kim Harding and Philippa Lewis

ACADEMIC ADVISORY TEAM

Dr Sue Sentance, King's College London
Dr Jane Sinclair, University of Warwick
Carl Simmons, Edge Hill University
Dr Neil Brown, University of Kent
Andrew Csizmadia, Newman University
David Hill, University of Portsmouth
Eleanor Overland, Manchester Metropolitan University

FOREWORD

This booklet contains summaries of research projects carried out by 17 teachers as part of the Computing At School Teaching Inquiry in Computing Education project from October 2015 to June 2016. Teachers attended two full-day meetings to learn about research, plan and carry out work and discuss their projects with others. The first day (October) was spent coming up with a research question and a plan, and the second day (March) was spent analysing data collected in the interim period and writing up results. Teachers were supported by academics who worked with teachers to develop and refine their ideas. In between the two meetings, participating teachers carried out a research study in their own classrooms. Finally, they developed an infographic of their findings and these make up this booklet.

Classroom-based research is not new and has been shown repeatedly in studies to be a useful aspect of a teacher's professional development. Teacher inquiry is a way of empowering teachers to investigate changes in teaching and learning and measure the impact of those changes on their learners, rather than having them dictated to them through other forms of training. It enables teachers to gain confidence in decision making, based upon the needs of their students and schools. Some teachers work in schools where research is a focus, but many others do not.

Small-scale research is not intended to change the world but it can make a dramatic change to your own teaching and understanding of pedagogy and how children learn. We all need this in Computing which is a new subject in the curriculum in England and at various stages of development elsewhere in the UK. I believe that teachers can make a valuable contribution to the development of pedagogy in this area through classroom-based research. If this is something that you are also interested in do join our CAS Research network where we hope that teachers will be able to support each other in running small-scale research projects in the classroom.

The teachers featured in this booklet are, quite simply, trailblazers. They volunteered to participate in this project, (hopefully) knowing that we had never organised anything quite like this before. They have demonstrated such enthusiasm, initiative and passion for teaching and learning, particularly in Computing, that they have astounded us with what they have been able to achieve with a small amount of support and encouragement. Hopefully we will have the opportunity to learn from our experiences and run something similar again. We all hope that you find the teachers' reports of their work interesting and that you learn something about the teaching of Computing and the value of classroom-based research.

This project was made possible with funding from Google and support from Computing At School.

Happy reading!

Sue Sentance, on behalf of all the teachers involved and the academic team.

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http://computingatschool.org.uk/research

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Student Perceptions of Computing in School (Group Project)

A small research study into student perceptions of computing across all key stages and how these views differ by gender.

Beverley Dillon- St Hilda's Prep, Bushey
James Jerrold - Trevelyan Middle School, Windsor
Kimberley Sayers - Landau Forte College, Derby

About Us

Beverley Dillon

I am the Maths and Computing coordinator at a small girls' Prep school in Bushey, Herts. I have been teaching maths for 30 years and computing for 18. I would like to inspire girls to continue with their enjoyment of computing and saw this project as a way to investigate this further.

James Jerrold

I am a Computing Teacher and Middle Leader at Trevelyan Middle School. I have been teaching in Primary and Middle for ten years I have been a CAS Master Teacher since 2011.

Kim Sayers

I am a secondary school teacher of Computing in my 5th year of teaching and have been teaching Computing for 3 years. I am a Cisco Certified Instructor as well as a Raspberry Pi Certified Educator holding a Masters in Education.

MT since 2011.

Motivation for our project

The group were all interested in why girls are not continuing with Computing as they progress with their education despite apparently enjoying the subject and being good at it.

Following initial discussion we decided to look at the underlying perceptions about Computing to see if we could identify some reasons behind the low uptake. We were particularly interested in girls and their attitudes to Computing.

This topic has recently been discussed by Carrie-Ann Philbin on CAS TV as well as on the CAS forums

#include computer science for all

CAS TV

Research questions

Our initial research questions were:

- What are the gender differences in attitudes to Computing?
- Do attitudes to Computing change across the key stages?
- Is there a cultural difference in attitudes to Computing?
- Are attitudes dependent on background?

Carrying out the research project

Our study

As a group we each did individual research along a common theme with several questions that were common to all of us.

We chose to do this as our research was covering all ages groups. We felt that questions or activities for a KS1 student would not reflect the thoughts of a KS3 student. In addition KS4 and KS5 students have already chosen their subjects which in turn ruled out some of the questions.

Questions were asked about students interest in the subject and their use of technology as well as their perceptions as to whom was better at the subject.

Bev did her research amongst the younger students, James had KS2 and KS3 students whereas Kim was able to collect data across KS3 to KS5.

Data collection

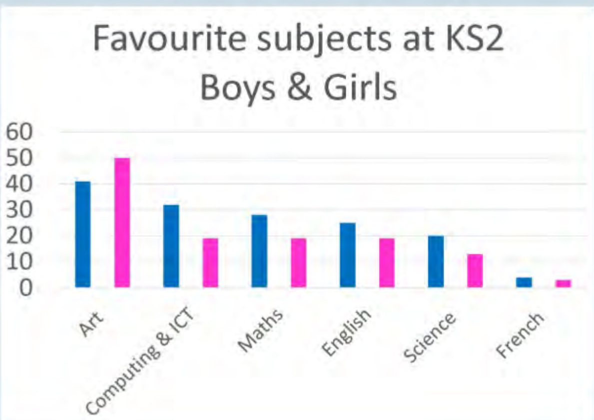
The group discussed how we could gather information whilst minimizing the potential influence and bias created by ourselves speaking to students directly.

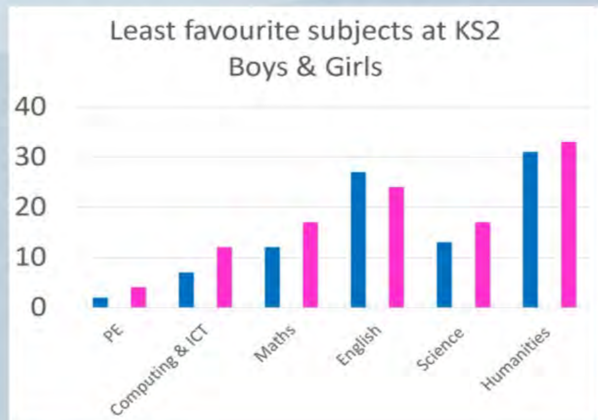
Questions were asked via an online survey and responses were collated from KS2-5 across two different schools in the country. Additional questions were asked to an additional group of KS1-2 students in a different school.

For the older students it was decided that an online questionnaire would be used in order to remove any potential influence. The younger students were asked questions verbally and the data was collected by a teacher. In addition a creative task was set (shown right) to gather additional information.

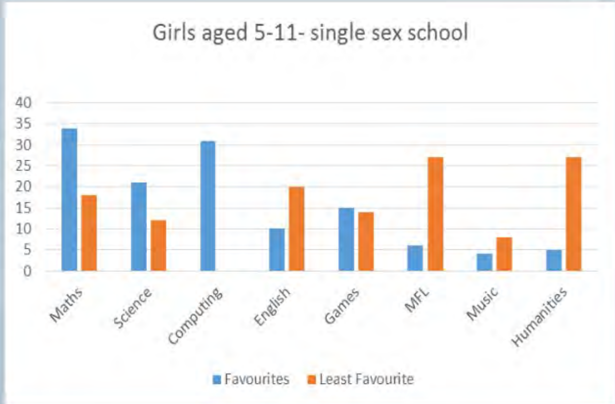
Where possible questions were given with multiple choice options to aid data analysis.

Data - KS2





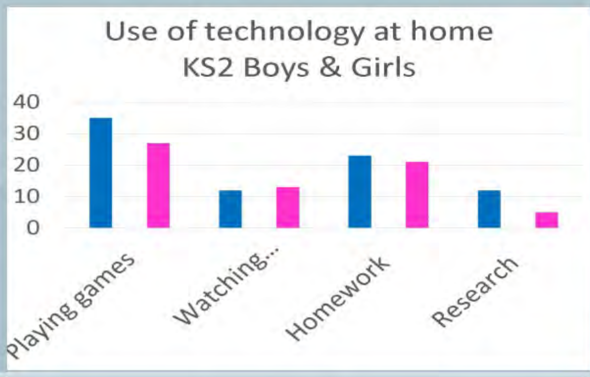
Data - KS2 (contd)



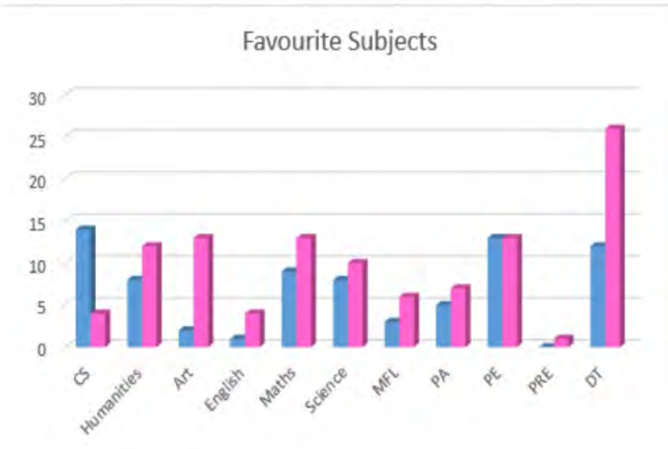
An interesting comparison from a single sex school

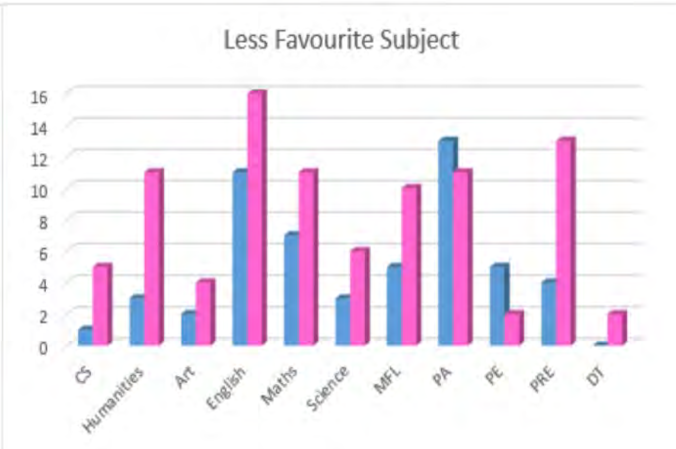
Although all the girls like computing and the other Stem subjects, most use computers at home for entertainment and socialising(year 4 upwards). Most still did not see themselves continuing with computer when older and chose traditional female jobs. This could be through lack of information or social conditioning.

In Years 5 and 6, more girls from Windsor dislike ICT / Computing than boys. However, looking at use of technology, girls use it less at home for homework and entertainment than boys. Sightly more girls said they used technology to watch videos than boys.



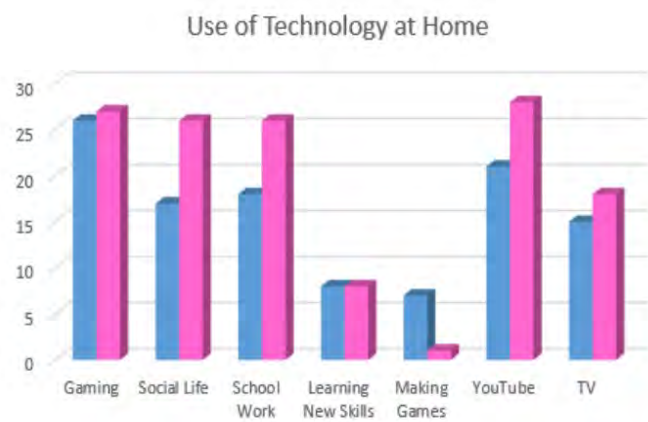
Data - Year 7





Data gathered from girls in year 7 showed that they were less likely to like computer science.

However,they are more likely to use technology for uses other than just gaming.



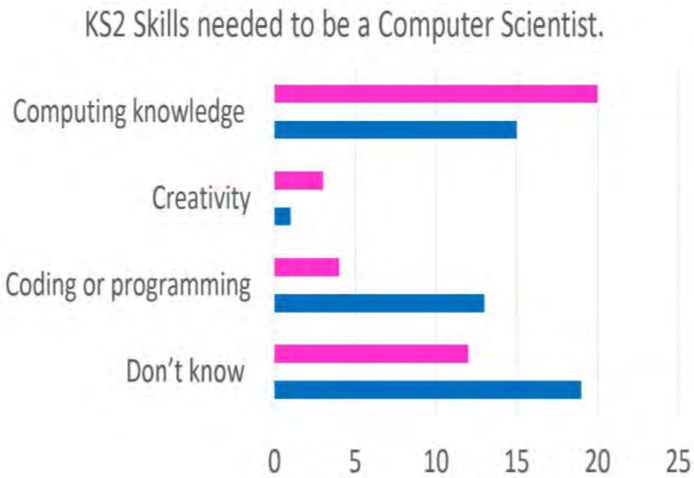
Results of the project

81% of KS3 Boys and 66% of KS3 Girls believe that Boys are better at Computer Science

As a group we collected a vast amount of data which in hindsight caused us an issue! Part of the problem was the shear volume of the data and therefore the time to get meaningful results from the data.

As the data was being collected across al Key Stages the initial method of questioning also needed to take into account the wide age range and language skills.

Going forward this data has the potential to help guide subject delivery but would need a lot more work.



On the whole, boys were more likely to offer an answer to "what skills do you need to become a Computer Scientist?"

There is a lot of work to be done on educating our children on what a Computer Scientist is and what they do.

This lack of knowledge about the industry could go some way to explain why we have a skills shortage.

Impact of the project

"This project has taught me a lot about research and inspired me to want to undertake a Doctorate in Education to investigate further into Computing and Education."
Kim

"I have learnt a great deal about attitudes to Computing in KS2 and KS3 as well as the intricacies of approaches to research, the challenges researchers face and the issues involved in creating unbiased questions. I'd love to take this further. "
James.

" This has been such an interesting project which has multifaceted implications . It is a huge topic and I only wish I had more time to investigate the issues further." Bev

PERSEVERANCE IN COMPUTING

How can perseverance in computing improve achievement across the curriculum?

An outline of the project

Motivation

Much has been said about the transferability of skills from computing into other curriculum areas.

- Can teaching using explicit perseverance activities increase a pupil's ability to persevere?

- Can they apply this into other areas?

Methodology

Three classes within Year 3 and Year 4.
Small sample of children from each class.

Observations using the Leuven Scale for Involvement

Class 1: Observation 1, intervention, observation 2
Class 2: Observation 1, observation 2
Class 3: Intervention, observation 2

About Me

Computing coordinator, team teaching computing with colleagues from Foundation Stage to Year 2. Manor Primary School, Reading

CAS Master Teacher, CAS Primary Hub Leader

Carrying out the research

Data collection

Observe 6 children in each class during a task looking for:
- Involvement (using Leuven Scale)
- Structure of asking for peer support
- Specificity of asking for adult support

Every 30 seconds was too much!
Every minute was manageable.

Original plan was to look at pupils in a range of different tasks; computing and others.

The intervention

- Unplugged activity on debugging paper plane instructions

- First exposure to Scratch through debugging

- Teaching through activities which explicitly model perseverance

- Reinforcement of school's existing system to encourage perseverance

Data

Initial observations

Differences in task lengths observed between classes

Involvement of some children fluctuated significantly within a task (non-computing)
- were observations too frequent?
- does this show fragility?

Anecdotal observations at the beginning of the intervention (computing) showing low skills set to persevere during a task
- staff habit of providing quick support

Children unaccustomed to being put in a position to struggle, with many finding this emotionally difficult

Process lessons learned

The amount of planned observations were too time-intensive once school-life got in the way.

The level of detail intended within observations was impractical once trialled, thus needing refinement within the process.

Within these limitations, the project feels like a valuable piece of action-research to inform our practice, but not robust enough to form an evidence base.

Results of the project

A structure is valuable for children to develop a process to extend how they persevere

Strong reinforcement of consistent messages across a number of subject areas helps to create linked understandings

Highlighting the focus on perseverance to staff has positively affected the language they use to support children

Some children would have benefited from greater physical resources to support the earlier stages of their perseverance

Impact of the project

"Our classes are more adept at knowing how to persevere, and demonstrating that they can persevere more now than they did in January. It's made a noticeable difference for some children."

Class Teachers

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Can children teach teachers to code?

Neil Kelsall

Children teaching, teachers learning, ideas flowing, fingers burning, if you practice what you preach, everyone can learn to teach!

Outline of the Project

Motivation

In traditional subjects, teachers are the expert and impart knowledge to students. However, in Computing, children are often the experts. This project seeks to investigate whether children can assist teachers, both new and experienced, in their development and understanding of the Computing curriculum, content and new software.

Research questions

Does child-led teaching improve teachers' computing knowledge, understanding and confidence?

About me

The author, Neil Kelsall, works as a year 6 teacher at Oasis Academy Limeside: a twice outstanding primary school and national teaching school.

Carrying out the research project

The intervention

In this two part process, children first learn to review computational software and then teach teachers how to use this software. Children follow a pro-forma based on Blooms levels of learning with an emphasis on the deeper thinking skills. They also learn and explain key vocabulary so they can help teachers link the software to the Computing National Curriculum.

Data collection

This project used a pupil focus group alongside a pre and post survey to ascertain teachers understanding before and after the intervention.

Key themes

All children could articulate concepts using key vocabulary

Children

-Enjoyed learning new software and teaching teachers
-Could articulate concepts clearly with key vocabulary
-Developed their own meta-learning

Teachers

-Enjoyed being taught by children
-Felt more confident teaching some concepts
-Enjoyed quickly learning new software

Most of teachers felt more confident teaching computing

Impact of the project

Amazing! Our children are now teaching our teachers

Principal

Teacher

Wow - I've just realised how much I have to learn!

I enjoyed learning how to teach: I want to be a teacher later

Child teacher

The future

Thoughts

- Scripts/survey can be tailored to schools' needs
- Each cohort of children will need time to:
  - o Learn the script
  - o Understand the vocabulary
  - o Practice teaching

Future research

- One school: what is the impact in other schools?
- 6 month period: Is the project sustainable?
- Pupil impact: what is longer term impact?

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ASHLEY COLLEGE

Deborah Thompson

How does the use of defusion, hard copy media and online interactive software help students with complex health needs to develop their programming skills?

Outline of the project

Motivation

Students with health needs often miss out on educational opportunities. I believe that these students deserve the opportunity to do well. My research was designed to find out whether hard copy and online interactive software such as Codecademy best facilitated the learning and developing of their Python skills. I also sought to ascertain whether the technique of defusion from ACT (Acceptance and Commitment Therapy) could help all our students to progress with their programming skills.

Research questions

- Do students find hard copy media useful when developing their Python programming skills?

- Do students find websites such as Codecademy useful when developing their Python programming skills?

- Can students identify negative thought processes associated with learning Python programming?

- Can students use defusion techniques to overcome these negative thought processes and to move forward with their learning of Python programming?

About me

My name is Deborah Thompson and I have been a teacher for over 20 years. I have been teaching Computer Science GCSE for 3 years.

Carrying out the research project

My intervention

Students were given a hard copy learning resource and access to an online learning site, each for 10 hours. Students were also given information on how to use defusion.

Defusion is a technique which can be used to help individuals manage negative thoughts which may occur in the learning process. After using these resources students were asked to evaluate each using a questionnaire. Answers were then analysed usng an Excel spreadsheet.

Findings were shared with colleagues, senior management and the management committee of the school.

Data collection

I designed a questionnaire which asked students to evaluate their experience using Python programming from hard copy and online media, and to suggest any improvements which they thought would aid their learning of python programming..

Students were also asked how they had engaged with defusion . 7 students out of 9 responded to the questionnaire.

Data

The table to the right shows the data that was collected from 7 students in this project

In this study all of the students had mental health issues which made it harder for them to access the mainstream curriculum than their peers in mainstream schools. This was to some degree due to their low average attendance rate of around 65%.

Questionnaires took some time to complete and most students needed a good deal of encouragement to complete all the questions.

Student ID	Age	Gender	Months learning python	% of Python items learned	Number of programs	Booklet improvements	Difficulties with booklet	Rating for booklet	Codecademy improvements	Rating for codecademy	%Control strategies used	%aspects of defusion used
A	15	M	12	79	4	4	U	3	2	4	38	60
B	13	M	6		3	4		3	3	4	0	0
C	13	F	12	42	4	4	N	4	0	4	0	0
D	14	F	12	47	4	4		4	2	4	0	0
E	15	F	2	11	4	5		4	2	4	50	60
F	15	M	12	74	3	5	U	4	4	4	25	80
G	16	M	7	37	3	5		4	3	4	25	0
	14		9	48	3.6	4.4		3.7	2.3	4	20	29

Results of the project

Key findings

1. All students rated online resource slightly higher than the hard copy resource.

2. Most requested extra features were more examples for the online resource and a glossary for the hard copy resource.

3. Health needs did not appear to hamper learning from either resource.

4. Students suggested more improvements be made to the booklet to help their learning, than for the website based learning tool.

On average students had completed 9 months of studying programming and had produced an average of 3.6 programs each consisting of around 150 lines of code.

Males were more likely to use control strategies than females and to deploy defusion techniques when coding. Students have had a limited amount of time to master defusion so may have been reluctant to use it consistently.

This project has shown me that students need to be given a good framework for learning systematically and that reinforcing and expanding their knowledge and experience of ACT techniques could be useful.

Impact of the project

My project has given me a greater focus on my work giving me a greater depth of understanding of students thinking and self management skills. It has also given me a very different perspective on how I plan and deliver programming lessons.

I have fedback on my project to other teachers in my school and to other teachers in Brent primary schools and the results have been very positive.

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Westfield Primary Community School

Is coding the new literacy?

Does the use of computational thinking impact progress of SEN learners in writing?

Helen Banks

Outline of the project

Motivation

As a mainstream primary school we have a high number (nearly 20%) of pupils with special educational needs (SEN). This is a particular concern as our SEN data commonly falls below national statistics and our school development plan reflects this. There are a significant number of children with SEN in our Year 4 cohort; so it is important that we explore ways in which we can support and look to accelerate the learning potential within this group before the end of their KS2 assessments.

With Computing being an interest of mine I wanted to see if computational thinking/a logical step by step approach to writing would be of benefit to children with SEN and explore if this could have an impact on their writing.

Research questions

Pulitzer Prize winner Don Murray has been quoted as saying, "Writing might be magical - but it's not magic. It's a process, a rational series of decisions and steps that every writer makes and takes, no matter what the length, the deadline, even the genre."

With the phrase "Coding is the new literacy" being argued globally, I wanted to investigate cross-curricular opportunities by looking at coding and in particular the use of computational thinking (the process of making logical steps to solve a problem), to see if children could transfer the skills learnt in Computing lessons and apply them to the process required for writing within English lessons.

About me

I teach at Westfield Primary Community School, a large mixed primary school of around 550 pupils in the west of York.

During my four years here since qualifying I have taught across both KS1 and KS2. I have had the role of Computing Lead for the past 2 years and in this time I have created our new Computing curriculum and assessment methods, updated our school policies and this year I have taught Computing to our KS2 children every afternoon. I am also due to complete the BCS Certificate in Computer Science Teaching this year.

Carrying out the research project

My intervention

NI (No Intervention)	I (Intervention)
Pre-task questionnaire	Pre-task questionnaire
'Cold' story writing task	'Cold' story writing task
Regular English lessons	Regular English lessons
	Additional intervention using Scratch Jr
'Hot' story writing task	'Hot' story writing task
Post-task questionnaire	Post-task questionnaire

The intervention was conducted with a group of six low ability and SEN children in Year 2, who were split equally into two groups (Intervention and No Intervention)

Data collection

I designed and conducted a pre-task questionnaire with the participants to gauge their view on writing and themselves as writers.

I asked the children to complete a 'cold' (pre story writing teaching) story writing task, where they were provided with a photo as visual stimulus for their ideas. This gave me examples of work that I collected and by filming this session, I could observe the level of concentration and engagement the children had when writing.

After this the children took part in regular English lessons together where they learnt about story writing. Alongside this three children had extra time in which to create their story using ScratchJr with an emphasis on computational thinking: the order of the slides and the content of each slide; to build a complete beginning, middle and end to their story.

At the end of the series of story writing lessons the children completed a 'hot' story writing task (post story writing teaching) which I again collected and filmed to compare outputs for both groups. I also conducted a post task questionnaire to gauge their view again on writing in an attempt to see if this changed throughout the course of the research.

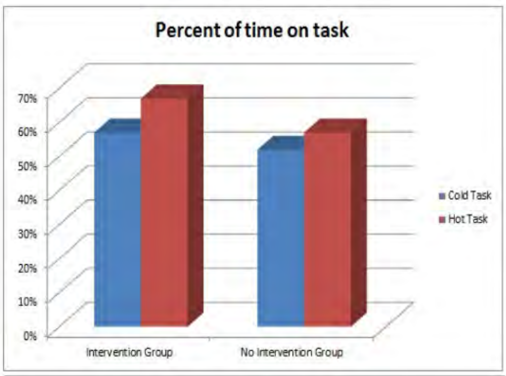
Considerations

When designing the questionnaire I wanted to make it age appropriate and easy to comprehend, so kept the questions simple and used emotion faces as a response where possible.

I took the decision to note if the children were on task every 3 minutes; this is a frequent measure bu considered appropriate because the children who took part in this project have limited stamina when writing. I decided to film each task so I could later review and observe more closely what each child was doing throughout the whole duration of the tasks. This also enabled me to accurately measure the amount of time one child had away from the hot writing task, who left to go to the bathroom.

Data

Engagement: There is a clear difference in the time on, or engagement with the task set between the cold and hot writing tasks for both the intervention and no intervention groups, with both groups spending 10% and 5% more time respectfully, on task when writing the hot story writing task after the story writing teaching.

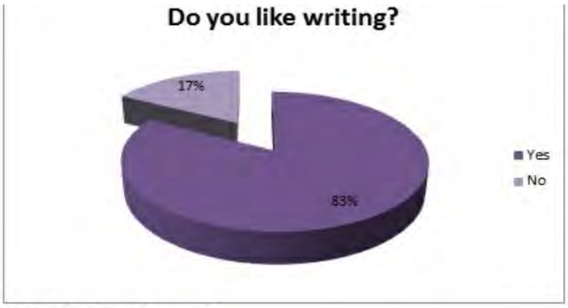


It is important to note that one child from the intervention group went to the toilet (see stars) during the hot writing task and was classed as off task.

This may have affected the data - had the child not needed to leave the class to go to the toilet, the outcome may have seen an even greater level of engagement in the hot writing task for the intervention group.

Results evidence that there is a 10% difference in the time spent on task during the hot writing task between those in the intervention group (67% of time on task) and those not in the intervention group (57% of time on task).

Questionnaire:



Work Produced:
The content and structure of the stories produced during the hot writing task by both groups were of a higher quality compared to those produced during the cold writing task. The hot writing task pieces of work generally included much more of a story structure with a series of events clearly detailed rather than a paragraph of action.

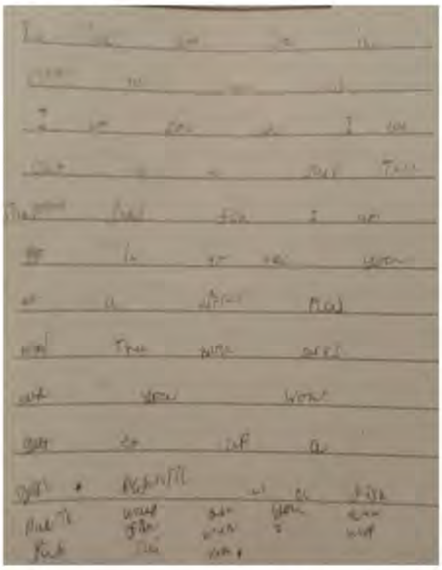
When examining the work produced in the hot writing task by the two different groups, those who had been in the intervention had much greater use of sentence structures and full stops than those who had not had the intervention, full stops being one of the aspects of writing the children outlined as finding hard to use in the pre task questionnaire. The intervention children also included much more description and detail in their writing.

Questionnaire:
Most children in the project (83%) like writing and it was good to see 100% of the children view themselves as a good writer. Children said others were good writers: "because they practice at home" and "[they write] stuff straight away". Examples of aspects of writing the children found hard were: spelling, full stops, rubbing out, having ideas and neat handwriting.

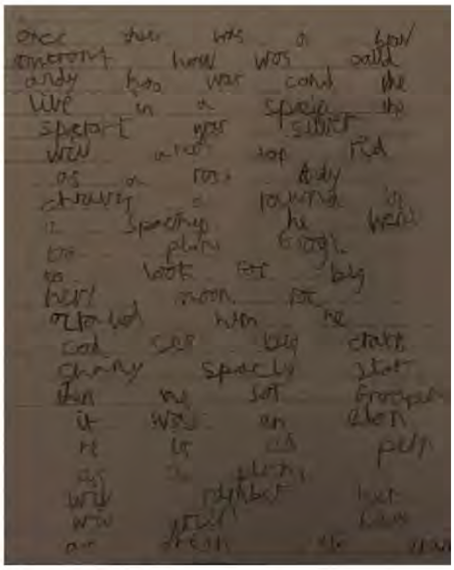
Are you good at writing?

Yes: 100%

No 0%



Intervention group Cold Task piece



Intervention group Hot Task piece

Results of the project

The difference in the quality of writing between the cold and hot tasks for both the intervention and no intervention groups may indicate that the story genre writing teaching between tasks may have had a positive impact on the quality of work the children created.

The better quality of work produced by those in the intervention group may indicate that the use of computational thinking and a step by step logical approach to writing may have a positive impact on the content and structure of their writing.

To follow this study I would examine story writing again and repeat the intervention to gather more data. This would allow me to draw stronger conclusions on the impact of using computational thinking when writing. I would also move into using the intervention with other genres of writing to compare outcomes.

I would look at trying the intervention out with other year groups moving up the school to see if any long term impact could be made on the progress in writing for learners with SEN.

Impact of the project

"I love using tablets to learn"
"It has helped me think of what to write"
"I liked listening to each part [of the story]"

This project has helped me see that research is not as daunting and demanding as first perceived! In completing this project I have become more reflective and I'm much more confident to try new and different ways to support the learning of the children I teach.

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St Paul's C of E Primary, Chipperfield

Does the use of computational thinking impact progress of SEN learners in writing?

Eilish Bateman

Outline of the project

Motivation

I have been the ICT/Computing lead teacher in two different schools and it has been a subject that I have always been passionate about. I have observed such technological changes during my many years of teaching and feel that the children we are now teaching need such advance knowledge and skills in this area to be ready for the future work force.

Having recently taken on the role of SENCo , I wanted to research whether the new push on computational thinking could improve learning outcomes for the children of St Paul's.

Research question

Is coding the new literacy?

"Writing might be magical—but it's not magic. It's a process, a rational series of decisions and steps that every writer makes and takes, no matter what the length, the deadline, even the genre...

Donald Murray

Does the use of computational thinking assist learners in the writing process?

About me

I have been teaching for nearly 20 years in a variety of settings. For the last 10 years I have been teaching at St Paul's Primary.

It is a village church school that values its strong links with parents, the parish and the community. There are approximately 240 pupils on roll comprising 30 in each year group from Nursery through to Year 6.

Carrying out the research project

The intervention

The research project involved eight children. The two separate focus groups consisted of two Year Two children diagnosed with a special educational need and two without. All the children began the intervention by completing a questionnaire which highlighted their personal views on the process of writing. After this they all completed a cold task without any teacher input. The cold task was to write a story titled 'The Laughing Giraffe'. They had a set amount of time to complete this task. This task was videoed to ascertain pupil engagement.

Both groups were then taught a unit of narrative, the teacher focused on the need to include adjectives, complete sentences and the five parts of a story; opening, build up, problem, resolution and ending.

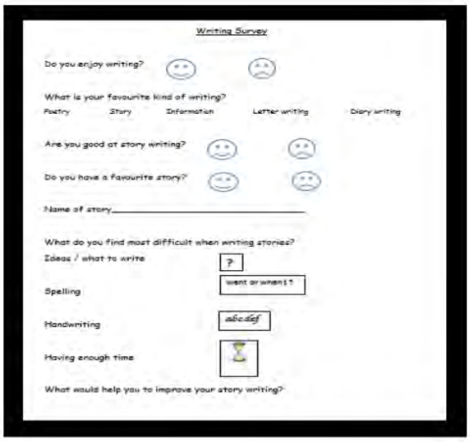
During the teaching unit of one week the intervention was delivered to one of the focus groups. The intervention consisted of the use of Scratch Junior for 30 mins daily to create the same story.

At the end of the teaching unit all the children completed a timed hot task where they had to use all they had learnt over the week to complete a story again titled 'The Laughing Giraffe' unaided..

Data collection

Pre-task questionnaires

The children all began by filling in a questionnaire. It was kept very simple due to the age of the children. Very quickly it was clear to see the views the children involved in the project had with regard to writing.



Writing Survey

Do you enjoy writing?

What is your favourite kind of writing?

Poetry Story Information Letter writing Diary writing

Are you good at story writing?

Do you have a favourite story?

Name of story__________________

What do you find most difficult when writing stories?

Ideas / what to write ?

Spelling went or when1?

Handwriting abcdef

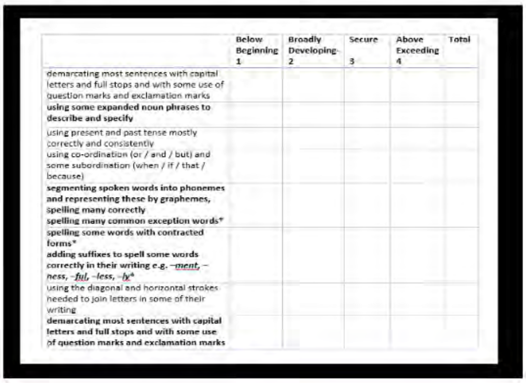
Having enough time

What would help you to improve your story writing?

Observations during and samples of cold and hot tasks

As no support was given during these task the children were observed to ascertain their involvement and engagement. The children's work was then analysed using the National Curriculum Year 2 writing assessment criteria.

Analysis of cold and hot task using a scaled score: A way of scoring the writing undertaken was devised to try to ensure the analysis was objective.



	Below Beginning 1	Broadly Developing- 2	Secure 3	Above Exceeding 4	Total
demarcating most sentences with capital letters and full stops and with some use of question marks and exclamation marks					
using some expanded noun phrases to describe and specify					
using present and past tense mostly correctly and consistently using co-ordination (or / and / but) and some subordination (when / if / that / because)					
segmenting spoken words into phonemes and representing these by graphemes, spelling many correctly **spelling many common exception words***					
spelling some words with contracted forms* **adding suffixes to spell some words correctly in their writing e.g. –*ment*, –*ness*, –*ful*, –*less*, –*ly****					
using the diagonal and horizontal strokes needed to join letters in some of their writing					
demarcating most sentences with capital letters and full stops and with some use of question marks and exclamation marks					

Post-task questionnaires

The children completed the same questionnaire from the start of the intervention to ascertain whether their views on writing had changed.

Data

Questionnaires

Pre-intervention

Do you enjoy writing?

Are you good at writing?

At the start of this intervention many of the children had a very negative view of themselves as writers. All the children with SEN felt they were not good writers and two of them didn't enjoy writing.

Post-intervention

Do you enjoy writing?

Are you good at writing?

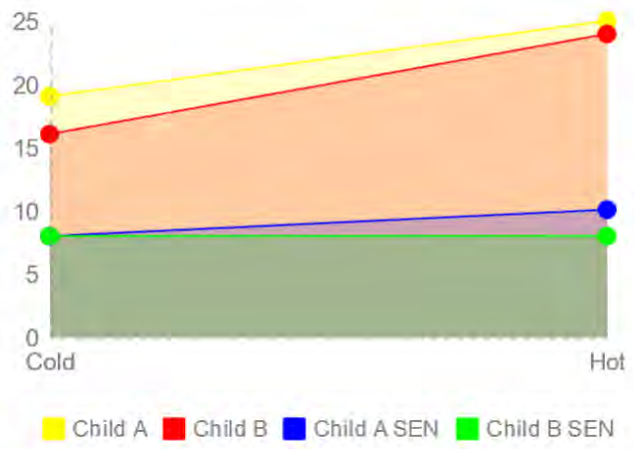
It is clear to see from the post intervention questionnaires that the children's attitudes and perceptions about themselves as writers has improved.

Observations

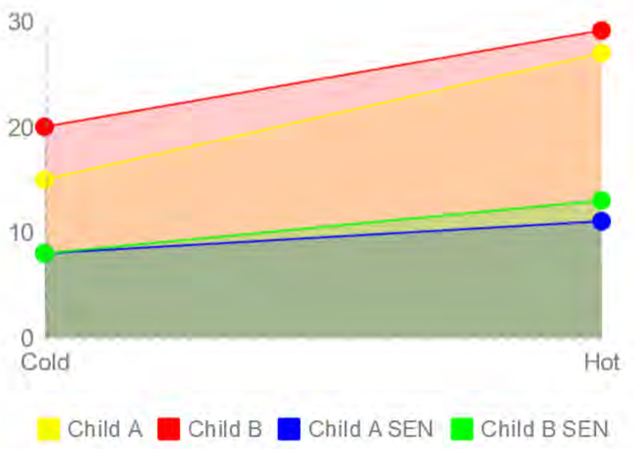
During the cold and hot tasks that both groups of children were required to complete, the teacher observed them and noted their concentration and engagement. As two of the children with SEN, presenting need is an attention disorder, the data was very difficult to analyse.

Using a scaled score to analyse the story writing

Results of non intervention groups cold and hot writing



Results of the intervention groups cold and hot writing



Results of the project

'I love it when we use Scratch. It makes my story come alive.'
Child B

Since completing tnis project I have ensured I give my pupils opportunities plugged and unplugged to plan each step of their writing journey. The use of ICT to produce better outcomes for children with SEN has been advocated and documented for many years. The term 'computational thinking' is fairly new in primary schools. However it is the use of this that I feel had a bigger impact on the children in this intervention.

As is clear from the results shown in the graphs above all the children in the intervention group made more progress in their writing following the use of Scratch Junior. However they each had 30 minutes more each day to work on their story. Therefore it is very difficult to determine whether it is the use of Scratch Junior and the coding aspect of the task or simply the extra time given to the project as a whole that has had such a positive impact on their writing progress.

All the children in the intervention made progress so it is difficult in this study to determine whether computational thinking assists SEN learners more then children without SEN.

However engagement and motivation to complete their stories was more evident when the children were using the ipads.

The children that had the time to plan each part of their story using Scratch approached the task of writing a story with increased confidence. This was evident in the post task questionnaires they completed.

Impact of the project

This project has really stimulated my interest in action research. I have seen the impact focusing on how children learn can improve outcomes.

The children all thoroughly enjoyed the use of Scratch Junior to assist them in their story writing. It definitely had an impact on their engagement in the writing process. As a school, we are now even more committed to ensure all learners has access to high quality cross curricular coding opportunities.

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Woodkirk Academy

What is the impact of common computing curriculum strategies on teacher confidence and pupil recall and application of computational thinking concepts?

Craig Walton

Outline of the project

Motivation

Currently students in Year 10 are taught IT skills once a fortnight. In this time it is expected that the students cover the Computer Science strand of the curriculum.

To meet this expectation, I chose to deliver lessons in Computational Thinking skills. I aimed to develop the students understanding and confidence in Computer Science.

The students do not get anything tangible out of the subject i.e a qualification, therefore I tried to ensure that the lessons were engaging and fun.

About me

I am currently in my 7th year of teaching, of which I taught ICT for 5 years and Computer Science for the last 2 years. I began my new role as Computing Coordinator on January 2015 at Woodkirk Academy. This is an oversubscribed secondary school based in the south of Leeds. With 1850 students on roll and more than 300 sixth form students.

I am responsible for re-designing the KS3 / KS4 curriculum as it moves from ICT to Computing. I teach across the different key stages from year 7 - 11. I am currently the sole teacher of Computer Science and have one group of year 9 students that will be studying GCSE in September 2016.

In the future my focus will be to teach A-level computing.

Research questions

How can Computational Thinking skills develop students' confidence about computer science?

Can Computational Thinking skills be taught as lessons to cover the computing strand in the curriculum?

Carrying out the research project

Your intervention

The research was carried out with mixed ability groups in year 10. The intervention involved five different groups taught by three different teachers. The students are taught one hour a week once a fortnight. The research was conducted from November 2015 to April 2016.

Data collection

The students started the lessons with a baseline test. I designed a baseline test alongside Samantha Sadler from a school in Birmingham, which was originally created in Excel. The baseline consisted of 25 questions with a mixture of multiple choice, single words and essay style questions. The questions were based on the Computational Thinking strands problem solving, decomposition, algorithms and pattern recognition.

The students completed the pre-test in November prior to any learning. After 6 weeks of lessons, this baseline was repeated on VLE moodle. The results from both tests were then analysed to determine the effectiveness of the lessons.

Due to timetable issues and changes in groups, there were only 98 students that took the baseline test twice.

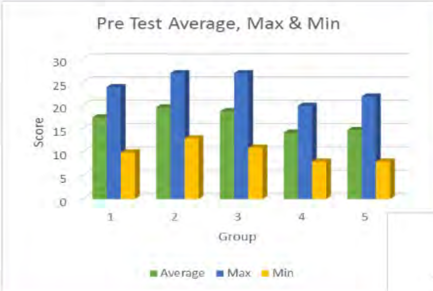
I also created a student survey on moodle which was given to the students after the intevention.

Data

There is a statistical significant difference between the pre and post test scores. The spread of results in both tests is small (SD<6) so results are clustered around the mean.

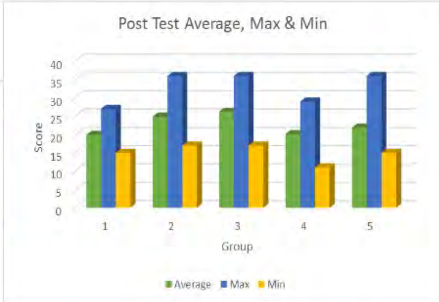
The post test results are improved by a mean difference of 5.51 marks and there is a 95% confidence that the samples match the means of the general population.

In total there were 5 groups of year 10 students with a total of 98. The comparisons of the two groups are shown by the T-test scores below.



Pre Test Mean = 17.11
Post Test Mean = 22.62

Pre Test Max = 27
Post Test Max = 36



T-test scores Group 1 = 0.0060 Group 2 = 0.0001 Group 3 = 0.00001 Group 4 = 0.00015 Group 5 = 0.00010

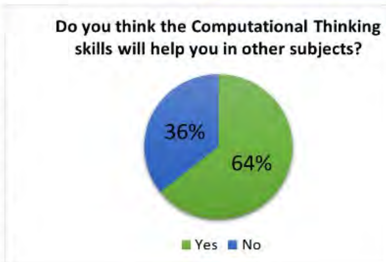
Results of the project

The students who took part in the project showed a positive attitude towards the subject and over 50% thought learning Computational Thinking Skills was important. They also believed that the skills learnt could be applied to other subjects and therefore further enhance their progress.

The pre-test results did highlight that the students knew some of the thinking skills already as the mean score was 17.11. However the results of the post-test showed that the lessons had enhanced the students skills further as the mean score was 22.62.

Some would say that as the students sat a similar test for both pre and post skills learning, they would be more relaxed for the post-test as they would have already been exposed to the question style and content.

Correct answers:
Pre Test = 44.1%
Post Test Result = 56.6%



To follow this project, I would like to implement the skills into the KS3 curriculum so that they are more aware of the transferable skills.

Impact of the project

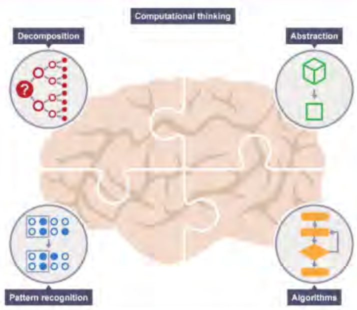
Teacher 1 Feedback:
It made me look into areas I knew nothing about and learn something new!

Do you think the CT skills help boost your confidence with Computer Science?

Teacher 2 Feedback:
Definitely! I enjoyed completing the various tasks with the students and learning the transferable skills

This was a successful project as the students showed progress in their Computational Thinking Skills following the lessons taught by the staff. Staff themselves enjoyed learning the new concepts and then teaching these new skills to the students.

Following this project, the aim is now to actually teach these skills from KS3 as I believe students would benefit greatly from learning the skills as early in their education as possible.



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Impact of Common Computing Curriculum Strategies on Pupil Recall and Application of Computational Thinking Concepts

Samantha Sadler

Outline of the project

Motivation

This project aimed to investigate how Computational Thinking could be taught within the Secondary Curriculum. Given that Computational Thinking concepts underpin students understanding and application of wider Computer Science topics, I feel that introduction and development of Computational Thinking is critical to students achievement within Computer Science.

For the purposes of this project I wanted to investigate how small and largely unobtrusive adjustments to lessons could help to develop Computational Thinking concepts, rather than impact on wider achievement.

Research questions

At the core of my research project were the following questions:

Do students have an understanding of Computational Thinking concepts without any explicit teaching?

Can students understanding and application of Computational Thinking concepts be developed with a small number of interventions?

Can a little and often approach to Computational Thinking have a measurable impact?

About me

I am a Secondary Computer Science NQT. I have recently attained curriculum responsibility for the development of Computer Science within my Academy, including the growth of GCSE and A-Level courses.

Currently I am developing the Computer Science curriculum at Key Stage 3 and teach a small group of Year 10 students at GCSE level. The quantity of Computer Science within our curriculum provision is set to grow in the coming year, which I also expect to see reflected in the uptake of Computer Science at GCSE and A-Level.

Carrying out the research project

Your intervention

The intervention was conducted with all Year 7 students and consisted of a series of 8 sets of Computational Thinking tasks. These were designed to be used as either starters or plenaries and a homework task. The original intention was that students would receive 8 consecutive weeks of interventions, however due to other demands within the Academy no group received 8 consecutive weeks.

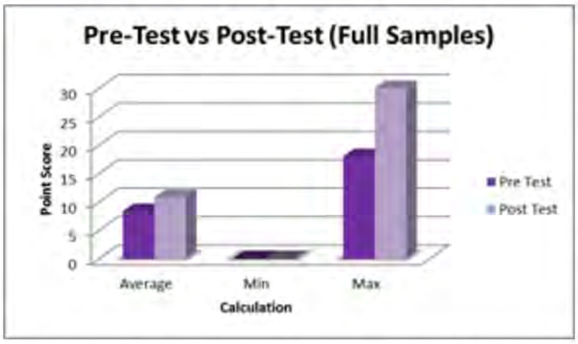
Each of the 7 class groups were provided with the interventions across a number of lessons. These activities were delivered by a variety of teachers from Computer Science to IT to non-specialist. Therefore the tasks themselves were designed to be as supportive and self-contained as possible in order to support the staff delivering the resources.

Data collection

Data has been collected in two stages for this project, pre and post testing. Students who agreed to participate in the project completed a questionnaire designed by myself and Craig Walton, measuring their ability to apply and identify the Computational Thinking concepts. The questionnaire was divided into two halves; part A was designed to test the application of concepts and part B identification and explanation of concepts.

Due to technical issues with the pre-test data collection the original sample of approximately 170 students was limited to 77 students. In order to overcome these difficulties in the post-testing phase the questionnaire format was re-formatted and the sample increased to 112 participants. However, the original sample of 70 students were tracked separately to measure impact more clearly.

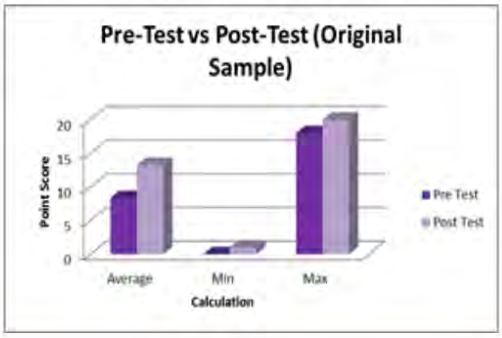
Data



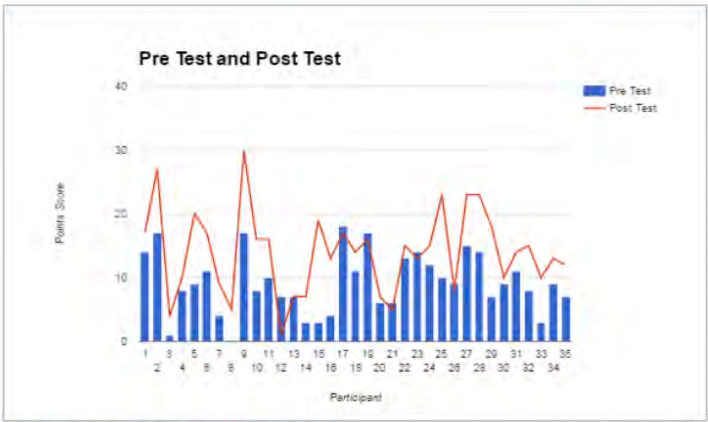
The data for this project was analysed using both the full samples obtained during the testing process (with the larger post-test sample) and a comparison of original sample participants.

As can be seen there was a slight rise in average points scored (+2.429) between the pre and post test of the original sample, and substantial increase in the maximum score achieved (+12) by an individual participant. In both instances the lowest score obtained remained 0 in both tests.

A comparison of the data obtained for the original sample of participants depicts slightly different results. In this instance there was a more substantial increase in the average score obtained by participants (+4.9). However the increase in maximum score obtained (+2) was much smaller than the difference isolated within the larger sample.



Results of the project



In order to establish whether or not the interventions introduced had an impact on students, those who participated in the pre-test were tracked in the post-test, and a t-test conducted. As can be seen in the graph provided the majority of students increased their score in the post-test, although 7 participants either remained the same or experienced a decline (1 remained the same, 5 participants post-tested at -1, with 1 participant testing -6).

The t.test revealed a score of 0.0000015, supporting the hypothesis that the interventions had a significant impact on the students understanding, application and explanation of the core Computational Thinking skills.

T.test score - 0.00000151

Through conducting this project I have found that Computational Thinking skills can be taught effectively through a little and often approach, as opposed to a scheme of work approach. Therefore these skills can be more easily integrated into existing curriculum plans.

Given the cross-curricular nature of many of the Computational Thinking skills, I feel it would be beneficial to further investigate whether the students increase in understanding of Computational Thinking is evident across the curriculum, or strictly within the boundaries of Computing lessons.

Impact of the project

In order to complete this project I was supported by a number of teaching staff within my school, both ICT teachers and non-specialists.

These activities have allowed me to teach students valuable skills, beyond those that typically form part of the Computing curriuculum. As a result I have noticed an improvement in the way studens are able to access curriculum materials and challenge tasks.

Teacher of Business Studies, 15 years in profession.

The tasks provided students with the opportunity to learn skills surrounding Computational Thinking that are not taught explicitly within the current curriculum. This has enabled students to apply these skils into the current computing curriculum areas studied, independently

Teacher of ICT, 10 years in profession

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Evaluation of "Computational Thinking" Enriched Curriculum

Keith Buncle BSc MBCS

Outline of the project

Motivation

Currently there is a huge cognitive disparity in my subject area between students who have a clearly supportive background in their home environment and have been self-learning coding since year 5/6. On the other hand students who are interested in learning about computer science but have no previous experience of programming yet have the same FFTD targets as the students in the previous group.

Research focus

Using exploratory learning based approach to teaching Computer Science to support learning in a situation where groups contain highly motivated and skilled individuals and motivated but less skilled individuals.

About me

Head of Computing and Computer Science, Health and Safety Officer at South Bromsgrove Academy Trust, CAS Master Teacher, CAS hub Leader and CEOP ambassador . Enthusiastic, self-motivated, adaptable learning facilitator. Passionate supporter of the new computing curriculum in schools.

The original plan was to use a freely available online test as a baseline and then intervene with the groups and analyse any changes utilising a second freely available online test from. The data from the pre and post tests would be reviewed to identify any patterns. Then selective interviews with participants would be used to guage various parameters such as motivation and backgrounds of the students involved.
However during the intervention process staff absence created a situation where intervention was not possible on the same scale with some groups of students. This provided an opportunity to modify the Question to one of gauging the effectiveness of a modified curriculum on the performance of different groups in pre and post tests rather than on selective individuals. Essentially allowing us to gauge how well the revised curriculum was preparing students for a computational thinking based set of tests

Carrying out the research project

Your intervention

In summary, the intervention was a change to delivery of content and means of assessing year 9 students. The intervention including use of puzzle based learning.
The curriculum had been revised to introduce strong computational thinking elements into the schedule to prepare students more effectively for progression to Computer Science and also to expand their knowledge and understanding of computational thinking as a transferable skill that could be engaged to solve complex problems.
A subsidiary target will be assessing the effectiveness of the online baseline testing in setting levels.
As the term unfolded it was clear that long terms staff absence and lack of specialist supply would mean that some groups would be following a less modified curriculum. This provided an opportunity to use these groups as a control by which we could evaluate the effectiveness of the revisions in preparing students for the new curriculum.

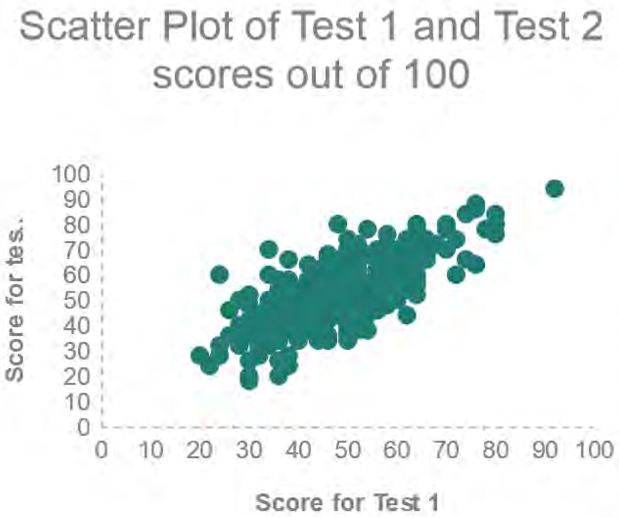
Data collection

Utilising "theingots" online baseline tests as a means to set baseline measure of understanding to be followed up with two further baseline assessments over three terms.
Baseline set across the year group but intervention targeted at four year 9 groups. Baseline test results were standardised against Maths results. The initial baseline facilitated the identification of target group of students. follow up tests identify level of change following interventions.

Data

The initial data was compared with in house Maths level data in an attempt to standardise. Maths data was used due to the relatively high confidence levels in the accuracy of levels and the time period over which such data has been collected.

From this a comparison with levels from the baseline testing was made and enabled us to set a baseline in house for computing. Follow up assessments will be compared with the initial baseline test and again compared with maths data. The comparison is based on max, min, SD and "t" tests using a spreadsheet.



The chart illustrating the data displays the results from 285 out of a cohort or 333 students. Note the data was filtered to remove students who did not take both tests within the set time period.

Students could be compared based on gender, pup premium/none pup premium and by group (which determined whether they were exposed to the enriched course or the non-enriched course).

Each set of data were analysed using "t" tests to determine whether there were any significant differences between the resulting data. Comparison of the enriched and non enriched groups resulted in a "t-stat of 5.65 against a t-crit of 1.65 for one tail and 1.98 for two tail

The next step would be to engage, through questionnaire, different student groupings to provide further data to develop an understanding of students learning.

Results of the project

In summary the resulting t-test values indicate that although there was a significant difference between the students who received the enriched curriculum and those that did not. In itself this is not surprising, however what it may indicate is that the use of this online test provides a useful gauge of student perfomrance at critical times in the year

I have already looked into any gender differences and differences between individual teachers within the enriched curriculum and found no significance. I aim to explore some preliminary work on pupil premium and non-pupil premium students.

This project has provided a tool to gauge the significance of variations in the performance of students using an external test. This gives me a means for showing progress within the school year or between school years and review the impact/significance of any in school variance

Impact of the project

Firm benchmarking to facilitate effective transition from feeder schools

The use of this data source provides a key means of assessing student progression and over time will help to understand the effectiveness of in school interevention

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Dyslexia and programming

Louise Branch

Outline of the Project

Motivation

Teaching GCSE Computer Science to a group of Year 10 students, I became aware of 2 students, both diagnosed with dyslexia, who had very different approaches to the spelling mistakes they made in programming.
IM was highly motivated,confident, severly dyslexic, who did not mind being corrected for spelling mistakes, as he understood that if it was spelt wrong, it was a different word to the word he intended to use. BG got frustrated when corrected for spelling, it was another indication that he could not spell. I wanted to understand why they had different approaches.
A case study methodology was used.

Research Questions

1) Is Dyslexia a barrier to programming?

2) Do other factors have a bigger or smaller influence on students' ability to learn programming?

3) Can teachers and educators help dyslexics with the way that they teach programming?

About Me

After university I initially worked in the car industry as a computer programmer and systems anaylst, using a Dec based language RTL2.
I retrained as teacher and got an MEd in IT. I taught for 20 years before resigning to explore new opportunities in July 2015.
I have always been interested in research based education and I was surprised that some educational initatives did not appear to have strong research to support it

Carrying out the research project

The 7 Stages of my research

1) Observation of IM and BG: I recorded progress and discussions with them both in my academic diary

2) Collection of data: I looked at their dyslexia diagnosis and additional information in the schools information system.

3) Monitoring progress: I monitored progress in programing over a half term with a GCSE preparation project. Their work was regularly taken in and feedback given.

4) Literature Research: I considered a wide range of sources. The internet and acadmic books and journals were used, as well as news article.

5) Consulting experts: I approached other people/ organisations to see if this theory was experienced by others and look at how they dealt with it. I went to a technical industry in France, contacted high profile successful computer programmers, contacted 3 schools and university students.

6) Interviews: I conducted interviews with LT (former student studying a degree in Computer Science, SP and EP two Airbus employees and IM.

7) Intervention: To implement and test strategies for teachers of dyslexics to use. I approached 3 schools who said they would allow me to survey their GCSE Computer Science students

Data

1) Observation: of IM and BG revealed a higher level of achievement for IM, and more tenacity and more willingness to accept advice and suggestions than BG who seemed to lack self confidence and would just give up easily.
2) Looking at their dyslexia diagnosis and additional information in the schools information system showed that there was more comprehensive evidence of IM and his progress in school than there was of BG.
The evidence showed that IM was considered to be a high ability dsylexic wheras BG was not.
3) Monitoring progress in programing over a half term with a GCSE preparation project. Their work was regularly taken in and feedback given. IM performed significantly better and used more difficult functions, iteration and complex loops BG who tried to find solutions directly off the internet or other people, saying it was too hard. IM was able to maintain good progress because he had learnt to keep a progress diary and wrote notes to himself. BG did not do this.
4) Literature Research from a wide range of sources. I found academic research on dyslexia and programming, in particular, Powell. Other information on what attributes dyslexics may have that suit them becoming programmers and working in the computer industry came from the British Dyslexia Association. Other ideas examined inclued the idea that it was people who were willing to take risks were likely to achieve, such as work by D H Hargreaves.
5) I approached other people/ organisations to see if this theory was experienced by others and look at how they dealt with it. I went to a technical industry in France, which was really interesting as they said they had a workforce with a lot of dyslexics in it, and the school closeby contacted high profile successful computer programmers, contacted 3 schools and university students.
6) Interviews with LT (former student studying a degree in Computer Science, SP and EP two Airbus employees and IM were conducted.
7) This turned out not to be possible

Results of the Project

Skills identified by Norman Powell as being characteristics of successful programmers and students who are dyslexic:

- spatial awareness
- visualisation
- creativity
- lateral thinking

Skills identified by CAS for computational thinking, which apply to dyslexics:

- logic
- decomposition
- abstraction
- creating

Dyslexic students can make good progress in programming, because they have skills such as logic, ability to break down tasks and abstraction.

This study needs to be verified with more data, as the data is high quality but small in number, so may not be representative.

I learnt that the organisational skills dyslexics have, make them good programmers. I never expected dyslexics to keep notes, but they did in this study and used them to keep track of what they were doing and jog their memory

Impact of the project

Next steps would be to see if "note taking" aids dyslexics. Note taking, is a generic term, as some of the people I spoke to o had a load of symbols and signs they used, to show importance of information

"Keeping notes, when I finished a lesson, helped me know where to start next lesson."

"If the teacher told everyone to make a note of where they were at the end of the lesson. I would not be singled out and it would not harm anyone else to do this".

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Developing Problem Solving Approaches in KS2

Lynda Anne Chinaka

Outline of the project

Motivation

Provoked by my initial experiences of teaching computing using a variety of programming environments. I am struck by the fact that random clicking seems to be the number one approach or route to success when it comes to programming (coding).

I teach very enthusiastic learners in KS1, KS2 and KS3. One key element of my role is to steer and support the entire school community as we transition from the teaching of ICT to delivering high quality and relevant Computing syllabus.

I am keen to explore how children respond to programming environments online.

Research questions

How do unplugged pattern activities support pupils' development of programming competencies?

What difference does the experience of completing tasks away from the computer have on children when they actually begin to work in programming environments?

About me

I work as the Head of ICT at ,Notting Hill Preparatory school, a thriving West London prep school.

The school values the importance of technology and its use of ICT for many aspects of learning.

My extensive teaching experience centres on the development of ICT and subsequently Computing in primary schools and with a local and authority.

Carrying out the research project

Your intervention

The sample selection involved activities that were carried out in two parallel KS2 classes. This was to ensure good quality data. One of the classes was to be the control group because the pupils in this sample had little or no experience of computational activities without the use of a computer.

A series of identical lessons were taught in two year 5 classes over four weeks. The initial lesson was unplugged; there was no use of technology. The following three lessons were carried out using the visual programming environment called Scratch The offline Scratch 2.0 editor.

The activities conducted in this way would afford me the opportunity to make comparisons between the two classes.

Data collection

Data collection was based on questionnaires completed by teachers and another participant observer.

Observers logged particular levels of engagement after certain intervals during each lesson. The duration of the lesson was approximately one hour.

Samples of work from the pupils include: paper based activities and scratch files saved at the end of each lesson.

The questionnaires were completed by extra adults in the room. The data was later anonymised; the pupil names were removed and replaced with numerals. The data was gathered within the same period as the lessons.

Data

Initial Interventions

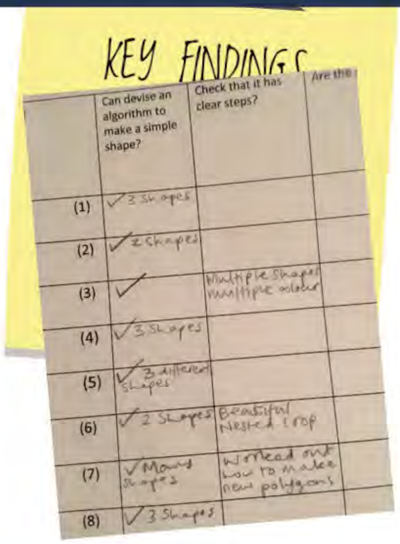
The initial task saw the children draw an algorithm of a strange character. They were required create it for someone else to follow (adapted from Barefoot Computing) . The children had great but some became a little perturbed when they saw that their partner's having difficulty following their carefully worded algorithms.
The activity drew a variety of responses from the children. Many refined their steps in a later activity acknowledging the importance of greater precision and the use of directional language for increasing the efficiency in an algorithm.

Further Interventions

Three further pattern activities took place using 'a drag and clip commands together' programming environment.
The children explored the idea of creating simple polygons in Scratch and later built scripts that involved the use of the loop command.

They investigated the use of a number of different shapes and found ways to calculate the number of sides along with size of turn or angle to make a desired shape. They introduced extra commands too.

Results of project



KEY FINDINGS

	Can devise an algorithm to make a simple shape?	Check that it has clear steps?	Are the
(1)	✓ 3 shapes		
(2)	✓ 2 shapes		
(3)	✓	Multiple shapes multiple colour	
(4)	✓ 3 shapes		
(5)	✓ 3 different shapes		
(6)	✓ 2 shapes	Beautiful Nested Loop	
(7)	✓ Many shapes	Worked out how to make new polygons	
(8)	✓ 3 shapes		

The data reveals that children can be trained to work in a systematic way.

It was interesting to see how well children listened to each other; there was a genuine exchange of ideas.

It was surprising to note that the outcomes were broadly similar across both classes.

Pupils maintained a sustained level of interest in the pattern activities over the duration of the project.
Further insights gained because the children started with quite a low skill set in Scratch having very little experience of it. Teachers and other participant observer agreed that some of the outcomes were unexpected.

Interactions allow pupils to make quicker progress as they explore new problem solving constructs.

Impact of the project

I did it! I did it! I worked it out. Okay , we worked it out....
We worked out how to make the polygon repeat itself and make a pattern. We were the first ones to do it.

Child

Learners expand their creativity as they share and articulate their ideas
They work in an open and collaborative way.

Process of learning overtakes the pursuit of the outcome

Further exploration in other subjects.

You sharpen your own practice.

Teacher

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Using AFL at KS3 to prepare students for GCSE coursework

Remi Gauvain

Outline of the project

Research question

Does making students aware of Bloom's taxonomy improves their ability to answer technical questions?

About Me

I teach Computer Science from KS3 to KS5. I have industrial experience in the electronics and software industry.
At the time of writing, I teach at Chase Terrace Technology College near Lichfield. In September, I will start at a new school much closer to home: the West Bridgford School near Nottingham.

Motivation

This method stems from two observations:

1/ If student's learning is accelerated by good Assessment For Learning practice, we need to use simple and meaningful assessment criteria that students fully understand.

2/ Now that anyone can download good code from the internet and pretend that it is their own, students are increasingly assessed on the quality of their written explanations. Many students find writing a piece of coursework challenging. Waiting until they start their GCSE to teach them how to write and how to structure a coursework project is too late for many students who choose Computer Science.

Impact of the project on the students

Increased engagement from KS3 students in the AFL process, evidenced from the following observations:

- Increased participation in Q&A about model answers,
- Willingness to grade each other's work and to advise their peers on writing higher level answers,
- Progression in writing skills throughout the different topics over the course of the academic year.

Carrying out the research project

Intervention

My initial idea was to teach my year 10 CS students better writing skills. These lessons did not work: some students, expecting to code every lesson, did not connect the literacy lesson with getting better grades at GCSE.
Meanwhile, these ideas were having a higher impact on my KS3 classes. I therefore concentrated my intervention on KS3.

The first step was to design a grade ladder. It is based on Bloom's revised taxonomy. The action verbs associated with the levels are chosen to promote the skills that every CS students should automatically do in their coursework:

Used in most lessons when setting tasks or when commenting model answers.

Level 4 = prove you've done the task with a print screen
Level 5 = print screen + explanations
Level 6 ie C grade @ GCSE = Level 5 + justify or evaluate
Level 7 = Level 6 + link - to other elements of your coursework (planning, testing etc.) or to comparable items in "real life"

The next part of the project was to create tests. The technical content of the test becomes the subject of the written explanation, in a similar manner to how coursework is assessed. During each test, developing good writing practice is reinforced.

The final element is to give feedback that helps to move students to the next level, by explaining how their grade was awarded and how they can move to the next level. Students are encouraged to read peer's assessments one level above theirs to see what a higher level answer looks like.

Because the grade ladder is not topic specific, it has been used throughout the year. Students were encouraged to improve their written answers as we moved from one topic to the next as the grade descriptors remained the same.

Data Collection

This project was started in 2014-15. The methodology was developed and delivered results, which were not documented at the time. The 2015-16 academic year was started with a view to refine and document the methodology as a CAS TICE action research project.

However, new departmental guidelines following managerial changes have impacted the project: all year 7 & 8 tests are now self marking questionnaires. Year 9 are no longer doing short projects. Consequently, the bulk of the data will come from the 2014-15 academic year. The research methodology, which had been arranged in the first CAS TICE meeting last autumn, may have to be revised. In anticipation, I have started to research literature that could explain what I found last year.

Result of the project - Observations

Students are able to assess each other's work, and to grade model answers given during Q&A

Higher level students - most of whom will not continue CS at GCSE - help to embed those skills in the class by helping and modelling for their peers

Facilitates transferring writing skills from other subjects to CS coursework

Linking is a harder skill for KS3 students than justifying their choice

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Upton High School

Has teaching Computer Science at KS3 improved the computational thinking skills of the students?

Amy Welsh

Outline of the project

Motivation

This is being done as an extension to my BCS Project 3 that looked briefly at the Baseline Test scores of the KS3 students. I am interested to see whether the students computational thinking skills improve over the course of the year through the teaching that they receive from the department. This will lead to the department evaluating the schemes of work and modifying for the next academic year.

Research questions

Has teaching Computer Science at KS3 improved the computational thinking skills of the students?

The project will consist of an analysis of the Baseline Test results. All year groups sat tests at the beginning and end of their curriculum years.

Test Data for Year 8 and 9 consists of 4 tests results and Year 7 have 2 test results. I will be looking at students that have sat all tests available to them in one year.

About me

I have been a qualified teacher since 2003 (but I have taught swimming since I was 16, so teaching was a natural progression), I have worked on the Isle of Man and I am now back at the school that I attended.

In September 2016 I was appointed Head of Department, which was a big change, and I am still learning now.

Carrying out the research project

Your intervention

Baseline Tests implemented in September 2014 through the TLM/Ingots system.

All students in KS3 sat the tests during a lesson. Tests were controlled by teachers and set up by A. Welsh.

Data collection

Research for this project started in September 2014 when the department first set up the use of Baseline Tests to track the students developing skills. Students are tested at the beginning and end of the year to give the department a starting level that is then assessed throughout the year by Teacher Assessment, and then examined again at the end of the year. Data collected is used in the student's reports, to help with options and streaming of classes.

Data

Sample data from one class on Baseline Tests September 2014 to June 2016

	Test 1		Test 2		Test 3		Test 4	
Id	%	Level	%	Level	%	Level	%	Level
162621	44	Emerging	62	Securing	56	Developing	62	Securing
162622	38	Emerging	48	Developing	34	Emerging	50	Developing
162623	58	Developing	66	Securing	64	Securing	70	Securing
162624	44	Emerging	48	Developing	68	Securing	70	Securing
162625	40	Emerging	42	Emerging	34	Emerging	50	Developing
162626	46	Developing	58	Developing	66	Securing	58	Developing
162627	28	Foundation	54	Developing	50	Developing	50	Developing

Results of the project

Results: Final test greater or equal to first

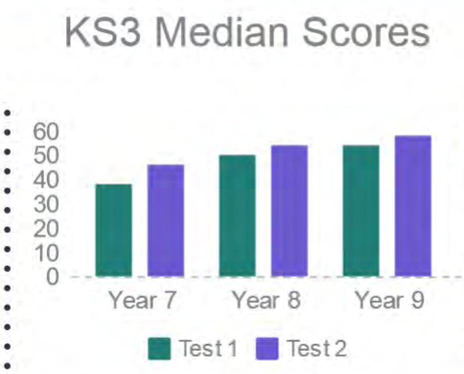
Year 7 70%
Year 8 75%
Year 9 63%

Average Scores over Tests:

Year 7 Median
Test 1 - 38
Test 2 - 46

Year 8 Median
Test 1 - 50
Test 2 - 54

Year 9 Median
Test 1 - 54
Test 2 - 58



- It is pleasing to see that the students have made progress through the year, with most student improving or maintaining their Baseline Scores.
- Looking at the first set of scores for Year 8 and 9, it is pleasing to see that the students have improved significantly since the previous year.

It was pleasing that all year groups either continued to achieve the same results or higher on their baseline tests.

- It would be interesting to compare the students first test to their final test to see the jump, and whether the new delivery of the curriculum had an impact on how the students retained the skills.
- The results suggest that Computer Science teaching is having an impact upon the students in a positive way. Students have voiced their opinion on the Baseline Tests and expressed that they like having a score to work from that equates to a level of understanding within the subject.
- Staff have commented on having a working level that shows the students' understanding, and enables them to give students individual plans to enable them to achieve more within the subject.

Impact of the project

The results are great to help plan the lessons to the right level. Teacher of Computer Science

The new schemes of work are really interesting and challenge the students. Teacher of Computer Science

We like the baseline tests as it tells us how we have improved. KS3 Student

The programming units have been really good this year, I have really liked Computer Science. KS3 Student

Can computational thinking improve achievement in reading?

Lise Bosher

Outline of the project

Motivation

Reading about computational thinking in materials provided for teachers new to computing as a discipline made me think that the new requirements of Computing, might allow scope for teaching thinking skills that could be part of children's 'toolkit' for work in other curriculum areas.

Children who do well at classroom subjects often have developed logic, the ability to break things down, and to see the bigger picture. Could CT provide an opportunity for other children to also develop these skills ?

Research questions

At the start of the project I taught reading comprehension to two Year 5 classes and computing to one of those classes.

Would it make a difference if I focused on logic, abstraction, decomposition, debugging, and perseverance with the class I taught computing and referred to these skills when teaching reading comprehension ?

Would it make a difference to how the children felt about reading comprehension if they were offered strategies credited to computing skills - so they were effectively discussing these skills in at least two areas of the curriculum?

About me

I've taught primary and EY classes for 20+ years.

My teaching role changed to part-time in Sept 2014 . I now 'borrow' other people's classes as I do cover teaching, or MFL teaching.

I am new to computing education. Although I have seen the hardware develop from mainframes to smartphones during my working-life, and have wrestled with punched cards, cds, logo and apps, my understanding has been mainly of the 'digital literacy/ art' variety. I'm self-taught for comp ed using the internet and learning with the children.

Carrying out the research project

Data collection

At the start and the end of the time available the children did two reading assessments :

1. an unaided reading comprehension from the textbook used by the school, marked by myself. This was followed by a self-review sheet to monitor children's perceptions.
2. an unaided reading test that provides age standardised scores as well as a reading age - PIRA, marked by the classteacher.

The intervention

I taught reading comprehension to two Year 5 classes for an hour a week. One class I also taught computing for an hour a week on the same day. The intervention ran over 2 terms, T2 and T3. In T3W3 the control class were taken back by their classteacher as the school timetable needs changed.

What I did:
In the computer lessons I drew out the concepts of algorithms - Pharrell Williams song adaption (which they loved), discussion, practise in class orally, looking at bits of code in 2code (the coding allocated for Y5 to use that term, Purplemash).

In reading lessons we drew up an algorithm for reading from children's suggestions and copies were on tables while working and it was referred to when offering support or discussing answers together.

In computer lessons we looked at debugging to improve our code, and talked about perseverance and having a go. In reading we double-checked our answers, finding the words in the text to support them, and persevering to use all the time available.

Maths too provided opportunities for using words and concepts like logic (does it make sense), debugging (checking and improving working out), perseverance, algorithm (method). Checking reading comprehension answers involved logic- does it make sense.

When looking at an example of an animation done in 2code, we decomposed it into its parts. We drew storyboards for the animations we were trying to create, then identified what we needed to know to realise each step in code (e.g. how to hide, wait..).

In reading we talked about texts in terms of decomposition- what is this bit about, and abstraction- what is the job of this bit (features, paragraphs, sections). Separating decomposition and abstraction was tricky to do and for the class to understand, so I favoured the term decomposition and we decomposed text features and content.

Data

Standardised Reading Test

The statistical analysis wasn't as straightforward as I'd imagined. There was not a significant difference in the change in reading score between the two classes. The difference in change in reading score was small compared to the variation in the data. This may be because the intervention technique was not effective/had very small effect -- or that the variation in change in reading score was too large to be likely to pick out an effect. A limitation of the test was the normalisation process (it turned out the test has a built-in expectation of progress with age, so the second test is always harder). However, just comparing the averages of the class scores: the intervention class scored higher in both tests and increased its difference in average score from 3.5 to 6.36 so gained 2.86 points compared to the control group class.

Textbook comprehension exercise

The second reading exercise showed the control class made the greater progress. (This was statistically significant). The control class also scored a higher average score (4.42 increased to 7.3 control class average score, compared to intervention class average score 5.4 increased to 6.7).

Self review sheet

The intervention class had 20 reviews completed at start and finish. At the end 2 children referred to using (from memory)the class algorithm 'I used the algorithm we did in class'. 11 children felt happier , 5 children felt worse, 4 children felt the same.

The control class had 24 completed reviews. At the end none referred to computational thinking. 8 children felt happier, 6 felt worse, 10 felt the same.

Results of the project

The statistical analysis makes my brain hurt in the same way that chess does. I am not sure what the results show because there are so many possible reasons, and further ways to analyse what is a small data sample.

I have a renewed respect for researchers.

You need to know how you are going to analyse your data so that you are collecting useful data. I got help with finding suitable statistical tests to check whether my results were robust.

However, I simply do not understand statistics well enough to be able to interpret the data collected. Another time if I was using tests I would use exactly the same test for a more straightforward comparison. However, that's not useful for measuring reading since children might just remember what they did before.

Impact of the project

Irritatingly I can't define what impact this project had on the children's thinking skills. I can draw lessons for myself as an educator and for future action research.
I need to know more about teaching Computational Thinking. I also think the children need longer and more practical experiences with CT before they can be expected to take ownership and transfer to abstract work such as reading.

As yet my results are inconclusive.
I still think this has potential but suspect it is a longer term project and will require more knowledge on my part to be able to plan precisely enough for the children to learn well, and for me to 'capture' their progress.

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Exploring how creating flowcharts supports Computational Thinking at Key Stage 3

John Feleppa

Outline of the project

Motivation

I undertook this project in order to understand how to facilitate the development of computational thinking in KS3 classrooms. My hunch was that mastering flowcharts would enable students to break down problems, hide away confusing details, and consider step-by-step solutions for them.

Accordingly, I wanted to explore my students' perspectives on working with flowcharts. For example, to understand how this practice enabled them to approach problem-solving more effectively, as well as to hear about their hurdles to mastering them.

To achieve this, I taught my students how to draw flowcharts, and then whenever teaching programming, I embedded a step where the class had to also produce a flowchart of their program.

Research question

EXPLORING HOW CREATING FLOWCHARTS SUPPORTS DEVELOPING COMPUTATIONAL THINKING AT KS3.'

I approached this research after teaching my Year 9 students about flowcharts and periodically having them use flowcharts to describe algorithms and programs.

About me

I am a teacher of Computing at Harrow High School, a comprehensive secondary school in London. During my seven years at the school, I have taught ICT & Computing at Key Stage 3-5, and am transitioning towards teaching Computer Science next year.

The school is a friendly community of various faiths and races, and our visitors often comment on how quickly they are made to feel at home. My teaching colleagues concur, although also describe their efforts to teach their subjects in majority EAL classrooms.

In this environment, Computing has become a popular subject. This is an opportunity to consider how to use my classroom time to improve the thinking skills of my students.

Carrying out the research project

My intervention

I carried out this research using an academically diverse sample of my own Year 9 Computing students.

In Term 1, I taught them about flowcharts and their contribution to designing and understanding algorithms. In future lessons in Terms 1-2, the students learned how to program using Scratch and Python. During these lessons, I included tasks where they had to use flowcharts to design their algorithms and represent their programs.

Later, I would explore their perspectives on using flowcharts, and on the contribution of this to developing computational thinking.

Data collection

I gave my class a questionnaire containing 14 questions exploring their experiences with flowcharts. They filled this in during one lesson.

The questions probed for responses which might shed light on their perspectives on how flowcharts :
- contribute to problem-solving;
- enable problems to be decomposed;
- reveal patterns in problems;
- abstract problems;
- support programming;
- present difficulties for students.

I felt that filling in the questionnaire should become a worthwhile learning experience for the students, who should better understand the language of CT by participating in this research. Accordingly, I was present during data collection to explain questions and support their efforts to express their thoughts clearly in writing.

Findings

The students described numerous ways that making flowcharts enabled them to EXPLORE the problems they were working on. Their responses might be seen as an emerging acknowledgement that flowcharts enable them to see problems in a helpful, structured way.

According to some, flowcharts CHUNKED problems into steps, which was a helpful way of looking at them. References to steps, processes, workings, repeated parts, laid out instructions, links, paths, shapes and symbols were commonly in these writings as features of flowcharts that enabled them to see problems for what they were. They would typically explain how any one of the above helped them to read programs quicker, identify issues quicker, understand what was happening, and so on.

Some higher ability students described how once they were able to see the big picture on a flowchart, it became something to base their thinking on, and almost meditate on. They described how flowcharts were MODELS of problems that enabled them to notice more than one solution.

Students who had mastered elementary flowcharts acknowledged how making flowcharts were a way to TAKE CONTROL of a problem. In fact, their explanations were signs of a developing line of computational thought.

One strand of discussion addressed how seeing the problem or program mapped out as an image enabled them to NOTICE its salient features. These were described as the steps, decisions, and details, all of which were divided up, or reduced, and therefore easier to consider and handle.

These students explained how they took control. One felt that the flowchart was like string, and seeing it on paper enabled you to untie its knots, as it showed what caused the problems. Once you ran through it, you could 'UNPUZZLE' it. Another added that the solution could be mapped out on a flowchart, and saw the flowchart as the place to map out your plans. This solution could then be coded from that.

The discussion on how flowcharts contributed to algorithmic thinking extended to both debugging and REFINING programs. Students described how this way helped them to catch and resolve errors when they were confused, as well as helping them restructure their programs when they were not satisfied with them.

After having learned programming and algorithms for a term, the class volunteered their differing approaches to solving problems. These may reveal how they are (or are not) starting to consider approaching programming more computationally:

- first consider the problem and then write a flowchart
- grapple with the idea
- trial and error
- map out your ideas on a flowchart
- consider the input, output, and data
- do it in steps

In fact, responses were often quite descriptive, or 'text bookish' answers to prompts about problem-solving. Furthermore, there was a great deal of empty responses on the questionnaire, and much to indicate that problem-solving itself was more of a challenge than it looked.

It may be fair to say that embedding flowcharts notwithstanding, there was much to do in facilitating the development of computational thinking in KS3.

The students described a range of difficulties working with flowcharts, which may highlight some issues developing thinking skills in the Computing classroom.

Some claimed that flowcharts were an unnecessary step obstructing the real task of programming saying they were "time-consuming" and "wasteful"

Others conceded the general difficulty working with this model, saying it was "Confusing", "Easy to mess up, one little mistake destroys everything" and "still overly detailed".

Some pinpointed specific difficulties with flowcharts, for example saying that "loops and decisions were hard to manage", "the syntax is confusing", "the decisions are confusing".

One voiced an issue with the Computing environment, where flowcharts posed the same difficulty as programs: "Mistakes get punished". Another student pointed to what she felt was a lack of intellectual development in some of her classmates, manifest in the flowcharts they produced: "They don't understand, they don't ask, they just write gibberish"

Results of the project

This project demonstrated that embedding flowcharts into the teaching of Computing did not bring about a transformation in how these students went about thinking about problems and programs. It revealed that a majority found problem-solving difficult, and tackling programs and flowcharts served to reveal this.

While the study revealed some ways that flowcharts supported computational thinking, it also flagged several difficulties my students were finding with them. I felt the need to engender a more robust 'beginners' spirit' among individuals who felt their shortcomings were exposed by code and flowcharts.

Any follow-up study might explore how to scaffold their engagement with flowcharts, so larger numbers of students can begin to notice how flowcharts can help them think about programming.

Nevertheless, it also found that flowcharts do contribute to a more computational approach to thinking about problems and programs:

ABSTRACTION
By visualizing a program as a flowchart, students might more readily explore it. This is because the flowchart shows a 'big picture' view without the overwhelming mesh of variables, decisions, loops, etc in program code. In fact, flowcharts can replace the tangled net of a program with a mental model of 'string to be untangled'. From here, the knots might better be untangled.

DECOMPOSITION
By reducing a program's complexity into a flowchart, students found that they were able to break problems down. The flowchart helped many students see the components of problems for what they were: steps, decisions, loops, data, instructions, etc.

ALGORITHMIC THINKING
By voicing problems and programs as puzzles, a few saw the flowchart as a method of 'unpuzzling'. When there was a logic error in a program, the flowchart revealed it. Similarly, when code needed to be rewritten, the flowchart mapped that out. Ultimately, it was seen by a few as a pre-coding stage, where you made a plan and then coded it.

This project underlined how some students were starting to think computationally while others required support to master flowcharts. This is a pedagogical matter to consider for the future, and future teaching of flowcharts might point out some functions of flowcharts. This might include how they abstract details away, reduce the problem into smaller chunks, and facilitate unpuzzling.

Impact of the project

It helps you see how you can solve the problem by yourself - you can see exactly what caused the problem. If you think of several ways of how to solve it, you can get different ideas and then find the best way to unpuzzle it...

Year 9 student