How do I contribute to enhancing the educational value of the new computing curriculum in the learning of teachers and children?

A PhD proposal to the University of Cumbria from John Reeves, July 2015

1) General overview

Computing is important educationally, economically and for employment. The new computing curriculum (DFE 2013) is intended to give every child the repeated opportunity to practice creative programming. The problem was that although it carried the great hope for the repeated opportunity for creative computing for all children the details read like a mini degree course. The recommended materials did not inspire or encourage creativity and teachers required the expertise of a competent computer specialist to deliver the material.

My research is based on my aims of contributing to the production of educational environments for children that is: developmental and age appropriate (Piaget 2001); creative and problems-solving; making use of computing environments that represent the real-world objects (Pappert 1994) situated within a real-world adult context (Montessori 2009) across a wide range of methods, including discovery and philosophical enquiry (Holt 1990,1991).

There is a gender bias to be faced in the research. Very few programmers are female and women that do qualify to enter the profession typically leave. The social exclusion of girls from computing subjects, starting at junior school and continuing into secondary school, is an exclusion from a range of careers.

2) Research questions

i) How do I contribute to the use of traditional educational tools of creativity, meaning making and supporting structures with computing to increase participation and engagement amongst under-represented groups, developing their long term interests in computational subjects?

ii) How do I contribute to increasing participation in computing by under-represented groups, influencing an increased awareness of minority groups by the majority in computing and a reduction in perceived hostility caused by the norms and values of the majority, as a beneficial outcome that has been observed in other social groups?

iii) How do I contribute to the use of creative computing to provide an educational benefit, showing that an increased participation by under-represented groups in computing as a creative discipline leads to an increase in attainment in other subjects?

3) Research contexts

For several years, I have been using my understanding of creative software development to guide the computing club at Beechen Cliff School in Bath, and over the past 18 months I have been collaborating with the software developer, Danielle Vass, who runs the computing club at Hayesfield Girls' School in Bath. When I use 'we' I am referring to Danielle Vass and myself. Working together we have been guided by students, teachers and educational researchers to improve our teaching practice and gain an understanding of our educational influence in ourselves, the people around us, and the institutions we are part of.

Typically, we have found the ICT facilities unusable for teaching. Each school's problems are different: usable software unavailable, children's prior knowledge and behaviours being inappropriate for systematic software development and self-determination, hardware being older than the children being taught. The software used in the classroom, and recommended by exam boards and publishers, being non-educational and counterproductive to developing good habits for study and development. As the computer systems were unavailable for presenting teaching materials, stepping children through the worksheets and collecting feedback for improvement, we are developing and researching our own. www.project-tigr.co.uk

We have been in contact with special needs groups and researchers such as young carers associated with the Carers' Centre in Bath and young offenders, who we believe would benefit from the educational, social and economic benefits of computing, but due to technical or logistical reasons we have not as yet been able to participate in these areas. However, throughout the proposed Ph.D. programme we will engage individuals from many groups as we are researching our educational influences in their learning. For example, I am researching my practice with researchers at Bath Spa University who specialise in social meaning making with young offenders using games design, and in girls' engagement with schools,

4) Theoretical Perspectives

a) Meaning making

Meaning making for me is physical sciences and if I want to understand something I find the applications and the computation models for it. I have found this doesn't work for everyone. At the boys school I had suggested engineering applications and games design (Sweigart 2010); at the girls school, art (Sedgewick & Sedgewick 1995); later at the junior school I suggested story making (Egrii 2001, Miller 2008). However, throughout this I am mindful that school-life plays a big part in a child's mind, so cross curriculum activities are 'games' and are 'meaningful' to a child.

b) Creativity

Creativity is one of the threads in teaching and learning, computing and engineering. For example engineers learn hard technological concepts by playing and talking about imaginary characters, rather than by reading manuals (over 12,000 pages for the microcontroller used in our new product introduction). Teaching can be about rote learning for basic skills and also inspiring people to further study. Demonstrating the creativity in computing is about making things relevant to teachers and students, and connecting it to what they already know.

Escobedo and Bhargava's (1991) research demonstrated that young children showed greater interest in the use of a graphics programme when their commands were required. The children wished to explore and create their own graphic symbols, irrespective of sex and age, when the graphics were developmentally appropriate ones. In the same way, Haugland (1992) found that children feel happier and more creative with a computer when it has developmentally appropriate CAI programmes, compared to CAI programmes, which do not allow control by the children themselves. The latter were found to diminish the children's creativity by 50% and made them passive users of software.

Much educational provision works against this creativity: less than 2% of junior school teachers are qualified in higher mathematics and Wired magazine reported that 75% of teachers claim to be unqualified to teach the current computing syllabus, supported by the fact only 7 of the newly qualified teacher trained by Bath Spa University in 2014 were computing specialists, a record high. The lesson planning methods for maths and computing are instructional, the course materials and equipment are out of date, 'educational' computing is subject to aggressive corporate marketing, and the assessment materials and the view of the qualifications agency are that creativity is impossible to grade.

In pure computing, STEM subjects and humanities current and future problems need creativity to help solve them. This is recognised in the government guidance for the computing curriculum, which identifies the importance of giving pupils the repeated opportunity for creative programming.

5) Producing and evaluating our use of learning resources for creative computing

The materials we are researching in the process of development are based on topics across the curriculum. Making things based on these is intended to provide interest, incentives and motivation for learners and teachers. We have evidence of children seeing the first practical application of sequences and coordinates in mathematics, interactions of characters in their story making, and researching the solar system to make authentic and attractive simulations. The students are excited by the use of colours and interaction, and by being able to demonstrate their work to friends and family outside the classroom. As we ourselves are.

Engineering is not a scientific discipline; it uses the tools of science to design products for economic or technological benefit. Typically we design a process to generate a product that meets its specification to the desired level of tolerance, when the process fails we analyse each individual anomaly to remove systematic failures from the design. Whereas the scientific method might try to induce a general rule that works in most cases; engineering uses experimental design to improve quality by examining individual failure in the long tail. The methods appear to be identical to Dewey's design based educational validation. Through my research I intend to explore how the knowledge drawn from the worlds of education and engineering might inform the development, use and evaluation of learning resources for creative computing.

6) Methods & Methodology

i) Methods

I am using quantitative research methods, such as statistical analysis of data collected from learners on project-tigr. For instance, there are about 150 unique users of project tigr, with data on time on task and the occasions of working with our materials.

I am also using qualitative research methods and keeping a range of data such as ethnographic field notes and research journals, online messaging and documentation, worksheets, my reflective notes, correspondence, images and video data of my practice and SKYPE conversations and work submissions. Permissions for collecting and using the data has been sought and given.

ii) Methodology

I am using a Living Theory research methodology (Whitehead, 2008) to research my practice and produce valid, values-based explanations for my educational influence in my own learning, the learning of others and the learning of the social formations I work with. I will continue to draw insights from a range of disciplines and fields of practice such as; psychology, sociology, business, industry, mathematics, engineering and computing, in the creation of my own living-theory methodology through a process of what Dadds and Hart refer to as methodological inventiveness. As they say:

> No methodology is, or should be, cast in stone, if we accept that professional intention should be informing research processes, not pre-set ideas about methods of techniques. (2001, p. 169)

In generating my original contribution to knowledge through my living-educational-theory I shall also be generating a living-theory-methodology that draws insights from methodologies, such as Ethnography, Case Study and Action research, but cannot be subsumed by these methodologies.

7. Timescale/research planning

The timescale for my research is three years from September 2015-September 2018. I envisage producing a transfer paper for the Ph.D. programme in October 2016.
My research planning will follow the design process of:

Expression of concern/identifying the problem to be solved.
Producing an action plan for resolving the problem.
Acting on the plan and gathering data to make a judgment on the effectiveness of the actions in relation to the problem to be solved.
Evaluating the actions in terms of their effectiveness.
Modifying the problems, plans and actions in the light of the evaluation.

Producing a validated explanation of my educational influences in my own learning and in the learning of others.

I shall hold two validation group meetings each year to strengthen the evidence-based explanations of educational influences in learning. The validation groups will be constituted by some 6-9 peers, some of whom already have their living theory masters degrees and doctorates. They will be asked to respond to the draft explanations in ways that could: strengthen their comprehensibility; the evidence produced to justify the assertions; the awareness of the sociohistorial and sociocultural influences on the practice and understandings; the authenticity of the explanations in the sense of show over time and interaction that I am truly committed to living as fully as I can the values I claim to hold.

Bibliography:

Dadds, M. & Hart, S. (2001) *Doing Practitioner Research Differently*. London; RoutledgeFalmer.

Egrii, L. (2001) *The Art of Creative Writing*. NY; Simon and Schuster.

Escobedo, T. and Bhargava, A. (1991). A Study of Children's Computer-generated Graphics. *Journal of Computing in Childhood Education*, 2 (4), 3-25.

Haugland, S. (1992). Effect of Computer Software on Preschool Children Developmentally Gains. *Journal of Computing in Childhood Education*, 3 (1), 15-30

Holt, J. (1990) *How Children Fail*, London; Penguin Education.

Holt, J. (1991) *How Children Learn*, London; Penguin Education.

Miller, H. C. (2008) *Digital Storytelling: A creator's guide to interactive entertainment*. Abingdon; Focal Press

Montessori, M. (2009) *The Absorbent Mind*. BN Publishing.

Pappert, S. (1994) *Mindstorms: Children, Computers, and Powerful Ideas*. NY; Basic Books.

Piaget, J. (2001) *The Language and Thought of the Child*. London; Routledge Classics

Sedgwick, D. and Sedgwick, F. (1995) *Art Across The Curriculum.* London; Hodder & Soughton.

Sweigart, A. (2010) In*vent your own computer games in Python*, 2nd edition. Accessed 30 July 2015 from https://inventwithpython.com/2/index.html

Whitehead, J. (2008) Using a living theory methodology in improving practice and generating educational knowledge in living theories. *Educational Journal of Living Theories*, 1(1), 103-126