# New computer science and computing curricula in schools - what perspectives should we research and how?

9th December 2015

**6th INTERNATIONAL DOCTORAL CONSORTIUM ON INFORMATICS ENGINEERING EDUCATION RESEARCH**

Don Passey
Professor of Technology Enhanced Learning
Director, Centre for Technology Enhanced Learning
Director of Studies, Doctoral Programme in e-Research and Technology Enhanced Learning

# Content

- Reasons why computing curricula have been introduced into compulsory education, not only in England but in other countries
- Implications for research in this field
- The importance of applying different methodological approaches according to the focus of studies
- Ways that research has already approached this field
- The role research should play over the next 10 years
- Gaps in our research understanding that currently exist
- Opportunities this provides for researchers
- The fundamental challenges these create in research design

# Reasons why computing curricula have been introduced

- **Economic –** increasingly jobs require computing skills, and there is a shortage of applicants with these skills
- **Organisational -** businesses and institutions increasingly employ learning technologists with computing skills
- **Community -** computing is increasingly used by social and community groups, creating social media, for example
- **Educational –** education should support understanding and development of emerging disciplines
- **Learning –** computer users need technical, operational and application skills and competencies to support uses
- **Learner –** learners should engage in areas that interest them

# Implications for research in this field

- **Economic –** how will shifts and predictions in employment and skill needs become accessible to and used by pupils?
- **Organisational –** how will group working be developed in computing lesson activities?
- **Community –** how will engagement with community groups be fostered and handled?
- **Educational –** how will pupils, teachers and schools be updated regularly about new developments?
- **Learning –** how will pupil problem-solving and creative skills be assessed, as well as computing and programming skills?
- **Learner –** how will prolonged interest in longer-term engagement with computing be fostered?

# The curriculum challenge

- *to ensure that all pupils: can understand and apply the fundamental principles and concepts of computer science, including abstraction, logic, algorithms and data representation; can analyse problems in computational terms, and have repeated practical experience of writing computer programs in order to solve such problems; can evaluate and apply information technology, including new or unfamiliar technologies, analytically to solve problems; and are responsible, competent, confident and creative users of information and communication technology. (National Curriculum for Computing 5-16, DFE, n.p.)*

# Applying different methodological approaches

| Focus | Research question(s) | Research timeline | Research approach | Research methods |
|---|---|---|---|---|
| **Economic** | How will shifts and predictions in employment and skill needs become accessible to and used by learners? | | | |
| **Organisational** | How will group working be developed in computing lesson activities? | | | |
| **Community** | How will engagement with community groups be fostered and handled? | | | |
| **Educational** | How will learners, teachers and schools be updated regularly about new developments? | | | |
| **Learning** | How will learner problem-solving and creative skills be assessed, as well as computing and programming skills? | | | |
| **Learner** | How will prolonged interest in longer-term engagement with computing be fostered? | | | |

# Ways research has approached this field in the compulsory sector

| Focus | Research question(s) | Research to date |
|---|---|---|
| **Economic** | How will shifts and predictions in employment and skill needs become accessible to and used by pupils? | Not explored, except in careers education, although some business-generated predictions at national level exist |
| **Organisational** | How will group working be developed in computing lesson activities? | Limited research – but group work is used in some HE courses; Johnson (2014); Passey (2014, 2015) |
| **Community** | How will engagement with community groups be fostered and handled? | Limited – Technasium is an example; Passey (2013) |
| **Educational** | How will pupils, teachers and schools be updated regularly about new developments? | Not really explored from a research dimension, but business-generated updates and trends are accessible |
| **Learning** | How will pupil problem-solving and creative skills be assessed, as well as computing and programming skills? | Possible background from Papert (1980); Papert and Harel (1991); http://technav.ieee.org/tag/8196/problem-solving#xplore |
| **Learner** | How will prolonged interest in longer-term engagement with computing be fostered? | Not really explored, except in some elements of careers education, and tracking through examination statistics |

# The role research should play over the next 10 years

Lancaster University

| Focus | Research question(s) | Role |
|---|---|---|
| **Economic** | How will shifts and predictions in employment and skill needs become accessible to and used by pupils? | |
| **Organisational** | How will group working be developed in computing lesson activities? | |
| **Community** | How will engagement with community groups be fostered and handled? | |
| **Educational** | How will pupils, teachers and schools be updated regularly about new developments? | |
| **Learning** | How will pupil problem-solving and creative skills be assessed, as well as computing and programming skills? | |
| **Learner** | How will prolonged interest in longer-term engagement with computing be fostered? | |

# Gaps in our research understanding

There are many gaps:

- We have few fundamental studies
- Most are based on an acceptance of the concept of constructionism
- We have no long-term studies
- We have limited studies that focus on economic or community goals
- We have limited concepts of progression in learning with computer science for 5-16 year old learners (models exist, but these have not yet been researched in practice)
- We do not fully understand the drivers or barriers
- We do not understand how tomorrow's technologies will influence today's learners

# Opportunities and challenges

- There are many :
  - We need fundamental studies
  - Questioning and taking forward concepts including constructionism (and computational thinking)
  - We need long-term studies, focusing on economic or community goals
  - We need to understand more fully the concepts of progression in learning with computer science for 5-16 year old learners
  - We need to understand the drivers or barriers
  - We need to know how tomorrow's technologies will influence today's learners

# References


- DFE, 2013. Statutory guidance - National curriculum in England: computing programmes of study. Accessed 5 January 2015 at: https://www.gov.uk/government/publications/national-curriculum-in-england-computing-programmes-of-study/national-curriculum-in-england-computing-programmes-of-study
- Johnson, C., 2014. 'I liked it but it made you think too much': A case study of computer game authoring in the Key Stage 3 ICT curriculum. PhD thesis, University of East Anglia, Norwich, UK.
- McDowell, J., 2015, Private communication.
- Papert, S., 1980. *Mindstorms - children, computers, and powerful ideas*. New York: Basic Books.
- Papert, S. & Harel, I. ,(eds.), 1991, *Constructionism: research reports and essays 1985 – 1990.* Ablex Pub. Corp., Norwood, NJ.
- Passey, D., 2013. *Inclusive technology enhanced learning: Overcoming Cognitive, Physical, Emotional and Geographic Challenges*. Routledge, New York, NY.
- Passey, D., 2014. Early uses of computers in schools in the United Kingdom: shaping factors and influencing direction. In A. Tatnall and B. Davey (eds.). *Reflections on the History of Computers in Education: Using Computers and Teaching about Computing in Schools from the late 1970s to the early 1990s.* Springer, Heidelberg, Germany.
- Passey, D., 2015. Computer science (CS) or information and communication technologies (ICT): the curriculum needs both. In A. Brodnik and C. Lewin. *IFIP TC3 Working Conference "A New Culture of Learning: Computing and next Generations": Proceedings.* pp. 26-44. Accessible at: http://www.ifip2015.mii.vu.lt/file/repository/IFIP_Proceedings.pdf
- http://technav.ieee.org/tag/8196/problem-solving#xplore

Lancaster University

# Discussion

d.passey@lancaster.ac.uk
http://www.lancaster.ac.uk/fass/edres/profiles/don-passey