Educating Adolescents: Applying Insights from Neuroscience in Key Stage 3 Computing Curriculum Design

Author: Julie Price **Affiliations:** NCCE Computer Science Champion, CAS Master Teacher, PhD Student at University of Roehampton

Background

- Technological advances - brain still developing through adolescence
- Higher-order cognitive processes change dramatically during adolescence, while emotion- and reward-processing is hypersensitive
- Implications for the design of the school curriculum—an engaging, inclusive and motivational student-centred computing curriculum design
- Computational thinking: *mental activity in formulating a problem to admit a computational solution*[1]; real to the students' lives and relevant links forged[2]
- Could an integrated, student-centred approach to computing curriculum design have a positive impact upon students' problem-solving attitudes and behaviours in Key Stage 3?

Method

- Action Research Project—BCS Certificate in Computer Science Teaching
- Intervention Group —28 Year 7 mixed group: 10 female and 18 male
- *Waitlist—Parallel Year 7 mixed group*
- Gender imbalance reflected in SEND for Mathematics and Reading
- Immersion in problem-solving attitudes and behaviours followed by self-evaluation and response to real-life problem
- Process repeated at conclusion of the project
- Intervention— Integrated study applying skills from English and PSE
- Computing learning hung on unfolding crime-investigation narrative
- Qualitative data processed quantitatively alongside analysis of observations and student outcomes

Findings

- Students became more confident and successful at solving problems:
- Girls—significant improvement in quality of responses and number engaging; Boys—80% project-end evidence, 0% project-start evidence
- Student responses indicated initial gender gap reduced
- Boys admitted being over-confident during initial self-evaluation; girls admitted to underestimating their level of confidence
- Boys and girls judged their ability to assess accurately improved as project progressed
- Computing teacher, a CAS Master Teacher, reported: overall positive effect upon student problem-solving skills, and their confidence in assessing and applying these skills; a significantly high level of engagement of both girls and boys, noticeably the disaffected
- Students and Computing teacher reported on: motivational nature of intervention and self-assessment against familiar, rehearsed criteria; reported light-bulb moments when encountering English learning in Computing lessons

Conclusions

- Limitations: time period; limited sample size; approximating to rigours of academic research; compromises due to timetabling/priorities
- Basis for Future Research: student engagement—contributions, subject-integration; problem-solving with responsive teacher intervention; signs of self-regulation; tentative evidence of developing cognitive functioning, i.e. 'shifting', 'updating' and 'inhibition'[3]

References and Acknowledgements

[1]Wing (2010). Computational Thinking: What and Why? The link - *Magazine of Carnegie Mellon Univ. Sch. of Comp. Sci*, March 2006, pp1–6 (supported by Román-González, et al. (2017). Which cognitive abilities underlie computational thinking? Criterion validity of the Computational Thinking Test. Computers in Human Behavior (2017) vol72 pp678-691); [2]Curzon, et al. (2014). Developing computational thinking in the classroom: a framework. Computing at School, June 2014, pp1-6; [3]Miyake, et al. (2000). The Unity and Diversity of Executive Functions and Their Contributions to Complex "Frontal Lobe" Tasks: A Latent Analysis. Cognitive Psychology, vol41, Iss1, August 2000, pp49-100