Inclusive practice – our learners' backgrounds, prior experiences and current situations are incredibly diverse. Inclusive teaching and learning practices are essential morally and sometimes legally. What should those practices be? How do we design and create inclusive student-centred learning environments and activities? What challenges and opportunities do digital environments bring? How do we ensure that we are representing all our students' voices and meeting their needs?

Inclusive Practice

Creating an inclusive computing curriculum: Exploring aesthetic techniques to enhance Welsh school children's engagement with programming.

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Despite efforts over the last fifteen years to encourage more girls into studying computing, the number of females in IT in the UK has continued to decline. To add to this, the shift in the UK towards computer science (CS) from ICT has further had an impact on the number of girls choosing further computing qualifications or pursuing computing as a career (Kemp, 2020). This aligns with the HESA (2020) figures which show that Higher Education (HE) student enrolments in UK (2018/2019) for computer science shows 21, 080 (females) to 93, 535 (male). Moreover, a recent British Computing Society (BCS) report (2020) shows that the level of female representation in IT varies by nation/region but even at its highest in Wales, women accounted for just 21% of IT specialists. Many have found that it is girls' lack of engagement with technology at school which is causing fewer women entering the Information Technology (IT) workforce (Lang et al., 2020).

This paper documents a research project that aims to introduce a new multidisciplinary approach using aesthetic techniques to enhance Welsh school children's engagement with programming. As Happe et al (2020, p.1.) highlight 'The interest of girls in computing drops early during primary and secondary education, with minimal recovery in later education stages'. This aesthetic programming project (initiated by the School of Technologies at Cardiff Met University) involves a team of five female student facilitators, a female research assistant and a female academic who work with primary schools in the South Wales region to ignite an enthusiasm for the practice of programming. This particular project included one two-hour face to face lessons with year 4, 5 and/or 6 year groups in over ten schools. Using a pre and post activity questionnaire, the research team aims to investigate whether this aesthetic approach to programming affords an engagement and a heightened motivation to code. As Denner (2011, p1.) noted: 'The strongest direct predictor of girls' interest in computing classes and careers was the extent to which they see value in computing, in particular their technological curiosity'. To truly maximise engagement in programming, the team aims to explore an aesthetic problem-solving approach to captivate a curiosity, enthusiasm and interest for programming.

This paper aims to give a snapshot of the level of ' pupil engagement' with aesthetic programming. It defines the novelty and value of the aesthetic programming approach and documents the way this programming approach was undertaken and received. The research team believe that a new approach to enhance engagement in programming could play a role in balancing the number of girls studying and working in the IT sector and this could have huge economic benefit to Wales and UK. For example, in the UK alone, equalising the labour market participation has the potential to increase the size of the UK economy by £55 billion by 2030 (EIGE, 2017). The IT sector employs 45,000 people in Wales and contributes to over £8 billion a year to the Welsh economy. An approach that makes CS learning more inclusive and supports more females to engage and study IT in

academic institutions and to work in the IT sector will make a significant contribution to the Welsh economy and the local community.

This product will provide more inclusive access to programming and in doing so, will attempt to change cultural perceptions about who programmers are and what they look like. In the long term, this will enhance the quality of life in our technological existence whilst also, support women within Wales to benefit from increased employment opportunities. Moreover, the product will adopt aesthetic computing principles to diversify the current 'programming' audience and engage more females. In line with this, it aims to do this bilingually affording opportunities to also promote Welsh culture and narrative. Interestingly, Welsh government education statistics (2020) show that only twenty Welsh speaking students (out of 280) enrolled on courses with some teaching through Welsh. This product will support more 'learning through Welsh' opportunities as well as the necessary mechanisms to support wider engagement with local communities and the ICT industry in Wales.

This research project will introduce a new multidisciplinary approach using aesthetic techniques to enhance engagement with programming (particularly but not exclusively amongst girls). Using grounded theory methods, this research project will run a number of focus group studies with local schoolchildren to investigate whether this aesthetic approach to programming affords an engagement and a new motivation to code.

Hesa (2020). Who's studying in HE? https://www.hesa.ac.uk/data-and-analysis/students/whos-in-he

BCS (2020). BCS diversity report 2020: ONS analysis. https://www.bcs.org/media/5766/diversity-report-2020-part2.pdf

GEO internal analysis using data from EIGE (European Institute for Gender Equality), 2017. "Economic case for gender equality in the EU"

https://tradeandinvest.wales/key-industries/tech

Lang, C., Fisher, J., Craig, A., Forgasz, H., 2020. Computing, girls and education: What we need to know to change how girls think about information technology. Australas. J. Inf. Syst. https://doi.org/10.3127/AJIS.V24I0.1783

Despite significant efforts and many intervention programs over the years to encourage girls to study computing, we continue to see a declining interest. Girls' lack of engagement with technology at school is resulting in fewer women entering the Information Technology (IT) workforce. Our research investigated whether a long-term intervention program with a specifically designed school-based curriculum could change girls' minds about computing generally and increase their confidence and interest in an IT career. Qualitative and quantitative data were collected from girls and teachers before, during, and after this program was implemented. A conceptual model of the school-based influences on girls' attitude was developed from the literature and used to explore the data. Findings

from this four-year project added rich insights and resulted in a comprehensive model of 'Factors that Influence Girls' Attitude to IT.' This research demonstrates that a carefully designed IT curriculum, delivered in single-sex classes, reinforced by opportunities to interact with role models, and timetabled in regular class time, can and does change girls' attitudes to IT. We also found that the students reported improved confidence and increased interest in IT. We posit that our refined model of 'Factors that Influence Girls' Attitude to IT' is a valuable reference tool. Teachers, academics and professionals who are implementing programs to promote IT to girls can use it.

Despite strong claims that middle school is a critical period for getting girls interested in computing, there is little research to guide the development of interventions. Many programs that target girls build on Eccles' expectancy-value model, which focuses on expectations for success, values, and support from others. However, there is little research to justify the use of this model to guide efforts to increase interest in computing during middle school. To test the model, I analyzed data from 140 Latina and white girls in a California middle school collected on the first day of an IT-intensive after school program. The strongest direct predictor of girls' interest in computing classes and careers was the extent to which they see value in computing, in particular their technological curiosity. Perceived support from school peers and teachers also had a direct effect, while perceived support from parents had an indirect effect via values. Expectations for success did not explain interest in computing. Implications for interventions are discussed.

Denner, J., 2011. What Predicts Middle School Girls' Interest in Computing? Int. J. Gender, Sci. Technol.

The interest of girls in computing drops early during primary and secondary education, with minimal recovery in later education stages. In combination with the growing shortage of qualified computer science personnel, this is becoming a major issue, and also a target of numerous studies that examine measures, interventions, and strategies to boost girls' commitment to computing. Yet, the results of existing studies are difficult to navigate, and hence are being very rarely employed in classrooms. In this paper, we summarize the existing body of knowledge on the effective interventions to recruit and retain girls in computer science education, intending to equip educators with a comprehensive and easy-to-navigate map of interventions recommended in the existing literature. To this end, we perform an aggregated umbrella literature review of 11 existing reviews on the topic, together accumulating joined knowledge from over 800 publications, and formulate the findings in a map of 22 concrete interventions structured in six groups according to their phase and purpose.

Happe, L., Buhnova, B., Koziolek, A., Wagner, I., 2020. Effective measures to foster girls' interest in secondary computer science education: A Literature Review. Educ. Inf. Technol. https://doi.org/10.1007/s10639-020-10379-x

Kemp, P.E.J., Wong, B., Berry, M.G., 2020. Female Performance and Participation in Computer Science. ACM Trans. Comput. Educ. https://doi.org/10.1145/3366016

The change in the English computing curriculum and the shift towards computer science (CS) has been closely observed by other countries. Female participation remains a concern in most jurisdictions, but female attainment in CS is relatively unstudied. Using the English national pupil database, we analyzed all exam results (n = 5,370,064) for students taking secondary school exams in 2016, focusing on those students taking GCSE CS (n = 60,736), contrasting this against ICT (n = 67,359).Combining gender with ethnicity and the IDACI poverty indicator, we find that females from the poorest areas were more likely to take CS than those from the richest areas and that CS was more popular among ethnic minority females than white females. ICT was far more equitable for females and poorer students than CS.CS females typically got better grades than their male peers. However, when controlling for average attainment in other subjects, males got 0.31 of a grade higher. Female relative underperformance in CS was most acute among large female cohorts and with girls studying in mixed-gender schools. Girls did significantly better than boys in English when controlling for CS scores, supporting theories around female relative strengths lying outside STEM subjects.The move to introduce CS into the English curriculum and the removal of the ICT qualifications look to be having a negative impact on female participation and attainment in computing. Using the theory of self-efficacy, we argue that the shift towards CS might decrease the number of girls choosing further computing qualifications or pursuing computing as a career. Computing curriculum designers and teachers need to carefully consider the inclusive nature of their computing courses.