



Teacher Research Projects in Computing

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OVERVIEW

We designed a project to support computer science (CS) teachers in implementing their own classroom research as a means of professional development (PD). The project was driven by a desire to engage teachers fully in their own PD at a time when many report low confidence in teaching CS. 22 teachers participated over a period of a year. Teachers carried out action research projects. To enable them to share their findings with other teachers we produced a booklet of all their work and they presented at a Computing teachers' conference.

Teachers reported feeling stimulated and empowered to teach Computing in a more investigative way as a result of the project: *"It's stimulating, great personal CPD and make you think about pedagogy, approach, theory, so much."*



Teachers at the first face to face meeting

METHODOLOGY

The project was structured around two face-to-face training days, the first to explain research methods and to formulate a research question (22 attendees) and the second to guide data analysis and reporting (15 attendees). Six university lecturers in CS education provided support throughout the process. Funding received for the project was used to support teachers to attend the two training days. The first meeting was held in October and the second in March. During the first meeting teachers discussed aspects of their teaching of Computing. They were introduced to research methods and through discussion and group work came up with their research question or topic, some as individuals and some in groups.



Teachers presenting their research questions

In the six months between the two meetings the teachers carried out their Computing action research project. Communication was maintained by an online community, emails and video conferencing. At the second meeting, teachers discussed their results with each other and further analysed their findings. They were supported by volunteer academics in their data analysis. They then prepared infographics summarising their work using a common template provided for this purpose.

To investigate the effectiveness of the project, we planned data collection activities relating to teachers' progress using a combination of questionnaires, video recordings, contributions to the online community, and the resultant project work produced by teachers. Teachers completed questionnaires following each meeting and at the end of the project. Teachers were videoed describing their potential project to the whole group in the first meeting and most were videoed privately during the second meeting to record their perceptions of the programme. Ethics procedures were strictly adhered to: all teachers were given full information about the research and gave informed consent before joining the project.

TEACHERS' RESEARCH TOPICS

Teachers were interested in a broad range of research topics. Some examples of the research questions they addressed are:

- Can a child's understanding of debugging be deepened by the use of unplugged CS?
- Does embedding a pupil democratic enterprise culture into the KS4 Computing curriculum aid in raising attainment?
- Does the use of computational thinking impact progress of SEN learners in writing?
- Does computational thinking improve achievement in reading comprehension?
- Does child-led teaching improve teachers' computing knowledge and understanding?
- How do attitudes to computing and gender change from KS1 – 5?
- How does the use of defusion, hard copy media and online interactive software help students with complex health needs to develop their programming skills?
- Does embedding a pupil democratic enterprise culture into the Computing curriculum aid in raising pupil motivation and attainment?

OUTPUT FROM THE PROJECT

It was important to give value to the teachers' research projects by planning opportunities for dissemination of the findings to other teachers. Each teacher produced an infographic of their work, and these were made into a booklet which was distributed at events, made available online and sent to the teachers' schools. Teachers were encouraged to present their research findings at the CAS (teachers') conference in June. 12 of the teachers presented their results at a CAS teachers' conference, which also provided them with feedback on their research findings from their peers.



Teacher presenting at the CAS Conference



An extract from the booklet



A wall display of the teachers' infographics

BACKGROUND

The inclusion of computer science (CS) within England's school curriculum has foregrounded issues of subject professional development (PD) for many teachers. Menekse's recent systematic literature review of CS PD programmes analyses a parallel development in the USA (Menekse, 2015). The 21 studies examined describe mainly workshops or short courses focusing on subject knowledge. The predominant focus on workshops for teacher PD in CS suggests an emphasis on a deficit model (Kennedy, 2005). Other approaches enabling teacher collaboration via activities that take place within a community of practice have met with notable success (Thompson, 2013; Goode, 2007, Sentance et al, 2014, Ryoo et al, 2015). These examples reflect a more sociocultural view of teacher learning: learning which is distributed across people and tools (Tenenber & Knobelsdorf, 2014).

The work of Lave and Wenger on situated learning (Lave & Wenger, 1991) informs us that teacher expertise is closely linked to the circumstances to which it pertains: not to precise situations, but to the particular working practices and the associated ways of thinking which define teachers' professional circumstances. Teacher PD in CS is no exception and it may therefore be beneficial to situate PD within a teacher's own practice. Adding to this the wealth of literature demonstrating the effectiveness of action research for teacher professional development formed the rationale for our research project.

PARTICIPANTS

22 participants were recruited from the Computing At School (CAS) community and selected by application form. Selection criteria were that they were currently teaching CS at primary or secondary level, and were not in their pre-service training year. Teachers were encouraged to reflect on their interests when completing the application form and before the first meeting to establish a research question that interested them.

Type school	No.	Computing teaching (average hours)	Experience (average years)
Primary	7	5	9.6
Secondary	14	16	14.5
Middle	1	17	9

TEACHERS' FEEDBACK

We collected data from the teachers via questionnaires, videos and discussions to enable us to analyse the affordances of action research in Computing. Teachers reflected on the benefits of the programme to them:

"[It] makes them more aware of how they are imparting knowledge, improves their practice and helps them potentially spread new approaches to other colleagues. If a teacher can say 'I do this because I've researched a number of approaches to X', then they are confident and empowered. Others learn from this, and it can only ever benefit our children and young people." (middle school teacher)

"By making our pedagogy more informed by a research base, we should be able to improve outcomes for learners and have a greater impact on our own professional development" (primary school teacher)

15 out of 16 teachers stated that the greatest obstacle in their CS action research was time.

CONCLUSIONS

The Teaching Inquiry in Computing Education (TICE) project ran from July 2015 to June 2016. Its intention was to give CS teachers an opportunity to develop their understanding of CS pedagogy by supporting them in the implementation of a classroom-based research project. A distributed community of inquiry developed, with teachers not normally co-located collaborating to build pedagogy knowledge.

There is clear evidence in the literature that classroom-based action research is effective in enabling teachers to make changes to their teaching, instigate change in school and gain ownership of their PD. Our project aimed to support teachers' professional development in the teaching of CS by engaging them in classroom research. Data collected through the project demonstrated that participant Computing teachers were enabled to reflect on their own teaching, helping them to better understand their own subject, and improve students' learning. This work is part of a broader move to support Computing teachers interested in research. In the next phase of the research we'll be using video evidence of teacher feedback to examine their attitudinal changes to research during the project.

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REFERENCES

- J. Goode.(2007) If you build teachers, will students come? The role of teachers in broadening computer science learning for urban youth. Journal of Educational Computing Research, 36(1):65-88
- A. Kennedy.(2005). Models of continuing professional development: a framework for analysis. Journal of In-Service Education, 31(2):235{250,
- J. Lave and E. Wenger. (1991). Situated learning: Legitimate peripheral participation. Cambridge Univ. Press
- M. Menekse. (2015). Computer science teacher professional development in the United States: a review of studies published between 2004 and 2014. Computer Science Education, 25(4):325-350
- J. Ryoo, J. Goode, and J. Margolis.(2015) It takes a village: supporting inquiry- and equity-oriented computer science pedagogy through a professional learning community. Computer Science Education, 25(4):351-370
- S. Sentance, S. Humphreys, and M. Dorling.(2014). The Network of Teaching Excellence in Computer Science and Master Teachers. In Proceedings of the 9th Workshop in Primary and Secondary Computing Education, pages 80-88. ACM
- J. Tenenber and M. Knobelsdorf.(2014). Out of our minds: a review of sociocultural cognition theory. Computer Science Education, 24(1):1-24