The Quantified Learner

An emerging research domain of the Quantified Learner is made possible through the introduction of wide-spread learning technologies and the data they generate. These include MOOCs and the BlackBox initiative from the BlueJ/Greenfoot team.

Mining large datasets will undoubtedly yield results for the understanding of computing education – common errors and common areas for errors are likely to be “low hanging fruit” and quickly identified. “One-on-a-hundred” errors may also be located; those that occur rarely within a class of 20 or 30, yet knowing of their existence and apprehending the logic of their error, are valuable tools for teachers. Common patterns and paths to success may also be identified and used in new instructional designs.

But I think there are more interesting research questions to ask of such data, to give an accelerated understanding to learners. The context of learning within an environment rich in comparable data (people who learned the same concept, or have undertaken the same assignment) expands an individuals’ ability to augment or shift their perspectives and knowledge. Self-tracking, self-management and self-awareness are activities that promote agency and a transformative sense of self.

For simple example, it may be possible to structure environments in such a way that when a learner gets “stuck” they can be shown what other students who have been stuck at the same place have done. Such timely, yet automatic, feedback from learners at the same stage (or one step ahead) is a quite new possibility for education. What would it mean to be “taught” by people you have never met, and are engaging with the experience for their own ends, not yours?

We must also ask what the emerging design and experience qualities for the quantified learner are. Learners vary tremendously by culture, community, income, age, politics, economic development and education. While choosing what and where to learn are individual choices, our individual selves are inextricably tied to historical concepts of identity and culture. How does acquisition of knowledge “out of place”, divorced from these links, reflect both public and private concerns? How does it address local needs, as well as those of the wider community? How do the experiences of the collection of learners scale to global and cultural influence? Do learners from one time and place learn differently, or in different order, or have different orders of concept acquisition, or different facility with programming constructs? Do learners display similarities when grouped by age, gender or ethnicity? Or are learners linked by more subtle indicators of cast of mind or approach?

Impact: A deeper and clearer understanding of how students actually navigate learning “in the wild”, as opposed to data from small samples elicited in controlled conditions. A focus on the learner (not the teacher or the curriculum) works to expand the boundaries of our understanding of the acquisition and deployment of education in computing.

How the US benefits: More people (from every background) better educated in computing. Addresses skill shortages and builds a globally competitive workforce.

How it will alter what’s been done to date: There has been virtually no exploration of these areas, as datasets of this size and nature have not previously been available.
The Regulated Researcher

Teaching, the practice of education, is a tightly situated activity: it takes place in this classroom, with these students learning this material. CS educational research, for the most part, is not. Or not in the way that it needs to be. CSED research has drawn on several traditions: in some part, and particularly in the early years, on cognitive psychology, with its emphasis on quantitative studies and claim to truth from statistical generalisation. Latterly, the classroom-scale empirical study has come to the fore (separate from Action Research studies). These small-scale studies draw on a variety of methodological approaches, and yield a variety of insights, but claims that their findings are applicable across teaching situations—across different combinations of classroom, curriculum and learner—is—are weak. At the same time, lack of adoption of research results by educators is an increasingly recognised phenomenon (Dancy & Henderson, 2008; Jamieson & Lohmann, 2009).

A more strategic and structured approach to CS Education research would, I contend, yield higher-quality and more usable results.

The approach I promote here draws on work from other domains, which have structural similarity to that of educational research. By “structural similarity” I mean the combination of a myriad of situated applications separated from the researcher, research aims, and often also from the site of research.

Rural development researchers have developed two practices which would, I believe, strongly benefit CS Education research. First, in regard to farming systems is the notion of “recommendation domain”.

Hence, we have proposed the concept of a recommendation domain (RD) as a group of farmers with roughly similar practices and circumstances for whom a given recommendation will be broadly appropriate. It is a stratification of farmers, not area; farmers, not fields, make decisions ... resulting domains are often not amenable to geographical mapping because farmers of different domains may be interspersed in a given area. (Byerlee, Harrington, & Winkelmann, 1982)

This approach is very appropriate to CS Education. Education research is nearly always contextualised to a type of institution (at least). Specifying the scope of applicability in this way both strengthens the validity of education research and also avoids the trap of thinking that the administrative unit, such as “school district” is of primary importance.

Lying alongside this are the coupled practices of using multi-disciplinary research teams and involving end-users in preliminary scoping. This approach is conducive because in rural development – like education – there is a gap between researcher and practitioner.

The practical world demands breadth, intelligibility and usefulness, while academics are freer to dig deeper down into narrow ruts, so often in the process becoming esoteric and obscure (Chambers, 1983, p. 170)
In innovative rural development studies, research teams have worked together on-site. Depending on the site and type of research, arrangements vary from “a team of two, usually a plant-breeder and an economist” to

... a week spent in the field by a team usually consisting of five social scientists (among whom there may be anthropologists, sociologists, economists or agricultural economists) who are paired each day with five agricultural scientists (among whom there may be both plant and animal technicians in entomology, breeding, pathology, physiology etc.). Over five days they change partners each day to reduce interview bias and to increase cross-disciplinary exchange. (Chambers, 1983, p. 68)

The benefits of this approach are several: to the quality of the research, to the developed understanding of the researchers, and to the end-users of the research, as these methods “force or precipitate learning from others”.

Undertaking a small number of CS education studies within a prescribed format – a multi-disciplinary team working together with educators and then focussing their results on a recommendation domain – would be relatively low-cost and low-risk. If the results of such work were either stronger, or more usable/used than is currently normal (or both) then the modest investment would give significant returns.

**Impact**: Higher-quality research results, better suited to their target audience.

**How the US benefits**: Better evidence, better suited for educator adoption may be expected to improve practice.

**How it will alter what’s been done to date**: At best it would provide a new paradigm for disciplinary-specific education research; at the least it would provide an interesting new model.

**What does a CS Education Researcher look like?**

Computing Education Research, compared to education research in other STEM disciplines, is in its infancy. Yet the rate of expansion of Computing teaching (10k, CSTA in the US; CAS and national curriculum in the UK), and recent focus of NSF funding initiatives (CE21) require more skilled CSEd researchers than ever. Yet there is little attention to, and no evidence-base for, building capacity in this area.

I propose a comparative, longitudinal study to document and characterise the development of CS Education researchers. The study takes as its start point two NSF-funded projects DUE-0122560 *Bootstrapping Research in Computer Science Education Research* (“Bootstrapping”), 2002/3 and DUE-0243242 *Scaffolding Computer Science Education Research* (“Scaffolding”), 2003/4. Several of the original participants of these projects are now prominent in the Computing Education Research field and have established distinctive and successful programs of research. Others appear to have had nothing to do with CS Education research after the final day of the workshop. This proposal is to
produce a collection of comparative case studies of workshop participants’ career development as researchers in Computing Education. Analysis of this collection will permit identification of significant or influential events, and facilitate the exploration of common stages or patterns of progress. This analysis will provide insights to inform the design of future approaches to foster the development of others.

There is a unique opportunity in regard to this work in that a comparator group exists: faculty members who applied to join the workshops, but were unsuccessful in their application. There is no reason to believe that there was any difference between these groups (in background, or belief) on application, and although the selection process was deliberate it was not perfect: if there had been capacity, a dozen more participants would have been accepted. Locating and interviewing the non-participants will provide otherwise unobtainable data – what happened to those who could have joined ten years ago, but didn’t. Are their career patterns similar, or different? Have they pursued CS Education, in scholarship or in research? Have they undertaken collaborative work, with faculty from their own, or from other, institutions? By surveying two populations, over time, the research design takes into account multiple factors which can be analysed for patterns of persistence and success. This data is of extraordinary richness and value.

Taking the original workshops as model, the research would be conducted in paired, residential workshops. Workshop one focusses on the participants, their experiences and life courses. This strand of work uses techniques from “project retrospective” models (Kerth, 2001) drawing from industry best practices. These techniques are invaluable for recognising what went well in a project, and so should be retained, as well as areas that went less well and so should be omitted or adapted for future interventions. Through a combination of artefact exploration and modified life grids (Berney & Blane, 2003; Blane, 1996) using a participatory interviewing technique (Wilson, Cunningham-Burley, Bancroft, Backett-Milburn, & Masters, 2007), a detailed set of case studies will be created. Between the first and second workshops, participants conduct interviews both with original “BootScaff” participants who were unable (or unwilling) to attend this workshop and with candidates who were not selected for participation. In creating the case studies (as individuals, and as interviewers), in collective analysis, and in preparing material for publication, participants generate a great deal of knowledge about CS education researchers.

There is an on-going need for capacity-building interventions at several levels. The fact that these have not emerged (or emerged in rather piecemeal fashion) suggests that systematic attention of a group of highly-motivated individuals would be a good way to extend the community, engender new activity in this area, and increase CS education research capacity in the future. Workshop two draws on the strong evidence-base generated in workshop one, and on the situated expertise of participants. Workshop two will focus on the design and development of a program of future interventions to build greater research capacity, and support wider engagement with more educators (separate funding would be sought for these activities).

Impact: There is very little work addressing capacity-building in research at all (although see (Adams et al., 2006) for a parallel endeavour), and none of this addresses the success and sustainability of initiatives over time. This project would examine longitudinal data over a decade, and provide a more substantial foundation for future work than the current discussion-and-guesswork model.
How the US benefits: More researchers in an under-represented domain; world-leading research.

How it will alter what’s been done to date: There have been few attempts to address capacity-building in CS Education. Evidence-based, community-developed interventions, from a small group of committed, informed individuals, are a new focus for development in this area.

References


